

Ontario Provincial Standards for Roads and Public Works



- Volume 1 -

MUNICIPAL AND PROVINCIAL COMMON

GENERAL AND CONSTRUCTION SPECIFICATIONS



OPS is co-owned by the
Ministry of Transportation, Ontario
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Municipal
Engineers
Association

MANUAL REVISION RECORD

Municipal and Provincial Common

Volume 1 – General and Construction Specifications

This record should remain in the manual at all times. Revisions are numbered sequentially. This sheet should be filled in after each revision has been placed into the manual. It will quickly indicate to users whether the contents of the manual are up-to-date.

REVISION NUMBER	REVISION DATE	ENTERED BY	REVISION NUMBER	DATE	ENTERED BY
74	APRIL 2005	Included in new manuals	100		
75	NOV 2005	Included in new manuals	101		
76	APRIL 2006	Included in new manuals	102		
77	NOV 2006	Included in new manuals	103		
78	APRIL 2007	Included in new manuals	104		
79	NOV 2007	Included in new manuals	105		
80	APRIL 2008	Included in new manuals	106		
81	NOV 2008	Included in new manuals	107		
82	APRIL 2009	Included in new manuals	108		
83	NOV 2009	Included in new manuals	109		
84	APRIL 2010	Included in new manuals	110		
85	JULY 2010	Included in new manuals	111		
86	NOV 2010	Included in new manuals	112		
87	APRIL 2011	Included in new manuals	113		
88	NOV 2011	Included in new manuals	114		
89	APRIL 2012	Included in new manuals	115		
90	NOV 2012	Included in new manuals	116		
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REVISION INFORMATION SHEET

ONTARIO PROVINCIAL STANDARDS FOR ROADS AND PUBLIC WORKS

VOLUME 1 MUNICIPAL AND PROVINCIAL COMMON GENERAL AND CONSTRUCTION SPECIFICATIONS

MANUAL REVISION #97

APRIL 2016

UPDATING ONTARIO PROVINCIAL STANDARDS FOR YOUR USE

Each roads and public works owner (Owner) is responsible for determining implementation dates and directions for use of Ontario Provincial Standards; therefore, manual holders are cautioned about immediately discarding superseded and cancelled standards.

A NOTE TO DESIGNERS OF MUNICIPAL CONTRACTS REGARDING APPENDICES

There are a number of OPS specifications published with appendices containing supplemental requirements that modify the specification. These specifications contain information written for use in provincial contracts. The appendices contain supplemental requirements that modify the provincial requirements so the specifications can be used in municipal contracts. The specifications are easily identified, as the table of contents for each specification lists the appendix containing the supplemental requirements (e.g., Supplemental Requirements for Using OPSS XXX in Municipal Contracts).

Designers of municipal contracts should review each specification to determine if the supplemental requirements should be invoked in their contracts. To ensure completeness of municipal Contract Documents, designers should invoke the appendices by referencing them in the Contract Documents.

ACCESSING AND OBTAINING ONTARIO PROVINCIAL STANDARDS

The Ontario Provincial Standards for Roads and Public Works (OPS) manuals and the latest published updates for each of the eight OPS manuals are available as follows:

- Available electronically on the OPS/MTO website. Online access to the current, updated, and archived standards; indexes; OPS User Notes; and publication Revision Information Sheets are available free of charge at the site.
(<http://www.rags.mto.gov.on.ca/techpubs/ops.nsf/OPSHomepage>)
- Hard-copy format available from Publications Ontario by telephone at 1-800-668-9938 or online. Updates and OPS manuals are available for a cost-recovery fee.
(www.publications.serviceontario.ca)

- The eight OPS manuals of standards are available on one CD in PDF format. The OPS drawings published in Volumes 3 and 4 are available in AutoCAD format on a separate CD. These CDs are available from Publications Ontario or by telephone at 1-800-668-9938 or online for a cost-recovery fee. The updates are not available on CDs as an update package.
(www.publications.serviceontario.ca)

At the Publications Ontario web page, you can type "Ontario Provincial Standards," "OPS," "OPSS," or "OPSD" in the search box, and all related products for the Ontario Provincial Standards will be listed, click on the item you wish to purchase, add the item to your cart, then follow the instructions to complete your order. If trying to order an OPS product online from Publications Ontario and it is shown as Out of Stock, you can backorder the product by telephone at 1-800-668-9938.

In order to receive the Municipal Engineers Association (MEA) purchase price, MEA members should visit the MEA website (www.municipalengineers.on.ca/) for the MEA Publications Ontario order form for hard-copy manuals and CDs.

MTO employees should contact Simon Leung, Account Representative at Publications Ontario, by email (simon.leung@ontario.ca) to set up an account in order to receive the MTO purchase price for technical publications, including the Ontario Provincial Standards.

Links to Publications Ontario and the Ontario Provincial Standards on the MTO Library website are available on the OPS website (www.ops.on.ca). Also on this site under News and Activities are notices for updates and changes in OPS.

Questions should be directed by email to Ontario.Prov.Standards@ontario.ca

YOU SHOULD REGISTER YOUR OPS MANUALS AND CDs

Users of OPS do not receive notices of OPS updates as they had in the past. Methods of notification from Publications Ontario for the future are being investigated, and you will be informed of them as they become available. In the interim, an email will be sent to OPS users who have registered their OPS manuals and CDs with OPS.

Owners of OPS manuals, who have not yet done so, are requested to register their OPS hard-copy manuals and CDs with OPS by email at Ontario.Prov.Standards@ontario.ca. The registration form and submission instructions are available on the OPS website (www.ops.on.ca), Miscellaneous Info, OPS Forms.

WAITING TO HEAR FROM YOU

If you have a suggestion to revise a standard or you have a standard that works in your ministry, municipality, or area, send it to the Head, OPS Administration, for review and possible inclusion into the Ontario Provincial Standards.

THIS MANUAL IS REVISED AS FOLLOWS:

Index Pages Volume 1

Please remove the entire index and replace with the attached revised index.

Standard Specifications Volume 1

Superseded/Cancelled (Remove)		Revised/New (Insert)		Remarks
OPSS	Dated	OPSS	Dated	
127	April 2015	127	April 2016	“SCHEDULE OF RENTAL RATES FOR CONSTRUCTION EQUIPMENT, INCLUDING MODEL AND SPECIFICATION REFERENCE” “Annual spring update”
352	November 2000			“CONSTRUCTION SPECIFICATION FOR CONCRETE STEPS” OPSS Cancelled as not used. Associated drawings are non-compliant with AODA.
490	November 2015	490	April 2016	“CONSTRUCTION SPECIFICATION FOR SITE PREPARATION FOR PIPELINES, UTILITIES, AND ASSOCIATED STRUCTURES” See Summary of Revisions.
903	November 2009	903	April 2016 Notice to Users of OPSS 903	“CONSTRUCTION SPECIFICATION FOR DEEP FOUNDATIONS” Superseded by OPSS.PROV 903 in OPS Volume 5 and OPSS.MUNI 903 in OPS Volume 7.

SUMMARY OF REVISIONS TO OPSS.PROV 490

SITE PREPARATION FOR PIPELINES, UTILITIES, AND ASSOCIATED STRUCTURES

- Section 490.02, References, "MUNI" reference removed.
- Section 490.07.06, Stripping and Stockpiling Topsoil, "MUNI" reference removed.



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NOV 2012	106	Electrical Work
NOV 2014	120	Notice to Users of OPSS 120 (The Use of Explosives)
APR 2016	127	Schedule of Rental Rates for Construction Equipment, Including Model and Specification Reference
APR 2006	128	Supply of Pre-Qualified Material and Products
NOV 2011	180	Management of Excess Materials
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NOV 2013	212	Notice to Users OPSS 212 (Earth Borrow)
NOV 2014	220	Notice to Users of OPSS 220 (Wick Drain Installation)
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NOV 2012	310	Hot Mix Asphalt
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NOV 2010	316	Extruded Expanded Polystyrene Frost Heave Treatment
NOV 2014	320	Notice to Users of OPSS 320 (Open Graded Drainage Layer)
NOV 2014	330	Notice to Users of OPSS 330 (In-Place Full Depth Reclamation of Bituminous Pavement and Underlying Granular)
NOV 2015	331	Notice to Users of OPSS 331 (Full Depth Reclamation with Expanded Asphalt Stabilization)
APR 2004	332	Hot In-Place Recycling and Hot In-Place Recycling with Integral Overlay
NOV 2015	333	Notice to Users of OPSS 333 (Cold In-Place Recycling)
NOV 2007	334	Cold Recycled Mix
NOV 2015	335	Notice to Users of OPSS 335 (Cold In-Place Recycling with Expanded Asphalt)
NOV 2009	336	Micro-Surfacing (<i>Reissued 2010-11</i>)
NOV 2008	337	Slurry Seal
NOV 2015	341	Routing and Sealing Cracks in Hot Mix Asphalt Pavement
MAR 1998	350	Concrete Pavement and Concrete Base
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NOV 2015	360	Full Depth Repair of Concrete Pavement or Concrete Base
NOV 2011	361	Rubblizing Concrete Pavement and Concrete Base
NOV 2015	362	Fast Track Full Depth Repairs to Concrete Pavement
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NOV 2012	412	Sewage Forcemain Installation in Open Cut
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NOV 2013	415	Pipeline and Utility Installation by Tunnelling
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NOV 2015	421	Notice to Users of OPSS 421 (Pipe Culvert Installation In Open Cut)
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NOV 2014	441	Watermain Installation in Open Cut (Formerly OPSS 701)
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NOV 2015	493	Temporary Potable Water Supply Services (Reissued 2010-11)

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NOV 2014	501	Notice to Users of OPSS 501 (Compacting)

NOV 2009	503	Site Preparation for Pipelines, Utilities, and Associated Structures (Relocated: Now OPSS 490)

NOV 2009	504	Preservation, Protection, and Reconstruction of Existing Facilities (Relocated: Now OPSS 491)

NOV 2013	506	Dust Suppressants

NOV 2005	507	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures (Relocated: Now OPSS 492)

NOV 2014	510	Notice to Users of OPSS 510 (Removal)

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NOV 2014	512	Notice to Users of OPSS 512 (Installation of Gabions)

NOV 2009	514	Trenching, Backfilling, and Compacting (Relocated: Now OPSS 401)

NOV 2005	515	Rock Excavation for Pipelines, Utilities, and Associated Structures in Open Cut (Relocated: Now OPSS 403)

NOV 2005	516	Excavating, Backfilling, and Compacting for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers (Relocated: Now OPSS 402)

NOV 2010	517	Dewatering of Pipeline, Utility, and Associated Structure Excavation

NOV 2011	518	Control of Water from Dewatering Operations

JUNE 1991	532	Pavement Marking (Relocated: Now OPSS 710)

NOV 2005	538	Support Systems (Relocated: Now OPSS 404)



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NOV 2005	541	Chain-Link Fence (Relocated: Now OPSS 772)
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NOV 2008	552	Steel Beam Guide Rail and Cable Guide Rail (Relocated: Now OPSS 721)
FEB 1991	553	Concrete Barriers (Relocated: Now OPSS 740)
NOV 2008	555	Guide Rail End Treatment - Eccentric Loader Terminal System (Relocated: Now OPSS 730)
NOV 2008	556	Connecticut Impact Attenuation System (Relocated: Now OPSS 753)
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NOV 2008	702	Cathodic Protection of New and Existing Watermains (Relocated: Now OPSS 442)
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NOTICE TO USERS OF OPSS 100

GENERAL CONDITIONS OF CONTRACT

General Conditions of Contract has been removed
from this OPS volume

The provincial version of the General Conditions is now in:

OPS Volume 5,
Provincial-Oriented
MTO General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.PROV 100

The municipal version of the General Conditions is now in:

OPS Volume 7,
Municipal-Oriented
OPS General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.MUNI 100

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



GENERAL SPECIFICATION FOR WEIGHING OF MATERIALS

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102.10 BASIS OF PAYMENT

102.10.01 Weighing

102.01 SCOPE

This specification covers the requirements for the weighing of materials where payment is based on mass.

102.02 REFERENCES

This specification refers to the following standards, specifications or publications:

Government of Canada Weights and Measures Act 1985.

Government of Canada Weights and Measures Regulations, 1990

102.03 DEFINITIONS

For the purpose of this specification the following definitions apply:

Limits of Error: means the In Service Limits of Error contained in the Government of Canada Weights & Measures Act.

Weigh Scales, weigh machines: means any device that measures mass and has a moving or movable part that has or can have an effect on the accuracy of the device.

102.04 SUBMISSION AND DESIGN REQUIREMENTS

- Testing and Certification of Scales

102.04.01 Testing Procedures

The Contractor shall give the Contract Administrator a minimum of 48 h notice in advance of any test to be carried out on the weigh scales. The Contract Administrator will be present throughout the duration of the test. Failure to comply may result in a re-test being required.

102.04.02 Portable Scales

Portable scales shall be tested and certified conforming to the Government of Canada Weights and Measures Act and Government of Canada Weights and Measures Regulations.

A completed copy of the "Heavy Duty Scale Inspection Report", form CCA-1409 of the Consumer and Corporate Affairs Department, the Federal Government of Canada shall be sent to the nearest office of the District Inspector of the Weights and Measures Division in each of the following circumstances:

- a. After the initial installation on a contract and before use on that contract.
- b. When the scale is moved to a new location.
- c. When the scale has undergone adjustments, alterations or repairs to the weighing mechanism.

- d. When weighing is resumed after winter suspension.
- e. When digital heads are changed or added.

A duplicate copy of the above report shall be on view in the scale house or trailer before weighing operations commence and at all times thereafter.

102.04.03 Permanently Installed Scales

Permanently installed scales shall show a Government of Canada certificate of inspection.

Where a rejection tag is on display and the Government of Canada certificate of inspection is shown as not currently in effect, but subsequent alterations, adjustments or repair have been carried out, verification of this work is required by the Contract Administrator and should either be on display or located on file in the scale house or trailer. Verification shall be documented on a form CCA-1409 including the following minimum requirements:

- a. Date work carried out.
- b. Items required, altered or adjusted.
- c. Name and signature of person performing the work and name of firm or organization responsible for the work.

102.04.04 Conveyor Scales

Conveyor scales shall be certified by an Inspector of the Government of Canada, Weights and Measures.

- a. After the initial installation on a contract and before use on that contract.
- b. After every relocation on that contract.

102.06 EQUIPMENT

102.06.01 General

Where the contract includes items that require measurement for payment by weighing, weigh scales shall be provided which meet the requirements of the Government of Canada Weights and Measures Act and Regulations for the purposes for which they are to be used.

102.06.02 Platform Scales

Platform scales shall be of sufficient capacity and dimension so as to fully contain the loaded vehicle or coupled vehicle combination in one setting and so as to permit weighing of the entire load in one operation. Weighing of various axle combinations in more than one operation will not be permitted. Scale foundations shall be adequate to support the largest gross load without any settlement occurring during the weighing operation. Scale pits shall be properly drained. Substantial retaining walls, which may be concrete, shall be built at each end of the scale platform to support the entrance and exit ramps. These retaining walls shall be of sufficient strength and so placed as to support the ramp material without binding on the ends of the platform.

In order to minimize the effect of impact loads on the scale adjustment and to reduce the effect of vehicle braking and kickback on the scale platform and scale adjustments, the approach ramp shall be constructed conforming to the weights and measures requirements on a straight and level grade at the same elevation as the scale platform. Vehicles shall enter and leave the platform at a maximum speed of 8.0 km/h.

The scale platform and mechanism shall at all times be maintained clean and free from encumbrances such as gravel, asphalt, snow and ice. The mass indicator mechanism shall be enclosed in the scale house or trailer.

102.06.03 Conveyor Scales

In order to ensure that the required operating temperature has been reached, electric power for conveyor scales shall be applied to the weighing system at least 30 min before the commencement of weighing.

Each conveyor scale shall be provided with a calibration chain certified by the testing agency of the Government of Canada and readily available at all times.

The mass recording device shall clearly indicate the mass so that weigh tickets can be conveniently completed by the weigher.

The mass recording device shall be enclosed in the scale house or trailer.

Span calibration controls shall be sealed during the period of operation and accessible only to the testing personnel.

102.06.04 Scale Houses or Trailers

Each scale house or trailer shall be properly ventilated and shall be clean, dry and weathertight, with a minimum floor space of 4.5 m² and minimum head room of 2.1 m. They shall be equipped with windows which can be opened and closed from within and from which the weigher, while seated at the scale or console, has an unobstructed view of the vehicle to be weighed, the scale platform or conveyor and the approach ramp.

Each scale house or trailer shall also have the following:

1. A free sliding window or other approved means for passing out weigh tickets.
2. Screens for doors and windows.
3. A door located remotely from the scale platform suitable for the occupant's unobstructed exit in case of fire.
4. Theft and vandal-proof locking devices for doors and windows.
5. Door key for the weigher.
6. Table, chair and bench, so that the weigher can be seated during weighing operations in front of the scale or console.
7. Heating equipment sufficient to maintain the temperature in the scale house at 20°C.
8. Adequate lighting to facilitate office work.
9. Fuel, for heating and lighting.
10. Sanitary facilities within 100 m of the scale house or trailer.

102.07 CONSTRUCTION - Weighing

102.07.01 Mass Measurements

Mass measurements will be made by a weigher supplied by the Contract Administrator except where the weigh scales to be used are equipped with an automatic printing device capable of producing tickets conforming to the Owner's requirements.

102.07.02 Scale Location

Scales for weighing hot mixed asphaltic concrete shall be located at the mixing plant. Scales for weighing other materials shall be installed at locations selected by the Contractor.

Where material is from a commercial source, the tickets issued at the source are acceptable providing the weighing operation conforms to this specification.

When, in the opinion of the Contract Administrator, waste or loss of material between the above scale location and the material's intended destination on the contract occurs, the hauling operation may be terminated until a scale has been provided on a site which is approved by the Contract Administrator and which is close enough to the intended destination to preclude the possibility of waste or loss.

102.07.03 Vehicle Tares

102.07.03.01 General

Vehicles shall be tared for all weighing operations with the normal hauling complement of driver, accessories and fuel.

The same scale shall be used for truck taring and establishing gross vehicle mass and the mass of the material to be delivered, with the exception of commercial sources, where separate tare scales are permitted in the same pit or quarry providing the electronics are interfaced from one scale to the other.

Each truck and each coupled vehicle combination shall have a distinguishing number prominently displayed where it will be readily visible to the weigher.

102.07.03.02 Weighing Non-Liquid Materials

When a platform scale is being used on the contract, the tares of the hauling vehicles will be determined randomly at least once daily, and more frequently if required by the Owner.

102.07.03.03 Weighing Liquid Materials

Weighing of liquid materials shall be carried out on permanently installed scales with automatic printing devices.

102.07.03.04 Volumetric Measurement

Where specified in the Contract as an alternative to weighing, a metering device, conforming to the Government of Canada Weights and Measures Act and Regulations thereto, shall be used in the conversion of liquid volume, to an equivalent mass in tonnes, using the factor specified in the Contract.

102.07.04 Checking of Weigh Scales by Enforcement Officers

During normal contract working hours weigh scales shall be at the disposal of Provincial Police Officers and enforcement officers of the Owner for the purpose of checking the mass of the loads of vehicles employed on this contract.

Scale houses or trailers shall be accessible during normal contract working hours so that weighing records may be examined.

102.08 QUALITY ASSURANCE

102.08.01 Scale Accuracy

The Owner reserves the right to check the accuracy or test the Contractor's scales at any time.

Where a device is found to be in error, in excess of the Limits of Error but less than three times the Limits of Error, the Owner will accept material measured for payment by the device for a period of 48 hours from the time the Contractor is notified in writing that the error exceeds the Limits of Error.

When a device is found to be in error, in excess of three times the Limits of Error, the Owner will immediately cease to accept material measured for payment by the device.

102.08.01.01 Conveyor Scales

A conveyor scale test shall be conducted a minimum of twice weekly or as required by the Owner. A minimum ten minute run is required for this test.

The material shall be collected in truck boxes and the total mass for each truck recorded. The material shall be reweighed on a recently verified platform scale, arranged for by the Contractor, and the material mass compared. The maximum allowable variation between the truck scale mass and the conveyor scale mass shall not exceed 0.5%. The test results are to be recorded and available at all times.

The Contractor shall be responsible for arranging the use of the platform scale.

102.10 BASIS OF PAYMENT

102.10.01 Weighing

Payment for the weighing of material shall be included in the contract price of the item(s) for the materials to be placed or the work to be done and shall be deemed to include full compensation for all labour, equipment and material required to carry out the weighing operation including any delay or inconvenience due to any checking or testing carried out by the Owner.



GENERAL SPECIFICATION FOR ELECTRICAL WORK

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106.01 SCOPE

This specification covers the general requirements for electrical work and is applicable to all electrical work in the Contract.

106.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

106.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

106.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 609	Grounding
OPSS 611	Installation of Underpass Luminaires
OPSS 614	Installation of Power Supply Equipment
OPSS 617	Installation of Roadway Luminaires
OPSS 620	Traffic Signal Equipment and Electrical Traffic Control Devices
OPSS 624	Traffic Signal Interconnection Equipment
OPSS 630	Installation of Sectional Steel High Mast Lighting Poles

Ontario Ministry of Transportation Publications

Electrical Engineering Manual, Volume 2, Electrical Maintenance

Ontario Traffic Manual (OTM):
Book 7 - Temporary Conditions

Electrical Safety Authority (ESA)

Ontario Electrical Safety Code

106.03 DEFINITIONS

For the purpose of this specification, definitions in the Ontario Electrical Safety Code and the following definitions apply:

Cable means a solid or stranded, bare or insulated metal conductor (wire) or group of conductors enclosed in a common jacket or twisted to form a group.

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Down Time means the time during which an electrical system is de-energized or not under full operation.

Duct means a circular pipe or conduit for the mechanical protection of cables.

Electrical Chamber means a chamber for placing and maintaining conductors, cables, ducts, or electrical equipment. A general name for electrical maintenance holes and handholes.

Electrical Maintenance Hole means a subsurface chamber large enough for a person to enter that allows facilities for placing and maintaining underground conductors, cables, and associated apparatus.

Electrical Work means any work associated with the installation, modification, removal, inspection, or testing of electrical system components, including work required for all auxiliary concrete, mechanical, metallic, or non-electrical components required for the work.

Electrician means a person in possession of a certificate of qualification for the trade of Electrician, Construction and Maintenance, 309A or 309D, issued by the Ministry of Training, Colleges and Universities, Ontario.

Emergency Maintenance or Emergency Repairs means an activity required to repair unexpected failure of electrical equipment components that requires immediate action and takes precedence over routine maintenance activities for the duration of the emergency.

Energized means electrically live.

Engineer means a professional engineer licensed by the Professional Engineers of Ontario to practice in the Province of Ontario.

ESA means Electrical Safety Authority.

High Mast Lighting Equipment means high mast poles complete with luminaire raising and lowering devices consisting of ring assemblies complete with tenon arms, shrouds, external or internal drive mechanisms, and pole anchorage assemblies.

Highway Lighting System means a system of luminaires, poles, sign luminaires, underpass illumination, cables, power supply equipment, control system, and all associated materials required to provide illumination on a highway, roadway, or associated appurtenances.

IMSA means International Municipal Signal Association.

Luminaire means a complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply.

Nighttime means the time during which the ambient natural horizontal illuminance at ground level is less than 15 lux.

Non-Routine Maintenance means any activity, other than routine maintenance activities, required to bring the electrical systems to full functionality according to standards.

Pad means a concrete footing with a level surface used to mount electrical equipment or for a temporary installation that could be made of wood.

Power Supply Equipment means electrical equipment installed to provide a source of power for electrical systems and includes transformation, switching, and control equipment.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Record Drawings means drawings illustrating constructed deviations from the original Contract Drawings in hard copy and scanned digital copy. Authorized deviations from the original Contract Drawings are marked up in red on one set of Contract Drawing prints in a neat legible manner.

Routine Maintenance means ongoing preventive maintenance activities according to the manufacturer's recommendations and the Owner's maintenance standards and includes the periodic adjustment of the electrical system components to correct deviations from the system specifications resulting from normal operation of the system.

Service Manuals means the full literature, drawings, directives, instructions, and procedures issued by the supplier or manufacturer of any system component for the purposes of assembly, installation, operation, preventive maintenance, or emergency maintenance of the system component.

Signalized Intersection means an intersection or junction of roadways or crosswalks or both where the vehicular and pedestrian traffic is controlled by a traffic signal system.

Switchover means the act of closing down an electrical system and bringing a new or modified electrical system into operation.

System Components means all hardware and software components, devices, parts, and materials included in the electrical work supplied and installed under a Contract, including all spare parts supplied by the Contractor.

Temporary means work that is done to serve a specific function and removed on the same Contract as it was placed.

Traffic Signal System means a system of traffic signal equipment, poles, traffic signal controllers, traffic signal actuation and interconnection equipment, and all associated materials required to regulate vehicular and pedestrian traffic.

Underpass Illumination means any work required for the installation of luminaires on the ceilings, walls, beams, abutments, or piers of a bridge or retaining walls.

106.04 DESIGN AND SUBMISSION REQUIREMENTS

106.04.01 Submission Requirements

106.04.01.01 Electrical Equipment Working Drawings

Working Drawings for the following electrical equipment are required:

- a) Luminaires
- b) High-voltage switches and fuses
- c) Transformers
- d) Distribution assemblies
- e) Supply control cabinet assemblies
- f) Traffic signal control cabinet assemblies
- g) Anchorage assemblies
- h) High mast lighting equipment (i.e., poles, and raising and lowering equipment)
- i) High mast luminaires
- j) Advanced traffic management systems (ATMS) equipment
- k) Traffic data collection systems equipment
- l) Roadway weather information systems equipment

Working Drawings for luminaires shall consist of manufacturer's catalogue information and photometric data. Working Drawings for all other items shall include all information required in the Contract Documents.

Working Drawings for all items shall include all information required in the applicable Owner's material specification.

Materials and dimensions shown on the final Working Drawings shall not be changed without approval of the Contract Administrator. Resubmission of Working Drawings showing any changes to the final Working Drawings is required.

106.05 MATERIALS

All similar electrical materials, equipment, components, or completed assemblies of components shall be approved according to the Ontario Electrical Safety Code.

106.07 CONSTRUCTION

106.07.01 Qualification of Workers

106.07.01.01 Contractor's Representative

A representative, who is experienced in the electrical work to be performed, shall be appointed to represent the Contractor.

The Contractor's representative shall attend such meetings required by the Owner to coordinate services affected by the Contract.

106.07.01.02 Contractor's Workers

The Contractor or electrical subcontractor shall be a licensed electrical contractor according to the Electricity Act and shall use workers qualified to do the electrical work according to the following:

- a) All electrical and advanced traffic management system work shall be performed by or under the direct personal supervision of an electrician.
- b) Traffic signal and traffic signal control equipment installation, inspection, and testing shall be performed by an electrician who has successfully completed one of the following:
 - i. Levels 1 and 2 of the IMSA Traffic Signal Technician Certification Program
 - ii. Ministry of Transportation's (MTO) 170 Training Course and 170 Advanced Training Course
 - iii. 170-332 IMSA/MTO Certification Program
- c) All high mast lighting installation, inspection, and testing shall be performed by an electrician who has successfully completed training from the manufacturer(s).
- d) All locates for electrical systems and advanced traffic management systems shall be performed by a licenced electrician who has successfully completed cable locate training.
- e) All electrical testing and inspection work shall be performed by an electrician.

The Contract Administrator may request at any time that the Contractor provide proof that the individual performing or supervising the electrical work is an electrician. If such a person is not present, the Contract Administrator may direct the Contractor to cease all electrical work until an electrician, with proof of such, is on site to perform or supervise the electrical work.

106.07.01.03 High-Voltage Work

High-voltage work shall be performed by qualified personnel.

106.07.02 Work to be Inspected by Electrical Safety Authority

All electrical work is subject to inspection by the ESA. The Contractor shall perform all work associated with inspection or re-inspection by the ESA. This work includes, but is not limited to the following:

- a) Arranging and coordinating all visits to the construction site by the ESA's inspectors.
- b) Correcting all defects identified by the ESA.
- c) Submitting all applications for inspection.
- d) Obtaining all permits.

- e) Obtaining all certificates.
- f) Obtaining all connection authorizations from the ESA.
- g) Payment of fees.
- h) Performing any other work that may be required under the Ontario Electrical Safety Code.

106.07.03 Work to be Coordinated with Others

The Contractor shall coordinate for the following work:

- a) Electrical power supply connection and disconnection by the electrical power supply authority.
- b) Communication connection and disconnection by the communication provider(s).
- c) Mounting of any electrical equipment on a pole or any structure owned by or under the jurisdiction of a Utility authority.
- d) Mounting of any electrical equipment in close proximity to or requiring modification of any plant owned by a Utility authority, private person, or other company.

The Contractor shall notify the Contract Administrator in writing at least 15 Business Days prior to commencing the above work. A detailed breakdown of the required Utility work and the corresponding Utility cost to complete the work, along with a Utility authority contact name, address, and telephone number, shall be provided to the Contract Administrator.

Utility authority invoices for the above work shall be forwarded to the Contract Administrator.

Obtaining all connection authorizations and layouts shall be completed by the Contractor.

The Contractor shall provide 2 copies of all Utility service layouts to the Contract Administrator.

The Contract Administrator and the Owner's electrical coordinator shall be notified a minimum of 72 hours in advance of all service layout meetings with an electrical power supply authority. The Contractor shall obtain electrical power supply billing account details from the Contract Administrator and provide them to the electrical power supply authority.

The Contractor shall locate all of the electrical systems and advanced traffic management systems within the limits of the Contract. The Contractor shall complete all locates on the Owner's electrical systems and advanced traffic management systems required for the Contractor to do the Work. The Contractor shall not rely on the Owner to complete the locates.

106.07.04 Traffic Signal Systems

106.07.04.01 General

Testing of signal displays and switch on for operation of traffic signals shall be under police supervision. Switch on and switchover for operation is not permitted on Mondays, Fridays, Saturdays, Sundays, and statutory holidays.

106.07.04.02 Existing Traffic Signal Systems

Except when the Contract requires modifications to existing traffic signal systems, the Contractor shall perform the operations with the existing traffic signal systems undisturbed and fully operational. When traffic signal systems are to be installed and the existing traffic signal system is to be removed or modified, the new traffic signal system shall be installed independently of the existing system such that short duration switchover from one system to the other is effected without appreciable down time.

106.07.04.03 New Traffic Signal Systems Activation

A new traffic signal system at a location not previously signalized shall be initially switched on for operation according to the following requirements:

- a) For the testing of circuitry and components, operation of the system shall take place with signal head covers in place.
- b) The Contract Administrator shall be given a minimum of 5 Days notice of when the system shall be ready for operation and 24 hours notice prior to completion of the work. Confirmation is to be given that the work shall be done as scheduled.
- c) The Contractor shall complete all preliminary system testing as specified in the Contract Documents and all repairs or replacement of defective components prior to final energizing.

106.07.04.04 Traffic Signal Systems Switchover

A new traffic signal system installed to replace an existing traffic signal system shall be initially switched on for operation according to the following requirements:

- a) The Contract Administrator shall be given a minimum of 3 Days notice of when the system switchover shall be done and 24 hours notice prior to completion of the work. Confirmation is to be given that the work shall be done as scheduled.
- b) All preliminary system testing shall be completed as specified in the Contract Documents and all adjustments or replacement of defective electrical equipment in the new system completed prior to system switchover.
- c) For the testing of circuitry and components, operation of the new signal system shall take place with the covers for the new signal head in place and the existing signal system operational.
- d) Signal heads of the existing traffic signal system shall be covered and covers shall be removed from the new signal heads with both systems de-energized. Traffic shall be under police supervision during this operation.

106.07.04.05 Maintenance of Traffic Signal Systems

106.07.04.05.01 General

All routine, non-routine, and emergency maintenance work shall be performed on all traffic signal systems for public use within the limits of the Contract, until the issuance of the Final Acceptance Certificate by the Contract Administrator.

The initial traffic signal timing shall be programmed into the traffic signal controller as directed by the Contract Administrator up to a maximum of four times. The traffic signal controller shall be set up by performing all programming, setting all timing controls and switch settings, and setting any other controller operational parameters obtained from the Contract Administrator. The Contractor shall verify to his own satisfaction that the revised signal timing is consistent and complete.

At any time during the Contract, the Contract Administrator reserves the right to review the timing and operations of the traffic signal system and the Contractor shall implement any changes to the operation settings and timings requested by the Contract Administrator.

All traffic signal system components shall be maintained in good working condition according to the Contract Documents and all routine maintenance and emergency repairs shall be provided as required.

On call local emergency repair service shall be provided 24-7 for the duration of the Contract, including winter shut down. Emergency repairs shall be required whenever there is a failure or cessation of the operation of any component or components of the traffic signal system.

Each time emergency repair work is performed on a traffic signal system, the Contractor shall notify the Contract Administrator within 72 hours of the completion of the emergency repair work.

Any traffic signal timing not included in the original Contract Documents shall be approved by the Owner before it is installed in a traffic signal controller.

Routine, non-routine, and emergency maintenance shall be according to the manufacturers' recommendations and the Electrical Engineering Manual, Volume 2.

106.07.04.05.02 Notification and Record Keeping - Traffic Signal Systems

The Contractor shall clearly identify in writing the designated contact person and alternate for liaison with the Contract Administrator. The Contract Administrator shall designate representatives and alternates as contact persons for the Owner.

A logbook shall be maintained and kept in the traffic signal field cabinet or at a location agreed upon with the Owner. The logbook shall record any fieldwork performed on the traffic signal system, including the replacement of any hardware, changes to the software, or changes to the configuration, phasing, or timing parameters. The time and date of each entry in the logbook shall be signed by the individual making the entry.

106.07.04.06 Traffic Signal Activation Meeting

A minimum of 48 hours prior to the planned activation of each set of traffic signals, the Contractor shall coordinate and attend an on-site quality control meeting with the Contract Administrator. As a minimum, the following individuals shall be in attendance at the meeting:

- a) Contractor's on-site representative
- b) Pavement marking sub-contractor representative
- c) Electrical sub-contractor representative
- d) Electrical Quality Verification Engineer
- e) Contract Administrator
- f) Contract Administrator's electrical inspection staff
- g) Contractor's person responsible for traffic control and highway work zone safety
- h) Owner's electrical coordinator, traffic representative, and electrical quality assurance representative

The purpose of this meeting is to ensure that the Contractor clarifies the roles and responsibilities of all parties involved in the traffic signal activation, that all advanced work is complete, and to confirm that all required arrangements have been made in order to ensure that the activation proceeds smoothly and expeditiously. The Contractor shall prepare the agenda for the meeting and record the minutes to be distributed to all attendees.

As a minimum agenda, the following shall be addressed:

a) General

- i. Confirm the name and position of the person responsible for coordinating traffic control during the signal activation.
- ii. Confirm that arrangements have been made with the appropriate police authority to provide traffic control.
- iii. Confirm that all the work has been constructed as specified in the Contract Documents and is in accordance with the signed legal drawing (PHM-125). Any deficiencies shall be brought to the attention of the Contract Administrator.
- iv. Confirm the date and time of the traffic signal activation.

b) Pavement Marking

- i. Confirm the name and position of the person responsible on site for carrying out the pavement markings.
- ii. Confirm that the pavement markings have been pre-marked as specified in the Contract Documents and are according to the signed legal drawing (PHM-125).
- iii. Review the Contract Drawings for the pavement markings that shall be in place on the day of signal activation.

c) Electrical

- i. Confirm that the Contract Administrator shall be in receipt of all Quality Verification Engineer certificates of conformance immediately following the activation of the signals.
- ii. Confirm that all vehicle detection is positioned as required and functioning correctly.

106.07.05 Maintenance of Highway Lighting Systems

106.07.05.01 General

All routine, non-routine, and emergency maintenance work shall be performed on all highway lighting systems for public use within the limits of the Contract, until the issuance of the Final Acceptance Certificate by the Contract Administrator.

The Contractor shall maintain all lighting systems located within the limits of the Contract in full nighttime operation. The Contractor shall perform all routine, non-routine, and emergency maintenance work required to maintain the lighting systems. Suitable combinations of existing, temporary, or new lighting systems may be used to achieve the required performance, safety, and reliability of the lighting system. The Contractor shall provide routine, non-routine, and emergency maintenance service during winter shut down. Routine, non-routine, and emergency maintenance work shall be according to the Electrical Engineering Manual, Volume 2.

106.07.05.02 Notification and Record Keeping - Highway Lighting Systems

The Contractor shall clearly identify in writing the designated contact person and alternate for liaison with the Contract Administrator. The Contract Administrator shall designate representatives and alternates as contact persons for the Owner.

A logbook shall be maintained and kept in the highway lighting system field cabinet or at a location agreed upon with the Owner. The logbook shall record any fieldwork performed on the highway lighting system, including the replacement of any hardware, changes to the software, or changes to the configuration, phasing, or timing parameters. The time and date of each entry in the logbook shall be signed by the individual making the entry.

106.07.06 Temporary Electrical Work

All temporary electrical work specified in the Contract Documents shall be installed and made ready for operation prior to opening the associated traffic lanes or sidewalks that the work is intended to serve.

106.07.07 Layout of Electrical Equipment

All equipment shall be installed at locations detailed in the Contract Documents.

Layout for stations and offsets of concrete pads and footings, electrical chambers, and poles shall not exceed a tolerance of ± 100 mm.

The Contractor shall ensure there are no Utility conflicts, both overhead and underground, with any pole locations prior to starting any excavation or pole installation work. Underground ducts and cables shall not be located within 600 mm of guide rail.

106.07.08 Adjustment of Electrical Equipment

All luminaires, traffic signal heads, optical lens assemblies, photoelectric controllers, and other devices shall be adjusted according to the Contract Documents. Luminaires shall be adjusted under nighttime operational conditions and in the presence of the Contract Administrator.

106.07.09 Open Excavations

Excavations within 4.0 m of the edge of travelled roadway shall not be left open overnight.

106.07.10 Quality Control

106.07.10.01 General

Tests and inspections on electrical equipment shall be according to the appropriate specifications covering the work.

The Contractor is responsible for all pre-installation and proof of performance testing and inspections for electrical work. Each time the Contractor is to perform an inspection or test, the Contract Administrator shall be notified 48 hours prior to commencing the inspection or test.

106.07.10.01.01 Pre-Installation Testing and Inspection

Pre-installation testing and inspection of electrical work shall include all testing and inspection of system components, including testing of mock-ups, prototype testing, and normal factory production testing undertaken on behalf of the Contractor prior to the installation of such components.

106.07.10.01.02 Proof of Performance Testing and Inspection

Proof of performance testing and inspection of electrical work shall include all testing and inspection of system component installations into the work in order to verify the physical and operational features of each part of the system components and electrical subsystems.

The Quality Verification Engineer shall witness the inspection, testing, and test results for the following electrical work according to the appropriate specification prior to issuing a Certificate of Conformance:

- a) Grounding according to OPSS 609
- b) Installation of underpass luminaires according to OPSS 611
- c) Installation of power supply equipment according to OPSS 614
- d) Installation of roadway luminaires according to OPSS 617
- e) Traffic signal equipment and electrical traffic control devices according to OPSS 620
- f) Traffic signal interconnection equipment according to OPSS 624
- g) Installation of high mast lighting poles according to OPSS 630

When issuing the Certificate of Conformance for the above work, the Quality Verification Engineer shall also certify that he or she has witnessed the inspection, testing, and test results for such electrical work.

106.07.10.02 High-Voltage System Testing

All high-voltage cable and electrical equipment shall be tested according to the Contract Documents.

One copy of test results and one copy of the cable and electrical equipment manufacturer's test report shall be submitted to the Contract Administrator.

106.07.11 Documentation

106.07.11.01 General

Documentation, including Working Drawings, catalogue sheets, calculations, drawings, diagrams, test print-outs, photographs, manufacturer's instructions, service manuals, and text shall be provided by the Contractor to a level of detail such that it assures the Contract Administrator that the system components that the Contractor is furnishing are according to the requirements of the Contract Documents. The documentation shall also be used to provide records for future operational and maintenance activities.

The Contractor shall submit, as part of the service manuals, a dated and signed form of inspection of each item of work.

106.07.11.02 Test Results and Inspection Reports

Test results and inspection reports, including any required verifications and certifications from the Quality Verification Engineer, shall be submitted to the Contract Administrator. Inspection reports shall include the completed checklist and any material observations made at the time of the inspection.

The documentation shall include the method of testing and inspecting of each item. The method of testing and inspecting shall ensure that the functional, physical, and environmental aspects of the contract specifications are demonstrated.

The documentation shall include all quantitative information generated as part of the testing and inspecting work, including meter readings, screen displays, charts, and any other numerical or graphical data.

The documentation shall include all applicable verifications and certifications from the Quality Verification Engineer. The documentation shall present the results of all tests and inspections in a format that is logical and easily understood.

Test results and inspection reports shall be submitted to the Contract Administrator within 48 hours of completion of the inspection or test detailing:

- a) The installation and operation of the system components on an item-by-item basis.
- b) Clear detailed illustrations, including control layouts, displays, schematic diagrams, and all other information, required to correctly operate a fully functional unit as well as the maintenance and service aspects of the system components.
- c) The model number, suggested and actual settings, and options as installed and configured for each piece of electrical equipment.
- d) Sections that completely describe the theory of operation using block diagrams and schematic drawings.
- e) Diagnostic and repair procedures for corrective maintenance of the unit, assembly and disassembly instructions and drawings, layout drawings showing location of all components, and complete components listing showing component type, ratings, cost, and acceptable manufacturers. Complete schematic diagrams to the component level.
- f) Fully described adjustments and alignment procedures and provide descriptions of expected signals at all test points and outputs.
- g) The specifications of system components performance.

106.07.11.03 Service Manuals

Each service manual shall be assembled in 3-ring binders of 75 mm maximum thickness and shall be indexed item by item. Several items may be covered in a single binder. The manual shall document in detail the installation and operation of the system components on an item-by-item basis. It shall contain clear detailed illustrations, including layout of controls, displays, schematic diagrams, and all other information required to correctly operate a fully functional unit as well as the maintenance and service aspects of the system components. The model numbers, with installed options and installed settings shall be clearly shown.

The manual shall provide sections that completely describe the theory of operation using block diagrams and schematic drawings. The manual shall include diagnostic and repair procedures for corrective maintenance of the unit; assembly and disassembly instructions and drawings; layout drawings showing location of all components; and complete components listing showing component type, ratings, cost, and acceptable manufacturers. Complete schematic diagrams to the component level shall be provided. The manual shall fully describe all adjustments and alignment procedures and provide descriptions of expected signals at all test points and outputs. Detailed specifications of the performance of system components shall be provided.

The Contractor is responsible for generating the required documentation in the event that it is not available from the manufacturer.

The manual shall detail, at the system engineering level, the procedures for installation of software on a given computer system. The manual shall also address the operation of the software at three different levels: beginner (trainee), intermediate (operator), and advanced (systems engineer).

106.07.11.04 Submission of Documentation

The Contractor shall provide the following:

- a) Three copies of all documentation required under the Documentation subsection.
- b) Three copies of the Working Drawings and service manuals for the items specified in Table 1.
- c) Three sets of record drawings to the Contract Administrator at the completion of the Contract. All deviations and design changes from the original design shall be marked accurately on the record drawings printed in red along with any required explanatory notes. The location of the underground facilities on the record drawings shall be drawn accurately and correctly with stations, offsets and tie down points.
- d) Three copies of any documents and drawings that are resubmitted.

106.07.11.05 Quality of Documentation

The documentation shall be of professional quality, including machine- or hand-printed text, inked or CAD produced drawings, and photographic material, if applicable.

106.07.12 Restoration

The site of all electrical works shall be restored to original or better condition than existed prior to the works or as specified in the Contract Documents.

106.07.13 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

106.08 QUALITY ASSURANCE

Electrical equipment requiring the submission of Working Drawings, as detailed in the Design and Submission Requirements section is subject to inspection by the Owner's representative prior to shipping of the electrical equipment. The inspection shall take place at the manufacturer's factory or at the supplier's place of business. The Owner's representative shall be informed when the electrical equipment fabrication is approximately 80% and 100% complete and suitable arrangements shall be made for any required inspection.

All electrical work is subject to random inspection by the Owner's representative. The Owner's representative may witness any testing performed by the Contractor.

Upon notification, any Owner's representative (e.g., electrical coordinator, quality assurance representative) shall have access to the working area for the purpose of inspection and testing of electrical installations.

106.10 BASIS OF PAYMENT

Payment at the Contract price for the tender items that require general electrical work shall be full compensation for all labour, Equipment, and Material to do the general electrical work.

When the Contract contains separate tender items for work required by this specification, payment shall be at the Contract prices and according to the specifications for such work.

106.10.01 Contractor's Workers

When the Contract Administrator directs the removal of staff or the cessation of electrical work, no extra payment shall be made by the Owner for any costs incurred by the Contractor as a result of such direction.

106.10.02 Work to be Inspected by Electrical Safety Authority

The work resulting from the inspection or re-inspection of electrical work by the ESA, except for correcting defects that are the direct result of compliance with the Owner's design of the work, shall be at no extra cost to the Owner.

106.10.03 Traffic Signal Systems

The activation of traffic signals, including police supervision, shall be at no extra cost to the Owner.

106.10.04 Maintenance Costs

When the Owner performs maintenance work resulting from inadequate workmanship on systems installed by the Contractor or defective materials supplied by the Contractor, the actual costs of the maintenance work shall be charged to the Contractor.

106.10.05 Temporary Work

Payment for temporary items shall be made at the rate of 80% of the Contract price upon acceptance of the installation, and the remaining 20% of the Contract price shall be paid upon acceptance of the removal work.

TABLE 1
Submission Requirements for Working Drawings and Service Manuals

Item	Submission Requirements	
	Working Drawings	Service Manuals
Luminaires	Y	Y
High-voltage switches and fuses	Y	-
Transformers	Y	-
Distribution assemblies	Y	Y
Supply control cabinet assemblies	Y	Y
Traffic signal control cabinet assembly	Y	Y
Anchorage assemblies	Y	-
High mast lighting equipment (i.e., poles, raising and lowering equipment)	Y	Y
High mast luminaires	Y	Y
Advanced traffic management systems equipment	Y	Y
Traffic data collection systems equipment	Y	Y
Roadway weather information systems equipment	Y	Y
Traffic signal controllers	-	Y
Flasher mechanisms	-	Y
Conflict monitors	-	Y
Load switches	-	Y
Loop detectors	-	Y
DC isolators	-	Y
AC isolators	-	Y
Thermostat panel	-	Y

Appendix 106-A, November 2012
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.

Appendix 106-B, November 2012

FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

Supplemental Requirements for Using OPSS 106 in Municipal Contracts

OPSS 106 Electrical Work, is amended as follows:

106.03 Definitions

Section 106.03 is amended by the deletion of the definition for Quality Verification Engineer and replaced by the following:

Quality Verification Engineer (QVE) means a representative of the Owner qualified to provide the services specified in the Contract Documents.

106.04.01 Submission Requirements

Subsection 106.04.01 is amended by the addition of the following:

106.04.01.02 Submission of Drawings

Seven sets of electrical equipment Working Drawings shall be submitted to the Contractor Administrator prior to the commencement of fabrication.

106.04.01.03 Return of Submissions

Each submission or resubmission shall be reviewed and returned within 4 weeks.

Three copies of the electrical equipment Working Drawings to be returned, shall be marked as one of the following:

- a) Stamped with wording that allows for permission to construct.

In this case, the Contractor shall then submit another seven copies of these final drawings to the Contract Administrator, who shall stamp them with wording that allows for permission to construct. Work can commence on receipt of the drawings by the Contractor.

- b) Showing only required changes.

In this case, the drawings shall be updated as required and the submission process repeated.

Once fabrication of the electrical equipment has commenced, materials and dimensions shown on the final Working Drawings shall not be changed.

Appendix 106-B

106.07.04.05.01 General

The last paragraph of clause 106.07.04.05.01 is deleted in its entirety and replaced with the following:

Routine, non-routine, and emergency maintenance shall be according to the manufacturer's recommendations and the Owner's maintenance standards.

106.07.05.01 General

The last paragraph of clause 106.07.05.01 is deleted in its entirety and replaced with the following:

The Contractor shall maintain all lighting systems located within the limits of the Contract in full nighttime operation. The Contractor shall perform all routine, non-routine, and emergency maintenance work required to maintain the lighting systems. Suitable combinations of existing, temporary, or new lighting systems may be used to achieve the required performance, safety, and reliability of the lighting system. The Contractor shall provide routine, non-routine, and emergency maintenance service during winter shut down. Routine, non-routine, and emergency maintenance work shall be according to the Owner's maintenance standards.



NOTICE TO USERS OF OPSS 120

GENERAL SPECIFICATION FOR THE USE OF EXPLOSIVES

OPSS 120 has been removed from this
OPS volume

The provincial version of OPSS 120 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 120

The municipal version of OPSS 120 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 120

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



**SCHEDULE OF RENTAL RATES FOR
CONSTRUCTION EQUIPMENT, INCLUDING
MODEL AND SPECIFICATION REFERENCE**

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.10	Self-Propelled, Static, Pneumatic Tires

127.02.04**Concrete Equipment**

127.02.04.01	Saw, Self-Propelled, Excluding Blades
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.04	Concrete Vibrator, Including Flexible Shaft and Electric Motor
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127.02.05**Crushing Equipment**

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.04	Screening Plant, Double Deck, Diesel
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127.02.07**Excavation Equipment**

127.02.07.01	Hydraulic Excavator, Crawler Mounted, Long Reach, 12 to 21 m Boom
.02	Hydraulic Excavator, Crawler Mounted
.03	Hydraulic Excavator, Rubber Tired
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.12	Skid Steer Loader, Rubber Tire

- .13 Skid Steer Loader, Tracked
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- .02 Rigid Gooseneck Float With Tractor
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- .04 Pickup, Two-Wheel Drive
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- .06 Rear Dump, Single Rear Axle, Diesel or Gas
- .07 Rear Dump, Tandem Rear Axle, Diesel or Gas
- .08 Rear Dump, Triaxle, Diesel
- .09 Tractor, On Highway, Diesel
- .10 Trailers, Rear Dump
- .11 Trailers, Live Bottom
- .12 Water Truck, Single Rear Axle
- .13 Water Truck, Tandem Rear Axle
- .14 Dump Trucks, Off Highway, Rigid Frame
- .15 Dump Trucks, Off Highway, Articulated Frame

127.02.09 Hoisting Equipment

- 127.02.09.01 Boom Truck
- .02 Hydraulic Crane, Rough Terrain
- .03 Hydraulic Crane, Carrier Mounted
- .04 Lattice Boom Crane, Crawler Mounted
- .05 Lattice Boom Crane, Carrier Mounted
- .06 Aerial Bucket Lift, Truck Mounted, Including Truck
- .07 Aerial Bucket Lift, Self-Propelled, Telescopic/Articulating
- .08 Scissor Lift, Self-Propelled
- .09 Tool Carrier
- .10 Telescopic Handlers

127.02.10 Pile Driving Equipment

- 127.02.10.01 Hammer, Open End, Diesel
- .02 Driver/Extractor, Vibratory Centrifugal, Including Power Pack, Excluding Crane
- .03 Leads, Including Hydraulics and Kicker
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- .05 Universal Piling Machine, Including Attachment

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.04	Portable Light Towers
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.10	Pile Driving Equipment - Not Used
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127.04.11.01	Mechanical Drilling Equipment, Carrier Mounted, Including Auger
.12	Broom and Sweeper Equipment - Not Used
.13	Forestry Equipment - Not Used
.14	Portable Generating Equipment - Not Used
.15	Pumping Equipment - Not Used
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.03	Compaction Equipment - Not Used
.04	Concrete Equipment - Not Used
.05	Crushing Equipment - Not Used
.06	Earth Moving, Grading Equipment
.07	Excavation Equipment
.08	Haulage Equipment - Not Used
.09	Hoisting Equipment - Not Used
.10	Pile Driving Equipment - Not Used
.11	Drilling Equipment
.12	Broom and Sweeper Equipment - Not Used
.13	Forestry Equipment - Not Used
.14	Portable Generating Equipment - Not Used
.15	Pumping Equipment - Not Used
.16	Welding Equipment - Not Used
.17	Traffic Control Devices - Not Used

127.01 SCOPE

This specification covers equipment rental rate compensation for work on a Time and Material Basis. The calculated rate represents the cost of owning and operating the equipment and is made up of direct and indirect costs such as fuel, oil, lubrication, field repairs, overhaul, depreciation, financing, storage, insurance, overhead, and profit.

The rental rates in this schedule are hourly, unless otherwise stated, and do not include the cost of the operator.

The information was compiled from manufacturers, equipment dealers and distributors, and contractors and is based on equipment specifications for standard models, including all necessary attachments to perform the work. Adjustments shall not be made to the rental rate due to optional components that may increase the weight, capacity, or power of a piece of equipment.

Except for Subsection 127.02.09, Hoisting Equipment, the rates listed cover the range of all equipment up to the next highest increment. When a piece of equipment falls in between listed categories, with respect to weight or capacity, the lower rental rate shall apply. For Subsection 127.02.09, Hoisting Equipment, when the size of the equipment falls between the increments shown, the rental rate is to be determined by a straight-line interpolation and rounded to the nearest five cents.

The rental rates reflect the existing tax situations as they pertain to the purchase of equipment at the date of publication.

Section 127.03, Manufacturers' Model, Specification, and Capacity Reference Guide, covers a partial listing of manufacturers' equipment model or specification numbers, with appropriate capacity and power ratings. This guide is provided for reference purposes only to assist in determining the appropriate ratings listed in Section 127.02, Schedule of Rental Rates for Construction Equipment.

The rental rates are reviewed annually; therefore, any errors, omissions, or additional suggestions or amendments should be addressed in writing to:

Head, Estimating Section
Contract Management Office
Ontario Ministry of Transportation
Garden City Tower, 2nd Floor
301 St. Paul Street
St. Catharines, ON L2R 7R4

127.02 SCHEDULE OF RENTAL RATES FOR CONSTRUCTION EQUIPMENT

127.02.01 AIR EQUIPMENT

127.02.01.01 Air Compressor, Silenced

Flow Rate m ³ /min	
3	14.60
5	18.45
7	27.15
10	36.95
17	65.25
25	101.95
45	160.35

127.02.01.02 Air Hammer, Including 15 m Hose, Excluding Points

Weight, kg	
3	1.10
14	1.90
28	2.10

127.02.01.03 Sand Blaster, Including Nozzles and Hoses

Sand Pot Capacity	
Weight, kg	
135	5.70
270	6.35

127.02.02 ASPHALT EQUIPMENT

127.02.02.01 Asphalt Paver

Weight, kg	
2,000	42.70
4,000	57.40
7,000	98.60
9,000	215.00
14,000	258.95
17,000	288.50
20,000	326.30

127.02.02.02 Asphalt Paver Attachment

Mechanical Floating Beam	6.60
Mechanical Grade and Slope Control	15.10
Screed Extension, Bolt On	4.25
Sonic Averaging Ski	7.35
Sonic Grade and Slope Control	14.65

127.02.02.03 Asphalt Distributor With Truck

Tank Volume, litre	
7,000	126.60
11,000	135.65

127.02.02.04 Asphalt Pavement Profiler

Power, kW	
32	107.85
90	158.85
135	266.20
340 *	438.30
590 *	520.30
700 *	594.90

* Excluding teeth

127.02.02.05 Asphalt Pavement Repair Equipment

Equipment Type	
4 kW Pavement Line Grinder	2.80
8 kW Pavement Line Grinder	6.95
Pavement Router	10.55
Hot Air Lance	9.85
Mastic Kettle	29.35

127.02.02.06 Asphalt Material Transfer Vehicle

Without Surge Bin	242.60
With Surge Bin	309.05

127.02.02.07 Profilograph

Equipment Type	
California Profilograph, including trailer	24.70
High Speed, including truck	59.75

127.02.02.08 Linestripper

Equipment Type	
Walk Behind	3.85
Walk Behind Ride-On Attachment	3.25
Skid Mounted	12.50
Ride-On	13.35
400 litre Truck Mounted	88.85
1,000 litre Truck Mounted	112.40
2,000 litre Truck Mounted	133.20
2,000 litre Truck Mounted, including attenuator	148.75

127.02.03 COMPACTION EQUIPMENT

Note: Equipment weights include water ballast, where applicable.

127.02.03.01 Rammer

Minimum Weight, kg

45	4.05
65	4.95
85	5.65

127.02.03.02 Manually Guided, Vibratory Plate

Minimum Weight, kg

65	3.20
100	5.35
160	10.20
280	14.70
390	21.40
500	31.90

127.02.03.03 Hoe Mounted, Vibratory Plate, Hydraulic

Minimum Weight, kg

100	8.90
300	10.55
600	15.20
900	27.60

127.02.03.04 Manually Guided, Self-Propelled, Vibratory, Tandem Drum

Minimum Weight, kg

400	14.15
600	17.20
800	19.10
1,200	38.10

127.02.03.05 Self-Propelled, Vibratory, Single Pad Foot Drum

Minimum Weight, kg

1,000	39.10
4,000	53.80
6,000	72.50
9,200	95.55
13,000	108.35
18,000	118.25

127.02.03.06 Self-Propelled, Vibratory, Single Smooth Drum

Minimum Weight, kg

1,000	37.35
4,000	51.05
6,000	64.90
9,200	87.05
13,000	102.75
18,000	113.65

127.02.03.07 Self-Propelled, Vibratory, Tandem Drum

Minimum Weight, kg	
1,000	29.35
3,000	41.90
6,000	78.95
8,000	95.85
10,000	100.25
12,000	107.65

127.02.03.08 Self-Propelled, Static, Tandem Drum

Minimum Weight, kg	
1,200	21.35
4,000	34.20
7,000	50.40
10,000	52.85

127.02.03.09 Self-Propelled, Static, Segmented, Four-Wheeled, Two Axles, Including Blade

Minimum Weight, kg	
19,000	209.40
30,000	287.70

127.02.03.10 Self-Propelled, Static, Pneumatic Tires

Minimum Weight, kg	
8,000	57.25
18,000	91.90

127.02.04 CONCRETE EQUIPMENT

127.02.04.01 Saw, Self-Propelled, Excluding Blades

Power, kW	
5	5.15
10	6.10
15	16.35
40	37.40
Ride-On, Vertical Cut	42.40
Ride-On, Horizontal Cut	103.30

127.02.04.02 Saw, Manually Guided, Excluding Blades

Power, kW	
3	2.45
5	3.65
10	6.10

127.02.04.03 Slip Form Paver

Power, kW	
10	45.80
30	136.35
70	172.15
120	240.10
200	453.30

127.02.04.04 Concrete Vibrator, Including Flexible Shaft and Electric Motor

Vibrator Diameter, mm	
< 50	0.95
50	1.05

127.02.04.05 Concrete Repair Equipment

Equipment Type	
50 mm Hammer Drill, excluding bits	3.65
Predampener	40.35
Shotcrete Pump, Dry Process	8.50
Shotcrete Pump, Wet Process	69.10
Batch Mixer Pump	39.15

127.02.04.06 Concrete Placing Equipment

Equipment Type	
15 m ³ /hr Concrete Pump, Trailer Mount	33.80
25 m ³ /hr Concrete Pump, Trailer Mount	37.20
35 m ³ /hr Concrete Pump, Trailer Mount	46.95
54 m ³ /hr Concrete Pump, Trailer Mount	102.60
98 m ³ /hr Concrete Pump, Trailer Mount	240.10
17 m Vertical Height, Concrete Pump-Truck Mount	156.35
24 m Vertical Height, Concrete Pump-Truck Mount	269.10
28 m Vertical Height, Concrete Pump-Truck Mount	306.50
33 m Vertical Height, Concrete Pump-Truck Mount	330.50
40 m Vertical Height, Concrete Pump-Truck Mount	415.75
47 m Vertical Height, Concrete Pump-Truck Mount	519.25
Concrete Deck Finisher, Self-Propelled	56.40
Concrete Placer	229.90
Concrete Placer Spreader	392.80
Concrete Texture Curing Machine	79.15
Concrete Conveyor	68.25

127.02.04.07 Hydraulic Breaker, Boom Mounted, Excluding Points

Impact Energy

Joules

200	10.95
400	11.25
900	15.30
1,400	24.70
2,200	36.70
3,300	58.90
4,500	62.75
6,000	67.70
12,000	117.70
20,000	207.65

127.02.05 CRUSHING EQUIPMENT

127.02.05.01 Jaw Crusher, Diesel

Jaw Opening, m

< 1.00	170.70
1.00	198.55
1.15	335.65

127.02.05.02 Cone Crusher, Diesel

Cone Diameter, m

0.90	252.15
1.00	332.10
1.30	399.10

127.02.05.03 Impact Crusher, Diesel

Crusher Size, m

1.0	207.20
1.2	265.65
1.3	379.45

127.02.05.04 Screening Plant, Double Deck, Diesel

Screen Size, m

3	96.30
4	104.30
5	156.25

127.02.05.05 Screening Plant, Triple Deck, Diesel

Screen Size, m

5	136.50
6	224.65

127.02.05.06 Surge Bins and Conveyor, Excluding Power Unit

Bin Volume, m³

7	42.55
10	60.90
20	73.10

127.02.05.07 Stacker, Excluding Power Unit

Conveyor Length, m

12	23.70
18	30.20
24	42.90
30	65.85

127.02.05.08 Telescoping Stackers, Excluding Power Unit

Conveyor Length, m

36	133.75
46	171.40
61	310.10
76	372.80

127.02.05.09 Trommel Screening Plant, Diesel

Drum Diameter, m

1.20	62.80
1.50	89.50
1.80	199.45

127.02.06 EARTH MOVING, GRADING EQUIPMENT

127.02.06.01 Scraper, Single Engine, Two-Wheel Drive

Minimum Struck Capacity, m³

10	223.45
16	290.30

127.02.06.02 Scraper, Twin Engine, Four-Wheel Drive

Minimum Struck Capacity, m³

10	312.40
16	394.15
22	513.55

127.02.06.03 Scraper, Single Engine, Self-Loading

Minimum Struck Capacity, m³

6	141.40
11	273.40

127.02.06.04 Scraper, Pull Type

Volume, m³

6	38.55
9	43.40
13	58.15

127.02.06.05 Tractor Bulldozer, Crawler Type

Minimum Net Flywheel Power, kW

25	41.40
50	54.35
60	63.60
80	95.20
120	123.75
160	175.00
210	238.85
280	327.55

127.02.06.06 Tractor Bulldozer Ripper Attachment, Hydraulic, Rear Mounted

Power, kW

50	9.10
120	12.45
160	21.45
210	23.20
280	34.85

127.02.06.07 Wheeled Tractor, Farm, Industrial, Two-Wheel Drive

Power, kW

10	12.00
25	19.30
40	25.05
50	37.20
70	51.90
90	60.50
120	81.80
160	101.35

127.02.06.08 Wheeled Tractor, Farm, Industrial, Four-Wheel Drive

Power, kW

10	13.45
25	20.15
40	25.90
50	40.00
70	50.30
90	60.70
110	81.75
135	93.40
150	103.65
180	118.60

127.02.06.09 Motor Grader, Articulated Frame

Minimum Operating Weight, kg

11,500	86.45
14,000	109.05
15,500	115.70
17,000	120.40
22,000	152.00

127.02.06.10 Motor Grader Ripper or Scarifier Attachment, Hydraulic Mounted

Grader Weight, kg

11,500 - Grader Ripper	6.30
14,000 - Grader Ripper	6.65
15,500 - Grader Ripper	7.55
17,000 - Grader Ripper	9.35
22,000 - Grader Ripper	13.40
Scarifier - any size grader	5.50

127.02.06.11 Gravel or Chip Spreader, Self-Propelled

Spreader Width, m

3 - 4	108.80

127.02.06.12 Spreader Attachment

Equipment Type

Grader/FEL - Shouldering	43.35

127.02.06.13 Shoulder Spreader/Road Widener

Spreader Width, m

2	133.50
3	180.40

127.02.06.14 Reclaimer/Stabilizer, Excluding Teeth

Equipment Power, kW

250	240.05
325	296.35
440	338.00
500	460.25

127.02.06.15 Grade Trimmer

Minimum Width, m
3

458.85

127.02.07 EXCAVATION EQUIPMENT

127.02.07.01 Hydraulic Excavator, Crawler Mounted, Long Reach, 12 to 21 m Boom

Minimum Operating Weight, kg

19,500	102.10
23,000	121.40
26,500	131.60
32,000	154.45
44,000	215.05

127.02.07.02 Hydraulic Excavator, Crawler Mounted

Minimum Operating Weight, kg

1,000	19.95
4,000	28.45
6,000	44.80
12,000	77.55
19,500	92.80
23,000	100.60
26,500	126.00
32,000	150.35
44,000	204.85
55,000	298.90
70,000	318.90
100,000	423.10

127.02.07.03 Hydraulic Excavator, Rubber Tired

Minimum Operating Weight, kg

11,000	97.35
18,000	113.65
21,000	129.30

127.02.07.04 Hydraulic Excavator, Bucket Attachment, Wrist Action

Minimum Carrier Weight, kg

4,000	5.15
9,000	6.30
13,000	9.60
18,000	12.60

127.02.07.05 Telescopic Boom, Carrier Mounted Excavator

Weight, kg

15,000	164.30
20,000	171.15
22,000	198.70

127.02.07.06 Telescopic Boom, Crawler Mounted Excavator

Weight, kg	
17,000	110.65
20,000	116.35
23,000	136.05

127.02.07.07 Tractor with Loader/Backhoe Combination, Two-Wheel Drive

Minimum Power, kW	
45	38.60
60	45.25
75	57.80
94	85.40

127.02.07.08 Tractor with Loader/Backhoe Combination, Four-Wheel Drive

Minimum Power, kW	
30	29.35
45	44.10
65	47.95
80	59.80
94	83.25

127.02.07.09 Tractor with Loader/Backhoe Combination Attachments

Attachment Type	
300 mm Auger	3.25
Jaw Bucket	6.30
For Hydraulic Ram Hoe Attachments, see 127.02.03.03	

127.02.07.10 Front End Loader, Crawler Mounted

Power, kW	
50	60.10
70	93.90
100	115.75
150	169.80

127.02.07.11 Front End Loader, Rubber Tire, Four-Wheel Drive

Power, kW	
40	43.40
75	64.40
100	78.50
125	86.10
150	108.00
175	115.25
200	140.25
225	158.60
250	169.60
300	294.30
400	357.15

127.02.07.12 Skid Steer Loader, Rubber Tire

Lift Capacity, kg	
300	25.60
700	28.80
850	31.25
1,000	36.00
1,200	38.00
2,500	41.60

127.02.07.13 Skid Steer Loader, Tracked

Lift Capacity, kg	
900	33.65
1,100	34.20
1,300	37.35
1,600	40.15
1,800	41.70

127.02.07.14 Skid Steer Loader, Attachments

Attachment Type	
Auger	2.80
Backhoe	4.20
Breaker	12.40
Cold Planer	9.60
Multi Bucket	4.50
Pick Up Broom	6.70
Power Rake	5.95
Scarifier	3.65
Steel Tracks	1.75
Sweeper, Angle Broom	6.25
Trencher	2.10

127.02.07.15 Chain Type Trenching Equipment

Power, kW	
13	16.25
20	29.60
35	41.55
50	74.15

127.02.08 HAULAGE EQUIPMENT

127.02.08.01 Tag Along Trailer

Load Capacity, kg	
2,000	2.90
3,000	4.80
9,000	9.20
16,000	12.90
19,000	15.25

127.02.08.02	Rigid Gooseneck Float With Tractor	
Load Capacity, kg		
20,000		118.00
40,000		123.15
127.02.08.03	Detachable Gooseneck Float With Tractor	
Load Capacity, kg		
30,000		120.60
45,000		124.90
127.02.08.04	Pickup, Two-Wheel Drive	
Pickup Type		
Mini Type		16.90
2,600 kg GVW		29.00
3,800 kg GVW		34.85
4,500 kg GVW		35.25
127.02.08.05	Pickup, Four-Wheel Drive	
Pickup Type		
Mini Type		20.75
2,600 kg GVW		30.30
3,800 kg GVW		35.40
4,500 kg GVW		37.70
127.02.08.06	Rear Dump, Single Rear Axle, Diesel or Gas	
AGW, kg		
5,000		61.80
12,000		68.80
127.02.08.07	Rear Dump, Tandem Rear Axle, Diesel or Gas	
AGW, kg		
24,000		91.90
127.02.08.08	Rear Dump, Tri-Axle, Diesel	
AGW, kg		
32,000		111.45
32,000 kg Stone Spreader		123.95
127.02.08.09	Tractor, On Highway, Diesel	
Tandem Axle		104.30
127.02.08.10	Trailers, Rear Dump	
Axle Configuration		
Pony/Pup		43.10
Tri		48.30
Quad		57.50
Quint		64.75

127.02.08.11	Trailers, Live Bottom	
Axle Configuration		
Tandem		44.55
Tri		50.75
Quad		54.35
Quint		59.30
127.02.08.12	Water Truck, Single Rear Axle	
Spray Bar Type		
Gravity / Pressure		80.35
127.02.08.13	Water Truck, Tandem Rear Axle	
Spray Bar Type		
Pressure		98.20
127.02.08.14	Dump Trucks, Off Highway, Rigid Frame	
Payload, kg		
35,000		226.10
38,000		250.20
50,000		318.00
75,000		435.55
127.02.08.15	Dump Trucks, Off Highway, Articulated Frame	
Payload, kg		
20,000		159.35
26,000		179.30
30,000		219.95
35,000		244.75
40,000		300.90
127.02.09	HOISTING EQUIPMENT	
127.02.09.01	Boom Truck	
Lift Capacity, kg		
7,000		144.60
11,000		190.65
19,000		205.40
25,000		233.00
127.02.09.02	Hydraulic Crane, Rough Terrain	
Lift Capacity, kg		
13,000		79.95
20,000		133.80
40,000		171.95
65,000		233.55
100,000		334.20

127.02.09.03 Hydraulic Crane, Carrier Mounted

Lift Capacity, kg

25,000	198.75
45,000	258.10
60,000	274.20
90,000	412.45
135,000	591.25
200,000	643.60

127.02.09.04 Lattice Boom Crane, Crawler Mounted

Lift Capacity, kg

50,000	216.95
70,000	263.85
90,000	359.70
130,000	432.80
200,000	605.90
250,000	706.40

127.02.09.05 Lattice Boom Crane, Carrier Mounted

Lift Capacity, kg

110,000	455.05
270,000	620.45

127.02.09.06 Aerial Bucket Lift, Truck Mounted, Including Truck

Platform Height, m

7.0	76.75
10.0	97.65
15.0	114.70
20.0	139.50

127.02.09.07 Aerial Bucket Lift, Self-Propelled, Telescopic/Articulating

Platform Height, m

9.0	36.80
12.0	51.35
18.0	59.85
22.0	94.00
30.0	130.35

127.02.09.08 Scissor Lift, Self-Propelled

Platform Height, m

4.0	9.60
7.0	24.40
9.0	36.95

127.02.09.09 Tool Carrier

Power Rating, kW

40	50.85
75	59.70
100	72.70
125	92.15

127.02.09.10 Telescopic Handlers

Lifting Height, m

5	48.60
10	71.04

127.02.10 PILE DRIVING EQUIPMENT

127.02.10.01 Hammer, Open End, Diesel

Rated Energy, joules

50,000	42.90
80,000	65.35
120,000	80.30

127.02.10.02 Driver/Extractor, Vibratory Centrifugal, Including Power Pack, Excluding Crane

Driving Force, kN

245	69.05
392	85.05
637	108.15
980	154.60
1,471	189.60

127.02.10.03 Leads, Including Hydraulics and Kicker

Length, m

20, Fixed/Vertical	69.90
20, Hanging	20.90
24, Fixed/Vertical	73.65
24, Hanging	24.55
30, Fixed/Vertical	77.85
30, Hanging	29.45

127.02.10.04 Hydraulic Post Driver

Track Mounted	54.00
Truck Mounted	137.45

127.02.10.05 Universal Piling Machine, Including Attachment

Power Rating, kW

< 450	358.10
450	613.60
570	828.10

127.02.11 DRILLING EQUIPMENT

Note: Use Manufacturer's Model, Specification, and Capacity tables to determine power rating for hydraulically driven rotary drilling equipment.

127.02.11.01 Mechanical Drilling Equipment, Truck Mounted, Including Auger and Crowd and Power Pack

Power, kW

80	166.50
120	318.15

127.02.11.02 Mechanical Drilling Equipment, Crawler Mounted, Including Auger

Power, kW

95	161.75
113	229.00
130	283.45

127.02.11.03 Hydraulic Drill Rig

Power, kW

185	452.90
250	645.55
350	710.60
430	873.65
570	1157.60
Additional Casing/Liner	5.20/metre

Note: Base rate includes initial casing up to 20 m, teeth, and auger. Replacement auger teeth not included.

127.02.11.04 Mechanical Drilling Equipment, Crane Mounted Attachment, Including Auger

Power, kW

110	98.15

127.02.11.05 Horizontal Earth Boring Equipment

Power Rating, kW

20	38.30
50	71.50
100	117.10
200	215.50

127.02.11.06 Trenchless Directional Drill, Track Mounted

Operating Weight, kg

1,000	84.10
7,000	198.60
12,000	256.10
20,000	307.70

127.02.11.07 Hydraulic Rock Drill, Including Power Pack, Excluding Drill Steel and Bits

Diameter, mm

< 75	69.25
75	201.90
125	228.40
150	293.90

127.02.11.08 Tieback Drill Rig, Hydraulic, Dual Head

Power, kW

< 140	175.05
140	260.75

Additional Casing 1.25/metre

* Base rate includes initial casing, drilling, augering components up to 20 m.

127.02.12 BROOM AND SWEEPER EQUIPMENT**127.02.12.01 Front Mounted Attachment, Hydraulic**

Broom Width, m

1.2	7.90
1.8	9.45
2.4	14.70

127.02.12.02 Self-Propelled, Dual Control

Sweeper Type

Bottom Dump	92.20
High Dump	109.30
Vacuum	112.95

127.02.13 FORESTRY EQUIPMENT**127.02.13.01 Brush Chipper, Tow Type**

Minimum Net Flywheel Power, kW

19	20.25
35	28.30
60	35.95
80	46.75
140	83.70

127.02.13.02 Log Skidder, Cable/Grapple

Minimum Net Flywheel Power, kW

75	132.60
120	177.00
150	185.05

127.02.13.03 Chain Saw

Power, kW

1	1.70
3	2.90
5	4.50

127.02.14 PORTABLE GENERATING EQUIPMENT

127.02.14.01 Generator, Gas or Diesel

Power, kW

0.5, Air Cooled, Gasoline	1.65
3, Air Cooled, Gasoline	2.75
5, Air Cooled, Gasoline	3.65
10, Air Cooled, Diesel	14.75
40, Water Cooled, Diesel	26.55
80, Water Cooled, Diesel	50.60
150, Water Cooled, Diesel	79.20
250, Water Cooled, Diesel	107.70
300, Water Cooled, Diesel	135.50
400, Water Cooled, Diesel	173.10
600, Water Cooled, Diesel	262.30
910, Water Cooled, Diesel	331.20

127.02.15 PUMPING EQUIPMENT

127.02.15.01 Centrifugal, Dewatering, Including 6 m Suction and 7.5 m Discharge

Intake Size, mm

25, Air Cooled, gasoline	2.40
50, Air Cooled, gasoline	2.55
100, Air Cooled, gasoline	3.55

127.02.15.02 Centrifugal, Trash, Including 6 m Suction and 7.5 m Discharge

Intake Size, mm

50	2.90
75	3.85
100	9.90
150	26.10
200	52.35

127.02.15.03 Diaphragm, Including 6 m Suction and 7.5 m Discharge

Intake Size, mm

50, Air Cooled, gasoline	4.20
75, Air Cooled, gasoline	4.80
100, Air Cooled, gasoline	17.95

**127.02.15.04 Electric Submersible, Including 30 m Cable and 7.5 m Discharge,
Excluding Generator**

Intake Diameter, mm

50	2.25
100	5.05
150	15.80
200	23.25

127.02.16 WELDING EQUIPMENT

127.02.16.01 DC Arc Welder, Engine Driven, Including Rods

Current, A

125	3.05
150	3.80
200	6.00
300	7.80
400	13.20

127.02.16.02 Oxygen/Acetylene Torch, Including Gas, Excluding Rods

Equipment Type

Hand Mobile, Heavy Duty	24.25

127.02.17 TRAFFIC CONTROL DEVICES

127.02.17.01 Portable Variable Message Signs

Equipment Type

Trailer Mounted, Solar	8.90
Truck Mounted	4.85

127.02.17.02 Buffer Vehicles, Including Arrow Board and Attenuator

Equipment Type

Crash Truck	71.95

127.02.17.03 Traffic Barrels

Each Per Day	1.00

127.02.17.04 Portable Light Towers, Trailer Mounted

Extended Tower Height, m	
9	16.95

127.02.18 MISCELLANEOUS EQUIPMENT

127.02.18.01 Hydro Excavation Equipment

Hydro Excavating / Vacuum Truck	
Single Axle	187.65
Tandem Axle	212.00
Tri Axle	226.95

Note: Each table has a number in parentheses as part of the table title that refers to the corresponding clause in Section 2 - Schedule of Rental Rates for Construction Equipment.

Air Compressor, Silenced (127.02.01.01)

CLASSIFIER	MAKE AND MODEL						
Flow Rate m ³ /min	Atlas Copco	Chicago Pneumatic s	Doosan and Ingersoll-Rand	Grimmer- Schmidt	Kaeser	Multiquip	Sullair
3	XA57 XASTS67 Hardhat XATS67 XAS67KD XATS67 Hardhat XAS77 XAS77 Hardhat	CPS 90	P-100WD P-130WD P-110WIR P-135WIR AIRSOURCE	125 150 H100G 125G OEM 125G			125
5	XAS97 XAHS106 XATS116 XAS185 XAST250KD7	CPS 185 CPS185KD	P-185WJD P-185WIR XP185WIR AIRSOURCE Plus IR AIRSOURCE Plus JD	175 185D 185E 185J 210D 210J H185D H210D H130E	M50 M57 M58	DIS185SSi4F	185
7	XAS126 XA(S)136 XAHS146 XATS300KD7		P-250WJD P-260WIR VHP300WIR	250 250D H300D			250 260
10	XATS156 XAHS186 XA(S)186 XATS400	CPS 375	P-375WCU P-600WCU XP375WIR HP375WIR VHP400WIR P425WIR HP450WIR	375 375D	M100 M114		375 375H 425
17	XAMS286 XAHS336 XAMS356 XRHS366 XATS750	CPS750 CPS750 CD3	P-750WJD P-600WIR XP675WCU XHP700WCAT XP750WCU HP750WCU VHP750WCAT MHP825WCAT XP825WCU MHP825WCU	800 800D			750
25	XAHS426 XRVS366 XAMS496 XRHS486 XAHS536 XAMS546 XATS1050		HP900WCAT HP915WCU HP1300WCU XP1200WCU	900			1050
45	XATS1800		P-1600WCU				

Sand Blaster, Including Nozzles and Hoses (127.02.01.03)

CLASSIFIER	MAKE AND MODEL					
Weight kg	Canablast	Clemco	Empire	Lindsay	Marco	Schmidt
135	340 P	4.0 6.0 1042 1642 1648	P-350 350 Super Blast 350 Super Blast 350 XL	300LAD	1.5 1.5 Portable 3.5 M Portable	4
270	640 P	21505 21545 2452	P-650 650 Super Blast 650 Super Blast 650 XL P-1050	600LAD	6.5 M Portable	7

127.03.02

ASPHALT EQUIPMENT

Asphalt Paver (127.02.02.01)

CLASSIFIER	MAKE AND MODEL											
Weight kg	ABG	Barber- Greene	Volvo (Blaw- Knox)	Caterpillar	Cedarapids/ Bomag	Gehl	Gilcrest	Ingersoll- Rand	Lee Boy	Mauldin	Roadtec	Vogele/ Wirtgen
2,000			M-450 PF-545			1448 1649				550E		
4,000			PF-150 PF-840 PF-855 PF-875 3120	AP255E		1648	813 814			690F 1500SP 1550-C		Super 700
7,000				P385	BSF-330			650P 660W 580W		1750C		Super 1300-3 Super 1303-3
9,000		BG- 210B	PF-120H PF-161 PF-171 PF-172 PF-400		CR351 CR352 CR361			780T 880TD 780W	8500			AP780WB AP880RTB
14,000			PF-2181 PF-3172 PF-3200 PF-4410	AP500E AP555E AP650B AP800C AP900 BG225C BG230	352 362S 362 CR 361R CR 451 CR 362							AP880WB Vision 5103-2 Vision 5100-2
17,000			PF-5500 PF-5510 PF-6160 PF-6170	AP655C AP900B AP1000B AP1050B BG240C BG245C BG260C BG2455C AP600D AP655D AP1000E	452 462S 462 552 562S CR 461R CR 461RX CR551 CR552 CR 561R CR 452 CR 462						RP-170 RP-175	AP1010WB AP1110WB Vision 5203-2 Vision 5200-2
20,000	325EPM 423		PF6110 PF6160 PF6170 PF7110 PF7170	AP1055B AP1055D AP1055E	562 CR652RX CR562 CR662RM						RP-190e RP-195e RP-2505 SP-200e	AP1110RTB Super 2100-3

Asphalt Distributor With Truck (127.02.02.03)

CLASSIFIER	MAKE AND MODEL		
Tank Volume L	Bearcat	E. D. Etnyre	Rosco
7,000	BC-501/CRC *	Shooter 1665 Centennial 2000	
11,000	BC-501/CRC *	Centennial 2500 Centennial 3000 Centennial 3500	Maximizer 3 Maximizer 11

* Equipment available in 7,000+ and 11,000+ tank capacities.

Asphalt Pavement Profiler (127.02.02.04)

CLASSIFIER	MAKE AND MODEL					
Power kW	Bomag	Caterpillar	Roadtec	Terex	Volvo	Wirtgen Inc.
32						W35 W50 W35DC
90	BM 500/15 BM 600/15				MW500	W600DC W1000L W50DCi
135	BM 1000/30 BM 1200/30 BM 1300/30	PM102	RX-400e			1000F 1000 W100Fi W130Fi W150i W100i W60i
340	BM 2000/60	PM 200 PM 201 *	RX500 RX700 RX-600e RX-700e	PR600	MT2000	W1900 W2000 W200i W210i W220
590		PM 201 *		PR800-7 PR860		W2200
700			RX-900e	PR950		W250i

* May be either capacity depending on equipment year of manufacture.

Asphalt Pavement Repair Equipment (127.02.02.05)

CLASSIFIER	MAKE AND MODEL		
Equipment Type	Bartell	Edco	Hoffman
4 kW Pavement Line Grinder	SP 8 SP8-G1	CPM-4	
8 kW Pavement Line Grinder	BGG10	TLR-7 CPM-10 CPU-10FC	H92

Asphalt Material Transfer Vehicle (127.02.02.06)

CLASSIFIER	MAKE AND MODEL			
Equipment Type	Ingersoll-Rand	Roadtec	Terex	Weiler
No Surge Bin		MTV-1000C MTV-1000D		E1250
Surge Bin	MC 330	SB 2500 SB-1500D SB-2500e	CR 662	E2850

127.03.03 COMPACTION EQUIPMENT**Rammer (127.02.03.01)**

CLASSIFIER	MAKE AND MODEL							
Min. Weight kg	Bomag	Chicago Pneumatics	Dynapac	Ingersoll- Rand	Multi-Quip / Mikasa	Vibromax	Wacker	Weber
45	BS 600 BT 50 BT 58 BT 60 BT 60/4	MS590 MS595		RX-55 RX-554	MT 55F MT 62HS MTR 40 MTR 40 SF MTR 50 MTR 60L MTX 60 MTX 60 HD MTX 60 SD	SL 1B VM1	BS 45 Y BS 50-2 BS 50-2i BS 50-4s BS 52 Y BS 60 Y BS 500 BS 600 ES 52 Y	SRV 590 HO SRV 600i
65	BS 720 BT 68 BT 65 BT 65-4	MS690 MS695 MS780	LC 50 LC 70	RX-65 RX-75 RX-654 RX-654H RX-754 RX-754H	MT 65H MT 70 MT 74F MT 75HS MT 76D MT 85HS MTX 70 MTX 70 HD MTX 70 SD MTX 80 MTX 80 SD	SL 2B VM2	BS 60-2i BS 60-4i BS 60-4s BS 62 Y BS 70-2i BS 700 DS 70 DS 72 Y	SRV 620 SRV 620 HO SRV 650 SRV 660 SRX 75 DH
85		MS840			MT 86D MTR 80L MTX 90		BS 100 Y BS 105 Y DS 70 H	

Manually Guided, Vibratory Plate (127.02.03.02)

CLASSIFIER	MAKE AND MODEL							
Min. Weight kg	Bomag	Chicago Pneumatics	Dynapac	Ingersoll- Rand	Multi-Quip / Mikasa	Vibromax	Wacker	Weber
65	BP 10/36 BP 10/36-2 BP 15/45 BP 18-45-2	KMR11 LF82 MV82 MV90 Asphalt MV100	LG 140	BX-6WH BX-8 BX-8WH BXR-7	MT-85HS MVC 64VH MVC 64VHW MVC 64XH MVC 77 MVC 82VH MVC 82VHW MVC-88GHW MVC 88VTH MVC-90H MVC 90L MXC 82VH	AT 8 AV 600 AV 601 AV 900 AV 901	VP 1135AW VP 1340 VP 1340A VP 1340W VP 1550 VP 1550A VP 1550AW VPA 1740 VPG 165A VPR 1330 VPY 1740 WP 1540 WP 1540A WP 1550 WP 1550A WP 1550V	CF1i CF1 PRO CF2 HO CF2i CF2 PRO CF2 PRO S CF3 PRO
100	BPR 25/32 BPR 25/40	MV100 MV100 Asphalt MV100 A MV115 Asphalt MV115 D MV135 MV140	LG 450	BX-12 BX-12WH	MVC 88VTHW MVC 110 MVC 135G MVH 120VGH MVH 150VGH MVH-R120GH MVH-R150GH	AV 1300B AV 22B 12	BPS 2550A BPS 2550R BPU 2440A BPU 2540A BPU2540AW DPU 2430 VP 2050 VP 2050A VP 2050Y VPA 1350W VPY 1770	CR1 HO CR2 HO
160	BPR 30/38 BPR 30/38D BPR 35/60D	MV165 MV170 MV220 MV245 MV305			MVH 150D MVH 200D MVH 200G MVH 200GH MVH 206GH	15 25	BPU 2950A BPU 3050A BPU 3750A DPU 2950 DPU 3050H DPU 3750A DPU 3750H	CR3 D CR3 E CR3 HO CR5 HO VPR 700
280	BPR 45/45	MV320 MV400			MVH-304DSB MVH-304GHB MHV306GH MVH308GH MVH308DZ MVH408GH	35	BPU 3345A BPU 4045A BPU 5045A BPU 5545A DPU 4045H DPU4545H DPU 5045H	CR5 E
390	BPR 55/52D	MV400 MV430			MVH-402DSB MVH-402GHB MVH 406GH MVH 408DZ		CPU 4545He DPU5545 DPU 5545He DPU 6055 DPU 6055H DPU 6555He	CR5 HO CR6 CR6 CCD CR6 CCD 2.0 CR6 MDM CR6 MSM CR7 CR7 CCD CR7 CCD 2.0 CR7 E CR7 HO CR7 MDM CR7 MSM
500	BPH 80/65S BPR 65/52D-3 BPR 100/80D	MV480 MV500			MVH-502DSB MVH 508DZ MVH-702DSRC	45	DPU 100-70 DPU 100-70Les DPU 130 DPU 7060 DPU 7060H DPU 7060RC	CR8 CR8 CCD CR8 CCD 2.0 CR8 E CR8 MDM CR8 MSM CR9 CCD CR9 CCD 2.0 CR9 E

Hoe Mounted, Vibratory Plate, Hydraulic (127.02.03.03)

CLASSIFIER	MAKE AND MODEL								
Min. Weight kg	Allied	Balderson	BTI (Formerly Teledyne)	Chicago Pneumatics	Kent	NPK	Rammer	Stanley	Tramac
100	300 500 4700 400B 700B			RC103	KHP 30 KHP 35	C-2 C2C C-2D	RP 10	HS 2500 HS 3000	TR-6 TR-7S TR-8
300	1000 1000B 8700C NT 8900	B4 B4S	TC-90S TC-91S TC-92V	CR308 RC409	KHP-12 KHP 65	C-4B C-4C C-3D	RP 20	HS 6000 HS 8000	TR-4S TR-9 TR-14
600	1600 9700C	B6 B6S	TC-151S TC-152V	RC920	KHP-25 KHP 135	C-6 C-6C		HS 11000	TR-21
900	9800 9801 2300	B8	TC-150S TC-301 TC-302V	RC2040 RC2041	KHP 210-11	C-8 C-8C C-10C C-12 C-12C	RP 40 RP 50	HS 20000 HS 22000	TR-40 TR-40M

Manually Guided, Self-Propelled, Vibratory, Tandem Drum (127.02.03.04)

CLASSIFIER	MAKE AND MODEL										
Min. Weight kg	Altrad Belle	APT	Bomag	Chicago Pneumatic s	Dynapac	Ingersoll- Rand	Mikasa	Multi-Quip	Vib- romax 2000	Weber MT	Wacker
400			BW 35 BW 65S BW 71E			DX-500E	V304 EH V304 EY	MRH601GS	W 50		RS 800A RS 800H RSS800A DPU5545
600	BWR650		BW 60HD BW 65S BW 65S-2 BW65 HD/E	MR7000	LP 650	DX-60 DX-70 DX-70E DX-600E	MR 8D MR 8G	MRH600GS MRH800DS2 MRH800GS	W 70		W 55T W 65T W 74A
800			BW 60S BW 65H BW 75S BW 75S-2		LP 750		MDR 9D MDR 9G MRH 800DS MRH 800GS				RD 7H RD7 RD 11 W 74T WH 74
1,200		WR85	BW 75AD-2 BW 90S BW 85T BMP 8500	TR630 TR850		FX-130	MRV 10G MRV 15 P 3324	RX1510C24 RX1510CI33 RX1575		TRC86 TRC88	RD 15H RT 560 RT 820

Self-Propelled, Vibratory, Single Pad Foot Drum (127.02.03.05)

CLASSIFIER	MAKE AND MODEL									
Min. Weight kg	Bomag	Case	Caterpillar	Dynapac	Hamm	Hypac	Multi- Quip	Super Pac	Vibromax	Volvo / Ingersoll- Rand
1,000	BW 124PD BW 124PDH-3 BW 124PDH40			A36PD A40PD		C812C	P35K P48K P54K	540P 4010P		SD-25F
4,000	BW 142PD-2 BW 145PDH-3 BW 145PDH-5		CP-323C CP-34	CA121PD CA141PD CA121PD-PDB CA141PD-PDB	3205P	C822C		540P 600P 540PC	405-PD	SD-40F SD-45F SD-45
6,000	BW 172PD2 BW 177PDH-3 BW 177PDH-40 BW 177PDH-5	SV 210 SV 208	CP-433C CP-433E CP-44	CA151PD CA152PD	2322 DS 3307P	C832C		6620P	602B-PD 605-PD	SD-70F SD-75F SD-75 SD-77F
9,200	BW 211PDH-3 BW 213PDH-3 BW 213PDH-40 BW 213PDH-4i	SV 212	CP-56 CP-563C CP-563E CP54B CP56B	CA250PD CA252PD CA262PD CA301PD CA302PD	2422-D 3412P	C842C C852C		840P 8410P 8420P	1102-PD	SD-100F SD-105F SD-115F SD-115D4 SD-116F
13,000	BW 218PD BW 213PDH-5	SV 216	CP-64 CP-76 CP-583 CP-68B CP-74B	CA302PD(2003) CA362PD CA512PD CA551PD CA602PD	2522-DS			8430P	1105-PD 1402-PD 1405-PD	SD-150F SD-160F SD-160
18,000	BW 219DH-5			CA602PD	3520P			8430P	1805-PD	SD-175F SD-180F SD-200F SD-200

Self-Propelled, Vibratory, Single Smooth Drum (127.02.03.06)

CLASSIFIER	MAKE AND MODEL									
Min. Weight kg	Bomag	Case	Caterpillar	Dynapac	Hamm	Hypac	Multi- Quip	Super Pac	Vibromax	Volvo / Ingersoll- Rand
1,000	BW 122D BW 124D BW 124DH-S BW 124DH-40					C815C	S35K S48K	A300V 540 4010		SD-25D
4,000	BW 142D-2 BW 145D-3 BW145DH-5		CS-323 C CS-34	CA 121D CA 141D	2220 D	C820C C825C		540 (2003) 600	405-D	SD-40 SD-40D SD-45D SD-45
6,000	BW 172D-2 BW 177D-3 BW 177DH40 BW 177DH-5	SV208D SV280 SV210	CS-423 E CS-431 B CS 433 C CS 433 E CS-44	CA 150D CA 151D CA 152D	2320 D 3307	C830C C835C		6620	602B-D 605-D	SD-70 SD-70D SD- 75D SD-75 SD-77DX
9,200	BW 211D-3 BW 213D-3 BW 213DH-3 BW 213DH40 BW 213DH-4i	SV212	CS-54 CS-54B CS-56 CS-56B CS-563 C	CA 250D CA 251D CA 252D CA 262D CA 320D	2420 D 3412	C840C C850C C855C		8410 8420 840	1102-D 1105-D	SD-100 SD-100D SD-115 SD-115 D4 SD-105DX SD-116DX
13,000	BW 217D BW 213DH-5	SV216	CS-573 E CS-583 C CS-583 E CS-64 CS-68B CS-74 CS-74B CS-76	CA 302D CA 362D CA 511D CA 512D	2520-D			8430	1402-D 1405-D	SD-150 SD-150D SD-160 SD-160DX
18,000	BW 219DH-3 BW 219DK-4 BW 219DH-5		CS-78B	CA 620D	3520				1805-D	SD-175 SD-180 SD-200DX SD-200F SD-200

Self-Propelled, Vibratory, Tandem Drum (127.02.03.07)

CLASSIFIER		MAKE AND MODEL										
Drum Width m	Min. Weight kg	Bomag	Case	Caterpillar	Dynapac	Hamm	Hypac	Ingersoll-Rand	Multi-Quip	Vibromax 2000	Wacker	Volvo (Super Pac)
0.75	1,000	BW 80AD-2 BW 90AD BW 100SL-5 BW 120SL-5 BW120AD-5 BW 120AD-2 BW 120AD-3 BW 80D BW 120	DV201 DV201 DV23 DV26	CB-14 CB-14B CB-214B,C CB-214D CB-22 CB-24 CB-224B,C CB-224D CB-225D	CC 102 CC 122 LA 75 2100V	HD 10 HD 12		DD-22 DD-24 DD-28HF DD-30	AR13G AB13D	102252 255265	RD 11A RD 11V RD12A-90 RD16-90 RD 25 WHK90L WHK4080 WHK5010	A421 A471 DD14S DD25
1.30	3,000	BW 130AD BW 135AD-5 BW 137AD BW 138AD-5 BW 138AD	DV36 DV45	CB-334D CB-335D CB-32 CB-34	CC 142	DV 3 * HD 13	C 754A C 754B C330B-3 ton C330B-5 ton	DD-32 DD-38HF		W 355 W 365 W 455 W 465 752C		DD38
1.40	6,000	BW 141AD-2 BW 141AD-5 BW 144AD-2 BW 151AD-2 BW 151AD-5	DV207	CB-434 CB-434C CB-434D	CC 211 CC 221 CC 222	DV 6 HD 70HV HD 75HV	C760C C340C-8 ton C340C-10 ton C350D-12 ton	DD-65 DD-70				DD70 DD70-HF
1.67	8,000	BW 161AD BW 161AD-2 BW 161ADS BW 164AD BW 161AD-5HF BW 174AP-4AM BW 174AP-4		CB-534B CB-44B	CC 232	DV 8 HD 85 HD 85-C HD 110HV	C766B C766C C350D-14ton	DD-90		W 752B		DD90
1.67	10,000	BW 180AD BW 190AD-AM BW 202AD BW 202ADH-2	DV210 DV210C	CB-534D CB-634 CB-54 CB-54	CC 421 CC 422H F CC 522H F CC 722	DV 10 HD 110HV HD 130HV	C778B	DD-110 DD-130				

1.67	12,000	BW 184AD BW 284AD BW 205 BW 206AD-5	DV21 3	CB-64 CB- 634D CB-63	CC 432 CC 622	HD 130HV	C784					DD118- HF DD112- HF DD132- HF DD138- HFA

* Hamm DV 3 Drum Width 1.10 m.

Self-Propelled, Static, Tandem Drum (127.02.03.08)

CLASSIFIER	MAKE AND MODEL					
Min. Weight kg	Bomag / Hypac	Dynapac	Lee Boy	Superpac	Volvo / Ingersoll-Rand	Weiler
1,200		2100	300	320		
4,000	BW 5AS BW 9AS BW 9ASW C 330B	CS 06T				
7,000	BW 11AS C 340C	CS 08T CS 10T			ST 60 ST 75	C307
10,000	C 350D	CS 12T CS 14T			ST 80 ST 105	C310

Self-Propelled, Static, Segmented, Four-Wheeled, Two Axles, Including Blade (127.02.03.09)

CLASSIFIER	MAKE AND MODEL		
Min. Weight kg	Bomag	Caterpillar	
19,000	BC 462EB BC 572RB-2	815 F 815 F Series 2	
30,000	BC 672RB-2 BC 772EB-4 BC 772RB-2	825 C 825 H 825 K	

Self-Propelled, Static, Pneumatic Tires (127.02.03.10)

CLASSIFIER	MAKE AND MODEL						
Min. Weight kg	Bomag	Case	Caterpillar	Dynapac	Hamm	Hypac	Volvo/ Ingersoll- Rand
8,000	BW 11RH (4+5)		CW 14 PS 110 (5+6) PS 130 (5+4) PS 150B (5+6) PS 180 (5+4)	CP 141 CP 142 (5+4) CP 15 (4+5)	GRW 5 (5+4)	C 530A C 530AH C 560B (5+4)	PT 140A (5+4) PT 125R (4+5) PT 124R

18,000	BW 20R (4+4) BW 24R BH 24RH BW 27RH	PT 240R	CW 34 PF 300B PS 200B (5+4) PS 300B (3+4) PS 360C	CP 21 (3+4) CP 221 (3+4) CP 22 (4+3) CP 27 CP 271 (5+4) CP 301 (5+4)	GRW 10 (4+4) GRW 15 (4+4) GRW 18 (4+4) GRW 35 (4+4)		

127.03.04 CONCRETE EQUIPMENT

Slip Form Paver (127.02.04.03)

CLASSIFIER	MAKE AND MODEL							
Power Kw	Curb Fox	Gomaco Corp.	Guntert and Zimmerman	Huron Mfg./ Overbuilt Paving and Mining	Miller Formless	Power Curbers	Rexcon	Terex Road Building
10	2000 3000 5000 5000-T	Curb Cadet		Easi-Pour 570		150 Extruder 440XL		
30		GT 3200 Commander II		Easi-Pour 650B				
70		GT 3400 GT 3600 GT 6000 GT 6300 4400 5700C		Easy Pour 880	M-1000 M-8100	5700C		
120		GP 2400 Commander III	S600	Easi-Pour 1000	M-8800	SF-2700 SF-3000 SF-1700		SF2204C
200		GP 2600 GP 4000 GHP 2800	S850 S1500				Town and Country	SF3502B SF3504B

Concrete Placing Equipment (127.02.04.06)

CLASSIFIER	MAKE AND MODEL						
Equipment Type	Gomaco Corp.	Guntert and Zimmerman	Heavy Equipment Mfg.	Power Pavers	Rexcon	Terex Bidwell	Terex Road Building
Concrete Deck Finisher	450 750 1750					2450 3600 4800	
Concrete Placer Spreader	RPT-500 PS 2600 PS 4000		MP 2500 PS 1230	PS-2700 PS-3000	Town and Country #1	PS3502	PS 3502 PS 6004
Concrete Texture Curing Machine	T/C-600 T/C-400B T/C-400	TC 850		TC-2700	2600	TC-360 TC3600M	
Concrete Conveyor	RC/Conveyor RC/Conveyor (wider)						

Scraper, Single Engine, Two-Wheel Drive (127.02.06.01)

CLASSIFIER	MAKE AND MODEL		
Min. Struck Capacity m ³	Caterpillar	Fiat-Allis	Terex
10	611 621F 621G 621H 621K	260B	
16	631E 631G 651E		S-24C

Scraper, Twin Engine, Four-Wheel Drive (127.02.06.02)

CLASSIFIER	MAKE AND MODEL		
Min. Struck Capacity m ³	Caterpillar	Fiat-Allis	Terex
10	627F 627G 627H 627K	262-B	TS-14C TS-14D TS-14G
16	637E 637G 657E 671E		TS-24C
22	657G		

Scraper, Single Engine, Self-Loading (127.02.06.03)

CLASSIFIER	MAKE AND MODEL			
Min. Struck Capacity m ³	Caterpillar	Fiat-Allis	John Deere	Terex
6	613C 613C SII 613G		JD 762B	S17E
11	615C 615C SII 623F 623G 623H 623K	161	JD 862B	

Scraper, Pull Type (127.02.06.04)

CLASSIFIER	MAKE AND MODEL			
Volume m ³	Bron	Caterpillar	John Deere	Reynolds
6			1512C 1512E	12C10 14CS10 12E10 12.5E12 14E10.5 15.5E14 15CFB14
9	35 E 35 F	TS180 TS185	1510C 1612E 1810C 1810E 1814E 2112E	16CS10 17C12 17C12LGP 17CS12 17E10.5 17E10.5LGP 18CMX12.5 18CS14 20E12.5
13	63 E 63 F	TS220 TS225	1812C 1814C 2010E 2012C 2014E 2412E	

Tractor Bulldozer, Crawler Type (127.02.06.05)

CLASSIFIER	MAKE AND MODEL									
Minimum Net Flywheel Power kW	Case	Caterpillar	Dresser	Dresssta	Fiat-Allis	Hanomag	John Deere	Komatsu	Liebherr	New Holland
50	550G 550H 650K 650L	D3C XL 111 D3CLGP111 D3C 111 D3G D3C, D4C D3K, D3K2	TD7G TD7H	TD-7H TD-7M			450E,G,H 450J 550G	D31 E and P D32 E and P D31EX-21 D31PX-21 D31EX-22 D31PX-22		D75
60	650G 750K 750L 750M 850D 850G 850K 850L	D4H,D5C D4C 111 D4C XL 111 D4CLGA111 D4G D4K D4K2 D5G D5K D5K2 D5XL 111	TD8G,H TD9H	TD-8H TD-8M TD-9H TD-9M	FD7 FD9	D500E	550G, H 550J 550K 650G, H 650J 650K	D32E-1 D41A D37 E and P D37EX-21 D37EX-22 D37PX-22 D38 E and P D38E-1 D38P-1 D39 E and P D39EX-22 D39PX-22 D39E-1 D39P-1 D41 E and P D41E-6 D41P-6	PR711 PR712B	D85 D95
80	850M 1150E,G 1150H 1150K 1150M 1450B 1550 1650K 1650L 1650M	D5H D5M LGP D5M XL D5NLGP D5N XL D5XL 111 D6K D6N LGP D6N XL D6K2	TD12 TD12G	TD-12C TD-15C TD-12C-XP	14C	D540E D600D	700H 700J 700K 750B, C 750BLT 750CII 750J 750K	D53A D65E D41E-6C D41P-6C D51EX-22 D61EX-15 D61PX-15	PR721 PR722B PR731	
120	1850K	D6RLGPD/S D6RLGP 11 D6RXL 11 D6RXW 11 D6T D7G, H	TD-20 TD15E	TD-15H	FD20	D700D	850B 850BLT 850C 850J 850K	D61EX-15EO D61PX-15EO D65 E and P D65EX-15 D65PX-15 D65EX-17 D65PX-17	PR732B PR741	
160	2050M	D7E D7R D/S D7RLGP 11	TD20G TD-25	TD-20H	FD30B		950J	D85E D85 E and P D85EX-15EO D85PX-15EO D155A D155AX-7	PR742B	
210		D8N, D9N D8R D/S D8R 11 D8T	TD25G	TD-25H			1050C 1050J	D155AX-3 D155AX-6	PR752	
280		D9R D/S D9T D10T2	TD40	TD-40C	FD40				PR751	

Note: The power rating should be obtained from equipment in use, as the models in the table above may span a number of years and categories/ratings.

Tractor Bulldozer Ripper Attachment, Hydraulic, Rear Mounted (127.02.06.06)

CLASSIFIER	MAKE AND MODEL					
Power kW	Case	Caterpillar	Dresser/ Dressta	John Deere	Komatsu	New Holland
50	550H 650H 650K 650L 750H 750K 750L 750M 850H 850K 850L 850M 1150H 1150K 1150M 1650K 1650L 1650M	D3G D3K D3K2 D4G D4K D4K2 D5G D5K D5K2 D6K D6K2 D6NXL D6NLGP	TD7H TD8H TD9H TD12C-XP	450J 550J 550K 650J 650K 700J 700K 750J 750K	D37E-5 D41E-6 D31EX-21 D31EX-22 D37EX-21 D37EX-22 D37PX-21 D37PX-22 D39EX-21 D41E-6C D51EX-22 D61EX-12	D75 D85 D95
120	1850K	D6R D6T	TD15H TD15H/LGP	850J 850K	D61EX-15EO D65EX-12 D65EX-15 D65EX-17	
160	2050M	D7E D7R	TD20H	950J	D85E-21 D85EX-15 D85EX-15EO D85PX-15	
210		D8R D8T D8R LGP	TD25H	1050J	D155AX-5 D155AX-7	
280		D9R D9T D10T2	TD40C		D275A-2 D375A-3	

Wheeled Tractor, Farm, Industrial, Two-Wheel Drive (127.02.06.07)

CLASSIFIER	MAKE AND MODEL						
Power kW	AGCO	Case	John Deere		Kubota	Massey Ferguson	New Holland
10			790 990 1023E 3005 4210 4310		BX25 B26	GC1715 GC1750 MF 1215-2 MF 1225-2 MF 1230-2 1233-2 1240-2 1250-2 1726E	TC-18 TC-25 TC-29 TC-30 TC-33 TC-35
25			110 4005 4044M 4044R 4052R 4510 4610 5045	5045D 5103 5105 5203 5205 5220 5225	L39 M 4900 F	MF 451 1734E 1736 1739E 1749 1754 2615 2605	3010S 3415 Boomer 3040 TC-40 TC-45 TN-55 TN-65
40			5055 5055D 5065E 5065M 5210 5303 5310	5320 5325 5403 5420 5425 6120	M59	MF 471 240 240S 253 263 271 1758 1759	TN-70F TN-70 TN-75 TL-80 STD
50	LT 70 LT 85	570L 570 Mxt 570 Mxt Turbo	210LE 5075E 5075M 5085M 5410 5510 5520 5525 6110	6210 6215 6220 6320 6403 6405 6415 6420 6603		281 2635 4335 4345 4608 4609 5609 6255-2 M 6800 F MF 481	LT-90 TN-80F TN-95F T4.75 Powerstar STD U80B
70	RT 95 RT 115		5095M 5100M 6100D 6105D 6105M 6115D 6115M 6230 6310 6330 6410 6430	6603 6605 6615 6715 7210 7220 7405 7410 7420		4360 4370 5610 5611 5612 6265-2 6270-2 6280-2 6290-25	TM-120 TM-130 TM-140 TS6.110 TS6.120 TV-140
90	RT 130 RT 145		6125M 6730 7130 7230 7320	7330 7520 7610 7710 7810		5613 6290-2	TM-155 TM-175 TM-190 TS6.125 TS6.140
120			7210R 7530 7630 7730	8120 8130 8220			
160			7230R 7830 7930				

Wheeled Tractor, Farm, Industrial, Four-Wheel Drive (127.02.06.08)

CLASSIFIER	MAKE AND MODEL									
Power kW	AGCO	Case	Ditch Witch	Fendt	JCB	John Deere		Kubota	Massey Ferguson	New Holland
10						790 990 1025R 1026R 2025R 2032R 2210 2305 2320 2520 2720 3005	3032E 3033R 3120 3203 3320 4010 4110 4115 4210 4310 4410	L310 DT	MF 1205-4 MF 1215-4 MF 1225-4 MF 1230-4 MF 1233-4 MF 1235-4 MF 1240-4 MF 1250-4 MF 1260-4 1526 1532 1533	TC-18 TC-21 TC-25 TC-29 TC-30 TC-33 TC-35 Boomer20 Boomer24 Boomer25 Boomer30 Boomer33
25			3610 3700 3700CD 5110			110 990 3046R 3038E 3039R 3520 3720 4005 4105 4120 4320	4510 4610 4710 5045 5045E 5105 5202 5205 5220 5225	L3410 DT L3710 DT L4310 DT L4610 GST R4205 R5205 L39 L48	MF 451 1529 1540 2605 2615	TC-40 TC-45 TN-55 TN-65 2120 3010S Boomer35 Boomer37 Boomer40 Boomer41 Boomer47
40					210SU	4520 4720 5055 5055E 5065 5065E	5210 5320 5325 5420 5425 6120	M6800 DT MX5700 DT	240 253 263 271 4325 MF 471	TN-70F TN-70 TN-75 TL-80
50		570L 570Mxt 570Mxt Turbo		409 410	212SU	210LE 5085E 5075E 5075M 5085M 5310 5410 5510 5520 5525	6110 6210 6215 6220 6320 6403 6405 6415 6603 7210	M6800 DT	281 MF 481 2630 4335 4345 4608 4609 5609 6255-4	TL-80F TL-90 TN-95F TS-90 TS-100 TS-100 TS-110 T4.75 T4.85F
70	RT 95 RT 115 DT 200 DT 225			411 412 712		5095M 5100E 5100M 5105M 5115M 6100D 6105D 6105M 6115D 6115M 6115R 6230	6310 6330 6410 6430 6605 6615 6715 7210 7220 7320 7420 7510	M100X M110X M126X M135X	4355 4360 4370 4610 4610LP 5610 5611 5612 6280-4 MF7614	TL-100 TM-120 TM-140 T4.95F T5.95 T4.105F T5.105 TS6.110 T5.115 TS6.120
90	RT 130 RT 145			714 716		6105R 6125M 6125R 6130 6140 6730	7130 7230 7520 7610 7720		5613 6290-4 MF6614 MF6615 MF7615	TM-155 TM-175 TS6.125 TS6.140 T7.175
110	DT 160 DT 180			918		7330 7530 7810	8120 8130 8220		MF6616 MF7616 MF7618 MF7619	TM-190 T7.210
135	DT 200			920		7630 8220 8230			MF7620 MF7622	T7.190 T7.230 T7.245
150	DT 225			924		7210R 7230 7730 7830	8320 8330 8420 9120		MF7624 MF7626	
180				926		7250R 7270R 7290R 7310R	7930 8430 9320 9420			

Motor Grader, Articulated Frame (127.02.06.09)

CLASSIFIER	MAKE AND MODEL							
Min. Operating Wt. kg	Case	Caterpillar	Fiat-Allis	Galion/ Dresser	John Deere	Komatsu	New Holland	Volvo/ Champion
11,500	845	135 H 140 H		830 850	670B 670C Series II 670CH Series II	GD530A GD530AW-2C GD555-3 Laterra GD650A GD650AW	RG 140	C70A 710A 710A VHP
14,000	845B 865 865B	12H 143H	FG 70A-B FG 75A-B FG 85A-B	970	770B 672CH Series II 770CH Series II 772CH Series II	GD650A-2C GD650AW-2C GD670A GD670AW GD750AW GD555-3 GD655-3	RG 170	710A 720A 720A VHP G710B G720B
15,500	865B AWD	160H 163H			670G 672G 770G	GD670AW-2C GD670A-2C GD675-3 Laterra GD675-3	RG 200	730A 730A VHP 740A 740A VHP G730B E740B G930 G930B G940 G940B
17,000	885 885B	14H 12M 120M 12M3 140M3 160M3	FG 105A-B		670G 672G 770G 772G 870G 872G	GD750A-1		750A 750A VHP 780A 780A VHP G780B G946 G946B G960 G960B G970 G976 G990
22,000		16H 14M 16M 140M 160M						

Spreader Attachment (127.02.06.12)

CLASSIFIER	MAKE AND MODEL
Equipment Type	Midland
Grader/FEL - Shouldering	SA-1 WA-1

Shoulder Spreader/Road Widener (127.02.06.13)

CLASSIFIER	MAKE AND MODEL		
Spreader Width m	Blaw-Knox	Midland	Weiler
2		SP-8 SPD-8	W430
3	RW-100A RW-195D	SP-10 SPD-10 SPD-12	W530 W730

Reclaimer/Stabilizer (127.02.06.14)

CLASSIFIER	MAKE AND MODEL					
Equipment Size kW	Bomag	Caterpillar	CMI	Hypac	Roadtec	Wirtgen
250	100R 100S 100S-DM MPH 362R MPH 362S MPH 362SDM MPH 364S MPH 364S-2 MPH 364R MPH 364R-2 MPH 364SDM PH 364SDM-2 RS446D	RM250C RM 300 RR250B SS250B	RS-350 RS-446	MPH 362 SDM	SX-2e	WR 200i WR 2000 WR 2000XL
325	MPH 122 MPH 122-2 MPH 454S	RM350B RM500	RS-425 RS-425B RS-500B RS-500C	MPH 364R MPH 364S MPH 454R MPH 454S	SX-4e	SS Raco 350 WR 2400
440	MPH 125		RS-600C RS-650 RS-650B RS-800 RS-950B		SX-6e	WR 240i WR 2500S WR 2500SK 2200CR
500	RS950B				SX-8e	WR 250

Grade Trimmer (127.02.06.15)

CLASSIFIER	MAKE AND MODEL	
Minimum Width m	CMI	Gomaco
2	TR 3503 TR 4503	
3	TR 6004	9000 9500

127.03.07 EXCAVATION EQUIPMENT
Hydraulic Excavator, Crawler Mounted (127.02.07.02)

CLASSIFIER		MAKE AND MODEL													
Min. Oper. Weight kg	Nominal Bucket Size m ³	Bobcat	Case	Caterpillar	Daewoo	Fiat-Allis	Hitachi	John Deere	Kobelco	Komatsu	Kubota	Liebherr	Linkbelt	Samsung	Volvo
1,000		320 325 331		300.9D 301.6C			EX17U EX27U	17ZTS 28CZTS		PC12R-8 PC15R-8 PC27R-8	KX018 KX91				EC20C ECR28
3,000				304DCR	DH50		EX35U EX80-5	35CZTS 17D 27D	30SR-3 35SR-3	PC35MR-2 PC35MR-3					EC35C
4,000			CX36B CX50B				EX50	50CZTS	50R 50SR-3	PC45MR-3 PC50MR-2 PC58UU-3	KX040 KX121			SE50-3	EC20C EC55 EC55C ECR58
6,000			9007B CX75MSR	305E CR 305.5E CR 307B 307D 308E2 308CR/SB 311B			EX110	80 190E 50D 290D	55SRX SK75R SK70SR SK85SR	PC60-7 PC78-8 PC95	KX057		1600		EC55C ECR58D ECR88 ECR88D
12,000	0.3		9010B CX130 CX130B CX130C CX135SR CX160C	312BL 312D 312E 314D 314E 316E 318E 311F RR		FX130LC	EX120 EX150	110 120 490D	SK135SR SK140SR	PC120-6 PC130-8	KX080		2650 LS2650	SE130LC-3	EC140B EC145D EC160D
15,000	0.5		9020B CX160 CX160B	315BL 318BL	DH170		EX160 EX200	590D 160LC		PC150LC-6 PC170-6 PC138LC-8		R900	2700 LS2700		EC145 EC150 EC160
19,500	0.7		9030B CX210 CX210C	319DL 320DL 320L	DH220LC	FX210LC	EX220 EX200LC-5 Zaxis 200	690ELC 200LC 210G LC	SK200SR SK210LC	PC200LC-6 HB215LC-1		R317 R900C R902 R904 - LITRONIC R912 R914 - LITRONIC	2800 LS2800	SE210LC-3	EC210B EC220D
23,000	1.0		9040B CX240 CX250 CX300C	320EL 321D 321D LR 322L, BL 326FL	DH280	FX250LC	EX230-5 EX270	790ELC 230LC 245G LC	SK230SR SK235SR SK260LC SK260SR	PC220LC-6 PC228LC-8 PC240LC-10 PC250LC-6		R906 R922 R924 - LITRONIC R932	3400 LS3400	SE240LC-3	EC240B EC240C EC220D ECR235D
26,500	1.2		9045B CX290 CX300	325BL 326FLCR 329FL 336EH 336F	DH320	FX310LC	EX270-5 EX300	270LC 290G LC 892	SK290LC	PC270LC		R934 - LITRONIC R942	3900	SE280LC-3	EC290B EC290C EC300D
32,000	1.5		9050B CX330 CX350 CX350C	328D 328DLCR 330BL 330L 336DL			EX330LC-5 EX370-5 EX400 EX450	330LC 350G LC 370	SK330LC SK350 LC	PC300LC PC360LC-10		R944 - LITRONIC	4300	SE350LC-2	EC330B EC330C EC340D EC360B EC360C EC380C
44,000	1.7		9060B CX460 CX470 CX470C	345BL 345DL 349F 350L	DH450		EX450-5	450LC 470G LC	SK480LC SK500LC	PC400LC PC400HD		R945B - LITRONIC R954/C R964/C	5800 LS5800	SE450LC-2	EC460B EC460C EC480D
55,000			CX700B	365BL			EX550 EX550-LC Zaxis 600	600LC		PC600LC					
70,000	2.0		CX800 CX800B	374DL 374FL 375L 375BL 385CL 390FL			EX700 EX750-LC Zaxis 800	670G LC 750 800C		PC750			8000		EC700 EC700C
100,000	5.0			5080 5090			EX1100	870G LC		PC1100-6					

Hydraulic Excavator, Rubber Tired (127.02.07.03)

CLASSIFIER	MAKE AND MODEL							
Min. Operating Weight kg	Badger	Caterpillar	Daewoo	John Deere	Komatsu	Liebherr	Samsung	Volvo
11,000		M312 M315 M318 M313D M315D	DH130W	595	PW170 PW170ES-6 PW160-7 PW140-7	A308 A900 A309 - LITRONIC A311 - LITRONIC A312 - LITRONIC A314 - LITRONIC A316 - LITRONIC	SE170W3	EW160C
18,000	1085C	M320 M316D M318D	DH200W	190D W	PW200-7 PW180-7	A900C - LITRONIC A904C - LITRONIC A904 - LITRONIC A914 - LITRONIC A924 - LITRONIC		EW180B EW180C
21,000		M322D		220D W	PW220-7	A914C - LITRONIC A924C - LITRONIC		EW210C EW230C

Telescopic Boom, Carrier Mounted Excavator (127.02.07.05)

CLASSIFIER	MAKE AND MODEL	
Weight kg	Badger	Gradall
15,000	450-4X2 450-4X4 460-6X4 460-6X6 470 TM 4x2 470 TM 4x2 A 470 TM 4x4 470 TM 4x4 A	65WD XL3100 XL3100IV XL3300
22,000	670-6X4 670-6X6 888-6X4 888-6X6	XL4100 XL4100-II XL4100IV XL4300-II XL5100 XL5100IV

Telescopic Boom, Crawler Mounted Excavator (127.02.07.06)

CLASSIFIER	MAKE AND MODEL
Weight kg	Gradall
17,000	XL3200 III XL3300 III
20,000	XL4200 XL4200 III XL4300 III
23,000	XL5200 XL5200 III XL5300 III

Tractor with Loader/Backhoe Combination, Two-Wheel Drive (127.02.07.07)

CLASSIFIER		MAKE AND MODEL						
Minimum Power kW	Nominal Bucket Size m ³	Case	Caterpillar	JCB	John Deere	Komatsu	Massey Ferguson	Volvo
45	0.7	580L 580M 580N	416B 416C 416D 416E 426B	214 E IV 214 III 3C 14FT 3C 15FT 3CX 14FT	310D 310E			
60	1.3	580SL 590SL 580M Turbo 580N 580 Super M 580 Super M+ 580 Super N 590 Super M	416F 420D 420E 420F 426C 430D 436B 436C 446B	214 214E 215 215 E III 217 217 III	310J 310K 310SE 310SK 310SJ 310SJTMC 410D 410E 410J 410JTMC 510D	WB150-2	50HX 60	BL60 BL60B
75	1.3	590 Super N	446B 446D		410K 710D			
94	1.3				710J 710K			

Tractor with Loader/Backhoe Combination, Four-Wheel Drive (127.02.07.08)

CLASSIFIER		MAKE AND MODEL						
Minimum Power kW	Nominal Bucket Size m ³	Case	Caterpillar	JCB	John Deere	Komatsu	Kubota	Volvo
30	0.5			208S Midi CX	110 TLB		L39 L45 M59	
45	0.7	580L 580M 580M Turbo 580N	416B 416C 416D 420D 426B 436	210S 212S 214 214 IV 215E 2CX 12FT	310D 310G 310J 310SG 315SG 410D	WB142-5		BL60
65	1.3	580SL 580 Super M 580 Super M+ 590 Super M 590 Super M+ 580 Super N 580 Super NWT	416E 416F 426C 430D 437C 446D 420E/IT 420F 430E/IT	214E 214 III, S, SM 215 215 III, S 217 217S 217 III 3C 14FT 3C 15FT 3CX 14FT 3CX 15FT 3CX 17FT 4CX 14FT 4CX 15FT 4CX 17FT	310K 310SJ 310SJ TMC 310SK 315SJ 315SK 410E 410G 410J 410J TMC 510D	WB146-5 WB146PS-5 WB156-5 WB156PS-5		BL60B BL70 BL70B
80	1.3	590 Super N	430F 446B 450E		410K 710D 710G			
94	1.3		450F		710J			

Front End Loader, Crawler Mounted (127.02.07.10)

CLASSIFIER	MAKE AND MODEL			
Power kW	Caterpillar	Fiat-Allis	John Deere	Liebherr
50	933 933C 939C		455G 555G	LR611
70	953B 955C 939	FL145	605C 605K 655C	LR614 LR621C LR622 - LITRONIC
100	755C 936B 939C 953C 953D 960C 963C 963D	FL175	655C-II 655K 755C 755K	LR614 LR624 LR631C LR632 - LITRONIC LR634
150	973 973B 973C/D 973D		755C-II	LR641C LR641 - LITRONIC

Front End Loader, Rubber Tire, Four-Wheel Drive (127.02.07.11)

CLASSIFIER	MAKE AND MODEL												
Power kW	Case	Cat	Dresser	Fiat-Allis	Hyundai	JCB	John Deere	Kawasaki	Komatsu	Liebherr	New Holland	Volvo	
40	21E 221E 221F 321E 321F	914G	510C	FR70 FR90		210SL 406 407B ZX 409 409B ZX 411 411B HT 411 HT	244E 244H 244J 304H 304J 324H 344G 344H 344J	WA95-3 50Z IV	WA120-1 WA65-5 WA70-5 WA80-5 WA100-5 WA150-5	L512 L525		L20B L20F L25B L25F L30B L30G L35B L35G	L40B L45B L50C L50D
75	521D 521F 621B 621C	924F 924G 924H 928F 928G	515C	FR100 FR120.2	HL 740-7	416 416B HT 416 HT 426 HT 426B HT 426B ZX	444G 444H TC 44H 544G 544H TC 54H	60Z IV 65Z V 70Z V-2	WA120-3 WA120L-3 WA180-1 WA180-3 WA250-3 WA250-5	L522	W110B	L45G L50G L70C	
100	521E 621D 621F 721B 721C	928HZ 930G 930H 938F 938G	520C 532	FR130.2 FR140.2		426 ZX 436 HT 436B HT 436B ZX	544J 624G 624H TC 62H	65Z IV-2 65Z V 70Z IV-2	WA250-1 WA300-3 WA320-1 WA320-3 WA320-5	L531-B L541-B L542	W130B	L60E L60F L60G L70E L90C	
125	621E 721D 721E 721F 821B	821C 821D 938H 939 950F 950G	938-II 950H 962G	FR160.2 FR180.2		456B ZX 456 HT 456 ZX 950G	624J 644E 644G 644H 644J 644H MH	70Z V 80Z V	WA380 WA380-5 WA400-5	L544 L550 L556	W170B W190B	L70F L70G L90E L90F L90G	
150	821E 821F 921B 921F	950K 960F 962K 966F	962G-II	545	FR220.2	HL 760-7	724J 744E 744H 744H MH	80Z IV-2 85Z IV-2 85Z V-2	WA420 WA420-1 WA430-6	L551		L110E L120C L120E	
175	921C	962H 966G	966H			HL 770-7	744J		WA450-5	L564 L566		L110G L120F	
200	921D 1021F	921E 970F 972G	966G-II 966K 972K				824J	90Z IV-2 90Z V	WA450-1 WA450-3 WA480-5 WA500-1	L576 L580		L120G L150C L150E L180C	
225	1121F	980G				HL 780-7	844J	95Z IV-2	WA500 WA500-3			L180E L220D	
250		980H 980K						95Z V	WA500-6	L586		L220E	
300		988F 988G 988H	990	560B				115Z IV-2 115Z V	WA600-1 WA600-3 WA700			L330C L330E L350F	
400		988K 990H	990K 992G					135Z V	WA700-3			L350F	

Skid Steer Loader, Rubber Tire (127.02.07.12)

CLASSIFIER	MAKE AND MODEL									
Lift Capacity kg	Bobcat	Case	Caterpillar	Gehl	JCB	John Deere	Mustang	New Holland	Thomas	Volvo
300	463 553 S100 S130 443B 543B 743B 753 753H	40 XT 1825B 1825 1838 410 SR130	216 226	3935 4635 SXT SL3410 SL3825 SL4625	160 170 165 Robot	240 313 315	2022 2032 2044	L213 LS120 LS125 LS140 LS150	85 105 135 T83 T103 T105 T133S	MC60 MC70
700	S160 S175 S185 S510 S530 S550 7753 853 853H	1845 1845C 420 SR160 SR175 SV185	232 236	4835 SXT SL5625		250 317	2054	L218 LS160 LS170	153 175 T173	MC60C MC70C MC80
850	A220 S205 S220 S570 S630 SR175 SR220	70 XT 75 XT 85 XT 430 435 440 SR210	242 246 248 252 260	5635 SXT 6635 SXT SL6625	190 185 Robot	260 320	2064 2074	L220	225 245HF T183 T203 T233HD	MC85C MC90 MC95C
1,000	A300 S250 SR250 SV250	90 XT 445 SR220	262 270		185 Robot	325		L223 L225 LS180	255	MC110 MC115C MC155
1,200	S300 S750 S770	95XT 465 SV300	280	7600 7800	1110	318D 318E 320D 320E 328 332	2095 2105	L230 LS190		MC135 MC135C
2,500	S650					328D 328E 332D 332E				

Skid Steer Loader, Tracked (127.02.07.13)

CLASSIFIER	MAKE AND MODEL						
Tipping Load * kg	Bobcat	Case	Caterpillar	John Deere	New Holland	Kubota	Volvo
900	T140					SVL75	MCT85C
1,100	T180 T550	420CT					MCT 125C
1,300	T590	440CT 445CT	279C	CT322	C175		MC 135C
1,600	T190 T250	450CT	289C		C185		
1,800	T300 T630 T650 T750 T870	TR270 TR320 TR380 TV380	299C	CT315 CT319D CT323D CT323E CT329D CT329E CT332 CT332D CT333D CT333E	C190	SLV90	

* SAE - Rated Operating Capacity @ 50% Tipping Load

Skid Steer Loader, Attachments (127.02.07.14)

CLASSIFIER	MAKE AND MODEL																
Attachment Type	Bobcat	Case	Caterpillar	Cleansweep	Gehl	John Deere	New Holland	Teledyne	Thomas	Volvo	Bore Pig	ETerra	Bradco	Quick Attach	Arrowhead	FFC	Sweepster
300 mm Auger	AB	CA15			300 A		300 P		AU 19	NR 3-10	9PD 12PD 15PD 19PD	3500 4500					
Backhoe		D100 D125							XR 911				509 511	QA640 QA940			
Breaker	BR		H45/H45S		550 BK	HB 15			HB 102					210SX 310SX 360SX	S30 S40 S50 S60		
Scarifier														Quick Tiller 66 and 78			
Sweeper			BA18	AMH72	72 BR	BA72	560B	TB 125	AB 101	ABR10-2							
Multi-Bucket	MB411				36 MB	MP66	40B-ML			MBU-2-10							
Power Rake	PR				65 PR	PR72			MB 106					RSC72 RSC84 FSC72 FSC84			
Steel Tracks	STR	Grouser 120 GR10 GR12 GR14	ST18			ST32	45T-ST			STR8-10							
Trencher	TR				24TR	TR48	16TR			TRE14-10				Mini Trencher Standard Trencher			
Cold Planer	CP	Alitec 30	PC4		16 CP	CP12	16C		CP 110	PL4-10			SP300 HP450 HP750 HP1000			FFC16 FFC18 FFC20 FFC30 FFC36	
Pick Up Broom	PB		BP18		72PB	PB72											SB60 SB72 SB84 VRS5 VRS6 VRS7 VS5 VS6 VS7

Chain Type Trenching Equipment (127.02.07.15)

CLASSIFIER	MAKE AND MODEL				
Power kW	Astec	Case	Ditch Witch	Toro	Vermeer
13	RT 60 RT 130 RT 160 TF 300B	TF300B	1820 RT12 RT25 100SX	TRX20 TRX26	RTX150 RTX250
20	RT 360 RT 460	360 460	3610 3700 RT36 RT40 RT45		LM42 PTX44
35	RT 560 RT 560 Quad RT 660 RT 669 Quad	560 660	3700 CD 5110 5700 RT55 410SX 420SX	RT600	
50	RT 960		7610 8020 RT70 RT75 RT80Q RT90 RT100 RT95 RT120 RT115	RT1200	T455 T555 T655

127.03.08 HAULAGE EQUIPMENT

Dump Trucks, Off Highway, Rigid Frame (127.02.08.14)

CLASSIFIER	MAKE AND MODEL			
Payload kg	Caterpillar	Euclid/Hitachi	Komatsu	Terex
30,000	770	R35		3305B TR35 TR40
35,000	769C 769D 770G	EH650	HD325-6	3340 3345
38,000	771D 772 772G	EH700 EH750-3	HD325-7 HD405-7	TR45
50,000	773D 773E 773F 775E 775F 773G	EH1000 EH1100 EH1100-3	HD465-7 HD605-7	3360B 3310E TR60 TR70
75,000	777D 777F 777G	EH1600 EH1700 EH1700-3		TR100

Dump Trucks, Off Highway, Articulated Frame (127.02.08.15)

CLASSIFIER	MAKE AND MODEL								
Payload kg	Caterpillar	Hitachi	John Deere	Komatsu	Link Belt	Moxy	Terex	Volvo	Bell
20,000	D25D D250E 725 725C	AH250-D	250D		D25		2566C 2766C TA25	A25B A25C A25D A325F	
26,000	D30D D300D D350E 730 730C 730C Ejector	AH300-D	300D	HM300-1 HM300-2	D300	MT30X	3066C TA30	A30C A30D A30F	
30,000	735 735B	350D	350D	HM350-1		MT36	TA35	A35C A35D A35F A35FFS	B35D
35,000	D40D D400D D400E 740 740 Ejector 740B 740B Ejector	AH400-D	400D	HM400-1 HM400-2		MT40B	4066C TA40	A40 A40D A40F A40FFS	B40D
40,000									B45D B50D

127.03.09 HOISTING EQUIPMENT

Boom Truck (127.02.09.01)

CLASSIFIER	MAKE AND MODEL				
Lift Capacity kg	National Crane	Terex	Maintex	Manitowoc	Tadano
7,000	300C 400B				TM-1052
11,000	300 C * 400 B * 500D 500E 600D 600E	3063B 3470 3874	1703 C 1704 C	1770 C 1781 C	TM-1882 TM-20110
19,000	800D * 900A * 900H * 500 E2 NBT 14 NBT 15 NBT 16 600E 600D 600 E2 600 H	BT3870 4485 4792	2601 C 2801 C	26101 C 22101 S 2892 S	
25,000	800 D * 800 H 900 A * 900 H * NBT 30 H 1100 1300 1400 1500 1800 NBT 36 NBT 45 NBT 55 1400 H	BT 4792 BT 28106 BT 70100 RS 70100 5092 60100	102 WL 3001 3001 C 3500	2892 C 2892 C-HYACS 38100 HL 38124 HL	

* May be either capacity depending on equipment year of manufacture.

Hydraulic Crane, Rough Terrain (127.02.09.02)

CLASSIFIER	MAKE AND MODEL						
Lift Capacity kg	Broderson	Grove	Link Belt	Badger	Tadano	Zoomlion	Terex
13,000	IC 200-3G IC 250-3D IC 200-F IC 250-A IC 250-3C RT 200-E RT 300-B RT 300-C RT 300-2E			CD 4415	TX 150XL		208S
20,000		RT 530E2 RT 540E RT 525E RT 530E TR 540E	ATC 822 C 8030-SII RT 8030-II RTC 8030 RTC 8040	CD 4430	TR 300XL-4 TR 450XL-4		CD 200 RT 200 RT 300-1 RT 230-XL
40,000		GMK 2035 GMK 3050 GMK 3055 RT 600E RT 700E RT 765E2	C 8050-SII RTC 8050 RTC 8050-IV RTC 8060 RTC 8065		ATF 500XL TR 450XL-3 TRX 600XL-4 TRX 650XL-4		RT 500-1 RT 555-1 RT 345-XL RT 670-1
65,000		GMK 4090 GMK 5120B GMK 5240 GMK 6250 GMK 6250L GMK 7550 RT 770E RT 875BXL RT 875C RT 880E RT 890E RT 9100 RT 9130E	C 8065-SII C 8080-SII C 8090-SII ATC 3130 RTC 8075-II RTC 8080-II RTC 8170		ATF 650XL ATF 1300XL TR 800XXL-4	RT75	600-1 RT 670 RT 700 RT 780 RT 780-1 RT 100
100,000		RT 9100 RT 9130E RT 9130E-2 RT 9150E	C 80110-SII C 80130-SII RTC 8090 RTC 80100			RT100	RT 130 RT 1000 RT 1100

Hydraulic Crane, Carrier Mounted (127.02.09.03)

CLASSIFIER	MAKE AND MODEL				
Lift Capacity kg	Grove	Liebherr	Link Belt	Tadano	Terex
12,000			ATC 822		
25,000	TMS 500E TMS 500E2	LTM 1030-2.1 LTM 1035-1 LTM 1040-2.1	HTC 8640 HTC 8640 Heavy Lift	TT 300XL	T 340-1 T 340-1-XL T 230 T 300 T 335 T 340 T 700
45,000	TMS 700E	LTM 1045-3.1 LTM 1050-3.1 LTM 1055-3.1 LTM 1045-1 LTM 1055-1	HTC 8660 HTC 8650 HTC 11100	TT 600XL	T 490 T 500-1 T 560
60,000	TMS 800E TMS 900E *	LTM 1060-1 LTM 1070-4.1 LTM 1080-1	HTTO 8675-SII HTC 8670LB HTT 8675 HTT 8690 HT 8675LB	TT 800XXL *	T 560-1 T 780-1 T 750 T 780 T 790
90,000	TMS 900E * TMS 9000E	LTM 1090-4.1 LTM 1100-4.1 LTM 1100-4.2 LTM 1100-5.2 LTM 1095-5.2 LTM 1100-5.1 LTM 1090-2 LTM 1095 LTM 1100-2 LTM 1130-5.1	HTTO 86100	TT 800XXL *	Roadmaster 9000
135,000		LTM 1150-1 LTM 1160-2 LTM 1200-1 LTM 1160-5.1			
200,000		LTM 1250-1 LTM 1300-1 LTM 1500 LTM 1800 LTM 1200-5.1 LTM 1220-5.2			
250,000		LTM 1250-6.1 LTM 1300-6.1 LTM 1350-6.1	ATC 3275		

* May be either capacity depending on equipment year of manufacture.

Lattice Boom Crane, Crawler Mounted (127.02.09.04)

CLASSIFIER	MAKE AND MODEL					
Lift Capacity kg	American Crane	Kobelco	Liebherr	Link Belt	Manitowoc	Terex
32,000			HS 833			
50,000	5299A 5300		HS 835 HD	108 HYLAB 5 LS-108 H II LS-138 H II LS-208 II		
70,000	HC 80 7225A	CK 800 III CK 850 III CK 850 G		138 HYLAB 5	Model 111 8500-1 8000-1	HC 80
90,000	7260 HC 110 HC 125 9260	CK 1000 III CK 1100 G	HS 855 HD HS 860 HD HS 885 HD LR 1090 LR 1100	LS-218 H II LS-308 H II 218 HSL	Model 222 11000-01 12000-01 10000 10000 B1	HC 110
130,000	9299 HC 150 HC 210	CK 1600 II CK 2000 II CK 1600 G	LR 1130 LR 1160	238 HSL LS-238 H LS-248 H II 248 HYLAB 5	Model 555 Model 777 MLC 165	HC 165
200,000	9310A 9320	CK 2500 II	HS 895 HD LR 1200 LR 1250	HC-278 H 248 HSL 298 HSL 348 HYLAB 5 *	Model 888 Model 999	HC 230 HC 275

* May be either capacity depending on equipment year of manufacture.

Lattice Boom Crane, Carrier Mounted (127.02.09.05)

CLASSIFIER	MAKE AND MODEL			
Lift Capacity kg	American Crane	Liebherr	Link Belt	Manitowoc
60,000	5530		HTT 8675 HT 8675 LB	
110,000	7150 8470 9460 9480		HC-238 HII HC-248 H	777T
270,000	9490	LG 1550 LG 1750	HC-278 HII	

Aerial Bucket Lift, Truck Mounted, Including Truck (127.02.09.06)

CLASSIFIER	MAKE AND MODEL			
Platform Height m	Altec	Mobile Tool International	Terex	Versalift
7.0	AT200AV	P3	T292	Vantel 29N/1
10.0	AO442 AT35G L42A TA36 TA37 TA40 TA41	83G-36 U3	SC40 TL36P T292 LT38 L13i TL37 TL41	SST37E1H VO431
15.0	AM50 AM55 AM650 AM855 AT37G CLASS A 50 LRV52 LRV55	83G-42 829-45 829-50 U5-50 805B-50 805B-55	OM50 TL 45 TL50 TL55 TL60	LT56 VO255/260 VO350/355 VST5000-6000
20.0	CLASS A 70 CLASS A 77T			VST7500 VXD 50

Aerial Bucket Lift, Self-Propelled, Telescopic/Articulating (127.02.09.07)

CLASSIFIER	MAKE AND MODEL				
Platform Height m	Genie	Grove	JLG	Snorkel	Terex
9.0	A-30/20 Z-30/20N Z-34/22N			TB 37	TA 33 TA 34
12.0	S40 S45 Z-45/25 Z-45/25DC		400S 400SJ 450A 450AJ 460SJ M450A	AB 50J TB 42 TB 42J TB 47J TB 50 T 46J UNO41	TA 40E TA 50E TA 50RT TB 42 TB 50
18.0	S60 S65 Z-60/34 560X	A60J Type I A60J Type II T60 T60 Type II T65T	600A 600AJ 600AJN 600AN 600S 600SC 660SJ 660SJC	AB 60J TB 60 TB 66J	TB 60 TB 66
22.0	S80 S85 S80X Z80/60	A80J T80 T86J	740AJ 800A 800AJ 800HX 800HX6 800S 860SJ	TB 80 TB 85J	TB 85
30.0	S100 S105			TB 100J	TB100 TB110
36.0	S120 S125		1200SJP 1250AJP 1350SJP 150 HAX	TB 120 TB 126J	

Scissor Lift, Self-Propelled (127.02.09.08)

CLASSIFIER	MAKE AND MODEL			
Platform Height m	Genie	JLG	Skyjack	Terex
4.0	GS-1530 GS-1930 GS-2032 GS-2046	1532E3 1930ES 1932E2 2030ES 2032E2 2033E3	SJIII 3015 SJIII 3215 SJIII 3219 SJII 3220 SJIII 4620	TSM 20
7.0	GS-2632 GS-2646 GS-2668 GS-2668RT GS-2669DC GS-2669RT	260MRT 2630ES 2632E2 2643E2 2646E3 2646ES 2658	2409 SJIII 3226 SJIII 6826 SJ 4626 SJ 7127 SJ 6826RT	TSM 25RT TSM 26
9.0	GS-3246 GS-3268DC GS-3268RT GS-3384RT GS-3390RT GS-4390 GS-4390RT GS-5390 GS-3369	3246E2 3369LE 339RT 3394RT 4069LE 439RT 4394RT 500RTS 3669ES	4832 6832 8831 8841E 9250RT SJIII 4632 SJIII 6832 SJ 7135 SJ 8243 SJ 8831 SJ 8841 SJ 9250	TSM 30 TSM 30RT TM54RT

Tool Carrier (127.02.09.09)

CLASSIFIER	MAKE AND MODEL				
Power Rating kW	Case	Caterpillar	JCB	John Deere	Komatsu
40	570 XT 570 NXT	IT 14G *	411-HT	310SJ TMC	
75		IT 14G	416-HT	410SJ TMC 410SK TMC	WA200PT-5
100		924 K 930 K	426-HT	544J 544K 624J	
125		IT 38G 938K	436-HT 456-HT 457-HT	624K 644J 644K	WA250PT-5

* May be either capacity depending on equipment year of manufacture.

Telescopic Handlers (127.02.09.10)

CLASSIFIER	MAKE AND MODEL			
Lifting Height m	Bobcat	Case	Caterpillar	JCB
5 - 10	V 518 V 723		TH210 TH215 TH220 TH255 TH330B TH406 TH407	520
> 10		TX742 TX842 TX945	TH350B TH460B TL642 TL943 TL1055 TL1255	506-C 506-C HL 508-C 540 TURBO 550 506-36 509-42 510-56 512-56

127.03.10**PILE DRIVING EQUIPMENT****Hammer, Open End, Diesel (127.02.10.01)**

CLASSIFIER	MAKE AND MODEL					
Rated Energy J	APE	Berminghammer	Delmag	ICE	MKT	Pileco
50,000	D16-42 D19-42 D25-32	B-21 B-3505 B-4005	D16-32 D19-32 D19-42 D112-32	42S I-19	DE-42 DE-50 DE-50C	
80,000	D25-42 D30-32 D30-42 D36-32	B-32 B-4505 B-5005	D25-32 D30-32 D30-32/33	I-30 60S 80S	DE-70	
120,000	D36-26 D36-42 D46-32 D46-42 D50-42 D62-42	B-64 B-5505 B-6505 B-6505HD G4	D36-32 D36-32/33 D46-32 D46-32/33 D62-22	D62-22 I-36 I-46 I-62 I-80 100S 120S 120S-15 205-S	DE-110 DE-150	D62-22 D80-23

Driver Extractor, Vibratory Centrifugal, Including Power Pack, Excluding Crane (127.02.10.02)

CLASSIFIER	MAKE AND MODEL					
Driving Force kN	APE	Delmag	HPSI	ICE	J and M	MKT
245			MODEL 100	216	216	
392	50 Vibro Model 50	HPSI 65 HPSI 130 HPSI 150	MODEL 150	23 RF 7 RF	11-23	VC 5
637	100 Vibro 150 Vibro Model 100 Model 150	HPSI 200 HPSI 260	MODEL 200 MODEL 250 MODEL 260 MODEL 300	11-23 14-23 14 RF 40-30 44-30 416L 14C-230M	416 44-30 22-30 28-35	V-20B
980		HPSI 300 HPSI 400		44-50 66-65 416L 28C-350E	44-50	150 Tandem Vibro
1,471	200 Vibro, 3 Model 200	HPSI 450		44-65 44B-595E 50B-595E 55B-595E 66C-800E	44-65 66-65 66-80	V-30 V-35

Universal Piling Machine (127.02.10.05)

CLASSIFIER	MAKE AND MODEL			
Power KW	A.B.I. (Mobilram)	Liebherr	Bauer	Casagrande
< 450	TM 11/14			
450	TM 13/16 TM 14/17	LRB 125 XL LRB 155	RG 16T RG 19T	PTC PR 16/19
570	TM 18/22	LRB 255	RG 21T RG 20S RG 25S	

127.03.11 DRILLING EQUIPMENT**Mechanical Drilling Equipment, Truck Mounted,
Including Auger and Crowd and Power Pack (127.02.11.01)**

CLASSIFIER	MAKE AND MODEL		
Power KW	Reedrill	Watson	CME
80	Texoma Model 650 Texoma Model 500 Texoma Model 330	1100 2100	CME-55 CME-75
120		2500 3110	

Mechanical Drilling Equipment, Crawler Mounted, Including Auger (127.02.11.02)

CLASSIFIER	MAKE AND MODEL		
Power KW	Reedrill	Watson	ICE
95	Texoma 600T Texoma 700T	1100	
113	Texoma 800T	2100 2500	
130	Texoma 900T Magnum XLT Taurus XLT	2500 3110 3000 3100 3400	EX-12 EX-25

Hydraulic Drill Rig (127.02.11.03)

CLASSIFIER	MAKE AND MODEL							
Power KW	APE	Bauer	IMT	Liebherr	Mait	Soilmec	Watson	Casagrande
185	SA-16 SA-20 SA-22	BG 18 H BT 50 BG 20 H BT 60	AF 160 AF 180		HR 180	SR-40 SR-50	4400CM	B125XP B175XP B200XP C7XP C9XP
250	SA-25	BG 24 H BS 70 BG 24 H BT 70C BG 24 H BT 75 BG 25 H BG 28 H BT 60	AF 220 AF 240	LB 20	HR 260	SR-60 SR-65 SR-70PDC SR-70PDW SR-80PDC SR-80PDW SR-80CAT SR- 80CPDW3		B250 XP
350		BG 28 H BS 80 BG 36 BS 80 BG 36 H BS 80 BG 36V BS 95 BG 30V BS 95	AF 280	LB 24	HR 240- 800 HR 300- 570	SR-90 SR-100 SR-100PDC SR-90PDW		B300XP B360XP
430		BG 40 BS 100 BG 40 BS 115		LB 28 LB 36				
570		BG 50 BT 180						

Mechanical Drilling Equipment, Crane Mounted Attachment, Including Auger (127.02.11.04)

CLASSIFIER	MAKE AND MODEL				
Power kW	Berminghammer	Calweld	Reeddrill	Steven M. Hain	Watson
110	Mark IV BDH-30/30 BDH 60/60	125 CH 155 CH	CM 100	165 K 8V71 450 K (2005)	5000 CA 200 K

Horizontal Earth Boring Equipment (127.02.11.05)

CLASSIFIER	MAKE AND MODEL		
Power Rating kW	American Augers	Barbco Inc.	Bor-it Mfg.
20	24/30-150 30/225	24-150 30-200	24 Brute 30 Power Plus Model 24 Model 30 Model 36
50	36/42-440G2 48/54-900G2 42-600G2 36-600NG 42-600NG	36-350 36-500 36-630	36 Workhorse 36/425 Workhorse Model 42 Model 48 48 Terminator
100	16-1200 72-1200 48/54-900NG 60-1200NG 72-1200NG	48-750 48-950 48/60-1350 60/72-1000HD 60-1HD	Model 54 Model 60
200	84/96-1800NG		

Trenchless Directional Drill, Track Mounted (127.02.11.06)

CLASSIFIER	MAKE AND MODEL					
Operating Wt. kg	Astec/Toro	Case	Ditch Witch	Vermeer	McCloskey	American Augers
1,000	DD-65 DD-1416 DD-2024	6010	JT 520 JT 921 JT 922 JT 1220 Mach I JT 5	D7 X Series II D16 X 20A D9 X 13 D20 X 22 Series III	DD15	
7,000	DD-3238 DD-4045	6030	JT 2020 Mach I JT 2720 Mach I JT 3020 Mach I JT 30AT	D24 X 40A Series II D24 X 40 Series III D18 X 22 D36 X 50 Series II		
12,000	DD-6		JT 4020 Mach I JT 8020 Mach I JT 100AT	D60 X 90 Series II D75 X 100 D15 X 300 D80 X 100 Series II		
20,000						D110 D155T

Hydraulic Rock Drill, Including Power Pack, Excluding Drill Steel and Bits (127.02.11.07)

CLASSIFIER	MAKE AND MODEL					
Diameter mm	Caterpillar	Atlas-Copco	Ingersoll-Rand	Sandvik	Tamrock	Terex/Reeddrill
< 75		ROC D5		DC120 DC301R	Commando 110 Commando 120	
75	MD 5050 MD 5050T MD5075C	ROC 642 HP ROC D3 ROC D7 ROC F7 ECM-580 ECM-590 ROC D7 RRC ROC D7C-11	ECM-470 ECM-580 ECM-590 ECM-660	DX700	Ranger 500 Scout 500 CHA 560 Dino 560 Ranger 600 Ranger 700 Scout 700 CHA 700	R20 SD345C
125	MD 5090 MD 5075	ROC F9 ECM-660 II ECM-720 ROC L7	CM-692 ECM-680 ECM-690	DP900 DP1100 DX800	Ranger 800	SD345 R30C
150	MD 5125C MD5150C		CM-695D	DP1500 D1550		SCH5000C

Note: Ingersoll-Rand line sold to Atlas-Copco.

Tieback Drill Rig, Hydraulic, Dual Head (127.02.11.08)

CLASSIFIER	MAKE AND MODEL			
Power Rating kW	Casagrande	Davey-Kent	Hutte	Klemm
< 140	M6	DK625		
140	C7 C8 M9 M9-1 Hutte HBR C6XP	DK720 DK725 DK820	HBR605	KR 600-1 806-3D 806-3F 806-4 KR807-7

Front Mounted Attachment, Hydraulic (127.02.12.01)

CLASSIFIER	MAKE AND MODEL					
Broom Width m	Case	John Deere	York	M-B Companies	Multi Sweep	Sweepster
1.2	VRS Series, 1.5 m	BR60	SSAB, 1.5 m	LB Series, 1.2 m CL-HT, 1.5 m FLB, 1.5 m HL Series, 1.5 m HTS, 1.5 m LB Series, 1.5 m SHL Series, 1.5 m SHT, 1.5 m	270	QCTL Series, 1.5 m RLH, 1.68 m SB, 1.5 m SSL Series, 1.5 m VRS Series, 1.5 m VS5, 1.5 m
1.8	SB Series, 1.8 m VRS Series, 1.8 m CS Series, 2.1 m SB Series, 2.1 m VRS Series, 2.1 m	BA 72 BP 72 BR 72 BA 84 BP 84 BR 84	FLB, 1.8 m SSAB, 1.8 m SSAB, 2.1 m TFB, 2.1 m FLB, 2.3 m	FLB Series, 1.8 m HL Series, 1.8 m HT Series, 1.8 m LB Series, 1.8 m LLB Series, 1.8 m SHL Series, 1.8 m SHT Series, 1.8 m HL Series, 2.1 m HT Series, 2.1 m LB Series, 2.1 m LLB Series, 2.1 m SHL Series, 2.1 m TK-H Series, 2.1 m TKH-TR Series 2.1 m HL Series, 2.1 m HT Series, 2.1 m LB Series, 2.1 m LLB Series, 2.1 m SHL Series, 2.1 m TK-H Series, 2.1 m HTP Series, 2.1 m HLP Series, 2.1 m TKH-T Series, 2.1 m	425 C 725 C	CH, 1.8 m LCH, 1.8 m LH, 1.8 m MCH, 1.8 m MH, 1.8 m RHFA, 1.8 m TMRH, 1.8 m 2500, 1.8 m QCTL Series, 1.8 m SSL Series, 1.8 m VS Series, 1.8 m VCS Series, 1.8 m AD AD, 2.1 m CS Series, 2.1 m LH Series, 2.1 m QCS Series, 2.1 m SB Series, 2.1 m TKH, 2.1 m VRS Series, 2.1 m VS Series, 2.1 m QCTL Series, 2.1 m SSL Series, 2.1 m VCS Series, 2.1 m
2.4	CS Series, 2.4 m	CS Series, 2.4 m	FLB, 2.43 m SSAB, 2.7 m TFB, 2.4 m TFB, 2.7 m TFB, 3.0 m	HL Series, 2.4 m HT Series, 2.4 m LB Series, 2.4 m LLB Series, 2.4 m TK-H Series, 2.4 m HLP Series, 2.4 m TKHL Series, 2.4 m TKH-T Series, 2.4 m TKH-TR Series, 2.1 m LLB Series, 2.7 m TK-H Series, 2.7 m TKH-T Series, 2.7 m TKHL Series, 2.7 m TKH-TR Series, 2.7 m TK-H Series, 3.0 m TKH-TR Series, 3.0 m TKH-T Series, 3.0 m TKHL Series, 3.0 m TK-H Series, 3.4 m TKHL Series, 3.4 m TKH-TR Series, 3.4 m TKH-T Series, 3.4 m TK-H Series, 3.7 m TKH-T Series, 3.7 m TKHL Series, 3.7 m TKH-TR Series, 3.7 m	900	AD, 2.4 m LA, 2.4 m LCH, 2.4 m LA, 2.7 m LCH, 2.7 m LA, 3.0 m LCH, 3.0 m CS Series, 2.4 m QCS Series, 2.4 m SSL Series, 2.4 m QCTL Series, 2.4 m WLA Series, 3.0 m

Self-Propelled, Dual Control (127.02.12.02)

CLASSIFIER	MAKE AND MODEL				
Sweeper Type	Allianz	Elgin	Schwarze Industries	Global Environmental	Johnston
Bottom Dump	RT 655 VT 650-1	Air Cub LX, 3.3 m ³ Crosswind, 6 m ³ Crosswind Fury, 6 m ³ Crosswind J, 6 m ³	A4 Storm, 3 m ³ A7 Tornado, 6 m ³ A9 Monsoon, 7 m ³		RT 655, 6 m ³ VT 651, 6 m ³ VT 801, 8 m ³
High Dump	3000 450 4000 MS-350 MT-350	Air Bear FL52H, 4.2 m ³ Broom Badger, 3 m ³ Broom Bear, 3.4 m ³ Eagle-1, 3.5 m ³ Eagle, 3.5 m ³ Pelican, 2.7 m ³ Pelican P Waterless Road Wizard, 3.5 m ³	A8 Twister, 4.4 m ³ M6 Avalanche, 3.8 m ³	Python S2000, 3.0 m ³ Python S2500, 3.8 m ³ Python S3000, 4.5 m ³	J3000, 4.3 m ³ J4000, 4.3 m ³
Vacuum	VT-650 VT-800	Crosswind, 6.0 m ³ Geo Vac, 6.0 m ³ Megawind, 6.0 m ³ Whirlwind, 6.0 m ³			605, 6.0 m ³

Brush Chipper, Tow Type (127.02.13.01)

CLASSIFIER	MAKE AND MODEL		
Minimum Net Flywheel Power kW	Bandit	Morbark	Vermeer
19	65 65XP 75 75XP	2050 2060-D	BC200XL BC600XL BC900XL
35	90 150		BC1000XL (Drum)
60	90XP 95XP 200 254 280	2012-D 2090-D 2070XL	BC1000XL BC1200XL
80	150 150XP 200 + 200XP 250 250XP 280 1390XP 1890 1990	2100-D 2400XL Storm 12	BC1200XL BC1500 BC1500XL BC1800XL
140	280XP 1890XP 1990XP		BC2100XL

Log Skidder, Cable/Grapple (127.02.13.02)

CLASSIFIER	MAKE AND MODEL					
Minimum Net Flywheel Power kW	Allied	Caterpillar	Franklin	John Deere	Tigercat	Timberjack
75	F65C	517 525B 525C		540G-II 540G III 548G II 548G-III		360DC 360DS 460D 460DC 460DS
120	H66DSC-II F68C	525C 527	170S2 185S2 Q70	640G III 640H 648G III 648H 648G III (2007) 748G III 784H 848G 848H	604 610	560DD 560DS 660DC 660DD
150		525D 535C 535D 545C 545D	Q80		625C 630C	

Generator, Gas or Diesel (127.02.14.01)

CLASSIFIER	MAKE AND MODEL										
Power kW	Caterpillar	Detroit Diesel Spectrum	Honda	MTU Onsite Energy	Yamaha	Wacker-Neuson	Multi-quip	Subaru	Magnum	Pramac	Doosan
0.5			EM2500CC EM3000CC EU1000iC EU2000iC EU3000iSCA Et1800XK1C Et2500XK1C EZ1800C EZ2500C EU 1000i EU 2000i EP 2500		EF1000 EF1000A EF1000iS EF1600 EF1600X EF2400iS EF2600 EF2600A EF2600X EF2800i EF3000iSE EF3000iSEB EF1000iS EF 2000iS EF 2000iSH EF 2000iSHC	GP2500A	GDP5HA GA25H				
3			EB3800XC EB5000iC EB5000XK2C EM3500XK1C EM3800SXC EM5000iSCT EM5000XK1C EM5000SX2C EX50CC9 EZ3500C EZ3500XL1C EZ5000C EZ5000XL1C EM 3000 EU 3000iS EU 3000iK EB 4000		EF4000DX EF4500iSE EF4600A EF4600DE EF5200DE EF5200DEC EF 3000iS EF 3000iSEB EF 4500iSE	GP3800A		RG3200iS RGD 3300H RG 4300iS RGX4800			

127.03.14
PORTABLE GENERATING EQUIPMENT
Generator, Gas or Diesel (127.02.14.01)

CLASSIFIER	MAKE AND MODEL										
Power kW	Caterpillar	Detroit Diesel Spectrum	Honda	MTU Onsite Energy	Yamaha	Wacker-Neuson	Multi-quip	Subaru	Magnum	Pramac	Doosan
5	D8L1		EB6500XC EB7000iC EB11000C EM6500SXC EM6500SXKC ES6500K2CA EV6010 EX5500K2C EG 5000 EB 5000 EM 5000S EB 6500 EM 6500S EM 6500SI EG 6500 EU 6500is EU 7000is		EDL6500S EF6200PDEX EF6300iSDE EF6600A EF6600DE EF6600DEC EF12000DEX EF 5500DE EF 5500D EF 7200D EF 7200DE	GP5600A GP6600A GP9700V		RGX 6500 SGX 7500E RGX 7500E	MLG8	S6000 S7200 Whisperwatt GA97HEA	5
10	D12L1 D17L1 D20P1 D25P1 D30P3 D40P3 XQ35	20DSEJB 30DSEJB 40DSEJB	EX12DCC9	25JC6DT4 30JC6DT4 35JC6DT3 40JC6DT3		G14 G25 G50			MLG15 MLG25 MLG20 MMG25 MMG35		G25 G40
40	D50P3 D60P3 D75P3 XQ60	50DSEJB 60DSEJB 80DSEJB 80DSJB		50JC6DT3 60JC6DT3 75JC6DT3		G70			MMG45i MMG55 MMG75 MMG100		G70
80	D90P1 D100P1 D125P1 D150P1 XQ125	100DSEJB D125DSEJB 125DSEJB 150DSEJ		100JC6DT3 125JC6DT3 150JC6DT3		G100 G120 G150 G180			MMG130 MMG175		G85 G125 G185

127.03.14

PORTABLE GENERATING EQUIPMENT

Generator, Gas or Diesel (127.02.14.01)

CLASSIFIER	MAKE AND MODEL										
Power kW	Caterpillar	Detroit Diesel Spectrum	Honda	MTU Onsite Energy	Yamaha	Wacker- Neuson	Multi-quip	Subaru	Magnum	Pramac	Doosan
150	D200P4 3306 3406, 275 kW XQ200	180DSEJB 200DSEJB 230SEJB 275DSE		180JC6DT3 200JC6DT3 230JC6DT3 250JC6DT3 250XC6DT3		G240			MMG205		G240
250				275JC6DT3 275XC6DT3 300XC6DT3		G320			MMG330		G325
300	3406, 320 kW 3406, 365 kW XQ375	350DSE 400DSE		350XC6DT3 400XC6DT3					MMG480		G450
400	3412, 455 kW 3412, 545 kW	450DSE-4 500DS-4 600DS-4		450XC6DT3 550VC6DT2 600VC6DT2							G570
600	3412, 635 kW 3412, 725 kW XQ800	750DS-4 800DS-4 900DS-4		650XC6DT2 750XC6DT2 900XC6DT2							
910	3508B XQ1000	1000DS-4		1000XC6DT2							

Centrifugal, Dewatering, Including 6 m Suction and 7.5 m Discharge (127.02.15.01)

CLASSIFIER	MAKE AND MODEL						
Intake Size mm	AMT / Gorman- Rupp / IPT	Honda	Kodiak	Kosin America	Kubota	Multi-Quip	Wacker
25	1G4XAR 1G1XH	WX10C1 WX10K1C WX10TC WB15CA1 WH15XK1C1 WN15CX1 WX15CX1					
50	4222-95 4225-95	WB20XK2C WB20XT2C WB20XT3 WB30XKZC WB30XT2C WB30XT3 WD30XK2C WH20XK1JC1 WN20CX1 WN30CX1 WP20XCX6 WP30XCF6 WT20XK2C	PWP2HX PWP3HX	SEV50X SERH-80X	KVP20 KVP20S	QP204H QP205SH QP205SLT QP2H QP303H QP305SLT	PG2 PG2A PG3 PG3A
100			PWP4HX	SHE-100	KVP40	QP402H	

Centrifugal, Trash, Including 6 m Suction and 7.5 m Discharge (127.02.15.02)

CLASSIFIER	MAKE AND MODEL								
Intake Size mm	Atlas Pumps	AMT / Gorman- Rupp / IPT	Hatz Diesel	Honda	Kodiak	Kosin America	Multi-Quip	Vanguard	Wacker
38		11-1/2 A2-9 2S5XAR 3163-95 3930-95							
50		12D-GX160 2S5XHR 2S5XZR 3930-D5 3932-95	PT2H	WT20XK3C WT20XK4C	PWP2SWT	KTH-50X	QP202TH QP2TH QP2TZ QP3TH		PT2A PT2 PT2H
75		13D-GX270 3941-96 3943-96 3944-96 3S5XAR 3S5XHR 3S5XZR 3S9XAR 3S9XHR 3S9XZR	PT3H	WT30SXK4C WT30XK3C WT30XK4C	PWP3SWT	KTH-75X	QP301TH QP3TH QP3Ti QP3TZ		PT3A PT3 PT3H
100		14C2-F3L 14D-GX390 3993-96 3993-Z6 3994-96 4S13XAR 4S13XHR 4S13XZR		WT40XK1C WT40XK2C WT40XK3C	PWP4SWT	KTH-100	QP40TH QP4TH QP4TZ QP4TZT10P QP4TZTMP16F QP4TZTMPXF	PTS4V	APT4S APT4T PTS4V
150	CA6DP	16A2-F3L 5586-H6 5586-Y6 T6A60S4045T					MQ61DD MQ600H MQ600HTP HQ600HTB		APT6S APT6T PT6LS PT6LT
200	CA8DP								APT8S APT8T

Diaphragm, Including 6 m Suction and 7.5 m Discharge (127.02.15.03)

CLASSIFIER	MAKE AND MODEL					
Intake Size mm	AMT / Gorman- Rupp / IPT	Honda	Kodiak	Multi-Quip	Small Line	Wacker
50	2D-X75 336G-96	PDT2A		MQ206H MQD2H		PDT2A PDT2
75	3D-13 3D-GX160 335A-96 335G-96 335H-96 335Z-96	PDT3A WDP30XK2AT	Pwp35md	MQ306H MQD3H		PDI3A PDT3 PDT3A PDT3AA
100	4D-E3 4D-E3-3P 4D-X3-1P 4D-X3-3P				PL4DDP-K SL4DDPHE SL4DDPYE	

Electric Submersible, Including 30 m Cable and 7.5 m Discharge, Excluding Generator (127.02.15.04)

CLASSIFIER	MAKE AND MODEL									
Intake Size mm	Flygt	Claeson	Grindex	AMT / Gorman- Rupp / IPT	Honda	Kodiak	Kosin America	Multi-Quip	Tsurumi	Wacker
50	2610 2620 3085	Mine He	MINEX MINOR H MASTER H MINETTE SALVADOR TUFF ONE	5771-95 5773-95 5777-95 577A-95 577B-95	WSP50AA WSP100AA	PSP200SSD	PB-65011 PB7-65011 PX-65011 PXL-65011	PX400 SS233 SS2038P ST2005CUL2 ST2010CUL ST2037 ST2037F ST2047 ST2040T ST3020BCUL ST3050D	LB480 LB800	ASP 400 PS2-1503 PS2-2203 PS2-400 PS2-500 PS2-501 PS2-750 PS2-800 PS2-801 PS3-1500 PS3-1501 PS3-2200 PS3-2203 PS3-3703 PS3-5503 PSA2-500 PSA-800 PSG2-500 PST2-400 PST2A-800 PST3-750 PST3-751 PSTF2-400 PSTF3-750 PSTF3-751 PSW3-1500 PSW3-1501 STP 400 STP 750
100	3102 2125		MAJOR H MAXI H MIDI H MAJOR N MASTER N MINOR N SANDY SEMI SENATOR SENIOR	577D-95 577E-95 S3A1				ST41230 ST41460		PS4-5503 PS4-7503HH PS4-11003HH
150	3152 2201		MATADOR H MASTER L MATADOR N MAXI N MIDI N	S6D1- E30				ST61230 ST61460		
200	3202 2250		MAXI L							

DC Arc Welder, Engine Driven, Including Rods (127.02.16.01)

CLASSIFIER	MAKE AND MODEL			
Current A	Lincoln	Miller	Multi-Quip	Thermal Arc / Red-D-Arc
125	Bulldog 5500 K2707-2 Outback 125 Power Arc 5500 Power Arc 5501-1 Weldan Power Weldan Power 125-1	Blue Star 145 Blue Star 145-K Cat Pro 300		Scout TA-4/170H
150	K2706-2	Blue Star 145-1 Blue Star 185 Blue Star 185 DX Blue Star 185DX-K Blue Star 6000 Bobcat 225 NT		
200	Ranger GXT Ranger 8, Honda Engine Ranger 8, Kohler Engine Ranger 8, Onan Engine Ranger 9 Ranger 225 Ranger 250 GTX Ranger 250, Kohler Engine Ranger 250, Onan Engine	Bobcat 225 Bobcat 250CH Bobcat 250EFI Bobcat 250GFGI Bobcat 250 NT, Diesel Bobcat 250 NT, Gas Bobcat 3-Phase Trailblazer 275	DW225SSAWR SDW225SS	GX200
300	Classic 300G Classic 300D Commander 300 K2409-3 Pipeliner 200G Ranger 305 D-1 Ranger 305G SA-250 SAE 300 Vantage 300	Legend 301G Legend 302 Trailblazer 301D Trailblazer 301G Trailblazer 302 Trailblazer 325 Trailblazer Pro 350D	DLW300ES DLW300ESA DLW300ESAWR	D300K3 GX300 Lincoln
400	Big Red 500 K2325-2 SAE-400 SAE-500 Vantage 300 Vantage 400 Vantage 500 Vantage 500 Deutz	Big Blue 40P Big Blue 251D Big Blue 300 Big Blue 300 Pro Big Blue 302 Big Blue 350 Pipe Pro Big Blue 400 Big Blue 400 Pro Big Blue D400 Big Blue 402 Big Blue 450 D CST Big Blue 500 Big Blue 500 Pro Big Blue 700 Duo Big Blue 800 Pro Big Blue 800 Airpak Big 40 Cat CC Miller Du-op Pro 300 Pipe Pro 304	DLW400ES DLW400ESA DLW400ESAWR DAW500SA DAW500SAWR	D302K DX450 D550KHO

Oxygen/Acetylene Torch, Including Gas, Excluding Rods (127.02.16.02)

CLASSIFIER	MAKE AND MODEL				
Equipment Type	Blueshield	Prostar	Purox	Smith	Victor
Hand Mobile, Heavy Duty	BLU 01300008 BLU 01300012 BLU DUOKIT 510	PRS21506 PRS21512	GT 350 Deluxe GT 510FG E Master Deluxe HD	LE 200 Kit LE 300 Kit LE 400HD	Cutskill 0384-2500 DLX G350-540/510 Journeyman II Journeyman 450 Journeyman 540/300 SuperRange II 0384 315FC ST2630FC Torch Vanguard XHD 510

127.04 NON-CURRENT EQUIPMENT, SCHEDULE OF RENTAL RATES FOR CONSTRUCTION EQUIPMENT

127.04.01 Air Equipment

127.04.01.01 Air Track, Crawler Mounted, Excluding Compressor, Excluding Drill Steel and Bits

Hole Diameter, mm	
≤ 100	37.15
> 100	50.45

127.04.04 Concrete Equipment

127.04.04.01 Air Breaker, Boom Mounted, Excluding Points

Rated Energy, joules	
600	5.30
900	10.10
2,200	21.50

127.04.04.02 Saw, Self-Propelled, Excluding Blades

45, Curb-Trailer, Self-Contained	51.75
157, Curb-Truck, Self-Contained	83.90

127.04.05 Crushing Equipment

127.04.05.01 Roll Crusher, Excluding Power Unit

Roller Size, m	
1.00 x 0.75	161.30
1.05 x 1.00	185.80

127.04.06 Earth Moving, Grading Equipment

127.04.06.01 Motor Grader, Rigid Frame

Minimum Operating Weight, kg	
11,500	44.40
14,500	52.15
17,000	72.30

127.04.07 Excavation Equipment

127.04.07.01 Clams, Draglines, Shovels, Crawler Mounted, All Cable

Minimum Operating Weight, kg	
27,000	154.05
40,000	186.50
60,000	209.55
75,000	246.90

127.04.08 Haulage Equipment**127.04.08.01 Rear Dump, Tandem Rear Axle, Diesel or Gas**

AGW, kg	
20,000	65.30
22,000	76.60
22,000 kg Stone Spreader	80.40
24,000 kg Stone Spreader	83.20

127.04.11 Drilling Equipment**127.04.11.01 Mechanical Drilling Equipment, Carrier Mounter, Including Auger**

Power, kW	
95	111.70
113	200.70
130	289.90
150	417.30
185	498.15

127.05 NON-CURRENT EQUIPMENT, MANUFACTURERS' MODEL, SPECIFICATION, AND CAPACITY REFERENCE GUIDE

Note: Each table has a number in parentheses as part of the table title that refers to the corresponding clause in Section 4 - Non-Current Equipment, Schedule of Rental Rates for Construction Equipment.

127.05.06 Earth Moving, Grading Equipment**Motor Grader, Rigid Frame (127.04.06.01)**

CLASSIFIER		MAKE AND MODEL		
Minimum Operating Wt. kg	Minimum Net Flywheel Power kW	Champion	Fiat-Allis	Galion
11,500	125		FG 85	
14,500	135	720 730	FG 95	T 500C
17,000	185	740 760 750-780		T 600C

127.05.07 Excavation Equipment

Clams, Draglines, Shovels, Crawler Mounted, All Cable (127.04.07.01)

CLASSIFIER		MAKE AND MODEL		
Min. Operating Weight kg	Size kW	American	Linkbelt	Manitowoc
27,000	1.1		LS-98D LS-108C	M50
40,000	1.3	5220	LS-138	
60,000	1.5	7225	LS-208H 11	M65 M80
75,000	1.9		LS-218H	

127.05.11 Drilling Equipment

Mechanical Drilling Equipment, Carrier Mounted, Including Auger (127.02.11.02)

CLASSIFIER	MAKE AND MODEL	
Power KW	Reedrill	Watson
95	Texoma 330 Texoma 500	
113	Texoma 600 Texoma 700 Texoma 800	2500
130		2500 3110
150	Texoma 900	3000 3100
185	Magnum XL	



GENERAL SPECIFICATION FOR SUPPLY OF PRE-QUALIFIED MATERIAL AND PRODUCTS

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128.01	SCOPE

This specification identifies the Material and products that shall be obtained from sources identified in the Owner's approved Material or product listings and used in the Work of the following Owners:

- a) Ontario Ministry of Transportation (MINISTRY)
- b) Ontario Municipalities and local authorities (MUNICIPALITY)
- c) Agencies in the transportation and related business (AGENCY)

This specification also describes the process that a manufacturer or supplier must follow to register with The Road Authority (TRA) and the procedures for classification of a Material or product shown on the TRA website.

128.01.01	Significance and Use of Appendices

Appendices are not a mandatory part of this specification unless invoked by the Owner.

Appendix 128-A is a commentary appendix to provide designers with actions and considerations for the use of this specification in a Contract.

128.02 REFERENCES

This specification refers to the following standards, specifications, publications, listings, and information resource for Material and products:

MINISTRY Publication:

Designated Sources for Materials (DSM)

MUNICIPALITY Listing:

Municipal Product Listing (MPL)

AGENCY Listing:

Agency Product Listing (APL)

Information Resource:

The Road Authority (TRA)

128.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Pre-Qualified Material and Products means Material and products included on a DSM, MPL, or APL.

Product means the same as Material.

Product Listing means a DSM, MPL, or APL that is appropriate to an Owner.

128.04 PRE-QUALIFIED MATERIAL AND PRODUCTS INFORMATION

128.04.01 Submission

Manufacturers or suppliers desiring inclusion of their Material and products in the product listing of a particular Owner shall register their Material and product with TRA. Application for registration on TRA and inclusion on a DSM, MPL, or APL shall be made online the OPS website at www.ops.on.ca, TRA Product Registration.

The OPS Products Management Committee (PMC) shall process applications following receipt of the completed application for the Material or product. Contractors, manufacturers, and suppliers are cautioned that the PMC, MINISTRY, MUNICIPALITY, or AGENCY accepts no obligation to process applications within any fixed period of time.

128.04.02 Pre-Qualified Material and Products

Inclusion of a Material or product in a product listing shall be granted by the MINISTRY, MUNICIPALITY, or AGENCY subject to compliance with this specification, the particular standards for the Material or product, and the classification granted by the PMC. For continuous listing, the manufacturer shall not change Material or product type or sources, production methods, or design without the prior written authorization of the Owner. Submission of changes shall be according to the Submission subsection.

128.04.03 Material and Product Endorsement

Inclusion of a Material or product in a product listing does not constitute a general endorsement of the Material or product for all Owners and shall not be used by the recipient to promote the sale of the pre-qualified Material or product in any way. The Owner tests and evaluates Material and products in the context of its specific needs only. Any violation of this restriction may result in the withdrawal of any listing granted.

Listing of Material and products classified by the OPS Products Management Committee on TRA does not constitute approval of the Material or product.

Companies wishing to publicize their classification may only refer to the decision of the PMC as:

"THIS PRODUCT HAS RECEIVED A ***“fill in correct classification type”*** CLASSIFICATION FROM THE ONTARIO PROVINCIAL STANDARDS PRODUCTS MANAGEMENT COMMITTEE. THE PRODUCT PROFILE MAY BE REVIEWED ON THE ROAD AUTHORITY (TRA) WEBSITE."

128.05 SUPPLY OF MATERIAL AND PRODUCTS

128.05.01 General

Any Material or products required for an Owner's Contract and included in their product listing shall be supplied by the Contractor from sources designated in the product listing, when the Contractor is responsible for such supply. A source shall only be considered as listed if it appears in the product listing that is in effect at the time of supply of the Material or product.

The MINISTRY is responsible for maintenance of the DSM. The individual MUNICIPALITY or AGENCY is responsible for maintaining its own MPL or APL. Although registration of Material and products is through TRA, inclusion of the Material or product on a product listing is the responsibility of and at the discretion of each Owner.

Any pre-qualified Material or products shown on a product listing is applicable only to the specific sponsoring Owner of the product listing.

Any Material or products required for an Owner's Contract that is not listed in their product listing shall be supplied from sources specified in the Contract Documents.

128.05.02 Queries

Queries regarding the content on a MPL or APL shall be directed to the MUNICIPALITY or AGENCY that has responsibility for the MPL or APL.

Queries during the bidding, tendering, or construction of the work regarding the DSM content shall be directed to:

Head, Contracts
Construction Office
Ministry of Transportation
Garden City Tower, 2nd Floor
301 St. Paul Street
St. Catharines, ON L2R 7R4
Telephone: 905-704-2203
Fax: 905-704-2040

128.05.03 Product Listings

The complete DSM and several MPLs are available online on the TRA website, Doing Business.

The hard-copy version of the DSM is available from Publications Ontario.

Any MPL or APL not shown on the TRA website is available from the MUNICIPALITY or AGENCY that has responsibility for the respective MPL or APL.

128.06 QUALITY ASSURANCE

128.06.01 Material and Product Quality and Quantity

Sources in a product listing have demonstrated their ability to produce Material or products according to the relevant Material and product specifications. However, the Owner does not warrant that these sources will produce acceptable or sufficient Material or product for any Contract. Contractors shall make independent investigation and examination, as they deem necessary, to satisfy themselves as to the quality and quantity of the Material or product that is available from these sources. The Contractor is responsible for ensuring that all Material and products supplied by the sources satisfy contractual requirements.

Appendix 128-A, Commentary for OPSS 128, April 2006

Note: This appendix does not form part of the standard specification. It is intended to provide designers with actions and considerations for the use of this specification in a Contract.

Designer Action/Considerations

The designer should specify sources of Materials and products in the Contract Documents, if there is a particular Material or product source required that is not included in an Owner's DSM, MPL, or APL. (128.05.01)

The designer should ensure that the Ontario Provincial Standards General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standards Drawings

None.



GENERAL SPECIFICATION FOR THE MANAGEMENT OF EXCESS MATERIALS

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180-A	Commentary

180.01 SCOPE

This specification covers requirements for the management of excess materials.

Where the management of excess material requirements of other Ontario Provincial Standard Specifications differs from this specification, the requirements of this specification will take precedence.

180.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

180.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

180.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206 Grading
OPSS 209 Swamp Excavation

Ontario Provincial Standard Specification, Material

OPSS 1004 Aggregates - Miscellaneous

Canadian and Provincial Statutes

Environmental Protection Act, R.S.O. 1990, c.E.19
& R.R.O. 1990, Regulation 347
GENERAL - WASTE MANAGEMENT
As amended

Transportation of Dangerous Goods Act, 1992,
S.C. 1992, c. 34

Fire Protection and Prevention Act, 1997
S.O. 1997, CHAPTER 4

180.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Bituminous Pavement means any combination of asphaltic material and aggregate, excluding asbestos modified asphaltic material.

Commercial Waste means waste described as commercial waste in Regulation 347, under the Environmental Protection Act, Ontario.

Concrete means concrete mixtures produced with Portland cement and may include blended hydraulic cement, supplementary cement materials, spent debris and silica sand abrasive blasting media from abrasive cleaning of concrete and reinforcing steel, and concrete brick and block and associated mortar. It may include embedded steel and excludes asbestos modified Portland cement concrete mixtures.

Disposable Fill means excess material other than that disposed of at a certified disposal site and that is managed in berms and mounds and as fill other than in road embankments.

Earth means earth as defined in OPSS 206.

Excess Material means material removed under the Work specified in the Contract Documents for which management is not specified and includes surplus and unsuitable materials.

Fabricated Metal and Plastic Products means metal and plastic products such as culverts, fence materials, and guide rails. It does not include containers, other packaging materials, storage tanks, septic tanks and ancillary equipment associated with sanitary sewage systems, septic systems, and fuel or lubricant dispensing and storage systems.

Groundwater means subsurface water and water that occurs beneath the water table in soils and rock formations that are fully saturated.

Manufactured Wood means wood that is not entirely natural wood.

Masonry means clay brick and associated mortar.

Natural Wood means stumps, trunks, branches, debris from tree and shrub removal, and wood products that are not treated, coated, or glued.

Non-Hazardous Solid Industrial Waste means waste described as non-hazardous solid waste in Regulation 347, under the Environmental Protection Act, Ontario.

Re-Use means using, processing, re-processing, or recycling of excess material into a construction material or other useful product and managed by these means for the Contract and other work.

Rock means rock as defined in OPSS 206.

Subject Waste means waste defined as subject waste in Regulation 347, under the Environmental Protection Act, Ontario.

Swamp Material means swamp material as defined in OPSS 209.

Waste means excess material that is not managed by re-use, open burning, or as disposable fill and includes any excess material.

Waterbody means waterbody as defined in OPSS 182.

180.04 DESIGN AND SUBMISSION REQUIREMENTS

180.04.01 Submission Requirements

180.04.01.01 Notification of Site Selection and Property Owner Release

A copy of the completed form OPSF 180-1, Site Selection Notification for Stockpiling Materials Managed Through Re-Use, or OPSF 180-2, Site Selection Notification for Material Managed as Disposable Fill or both shall be submitted to the Contract Administrator and the property owner at least two weeks prior to the use of the property. These forms are not required for property owned by the Owner or designated for use in the Contract Documents.

At the completion of such work, a completed copy of the form OPSF 180-3, Property Owner's Release, shall be provided to the Contract Administrator.

180.04.01.02 Verification of Management by Disposal as Non-Hazardous Solid Industrial or Commercial Waste

When excess material is managed by disposal as non-hazardous solid industrial or commercial waste, a copy of the weigh ticket or receipt provided by the disposal site operator shall be submitted to the Contract Administrator on a weekly basis. When such documentation is not available, written confirmation that the waste has been received shall be obtained from the operator of the disposal site and provided to the Contract Administrator within two weeks after disposal activities are complete.

Within three weeks of the completion of all disposal activities associated with the work, a completed copy of the form OPSF 180-5, Waste Quantity Report, shall be provided to the Contract Administrator and shall account for all excess material managed by disposal as solid non-hazardous industrial or commercial waste.

180.04.01.03 Notification of Forest Resource Licensees

Forest Resource licensees identified in the Contract Documents shall be notified at least two weeks prior to commencement of open burning.

180.04.01.04 Certificate of Approval

When Certificates of Approval for a Waste Management System or a Waste Disposal Site are required, a copy of such certificate shall be supplied to the Contract Administrator prior to transporting excess material from the Working Area.

180.04.01.05 Subject Waste Documentation

For each subject waste listed in the form OPSF 180-4, Subject Waste Classification, that is being shipped from the Working Area to a waste disposal site, the following shall be completed:

- a) The Contract Administrator shall be notified at least two weeks prior to the first shipment of subject waste, and at least 24 hours prior to each subsequent shipment of subject waste.

- b) A Regulation 347 manifest with Part B completed by the carrier for each truckload of subject waste, shall be submitted to the Contract Administrator for Part A completion. Copies #1 and #2 of the manifest with Parts A and B completed shall be retained by the Contract Administrator and the remaining copies #3 to #6 returned to the carrier.
- c) Copy #6 of the Regulation 347 manifest shall be forwarded to the Contract Administrator at the mailing address indicated on Part A of the manifest, within four weeks of the shipment of subject waste from the Working Area.

For each subject waste that is generated by the Contractor's operations and that is not listed in form OPSF 180-4, Subject Waste Classification, that is being shipped from the Working Area to a waste disposal site, the following documentation shall be provided to the Contract Administrator.

- a) Prior to shipment of the subject waste:
 - i. Test results from testing to determine the Regulation 347 waste class and characteristics of the subject waste from the Canadian Association for Laboratory Accreditation (CALA) accredited laboratory selected by the Contractor;
 - ii. Notification from the Ministry of the Environment (MOE) Hazardous Waste Information Network (HWIN) of the registration of the subject waste to obtain a Regulation 347 Generator Registration Number (GRN); and
 - iii. A duplicate of Copy #2 of the Regulation 347 manifest with Parts A and B completed and signed by the generator and carrier respectively.
- b) After shipment of the subject waste:
 - i. Notification of payment of all registration, manifest, and tonnage fees associated with the shipment from the MOE HWIN;
 - ii. A duplicate of Copy #6 of the Regulation 347 manifest with Part C completed and signed by the receiver; and
 - iii. Notification of de-activation of the Regulation 347 GRN in the MOE HWIN.

A record of all test sample numbers and sample dates shall be kept and made available to the Contract Administrator upon request.

180.04.01.06 Excess Material Audit or Inventory Document

When an excess material audit or inventory is imposed by statute or is a condition specified in the Contract Documents, a copy of the audit or inventory documents shall be provided to the Contract Administrator.

180.04.01.07 Alternative Management Condition Approvals

When certain excess material is to be managed according to the conditions approved in writing by the local District office of the Ministry of Environment of Ontario and such conditions differ from those specified in Table 1, a copy of such approval shall be provided to the Contract Administrator at least two weeks prior to commencement of the work governed by the condition.

180.07 CONSTRUCTION

180.07.01 Conditions on Management of Excess Material - General

Management of excess material shall be as described in Tables 1 and 2 and the appropriate subsections of this specification, unless prior alternative management conditions are approved in writing by the Ministry of Environment of Ontario (MOE).

When an excess material is a mixture of materials, it shall be managed in compliance with the most stringent conditions associated with any of the constituent excess material.

When excess material includes asbestos waste, the asbestos waste shall be managed as specified in the Contract Documents.

Excess materials shall not be permitted in waterbodies and sensitive areas as identified in the Contract Documents, except when re-used according to the appropriate Ontario Provincial Standard.

180.07.02 Conditions on Management by Re-Use

Management of excess material by re-use for incorporation into the work or for other designated re-use shall be as specified in the Contract Documents.

Management by re-use shall otherwise be outside the Owner's property.

Distance separations described in Table 2 do not apply for the following:

- a) Re-use of excess materials for the same purpose.
- b) Re-use of bituminous pavement, concrete, and masonry within a road right-of-way.
- c) Re-use of concrete as aggregate in bituminous pavement.
- d) Re-use of concrete as rip-rap, gabion stone, or rock protection in compliance with the requirements of OPSS 1004.

Except cutting for construction purposes, excess material consisting of manufactured wood shall not be reprocessed.

180.07.03 Conditions on Management as Disposable Fill

Management of excess material as disposable fill, including sidecasting of swamp material, within the Owner's property and on other property designated in the Contract Documents shall be as specified in the Contract Documents.

Natural wood and debris from open fires may be managed as disposable fill only within a road right-of-way or on property with a boundary common to a road right-of-way, both within the Contract limits.

Such material shall be top covered by at least 300 mm of earth or topsoil.

180.07.04 Conditions on Management by Open Burning

Management of excess material by open burning is permitted only when specified in the Contract Documents. Where management by open burning is permitted, it shall be subject to the following conditions and conducted in accordance with the Fire Protection and Prevention Act, 1997 where it applies, and with any applicable, local, municipal by-law(s):

- a) A permit from the Ministry of Natural Resources (MNR) under the Fire Protection and Prevention Act, and/or applicable local or municipal by-law shall be obtained by the Contractor for open burning, as required.
- b) Open burning is prohibited in areas subject to a restricted fire zone order as issued by MNR or to a smog alert advisory as issued by MOE.

180.07.05 Conditions on Management by Disposal as Non-Hazardous Solid Industrial or Commercial Waste

Management of excess material by disposal as non-hazardous solid industrial or commercial waste at receiving sites designated in the Contract Documents shall be as specified in the Contract Documents.

When receiving sites are not specified in the Contract Documents for management by disposal as non-hazardous solid industrial or commercial waste, such material shall be disposed of at sites identified by the Contractor.

Management as non-hazardous solid industrial waste or commercial waste shall be subject to the following conditions:

- a) Non-hazardous solid industrial or commercial waste shall be transported from the Working Area directly to a site that has a Certificate of Approval for a Waste Disposal Site that is valid for non-hazardous solid industrial or commercial waste.
- b) Non-hazardous solid industrial or commercial waste may be transported by a hauler who is engaged in other work on the Contract, without a Certificate of Approval for a Waste Management system, provided the waste is transported from the Working Area directly to the disposal site.
- c) Non-hazardous solid industrial or commercial waste shall otherwise be transported by a hauler with a Certificate of Approval for a Waste Management System that is valid for the following:
 - i. The entire period of the work.
 - ii. The entire area within the limits of the work and the entire hauling route to the receiving site.
 - iii. The equipment to be used.
 - iv. Non-hazardous solid industrial or commercial waste.

180.07.06 Conditions on Management by Stockpiling

Management of excess material by stockpiling within the Owner's property and on other property designated in the Contract Documents shall be as specified in the Contract Documents.

Stockpiling shall otherwise be outside the Owner's property.

Stockpiles of bituminous pavement, concrete, and masonry shall be separated according to Table 2, unless either of the following occurs:

- a) Stockpiles are located within a road right-of-way or on property with a boundary common to a right-of-way, both within the Contract limits for a period not exceeding 120 Days.
- b) Stockpiles are located within a provincial or municipal works yard or in a commercially licensed pit or quarry.

For all other excess materials, where Table 1 indicates that stockpiling is subject to management conditions in Table 2, such management conditions only apply to stockpiles that are to be in place for a period exceeding 120 Days.

180.07.07 Conditions on Management by Disposal as Subject Waste

When an excess material is identified as a dangerous good waste or a subject waste in form OPSF 180-4, Subject Waste Classification, management shall be as follows:

- a) Subject waste shall be carried only by a certified carrier directly to a certified waste disposal site. The carrier and waste disposal site shall have Certificates of Approval for a Waste Management System and a Waste Disposal Site, respectively, issued by the MOE that is valid for the following:
 - i. The entire period of the work.
 - ii. The entire area within the limits of the work and the entire haul route.
 - iii. The equipment to be used.
 - iv. The waste class to be managed.
- b) When the subject waste is also a dangerous good as described in the Transportation of Dangerous Goods Act (TDGA), the carrier shall provide all necessary TDGA labels and placards.
- c) All shipments of subject waste shall be manifested.

When an excess material generated by the Contractor's operations may be subject waste and it is not identified in form OPSF 180-4, Subject Waste Classification, the Contractor shall be responsible to manage it in accordance with the following:

- a) Conduct sampling and testing using a laboratory certified by the Canadian Association of Laboratory Accreditation (CALA) selected by the Contractor to determine whether it is subject waste and to determine the Regulation 347 waste class and characteristics.
- b) Register all subject waste in the MOE HWIN to obtain a Regulation 347 GRN for disposal.
- c) Package and label all subject waste for transportation and disposal.
- d) Arrange for shipment of all subject waste to a certified waste disposal site using a certified carrier.
- e) Complete Part A of a Regulation 347 manifest including the GRN obtained from the MOE HWIN and provide the manifest to the certified carrier for completion of Part B.
- f) Provide a duplicate of Copy #2 of the Regulation 347 manifest to the Contract Administrator with Parts A and B completed and signed.
- g) Pay all registration, manifest and tonnage fees associated with subject waste disposal in the MOE HWIN.
- h) De-activate the GRN in the MOE HWIN after shipment of all subject waste to a certified waste disposal site is complete and acceptance of the subject waste is acknowledged by the receiver completing and signing Part C of the Regulation 347 manifest.
- i) Provide a duplicate of Copy #6 of the Regulation 347 manifest to the Contract Administrator upon receipt from the receiver.

Subject waste shall be carried only by a certified carrier directly to a certified waste disposal site. The carrier and waste disposal site shall have Certificates of Approval for a Waste Management System and a Waste Disposal Site, respectively, issued by the Ministry of the Environment that is valid for the following:

- a) The entire period of the work.
- b) The entire area within the limits of the work and the entire haul route.
- c) The equipment to be used.
- d) The waste class to be managed.

When the subject waste is also a dangerous good waste as described in the Transportation of Dangerous Goods Act, 1992 (TDGA), the carrier shall provide all necessary TDGA labels and placards.

When an excess material is tested and found not to be a dangerous good waste or a subject waste, it shall be managed by disposal as Non-Hazardous Solid Industrial or Commercial Waste in accordance with this specification.

180.10 BASIS OF PAYMENT

Payment for the management of excess material shall be included in the tender items requiring such management and shall include all costs associated with acquiring approvals, releases, and agreements.

Payment for the management of excess material that is subject waste generated by the Contractor's operations and not listed in form OPSF 180-4 by the Owner, and is in addition to the cost of disposal as non-hazardous, solid industrial, or commercial waste, shall be paid as Extra Work, with provisions subject to testing to verify that the excess material is subject waste.

TABLE 1
Excess Material Management Conditions

EXCESS MATERIAL DESCRIPTION	Subsection in This Specification				
	Conditions on Management by Re-Use	Conditions on Management as Disposable Fill	Conditions on Management by Open Burning	Conditions on Management by Disposal as Non-hazardous Solid Industrial or Commercial Waste	Conditions on Management by Stockpiling
EARTH	Yes	Yes	n/a	Yes	Yes
SWAMP MATERIAL	Yes	Yes TABLE 2	n/a	Yes	Yes TABLE 2
AGGREGATE	Yes	Yes	n/a	Yes	Yes
ROCK	Yes	Yes	n/a	Yes	Yes
BITUMINOUS PAVEMENT	Yes TABLE 2	Not Permitted	n/a	Yes	Yes
CONCRETE	Yes TABLE 2	Not Permitted	n/a	Yes	Yes
MASONRY	Yes TABLE 2	Not Permitted	n/a	Yes	Yes
MANUFACTURED WOOD	Yes	Not Permitted	Not Permitted	Yes	Yes TABLE 2
NATURAL WOOD	Yes	Yes TABLE 2	Yes	Yes	Yes TABLE 2
DEBRIS FROM OPEN FIRES	n/a	Yes TABLE 2	n/a	Yes	Yes TABLE 2
METAL/PLASTIC POLYSTYRENE PRODUCTS	Yes	Not Permitted	Not Permitted	Yes	Yes
SUBJECT WASTE	Subject waste shall be managed as specified in the subsection for Conditions on Management by Disposal as Subject Waste.				
MATERIALS SUSPECTED OF BEING CONTAMINATED	When excess materials that were not generated by the Contractor's operations and are not listed in form OPSF 180-4, Subject Waste Classification, are suspected of being contaminated, direction on their management shall be obtained from the Contract Administrator.				
OTHER MATERIALS	Excess materials that are not listed above shall be managed as specified in the subsection for Conditions on Management by Disposal as Non-Hazardous Solid Industrial or Commercial Waste, unless prior alternative management conditions are approved in writing by the Ministry of Environment of Ontario.				

TABLE 2
Excess Material Management Distance Separation Requirements

ADJACENT FEATURE	MINIMUM DISTANCE SEPARATION
Groundwater	2 m (Above)
Waterbodies	30 m
Water Wells	100 m
Residences	100 m

SITE SELECTION NOTIFICATION FOR STOCKPILING MATERIALS MANAGED THROUGH RE-USE

Contract Information

Contract No: _____ Owner: _____

The following describes the notification process between the Owner of the Contract and the Contractor, wherein the Contractor formally notifies the Owner that agreement has been reached with a third party property owner for the stockpiling of Contract generated excess material. Such excess material, stockpiled for re-use or disposal, may be one or a combination of: earth; aggregate; swamp material; rock; concrete; masonry; bituminous pavement; natural wood; metal, plastic, and polystyrene; wood which has been treated, coated, or glued; and debris from open fires, provided the conditions on management are satisfied.

Site Information

Property Owner(s) for the subject property: _____

The subject property:

Lot _____, Concession _____, Township of _____

County/Region/District of _____, Quantity and Type of Excess Material stockpiled:

This is to notify you, as Owner, that permission has been obtained from the property owner(s) named herein for the management of excess materials through re-use from this Contract. The property owner has signed and been provided with a copy of this form and has been advised that a Property Owner's Release Form, OPSF 180-3, will also be required. The use of this management site will comply with the following:

Conditions on Management

It is understood that materials are stockpiled to be re-used or held for disposal at a certified waste disposal site. Stockpiles of natural wood, manufactured wood, debris from open fires, and swamp material may only be located:

- a) A minimum of 2 m above the level of ground water.
- b) A minimum of 30 m from waterbodies.
- c) A minimum of 100 m from any water wells.
- d) A minimum of 100 m from residences.

Stockpiles of bituminous pavement, concrete, and masonry may only be located:

- a) A minimum of 30 m from waterbodies; and
- b) A minimum of 100 m from residences unless
 1. on property with a boundary common to a right-of-way, within the contract limits for a period not exceeding 120 calendar days, or
 2. such stockpiles are located within a provincial or municipal works yard or in a commercially licensed pit or quarry.

The property owner(s) agrees to sign the Property Owner's Release after the Contractor has placed the excess material on the above-noted property in accordance with the terms of this form.

These conditions do not supersede any constraints imposed on this property by Federal, Provincial or Municipal, including Conservation Authority, statute or regulations and bylaws made thereto.

Dated this _____ day of _____ 20____

Print Contractor's Name & Field Representative's Name

Contractor's Field Representative Signature

Property Owner's Signature(s)

cc: Contract Administrator, Property Owner(s), Contractor

OPSF 180-1

SITE SELECTION NOTIFICATION FOR MATERIAL MANAGED AS DISPOSABLE FILL

Contract Information

Contract No: _____ Owner: _____

The following describes the notification process between the Owner of the Contract and the Contractor, wherein the Contractor formally notifies the Owner that agreement has been reached with a third party property owner for the disposition of Contract generated excess material. Such excess material, managed as disposable fill, shall be limited to one or a combination of: earth, aggregate, swamp material, rock, natural wood, and debris from open fires, provided the conditions on management are satisfied.

Site Information

Property Owner(s) for the subject property: _____

The subject property:

Lot _____, Concession _____, Township of _____

County/Region/District of _____, Quantity and Type of Excess Material used as fill:

This is to notify you, as Owner, that permission has been obtained from the property owner(s) named herein for the management of excess materials from this Contract. The property owner has signed and been provided with a copy of this form and has been advised that a Property Owner's Release Form, OPSF 180-3, will also be required. The use of this management site will comply with the following:

Conditions on Management

Swamp material, natural wood, and debris from open fires managed as disposable fill will be top covered by a minimum of 300 mm of earth or topsoil. Swamp material, natural wood, and debris from open fires managed as disposable fill may only be placed:

- a) A minimum of 2 m above the level of ground water.
- b) A minimum of 30 m from waterbodies
- c) A minimum of 100 m from any water wells
- d) A minimum of 100 m from residences.

The Property Owner(s) agrees to sign the attached form of Property Owner's Release after the Contractor has placed the excess material on the above-noted property in accordance with the terms of this form.

These conditions do not supersede any constraints imposed on this property by Federal, Provincial, or Municipal, including Conservation Authority, statute or regulations and bylaws made thereto.

Dated this _____ day of _____ 20____

Print Contractor's Name & Field Representative's Name

Contractor's Field Representative Signature

Property Owner's Signature(s)

cc: Contract Administrator, Property Owner(s), Contractor

OPSF 180-2

PROPERTY OWNER'S RELEASE

Contract No: _____

Work Description: _____

I/We _____ being the owner(s) of Lot, _____

Concession _____, Township of _____, and County/Region/District of _____, verify that the Contractor for the above noted work has placed excess material from the above noted Contract on my/our property with my/our permission. I/We have signed together with the Contractor OPS Forms 180-1, Site Selection Notification for Stockpiling Materials Managed Through Re-Use, or 180-2, Site Selection Notification for Material Managed as Disposable Fill, or both, that describe Conditions on Management, and have been assured by the Contractor that these conditions have been met.

Where materials are managed as disposable fill, I/we agree to be responsible for any subsequent relocation and management of the material so placed.

Where materials are to be stockpiled, I/We agree that the stockpile(s) will be removed by the date(s) herein noted.

I/We hereby release the Owner and the Contractor in respect of the activities of the Contractor carried out in accordance with this release.

Dated this _____ day of _____ 20____

Property Owner's Signature(s)

Print Contractor's Name & Field Representative's Name

Contractor's Field Representative Signature

cc: Contract Administrator, Property Owner(s), Contractor

OPSF 180-3

SUBJECT WASTE CLASSIFICATION

The following named waste is to be disposed of as a subject waste:

The classification of the above waste is as follows:

Shipping Name of Waste	
Reg. 347 Classification	
TDGA Identification No. (PIN)	
TDGA Classification	
TDGA Packaging Group	
Volume of Waste	
Container Type and Condition	

The following named waste is to be disposed of as a subject waste:

The classification of the above waste is as follows:

Shipping Name of Waste	
Reg. 347 Classification	
TDGA Identification No. (PIN)	
TDGA Classification	
TDGA Packaging Group	
Volume of Waste	
Container Type and Condition	

cc: Contract Administrator, Property Owner(s), Contractor

OPSF 180-4

WASTE QUANTITY REPORT

For Solid Non-Hazardous Industrial and Commercial Waste

Contract No: _____

Contractor: _____

Material Description	Location of Disposal Site and Certificate of Approval Number	Quantity of Materials

cc: Contract Administrator, Property Owner(s), Contractor

OPSF 180-5

Appendix 180-A, November 2011
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Property available for stockpiling for re-use and disposal of fill, or management as disposable fill of excess materials. (180.04.01.01)
- Forest resource licensees within the Contract limits. (180.04.01.03)
- Excess material audit or inventory when required. (180.04.01.06)
- Management conditions of materials with asbestos waste. (180.07.01)
- Identification of waterbodies and sensitive areas. (180.07.01)
- Management by re-use. (180.07.02)
- Management of disposable fill within the Owner's property and on other property. (180.07.03)
- Conditions on management by open burning. (180.07.04)
- Management by disposal of non-hazardous solid industrial or commercial waste. (180.07.05)
- Receiving sites. (180.07.05)
- Management by stockpiling within the Owner's property or on other property. (180.07.06)
- Management of dangerous good waste or subject waste. (180.07.07)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



NOTICE TO USERS OF OPSS 182

GENERAL SPECIFICATION FOR ENVIRONMENTAL PROTECTION FOR CONSTRUCTION IN WATERBODIES AND ON WATERBODY BANKS

OPSS 182 has been removed from this
OPS volume

The provincial version of OPSS 182 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 182

The municipal version of OPSS 182 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 182

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



**CONSTRUCTION SPECIFICATION FOR
CLEARING, CLOSE CUT CLEARING, GRUBBING,
AND REMOVAL OF SURFACE AND PILED BOULDERS**

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201-A	Commentary

201.01 SCOPE

This specification covers the requirements for the removal of trees, brush, bushes, stumps, windfalls, surface boulders, and piled boulders.

201.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

201.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

201.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206 Grading

Ontario Government Publications

Crown Forest Sustainability Act, 1994, S.O. 1994, c. 25

201.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Clearing means the cutting of all standing trees, brush, bushes, and other vegetation to a maximum height of 300 mm above original ground level and the removal of felled materials and windfalls.

Close Cut Clearing means the cutting of all standing trees, stumps, brush, bushes, and other vegetation at original ground level and the removal of felled materials and windfalls.

Grubbing means the removal of all stumps, roots, embedded logs, debris, and secondary growth.

Piled Boulders means any cobbles, boulders, or rock fragments that have been placed in fencerows or piles.

Rock means rock as defined in OPSS 206.

Surface Boulder means any boulder or rock fragment that measures 200 mm or greater in any one dimension, extends a minimum of 200 mm above original ground, and can be removed without excavation.

201.04 DESIGN AND SUBMISSION REQUIREMENTS

201.04.01 Submission Requirements

201.04.01.01 Crown Forest

Crown forest, as defined by the Crown Forest Sustainability Act, shall not be cut until a permit has been obtained from the Ministry of Natural Resources (MNR).

201.07 CONSTRUCTION

201.07.01 General

Trees measuring 150 mm or more in diameter, measured 1.0 m above ground, shall be cut, limbed, and stacked for collection by others. Cut trees shall not be stacked in or transported through areas identified as being environmentally sensitive in the Contract Documents or elsewhere by an Authority.

When specified in the Contract Documents, cut trees shall be stacked outside and adjacent to the right-of-way for the property owner, adjacent to and between the stations listed.

Within Crown Land areas specified in the Contract Documents for clearing and close cut clearing, marketable timber shall be made available for purchase from the Contractor to the holder of the sustainable forest licence. All cut and stacked trees shall be cut into lengths agreed to by the Contractor and the sustainable forest licence holder, but in no case exceeding 5.0 m.

All timber not purchased by others or stacked for adjacent landowners is excess material.

The work shall not damage or disturb the area outside the areas specified in the Contract Documents.

When work is done in or near waterbodies or waterbody banks, the work shall be according to the Contract Documents.

201.07.02 Clearing

The work shall consist of clearing all areas of earth excavation, earth surfaces to be covered by embankments up to and including 1.2 m in height, and any other areas specified in the Contract Documents.

201.07.03 Close Cut Clearing

The work shall consist of close cut clearing all earth surfaces to be covered by embankments greater than 1.2 m in height, and any other areas specified in the Contract Documents.

201.07.04 Grubbing

The work shall consist of grubbing all areas of earth excavation, earth surfaces to be covered by embankments up to and including 1.2 m in height, and any other areas specified in the Contract Documents.

Grubbing is not required in swamps.

Mechanical stump cutters are permitted, provided the entire root structure is removed.

Depressions remaining after grubbing shall be backfilled with suitable earth material and compacted to avoid settlement.

When clearing has been previously completed by others, all secondary growth, brush, and debris shall be removed.

Piled boulders and surface boulders that are not specified in the Contract Documents for removal and lie within areas to be grubbed shall be removed.

201.07.05 Removal of Surface Boulders and Removal of Piled Boulders

The work shall consist of the removal of surface boulders and removal of piled boulders within the areas specified in the Contract Documents.

Depressions remaining after removal shall be backfilled with suitable earth material and compacted to avoid settlement.

201.07.06 Mechanical Stump Cutting

The work shall consist of mechanical cutting of stumps to a depth of 150 mm below original grade, as specified in the Contract Documents.

201.07.07 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

201.09 MEASUREMENT FOR PAYMENT

201.09.01 Actual Measurement

Measurement shall be by area or by each, as specified in the Contract Documents.

201.09.01.01 Clearing, Close Cut Clearing, and Grubbing

Measurement of clearing, close cut clearing, and grubbing shall be by area or by each, as specified in the Contract Documents.

201.09.01.01.01 By Area

Removal shall be measured by area in a horizontal plane in hectares or square metres.

201.09.01.01.02 By Each

For measurement purposes, a count shall be made of the trees or stumps removed.

201.09.01.02 Removal of Surface Boulders and Removal of Piled Boulders

Removal shall be measured by area in a horizontal plane in hectares or square metres.

201.09.01.03 Mechanical Stump Cutting

For measurement purposes, a count shall be made of the stumps removed by mechanical cutting.

201.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

201.10 BASIS OF PAYMENT

- 201.10.01 Clearing - Item**
- Close Cut Clearing - Item**
- Grubbing - Item**
- Removal of Surface Boulders - Item**
- Removal of Piled Boulders - Item**
- Mechanical Stump Cutting - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Areas designated for removal of piled boulders that lie within areas specified in the Contract Documents for either grubbing or removal of surface boulders shall be paid separately with no deduction from the grubbing or surface boulder removal item.

Removal of individual boulders that are 1 m³ and greater in volume, shall be paid as rock excavation according to OPSS 206.

Appendix 201-A, November 2011 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Areas identified for clearing, close cut clearing, grubbing, removal of surface boulders and removal of piled boulders, and mechanical stump cutting, in addition to those areas required by this specification. (201.07)
- Areas identified as being environmentally sensitive. (201.07.01)
- Areas for clearing and close cut clearing within Crown Land. (201.07.01)
- Areas where cut trees are to be stacked. (201.07.01)
- The areas where work is to be done in or near waterbodies or waterbody banks. (201.07.01)
- Review crown land clearing with Ministry of Natural Resources (MNR) to determine volume of marketable timber available. (201.07.01)
- Identify holders of sustainable forest licences and their addresses from the MNR and make them available to the Contractor. (201.07.01)
- Method of measurement for clearing, close cut clearing, and grubbing. (201.09.01.01)

When surface boulders and piled boulders are to be removed that are outside the general grading limits, the Removal of Surface Boulders and Removal of Piled Boulders items should be used.

Swamp excavation areas do not require grubbing, therefore, designers should not include a grubbing quantity in the Contract Documents for these areas.

The designer should include an additional quantity for individual boulders over 1 m³ in the rock excavation quantity. (201.10.01)

Mechanical stump cutting should be considered to avoid damage to adjacent structures that may result from grubbing.

Piled boulders greater than 100 m³ should be designated for removal and be included for payment in the tender item for Removal of Piled Boulders regardless of where they are located.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



NOTICE TO USERS OF OPSS 206

CONSTRUCTIONS SPECIFICATION FOR GRADING

OPSS 206 has been removed from this
OPS volume

The provincial version of OPSS 206 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 206

The municipal version of OPSS 206 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 206

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



NOTICE TO USERS OF OPSS 209

CONSTRUCTION SPECIFICATION FOR EMBANKMENTS OVER SWAMPS AND COMPRESSIBLE SOILS

OPSS 209 has been removed from this
OPS volume

The provincial version of OPSS 209 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 209

The municipal version of OPSS 209 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 209

USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS



NOTICE TO USERS OF OPSS 212

CONSTRUCTIONS SPECIFICATION FOR BORROW

OPSS 212 has been removed from this
OPS volume

The provincial version of OPSS 212 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 212

The municipal version of OPSS 212 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 212

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



NOTICE TO USERS OF OPSS 220

CONSTRUCTION SPECIFICATION FOR WICK DRAIN INSTALLATION

OPSS 220 has been removed from this
OPS volume

The provincial version of OPSS 220 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 220

The municipal version of OPSS 220 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 220

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



CONSTRUCTION SPECIFICATION FOR RESTORING UNPAVED ROADWAY SURFACES

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APPENDICES

301-A	Commentary

301.01 SCOPE

This specification covers the requirements for the restoration of unpaved roadway surfaces to the required cross-section, profile, and density in preparation for its subsequent cover with a granular or surfacing course.

301.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

301.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

301.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 314	Untreated Granular, Subbase, Base, Surface Shoulder, and Stockpiling
OPSS 501	Compacting
OPSS 506	Dust Suppressants

301.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Restored Surface means unpaved roadway surfaces prepared to the required grades and density and ready for a subsequent cover of granular or surfacing courses.

Scarification means uniform loosening of the roadway surface to remove damaged areas such as ravelling and potholes.

Surfacing Course means any bearing or wearing course or courses placed on the roadway and consisting of hot mix asphalt (HMA), Portland cement concrete, bituminous cold mix, and surface treatment.

Unpaved Roadway Surface means surfaces that are typically existing granular, but may include sub-grade soil surfaces.

301.06 EQUIPMENT

301.06.01 Templates

Templates not less than 3 m long shall be used to determine the crossfall of all restored surfaces.

Where the surface is to receive concrete pavement or concrete base, a metal template shall be used.

301.07 CONSTRUCTION

301.07.01 Dust Suppressants

Dust suppressants shall be according to OPSS 506.

301.07.02 Method

Restoring roadway surfaces shall consist of the following:

- a) The scarification of the existing surface specified in the Contract Documents to a depth not less than 75 mm but sufficient to remove potholes.
- b) Restoring or reshaping the scarified material.
- c) Compacting of the scarified materials according to OPSS 501.
- d) Ensuring that the finished surface is within tolerance by checking the accuracy with the template.

The Contractor is responsible to maintain the scarified surface to the profile, cross-section, and density specified in the Contract Documents until the project is accepted or, if applicable, until any subsequent granular or surfacing course is completed.

Prior to scarification, roadway surfaces not more than 150 mm above grade shall be loosened and the materials removed to grade.

Unsuitable material encountered during restoring operations shall be removed to a depth not greater than 150 mm and replaced by acceptable granular material.

Materials loosened from the roadway surface and reshaped or incorporated during the restoring operation shall not require loading, hauling, or moving other than by blading.

301.07.03 Surface Tolerances

The surface of the unpaved roadway shall be restored to the specified tolerances for the following types of surfacing courses.

301.07.03.01 Granular Courses

The restored surface shall not deviate more than the following:

- a) 30 mm from the specified grade and cross-section.
- b) 30 mm at any place as measured in any direction with a 3 m straight edge when the work is to prepare the subgrade for granular courses.
- c) 15 mm at any place as measured in any direction with a 3 m straight edge when the work is to prepare the granular surface for granular courses.

301.07.03.02 Bituminous Courses

The restored surface shall not deviate more than the following:

- a) 30 mm from the specified grade and cross-section.
- b) 30 mm at any place as measured in any direction with a 3 m straight edge when the work is to prepare the subgrade to receive full depth HMA.
- c) 10 mm at any place as measured in any direction with a 3 m straight edge when the work is to prepare the granular surface to receive HMA.

301.07.03.03 Portland Cement Concrete Courses

The restored surface shall not deviate more than the following:

- a) 10 mm from the specified grade and cross-section.
- b) 10 mm at any place as measured in any direction with a 3 m straight edge when the work is to prepare a granular surface to receive concrete pavement or concrete base.

301.07.04 Surface Widths

The restored surface width shall be as specified in the Contract Documents.

301.07.05 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

Acceptable material from resurfacing operations shall be placed on the adjacent shoulders, spread, and trimmed to the specified grade and cross-section and compacted according to OPSS 501.

301.09 MEASUREMENT FOR PAYMENT

301.09.01 Actual Measurement

301.09.01.01 Restoring Roadway Surfaces

Measurement of restored roadway surfaces shall be by area in square metres.

301.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

301.10 BASIS OF PAYMENT

301.10.01 Restoring Roadway Surfaces - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

301.10.02 Water

Payment for water for compaction shall be according to OPSS 501 and payment for water for dust suppression shall be according to OPSS 506.

301.10.03 Additional Materials

Payment for additional materials shall be according to OPSS 314.

Appendix 301-A, November 2009
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- The location, profile, and cross-section of the surfaces to be restored. (301.07.02)
- The density of materials used to restore roadway surfaces. (301.07.02)
- The surface width of restored surface. (301.07.04)

The designer may consider the following when determining surfaces to restore: (301.07.04)

- The width of the granular course when the work is to prepare the sub-grade or base for granular courses.
- The width of the proposed pavement plus 0.5 m on each side when the work is to prepare a granular road surface to receive the surfacing course.
- The full width of the earth surface when the work is to prepare the earth surface to receive a full depth hot mix asphalt.
- The width of proposed subsequent lanes against initial concrete base or pavement plus 0.5 m.

The designer may consider a geotechnical investigation to identify the existing conditions.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR PRIMING GRANULAR BASE

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APPENDICES

302-A	Commentary

302.01	SCOPE

This specification covers the requirements for surface preparation and application of bituminous primer on a granular base and placement of a sand cover to accommodate traffic.

302.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

302.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

302.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 304 Single and Double Surface Treatment

Ontario Provincial Standard Specifications, Material

OPSS 1006 Aggregates - Surface Treatment
OPSS 1102 Liquid Asphalt
OPSS 1103 Emulsified Asphalt

Ministry of Transportation Publications

MTO Laboratory Testing Manual

Ontario Traffic Manual (OTM):
Book 7 - Temporary Conditions

302.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Appurtenances mean maintenance hole, catch basin, valve chamber, and water valve covers and similar Utility access covers located within the pavement portion of the roadway.

Lot means the quantity of work completed with a tanker truck shipment of primer.

Primer means the emulsified asphalt or low viscosity liquid asphalt sprayed on a prepared granular base.

Sand Cover means an aggregate applied over the primer to blot the primer and permit the passage of traffic.

302.05 MATERIALS

302.05.01 Primer

Primer shall consist of one or more of the following types of asphaltic materials:

- a) Emulsified Asphalt Primer according to OPSS 1103.
- b) MTO Primer or RC-30 according to OPSS 1102.

302.05.02 Sand Cover Aggregate

Aggregate shall be a Class 4 aggregate according to OPSS 1006.

302.06 EQUIPMENT

302.06.01 Pressure Distributor

The pressure distributor shall be designed and manufactured to spray primer uniformly on the road surface. The pressure distributor shall be capable of applying primer at the specified rates and in a continuous and uniform manner both longitudinally and transversely for a full lane width.

302.06.02 Mechanical Aggregate Spreader

The mechanical aggregate spreader shall be designed and manufactured to be self-propelled and capable of continuously and uniformly distributing aggregate on the primed granular base at the specified application rate.

302.06.03 Pilot Vehicle

The pilot vehicle shall be equipped according to the requirements of the OTM, Book 7.

302.06.04 Rollers

Rollers shall be according to OPSS 304.

302.07 CONSTRUCTION

302.07.01 Operational Constraints

Primer shall not be applied when the ambient temperature at the work location is less than 10 °C or when climatic conditions preclude the curing of the primer.

Primer shall not be applied prior to May 15th south of a line through Pembroke, Magnetawan, and Pointe au Baril Station and not prior to June 1st north of the line.

Emulsified primers shall not be applied after September 1st.

The placing of aggregate shall be terminated one hour before sunset.

302.07.02 Sampling

302.07.02.01 Primer

The Contractor shall provide primer field samples for quality assurance (QA) testing purposes when specified in the Contract Documents.

The work shall include sampling, labelling, packaging, and delivery of samples to the laboratory designated in the Contract Documents within 5 Business Days.

Each liquid asphalt primer sample shall consist of a one-litre quantity of material. The sample containers for liquid asphalt primer samples shall be new epoxy-lined triple tight cans.

Each emulsified asphalt primer sample shall consist of 2 four-litre quantity of material. The sample containers for emulsified asphalt primer samples shall be new triple tight cans.

Sample containers shall be supplied by the Contractor. Sample labels supplied by the Contract Administrator shall be used to identify all samples.

302.07.02.02 Sand Cover Aggregate

The Contractor shall provide sand cover aggregate samples for QA testing purposes when specified in the Contract Documents.

302.07.03 Demonstration of Primer and Aggregate Application Rates

The Contractor shall demonstrate to the Contract Administrator satisfactory compliance to the specified application rates of primer and aggregate. At the Contract Administrator's option, this compliance may include a minimum 300 m length, one lane width trial section to ensure that the primer and aggregate are applied at the specified rate.

302.07.04 Longitudinal and Transverse Joints

Joints shall be constructed so that all granular base is covered with primer and the overlap of primer and sand cover is minimal.

302.07.05 Protection of the Work

Traffic shall not be allowed on the primed granular base until the sand cover has been applied. Primed surfaces damaged by traffic shall be repaired by the Contractor.

302.07.06 Surface Preparation

The surface shall be free of standing water. The surface shall be prepared by dampening, fine grading, and compacting and finished rolled using a steel-drum roller to ensure a compacted smooth and float free surface immediately prior to the application of primer.

302.07.07 Application of Primer

Primer application temperatures shall be according to OPSS 1102 and OPSS 1103.

After the surface has been prepared, the primer shall be uniformly sprayed on the granular base at the rate specified in the Contract Documents.

The application of primer shall terminate at the same station for both lanes at the end of each day.

All roadway appurtenances within the area to be surfaced shall be properly covered and protected immediately prior to priming.

302.07.08 Application of Sand Cover

When specified in the Contract Documents, a sand cover shall be applied following the application of primer. A minimum curing time of 20 minutes for the primer shall be provided before sand cover aggregate is applied. Sand cover aggregate shall be uniformly applied by means of a mechanical aggregate spreader at the rate of $11 \pm 1.0 \text{ kg/m}^2$.

Two passes of a pneumatic-tired roller shall be used to seat the aggregate.

302.07.09 Traffic Convoy

When specified in the Contract Documents, the Contractor shall convoy traffic according to OTM, Book 7.

The pilot vehicle shall guide one-way traffic through or around construction. The maximum speed of the convoy shall be 30 km/h. Convoys shall be maintained for a minimum of one hour after application of the sand cover, or longer, if directed by the Contract Administrator.

302.07.10 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

302.08 QUALITY ASSURANCE

When specified in the Contract Documents, testing of the primer shall be conducted by the Contract Administrator, using current LS test methods of the MTO Laboratory Testing Manual or ASTM test procedures as required by OPSS 1102 or 1103.

302.09 MEASUREMENT FOR PAYMENT

302.09.01 Actual Measurement

302.09.01.01 Primer

Primer shall be measured by mass in kilograms according to the Contract Documents.

302.09.01.02 Sand Cover Aggregate

Measurement of sand cover shall be by mass or volume as specified in the Contract Documents.

302.09.01.02.01 By Mass

Sand cover aggregate applied to the road shall be measured by mass in tonnes according to the requirements of the Contract Documents.

302.09.01.02.02 By Volume

Sand cover aggregate applied to the road shall be measured by volume in cubic metres, loose, by pre-determined truck capacities. The pre-determined capacity of each truck shall be that computed from its box dimensions.

Loading of each truck shall be to full pre-determined capacity. The Contractor shall not be required to load trucks in excess of this capacity to allow for bulking, and no deduction shall be made for any settlement of the load during transportation, provided that such settlement is not caused by spillage or leakage.

Each truck shall be uniquely and readily identifiable.

302.09.01.03 Traffic Convoy

The measurement for traffic convoy shall be in hours based on the number of hours that the pilot vehicle is convoying traffic.

302.10 BASIS OF PAYMENT

**302.10.01 Primer - Item
 Sand Cover Aggregate - Item
 Traffic Convoy - Item**

Payment at the Contract price for the above items shall be full compensation for all labour, Equipment, and Material to do the work.

Primed surfaces damaged by traffic shall be repaired at no cost to the Owner.

**Appendix 302-A, November 2007
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Rate of application of primer. (302.07.07)

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- Frequency and type of QA testing required. (302.07.02.01 and 302.07.02.02)
- Location of laboratory for delivery of samples. (302.07.02.01)
- Sand cover. (302.07.08)
- Traffic convoy requirements. (302.07.10)
- Measurement for payment of sand cover aggregate by mass or volume. (302.09.01.02)

Priming of the granular base is required for the application of single surface treatment or one lift of hot mix asphalt.

Sand cover is required when traffic travels on the primed granular base prior to placement of a surface.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

None



CONSTRUCTION SPECIFICATION FOR DOUBLE CHIP SEAL

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303.10	BASIS OF PAYMENT

APPENDICES

303-A	Commentary

303.01	SCOPE

This specification covers the requirements for the use of double chip seal.

303.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

303.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

303.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Material

OPSS 1006 Surface Treatment
OPSS 1103 Emulsified Asphalt

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-601 Material Finer than 75 µm Sieve in Mineral Aggregates by Washing
LS-602 Sieve Analysis of Aggregates

Ontario Traffic Manual (OTM):
Book 7 - Temporary Conditions

SP-021 Manual for the Condition Rating of Surface Treated Pavement

European Standards (EN)

EN12272-3:2003 Determination of Binder Aggregate Adhesivity by the Vialit Plate Shock Test Method

303.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Appurtenances mean maintenance hole, catch basin, valve chamber, and water valve covers and similar Utility access covers located within the paved portion of the roadway.

Double Chip Seal means two successive single chip seals with different aggregate gradations.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Median Size of Aggregate means the aggregate size that is determined by a standard plot of the gradation of the aggregate, using all standard sieve sizes, and then graphically determining the median size, which is the size in mm corresponding to per cent finer than 50%.

Single Chip Seal means a single application of bituminous binder followed by a single application of uniformly graded aggregate.

Single Sized Aggregate means a uniformly graded aggregate with at least two-thirds, by weight, passing through a sieve of the specified size and retained on a sieve no less than 70% of the specified size, when tested according to LS-602. The specified size shall vary according to the design of the chip seal application.

303.04 DESIGN AND SUBMISSION REQUIREMENTS

303.04.01 Design Requirements

To ensure satisfactory performance on the roadway according to the traffic, pavement, and geometric roadway data specified in the Contract Documents, using a recognized chip seal design methodology, a laboratory equipped and staffed to carry out chip seal design shall designate the type and grade of asphalt binder, the class of aggregate, and their application rates.

The laboratory designing the chip seal shall confirm the compatibility for the first application of the asphalt binder and the aggregate used in the chip seal by performing the mechanical adhesivity test as per EN12272-3 and meeting the requirements as specified in the Compatibility of Asphalt binder and Aggregate subsection.

All component materials used in the chip seal design shall be representative of the material proposed by the Contractor for use on the Contract.

Chip seal shall only be placed after the Contract Administrator has issued confirmation in writing within 5 Business Days that the chip seal design has been reviewed and meets the specified requirements.

303.04.01.01 Laboratory Requirements

303.04.01.01.01 General

Equivalent alternate laboratory and technician certifications or laboratory proficiency sample testing programs may be used to demonstrate similar requirements to those specified below provided they are acceptable to the Owner.

303.04.01.01.02 Aggregates

An acceptable laboratory conducting tests for physical properties or consensus properties shall be one that holds a certificate from the Canadian Council of Independent Laboratories (CCIL) as Type D for the applicable test methods and also participates in the annual MTO Proficiency Sample Testing Program.

An acceptable laboratory conducting tests for LS-601 and LS-602 shall be one that holds a valid certificate from CCIL as Type C. Testing for LS-601 and LS-602 shall be conducted by qualified laboratory staff who hold a valid certificate from CCIL in aggregate testing.

303.04.01.01.03 Asphalt Binder

An acceptable laboratory for conducting the tests to ensure the binder meets the requirements of OPSS 1103 shall be an accredited laboratory in Ontario's inter-laboratory correlation program. An accredited laboratory shall be one that maintains a satisfactory rating from the MTO Emulsion Correlation Program.

303.04.01.01.04 Asphalt Binder and Aggregate Compatibility Testing

An acceptable laboratory for conducting a test EN12272-3 shall be one that holds a valid certificate from CCIL as Type A or a laboratory that maintains a satisfactory rating from the MTO Emulsion Correlation Program.

303.04.02 Submission Requirements

303.04.02.01 Chip Seal Design

Ten Business Days prior to the start of the placing of the chip seal, the chip seal design shall be submitted in writing to the Contract Administrator together with supporting test results showing conformance of the asphalt binder and aggregates with the requirements of the Contract Documents. For test EN12272-3, a written report on the test method and the results, including a photographic record, shall be provided.

Prior to making the submission, an Engineer's seal and signature shall be affixed on the chip seal design verifying that the chip seal design is consistent with the requirements of the Contract Documents.

Test data must be legible and signed by the testing laboratory representative.

Representative samples of the materials to be used in the work shall be provided with the chip seal design.

303.04.02.01.01 Material Samples

Samples shall be labelled with the following information:

- a) Contract number.
- b) Material type.

- c) Material source.
- d) Date sampled (i.e., yyyy-mm-dd).
- e) Sample location.

Each material sample shall be packaged separately and the samples shall be in containers that are clean, closed, and rupture proof, when lifted or handled. Each filled sample container shall have a maximum mass of 30 kg.

The minimum emulsified asphalt sample quantity shall be 4 litres evenly split between 2 containers.

Aggregate sample quantities shall be a minimum of 25 kg of each aggregate.

Samples for all other materials to be used in the chip seal applications shall be provided in quantities large enough to allow confirmation of the design.

303.04.02.02 Calibration Records for Distributors and Aggregate Spreaders

Prior to the start of the work of chip sealing, calibration records shall be submitted, in writing, to the Contract Administrator.

303.05 MATERIALS

303.05.01 Asphalt Binder

The asphalt binder shall be a rapid setting polymer modified emulsified asphalt according to OPSS 1103.

303.05.02 Aggregates

303.05.02.01 General

Aggregates for both applications of chip seal shall be of the same geological parent produced from the same source.

Aggregates shall be obtained from a source listed in the MTO's pre-qualified products list for coarse aggregates for HL 1 or Superpave 12.5 FC1 hot mix.

Aggregates containing slag are not permitted for use in a chip seal application.

303.05.02.02 Physical Requirements

The physical requirements of the aggregates for the first application of chip seal shall be according to those of a Class I aggregate according to OPSS 1006.

303.05.02.03 Gradation Requirements

303.05.02.03.01 First Application

Aggregate for the first application of chip seal shall be single sized aggregate determined by the chip seal design with the following additional requirements:

- a) The aggregate shall be no finer than the gradation of a Class 1 aggregate according to OPSS 1006.
- b) The maximum median size shall be 13.6 mm.

303.05.02.03.02 Second Application

The gradation requirements of the aggregate for the second application of chip seal shall be determined by the chip seal design with the following requirements:

- a) The gradation of the aggregate shall be 100% passing the 9.5 mm sieve and a maximum 1% passing the 75 µm sieve.
- b) The median size of the aggregate shall be 30 to 50% of the median size of the aggregates used in the first application.

303.05.03 Compatibility of Asphalt Binder and Aggregate

Adhesivity values or % aggregate retentions of the selected binder-aggregate combination determined by the mechanical adhesivity test in EN12272-3 shall be minimum 90%.

303.06 EQUIPMENT

303.06.01 Pilot Vehicle

The pilot vehicle shall be equipped according to the requirements of the OTM, Book 7.

303.07 CONSTRUCTION

303.07.01 Operational Constraints

Public traffic shall only be permitted to travel on the final compacted surface of the second application of chip seal.

The work shall not be carried out when the ambient temperature is less than 10 °C or when climatic or site conditions preclude the curing of the binder.

The application of binder and aggregate shall terminate 1 hour before sunset.

Chip sealing shall not be carried out prior to May 15th south of a line drawn through Pembroke, Magnetawan, and Pointe au Baril Station or prior to June 1st north of the line.

After September 1st, written approval shall be obtained from the Contract Administrator prior to chip sealing.

303.07.02 Calibration of Distributors and Aggregate Spreaders

Within 14 Days before the start of the work of chip sealing, all distributors and aggregate spreaders to be used in the work shall be calibrated using a recognized calibration method.

303.07.03 Traffic Convoy

The Contractor shall convoy traffic according to the OTM, Book 7.

The pilot vehicle shall guide one-way traffic through or around construction. The maximum speed of the convoy shall be 30 km/h.

Convoying shall be maintained until such time as the chip seal is able to carry traffic without damage.

303.07.04 Quality Control

The Contractor shall conduct such quality control procedures, including sampling and testing, as is necessary to ensure that all aggregates and all asphalt binder to be used in the work conform to the requirements of the Contract.

Upon request of the Contract Administrator, the Contractor shall supply copies of any or all test results.

303.07.05 Surface Preparation

The area to receive chip seal shall be thoroughly cleaned using a rotary power broom to remove all sand, dirt, and other debris. Areas inaccessible to a rotary power broom shall be manually cleaned.

All roadway appurtenances within the chip seal area shall be properly covered and protected immediately prior to chip sealing.

303.07.06 Chip Seal Application

A double application of asphalt binder and aggregate shall be placed according to the Contract Documents in the location and to the length and width requirements specified in the Contract Documents.

303.07.07 Joints

Longitudinal joints shall be placed on lane lines.

Longitudinal joints, on the second application, shall have an overlap of 50 to 100 mm.

303.07.08 Appearance

The longitudinal and transverse joints shall be neat and uniform in appearance, with no excessive build-up, uncovered areas, or unsightly appearance.

The chip seal edge shall be neat and uniform along the roadway lane, shoulder, and curb lines.

303.07.09 Clean-up

Areas not to receive chip seal shall have the chip seal material removed immediately.

Appurtenances shall be free of chip seal and left in an operable condition.

303.07.10 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

303.08 QUALITY ASSURANCE

303.08.01 Sampling and Testing

The Contract Administrator reserves the right to request samples of field asphalt binder and aggregate for quality assurance testing purposes. Material samples shall be according to the Material Samples clause.

303.08.02 Initial Acceptance

At the completion of the chip sealing operations, the completed surface course shall be free of flushing, streaking, or loss of cover aggregate, including delamination, as described by SP-021.

303.08.03 Warranty Requirements

303.08.03.01 Warranty Period

The Warranty Period shall be 24 months.

303.08.03.02 Warranty Repairs

The Owner shall inform the Contractor in writing any time within the first 23 months of the Warranty Period of surface defects requiring repair.

In addition, a survey of surface defects shall be completed by the Owner at the end of 1 year and a second survey of surface defects a minimum of 45 Days prior to the end of the Warranty Period. The results of both surveys shall be sent to the Contractor.

The types of surface defects, their severity, their density or extent, and the exact dimensions of the warranty repairs shall be determined by the Owner and recorded according to Table 1.

If the Owner determines that the surface defects pose a hazard to the travelling public at any time during the Warranty Period, the Contractor shall make the repairs in accordance with this specification within 14 Days of being notified. In all other cases, repairs shall be completed no later than 14 Days prior to the warranty expiration date.

Repairs shall be made according to Table 1.

The length of a repair shall be sufficient to eliminate all surficial defects as described.

The width of a repair area shall not be less than one lane width unless approved by the Owner

Materials used in the repair area shall be consistent with those originally used on the Contract. The use of alternate aggregates meeting the aggregate requirements of the Aggregates subsection may be used in the repair area with the approval of the Owner.

Repairs shall be to the approval of the Owner.

Repair areas shall not have transverse or longitudinal ripples of 6 mm or more as measured with a 3 m straight edge.

303.08.04 Completion of Warranty Period

At the end of the Warranty Period, the work shall meet the provisions of the Performance Requirements subsection in order for the Contractor to be released from responsibility and ensure return of the performance bond or letter of credit or certified cheque.

303.08.05 Performance Requirements

The chip seal shall be free from any:

- a) Aggregate loss that is moderate to severe.
- b) Flushing that is moderate to severe.
- c) Streaking that is moderate to severe.

Shaving of the chip seal surface during snow-plough operations (snow-plough damage) is exempt from the Performance Requirements and Warranty Requirements.

303.09 MEASUREMENT FOR PAYMENT

303.09.01 Actual Measurement

303.09.01.01 Double Chip Seal

Measurement of the chip seal placed shall be by area in square metres.

303.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

303.10 BASIS OF PAYMENT

303.10.01 Double Chip Seal - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Repair, removal, disposal, and replacement of any damaged or defective chip seal shall be at no extra cost to the Owner.

TABLE 1
Chip Seal Repair

Surface Defect	Severity	Density or Extent per 100 m of lane length	Required Repair
Loss of Cover Aggregate	Slight	Intermittent, frequent, or extensive	No action required.
	Moderate or Severe	Intermittent or frequent	Double chip seal of the affected area applied manually or by machine.
	Moderate or Severe	Extensive (Note 1)	Double chip seal of the affected area.
Flushing	Slight	Intermittent, frequent, or extensive	No action required.
	Moderate	Intermittent (Note 2) Frequent or extensive (Note 1)	Single chip seal with top aggregate of the affected area.
	Severe	Intermittent (Note 2) Frequent or extensive (Note 1)	Remove and replace the double chip seal of the affected area.
Streaking	Slight	Intermittent, frequent, or extensive	No action required.
	Moderate	Intermittent (Note 2) Frequent or extensive (Note 1)	Single chip seal with top aggregate of the affected area.
	Severe	Intermittent (Note 2) Frequent or extensive (Note 1)	Sand seal followed by double chip seal of the affected area.
Notes: - Area of the repair or replacement shall not be less than one lane width x 50 m in length. - Area of the repair or replacement shall not be less than one lane width x 10 m in length. If there is less than 10 m between 2 sections in the lane designated for repair or replacement, the repair or replacement shall be continuous. A. Descriptions of surface defects and severity are according to SP-021.			

Appendix 303-A, November 2009 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

Chip seal is a preventive maintenance or holding strategy used to preserve and extend the life of an existing road surface.

The designer should specify the following in the Contract Documents:

- Traffic data (e.g., AADT, % Commercial traffic, and intersections with heavy commercial traffic turning movements). (303.04.01)
- Pavement data (e.g., existing pavement type, type of treatment applied to the existing pavement and the year of application, and conditions and problems with the existing pavement (e.g., occurrences of flushing). (303.04.01)
- Geometric data (e.g., maximum grade). (303.04.01)
- Location, length, and width requirements of area to receive chip seal. (303.07.06)

To achieve pavement preservation benefits, chip seal must be carried out when the level of pavement distress is low.

Significant deficiencies in the pavement surface (i.e., deformations, rutting, cracks, potholes, subgrade failures, drainage, and excess asphalt on patches and joints) should be repaired before applying chip seal to the roadway.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR SINGLE AND DOUBLE SURFACE TREATMENT

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APPENDICES

304-A	Commentary

304.01 SCOPE

This specification covers the requirements for surface preparation, application of bituminous binder, and application of aggregate for single and double surface treatment.

304.01.01 Significance and Use of Appendices

Appendices are not a mandatory part of the specification unless invoked by the Owner.

Appendix 304-A is a commentary appendix to provide designers with information on the use of the specification in a Contract.

304.02

REFERENCES

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Material

OPSS 1006 Aggregates - Surface Treatment
OPSS 1103 Emulsified Asphalt

Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 7 - Temporary Conditions

304.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Appurtenances mean maintenance hole, catch basin, valve chamber, and water valve covers and similar Utility access covers located within the paved portion on the roadway.

Binder means an emulsified asphalt with or without polymer modification used to bind aggregates.

Double Lap means the coverage produced from the application of binder where the binder from each spray bar nozzle overlaps the binder application from the adjacent nozzle by one half.

Double Surface Treatment means two successive single surface treatments.

End Nozzle means a spray bar nozzle which delivers binder to the inside half of a standard spray pattern.

Lot means the quantity of work completed with a tanker truck shipment of binder.

Single Surface Treatment means a single application of bituminous binder followed by a single application of Class 1, Class 2, Class 3, Class 4, Class 5, or Class 6 aggregate.

Triple Lap means the coverage produced from the application of binder where the binder from each spray bar nozzle overlaps the binder application from the adjacent nozzle by two thirds.

304.05

MATERIALS

304.05.01

Binders

Binders shall be according to OPSS 1103.

304.05.02

Aggregates

Aggregates shall be according to OPSS 1006 and as specified in the Contract Documents.

304.06 EQUIPMENT

304.06.01 Pressure Distributor

The pressure distributor shall be designed and manufactured to spray binder on the road surface. The pressure distributor shall be capable of applying binder at the specified rates and in a continuous and uniform manner both longitudinally and transversely for a full lane width.

304.06.02 Mechanical Aggregate Spreader

The mechanical aggregate spreader shall be designed and manufactured to be self-propelled and capable of continuously and uniformly distributing aggregate at the specified application rate.

304.06.03 Rotary Power Brooms

Brooms shall be capable of cleaning gravel, sand, dirt, and other debris from the roadway surface.

304.06.04 Rollers

304.06.04.01 General

Rollers shall be ballasted according to the manufacturer's recommendations.

304.06.04.02 Steel Drum Rollers

Steel drum rollers shall be single drum vibratory rollers according to Table 1 and shall be operated in the static mode, if the drum is not rubber coated. Drive wheels shall not mark the aggregate.

304.06.04.03 Pneumatic-Tired Rollers

Pneumatic-tired rollers shall be self-propelled and be according to Table 2. The wheels shall be mounted with smooth tread rubber tires. Tire inflation pressure shall be a minimum of 350 kPa when the tires are cold. All tires shall have equal pressure. Each roller shall be equipped with a suitable tire pressure gauge for checking tire inflation pressure.

304.06.05 Pilot Vehicle

The pilot vehicle shall be equipped according to the requirements of the OTM, Book 7.

304.07 CONSTRUCTION

304.07.01 Operational Constraints

Surface treating operations shall not be carried out when the ambient temperature at the work location is less than 10 °C or where climatic or site conditions preclude the curing of the binder.

The application of binder and aggregate shall terminate one hour before sunset.

Surface treatment shall not be carried out prior to May 15th south of a line through Pembroke, Magnetawan, and Pointe au Baril Station or prior to June 1st north of the line.

Surface treatment shall not be carried out after September 1st except with the approval of the Contract Administrator. Surface treatment may be extended to September 30th provided a high float emulsion is used.

304.07.02 Sampling

304.07.02.01 Binder

The Contractor shall provide binder field samples for testing purposes as specified in the Contract Documents.

The work shall include sampling, labelling, packaging, and delivery of samples to the laboratory designated in the Contract Documents within 5 Business Days.

Each binder sample shall consist of a minimum size of two full 4-litre samples of material. The sample containers for emulsified asphalt binder samples shall be new triple tight cans. Sample containers shall be supplied by the Contractor.

304.07.02.02 Aggregates

The Contractor shall provide aggregate samples for testing purposes as specified in the Contract Documents.

304.07.03 Determination of Binder and Aggregate Application Rates

The application rate for the binder and the aggregate shall be as specified in the Contract Documents.

The Contractor shall demonstrate to the Contract Administrator satisfactory compliance to the specified application rates of binder and aggregate. At the Contract Administrator's option, this compliance may include a minimum 300 m one lane width trial section to ensure that the binder and aggregate are applied at the specified rate.

304.07.03.01 Acceptance of Binder Application Rate

The binder application rate is acceptable when the rate of application is within a tolerance of $\pm 5\%$ of the specified rate.

304.07.03.02 Acceptance of Aggregate Application Rate

The aggregate application rate is acceptable when the rate of aggregate application is within a tolerance of $\pm 10\%$ of the specified rate.

304.07.04 Surface Preparation

Existing bituminous surfaces shall be clean and free of all debris and standing water before application of binder.

Where a binder is to be applied on a granular surface, the surface shall be free of standing water and shall be prepared by dampening, fine grading, and compacting immediately prior to the application of the binder. The surface shall be finish rolled to ensure a compacted smooth and float free surface.

304.07.05 Binder Application Temperatures

Binder application temperatures shall be according to OPSS 1103.

304.07.06 Application of Binder

After the surface has been prepared, the binder shall be uniformly sprayed on the road surface at the specified application rate. When binder is to be applied to two adjacent lanes, the application of binder on the initial pass shall be done without the use of an end nozzle. When binder is applied to the adjacent lane, the nozzle positioned closest to the first application of binder shall be an end nozzle.

The spray bar height shall be adjusted to ensure that there is triple lap of the binder application. At the written request of the Contractor, the Contract Administrator may allow the use of a double lap application.

Longitudinal joints shall be constructed to ensure full coverage on the centreline.

The application of binder shall terminate at the same station for both lanes at the end of each day.

All roadway appurtenances within the area to be surfaced shall be properly covered and protected immediately prior to single and double surface treatment.

304.07.07 Application of Aggregate

Aggregate shall be uniformly applied at the rate specified. The distance between the pressure distributor and the spreader shall not be more than 30 m.

If excess aggregate is present when constructing a double surface treatment, the excess shall be removed prior to the second application of binder.

304.07.08 Rolling

Immediately after spreading, the aggregate shall be rolled with a minimum of two pneumatic-tired rollers. The entire treated area shall receive two passes from each pneumatic-tired roller.

When the surface treatment is placed on a prepared granular grade, one pneumatic-tired roller shall be replaced by a steel drum roller. The entire treated area shall receive two passes from the pneumatic-tired roller and one pass from the steel drum roller.

Rollers shall be operated at such a speed as to prevent aggregate pick-up, but in no case shall the speed of rollers exceed 10 km/h.

All rolling shall be completed within 300 m of the aggregate spreader. When the combination of rollers is not sufficient to maintain the completed rate of progress, additional rollers shall be used.

304.07.09 Traffic Convoy

When specified in the Contract Documents, the Contractor shall convoy traffic according to the OTM, Book 7.

The pilot vehicle shall guide one-way traffic through or around construction. The maximum speed of the convoy shall be 30 km/h. Convoying shall be maintained until such time as the surface treatment is able to carry traffic without damage.

304.07.10 Protection of the Work

The Contractor shall repair damaged areas until such time as the work has been accepted by the Contract Administrator.

Signs indicating fresh surface treatment, or similar wording, shall be erected at the project limits and any intersections throughout the project immediately after placement of surface treatment and shall remain in place for a minimum of 72 hours.

304.07.11 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

304.09 MEASUREMENT FOR PAYMENT

304.09.01 Actual Measurement

304.09.01.01 Binder

Binder shall be measured for payment by mass in kilograms according to the requirements of the Contract Documents.

304.09.01.02 Class 1, 2, 3, 4, 5 or 6 Aggregate

304.09.01.02.01 By Mass

Aggregate applied to the road shall be measured in tonnes according to the requirements of the Contract Documents.

304.09.01.02.02 By Volume

Measurement shall be by volume in cubic metres, loose, by predetermined truck capacities. The predetermined capacity of each truck shall be that computed from its box dimensions.

Loading of each truck shall be kept to not less than the predetermined capacity. The Contractor shall not be required to load trucks in excess of this capacity to allow for bulking, and no deduction shall be made for any settlement of the load during transportation, provided that such settlement is not caused by spillage or leakage.

Each truck shall be uniquely and readily identifiable.

304.09.01.03 Traffic Convoy

The measurement for traffic convoy shall be in hours based on the number of hours that the pilot vehicle is convoying traffic.

304.10 BASIS OF PAYMENT

**304.10.01 Binder "type" - Item
Class 1 Aggregate - Item
Class 2 Aggregate - Item
Class 3 Aggregate - Item
Class 4 Aggregate - Item
Class 5 Aggregate - Item
Class 6 Aggregate - Item
Traffic Convoy - Item**

Payment at the contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Damaged areas requiring repair prior to the acceptance of the work shall be repaired by the Contractor at no extra cost to the Owner.

TABLE 1
Requirements for Steel Drum Rollers

Minimum Drum Diameter mm	Minimum Drum Width mm	Minimum Static Mass per mm of Drum Width kg
1500	2100	2

TABLE 2
Requirements for Pneumatic-Tired Rollers

Roller Class	Minimum Mass t	Minimum Mass per Tire kg
R1	8	900
R2	18	2500
R3	25	3600

Appendix 304-A, Commentary for OPSS 304, November 2006

Note: This appendix does not form part of the standard specification. It is intended to provide information to the designer on the use of this specification in a contract.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Class of Aggregate required. (304.05.02.01)
- Frequency and type of QA testing required. (304.07.02)
- Location of laboratory for delivery of samples. (304.07.02.01)
- Application rate for the binder and aggregate. (304.07.03)
- Traffic convoy requirements. (304.07.09)

The following applications are available depending on traffic volumes, status of road, and type of road surface:

- Single surface treatment is typically applied to either a primed road, a roadway with a previously applied surface treatment, or a paved road.
- Double surface treatment is typically applied to either a granular base or a primed road.

For design estimating purposes, the following application rates may be used:

Treatment	Aggregate Type	Primer or Binder (Note 1)			Aggregate		
		Grade	Range kg/m ²	Typical kg/m ²	Class	Range kg/m ²	Typical kg/m ²
Prime	Class 4	Primer	1.90+/-	1.9	4	10-12	12
Single Surface Treatment	Class 1	CRS-2 or RS-2	1.65-1.90	1.8	1	14-17	16
	Class 2 (Notes 2, 6)	HF-150S	1.35-1.55	1.45	2	16.5-19	19
	Class 4 (Note 3)	CRS-2, HF-150S	1.20-1.40	1.3	4	8-11	11
	Class 5	CRS-2 or RS-2	1.15-1.45	1.3	5	11-13	13
	Class 6	HFMS-2(ON) or HFMS-2P(ON)	1.50-1.80	1.7	6	16-20	17
Double Surface Treatment	Class 2, Note 6	HF-150S (Note 4)	1.60-1.80	1.65	2	16-18	18
		HF-150S (Note 5)	1.45-1.65	1.5	2	16.5-19	19
	Class 3 & 1	CRS-2, RS-2 (Note 4)	1.60-2.10	1.9	3	15-18	17
		CRS-2, RS-2 (Note 5)	1.40-2.10	1.8	1	12-15	14
	Class 3 & 4	CRS-2, RS-2 (Note 4)	1.60-1.75	1.65	3	15-18	17
		CRS-2, RS-2 (Note 6)	1.05-1.20	1.1	4	6.5-8	8
	Class 3 & 5	CRS-2, RS-2 (Note 4)	1.80-2.00	1.90	3	15-17	17
		CRS-2, RS-2 (Note 5)	1.30-1.50	1.35	5	11-13.5	13
	Class 2 & 6	HFMS-2P(ON) (Note 4)	1.60-1.80	1.65	2	13.5-18	16
		HFMS-2P(ON) (Note 5)	1.50-1.70	1.60	6	15-19	16

Notes:

1. Decrease binder rates towards the lower limit of the range when there is heavy commercial traffic.
2. Class 2 surface treatment may cause dust problems in urban areas.
3. Do not apply to flushed surface treatments, flushed pavements or where low friction values are a concern.
4. Initial application.
5. Second application.
6. The use of Granular A aggregate in a Single or Double Surface Treatment is not recommended.

Appendix 304-A

If a granular grade is planned to be open to traffic for a considerable length of time prior to the surface treatment operation, the designer should consider including an item for surface restoration according to OPSS 301, Restoring Unpaved Roadway Surfaces.

The designer should ensure that the Ontario Provincial Standards General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

None.



CONSTRUCTION SPECIFICATION FOR GRANULAR SEALING

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305.10	BASIS OF PAYMENT

APPENDICES

305-A	Commentary

305.01	SCOPE

This specification covers the requirements for the work of surface preparation and the supply and application of sealer to granular shoulders, shoulder rounding, and other designated areas.

305.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

305.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

305.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 304 Single and Double Surface Treatment

Ontario Provincial Standard Specifications, Materials

OPSS 1102 Liquid Asphalt
OPSS 1103 Emulsified Asphalt
OPSS 2510 Tall Oil Pitch Emulsion

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:
LS-100 Rounding-Off of Test Data and Other Numbers

305.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Lot means a specific quantity of material or a specific amount of construction obtained from a single source and produced by the same process.

305.05 MATERIALS

Sealer shall consist of one or more of the following materials:

- a) RC-30 and MTO primer according to OPSS 1102.
- b) Emulsified asphalt primer according to OPSS 1103.
- c) Sealer approved by the Owner.
- d) When specified in the Contract Documents, tall oil pitch emulsion (TOP emulsion) according to OPSS 2510.

305.06 EQUIPMENT

The pressure distribution system used for sealer application shall be according to OPSS 304 and, when applicable, shall include an attachment for hand spraying.

Rollers shall be steel-drum or pneumatic-tired according to OPSS 304.

305.07 CONSTRUCTION

305.07.01 Operational Constraints

For sealer to be applied, the following conditions shall exist:

- a) The ambient temperature is a minimum of 5 °C and rising.
- b) The designated area to be sealed is not frozen.
- c) Precipitation is not occurring or imminent and, for TOP emulsion applications, precipitation has not occurred within the 24 hours prior to application.
- d) The surface is free of standing water.
- e) The wind is not strong enough to cause drifting of sealer spray.
- f) The shoulder shall be smooth and conform to the crossfall and grade specified in the Contract Documents.

305.07.02 Surface Preparation

As soon as is practical prior to applying sealer, the granular shoulder shall be rolled with a minimum of two passes. The shoulder rounding surface shall not be rolled.

Immediately prior to the application of RC-30, MTO primer, or emulsified asphalt primer, the granular material to be sealed shall be uniformly dampened.

The moisture content of the granular material to be sealed with TOP emulsion shall be according to the manufacturer's recommendations.

305.07.03 Application

Sealer shall be uniformly applied to the areas specified in the Contract Documents using a pressure distribution system.

RC-30, MTO primer, and emulsified asphalt primer shall be applied at the rate of 3.4 kg/m² for hand sprayed areas and at the rate of 2.6 kg/m² for all other areas.

TOP emulsion shall be applied at a rate of 5.5 L/m² for hand sprayed areas. Machine applied areas shall be applied in 3 coats to deliver a total of 4.5 L/m² minimum.

All inadequately treated areas identified by the Contract Administrator shall be retreated.

Sealer applied to an adjacent pavement surface shall be overlapped 100 mm onto the pavement surface.

The application temperature of the sealer shall be within the following limits:

- a) RC-30 and MTO primer: 30 to 45 °C
- b) Emulsified asphalt primer: Manufacturer's recommendations
- c) TOP emulsion: Ambient
- d) Owner approved sealers: Manufacturer's recommendations

305.07.04 Repair

All damaged sprayed areas shall be repaired and retreated to the satisfaction of the Contract Administrator.

305.07.05 Sampling of Sealer for Acceptance

The size of a lot is a single truck tank load of sealer as shipped to the site.

Samples shall be taken from a sampling spigot on the transfer line or, if one is not available, from the end of the transfer line. Each sample shall be taken after sufficient material has been drawn from the truck tank to purge the transfer line. The Contractor shall supply and fill sample containers, leaving sufficient space to allow for expansion.

Sample containers for liquid asphalt sealer and TOP emulsion shall be triple tight one-litre cans. A minimum of 1 can is required per sample.

Sample containers for emulsified asphalt sealer shall be triple tight, epoxy lined 4-litre pails, or suitable plastic containers of similar capacity that can be closed to prevent any leakage. A minimum of 2 pails are required per sample.

Identification tags, provided by the Contract Administrator, shall be completed and attached to each sample container. Samples shall be delivered within the required time specified in the Contract Documents.

All sample containers shall be supplied with appropriate WHMIS labels.

305.07.06 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

305.08 QUALITY ASSURANCE

305.08.01 Testing

The Owner reserves the right to make inspections, take samples, and perform tests at such times and locations as the Owner may consider necessary to ensure that the materials supplied are in accordance with this specification.

Testing, when conducted, shall be at the laboratory specified in the Contract Documents using test methods according to OPSS 1102, OPSS 1103, and OPSS 2510, as applicable.

305.09 MEASUREMENT FOR PAYMENT

305.09.01 Actual Measurement

305.09.01.01 Granular Sealing

Measurement of granular sealer shall be by mass in kilograms or by area in square metres as specified in the Contract Documents.

305.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

305.10 BASIS OF PAYMENT

305.10.01 Granular Sealing

305.10.01.01 Granular Sealing - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Sprayed areas damaged by the Contractor's operations or identified by the Contract Administrator as inadequately treated shall be repaired and retreated at no extra cost to the Owner.

Sprayed areas damaged by others shall be repaired and retreated by the Contractor as Additional Work.

305.10.01.02 Payment Adjustment for Asphalt Sealers

305.10.01.02.01 General

Payment for any lot of RC-30, MTO primer, and emulsified asphalt primer that does not meet all Contract requirements shall be subject to a price adjustment. A calculated price adjustment shall be determined through a system of adjustment points based on test results for any lot sample, provided the sample remains in a condition suitable for testing.

Price adjustment shall not be applied when testing is not started within 14 Days of sampling, provided that the sample has been delivered within the required time specified in the Contract Documents.

When more than one test result is available on any one sample, the test result with the least deviation from the specification limit shall be used to calculate the price adjustment.

The total number of adjustment points for each sample shall be divided by 25 to obtain the price adjustment as a percentage for the lot.

A fixed price adjustment of 50% of the Contract price shall be made for lots to which at least one of the following conditions apply:

- a) A lot sample has not been received for testing.
- b) The lot sample contains insufficient material for testing.
- c) The lot sample does not remain in a condition suitable for testing for 14 Days after sampling (e.g., broken emulsion or foamover during distillation).

Prior to the summation, all adjustment points shall be rounded to one decimal place according to LS-100.

305.10.01.02.02 Adjustment Points for RC-30 and MTO Primer

The total number of adjustment points shall be equal to the summation of the number of units that each test deviates from the specification limits times the multiplier as shown in Table 1.

305.10.01.02.03 Adjustment Points for Emulsified Asphalt Primers

The total number of adjustment points shall be equal to the summation of the number of units that each test deviates from the specification limits times the multiplier as shown in Table 2, plus:

- a) 1,000 adjustment points for failure of the Storage Stability Test, 24 hours; and
- b) 1,000 adjustment points for failure of the Particle Charge Test.

The Storage Stability Test and the Particle Charge Test, performed according to OPSS 1103, have a pass or fail criteria.

305.10.01.03 Payment Adjustment for Tall Oil Pitch Emulsion

Payment for any lot of TOP emulsion that does not meet the solids content of OPSS 2510 shall be subject to a price adjustment of 2.5% for every 0.1% less than 8% solids.

TABLE 1
Tests, Units, and Multipliers for RC-30 and MTO Primer

Test	Unit	Multiplier
Residue by Distillation to 360 °C	%	200
Kinematic Viscosity at 60 °C	mm ² s	20
Distillate, as % of total distillate to 360 °C		
to 190 °C	%	10
to 225 °C	%	10
to 260 °C	%	10
to 316 °C	%	10
Residue Penetration at 25 °C	0.1 mm	15
Residue Ductility at 25 °C	cm	10
Residue Solubility	%	10

TABLE 2
Tests, Units, and Multipliers for Emulsified Asphalt Primers

Test	Unit	Multiplier
Residue by Distillation	%	200
Viscosity at 50 °C, less than minimum	SFS	30
Viscosity at 50 °C, greater than maximum	SFS	5
Oil Portion of Distillate, by volume	%	50
Residue Penetration at 25 °C	0.1 mm	15
Flash Point, Open Tag	°C	10
Residue Ductility at 25 °C	cm	10
Residue Solubility	%	10
Note:		
A. SFS = Saybolt Furol Seconds		

Appendix 305-A, November 2008
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Areas designated for granular sealing. (305.07.03)
- Number of Business Days for the delivery of samples. (305.07.05)
- Name and location of the testing laboratory. (305.08.01)
- Unit of measurement for granular sealer. (305.09.01.01)

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- The use of TOP emulsion. (305.05)

TOP emulsion should only be selected where minimal risk of damage by traffic or water erosion is expected. TOP emulsion should only be applied to aggregates meeting the requirements of Granular A, S, or M.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 210.070 Granular Sealing



**CONSTRUCTION SPECIFICATION FOR
STOCKPILING OF PATCHING MATERIALS
AND PATCHING OF ASPHALT PAVEMENT**

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307.10	BASIS OF PAYMENT

APPENDICES

307-A	Commentary

307.01 SCOPE

This specification covers the requirements for transportation and stockpiling of patching materials and the patch repairs to asphalt pavement using SC-800 patching material, emulsified asphalt patching material, or proprietary cold patching material (PCPM).

307.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

307.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

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307.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 309 Cold Mixed, Cold Laid, Open and Dense Graded Bituminous Mix

Ontario Provincial Standard Specifications, Material

OPSS 1003 Aggregates - Hot Mix Asphalt
OPSS 1152 SC-800 Patching Material
OPSS 1153 Emulsified Asphalt Patching Material

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-282 Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
LS-289 Workability of Cold Bituminous Patching Materials by Blade Resistance Method

307.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Binder means the approved bituminous binding material conforming to the manufacturer's product specification.

Manufacturer means the company that produces the PCPM being used.

Manufacturer's Product Specification means the manufacturer's PCPM specification, including the ingredients that were submitted to obtain Owner approval of the PCPM.

Manufacturer Terminal means the location where the final PCPM is produced, without further blending or modification prior to distribution to the work site.

Proprietary Cold Patching Material (PCPM) means a cold patching mix consisting of binder and aggregates, and manufactured by a specific company.

307.04 DESIGN AND SUBMISSION REQUIREMENTS

307.04.01 Design Requirements

307.04.01.01 Proprietary Cold Patching Material

PCPM to be stockpiled shall be capable of maintaining its effective properties for a minimum period of 8 months from the date of supply.

307.04.02 Submission Requirements

307.04.02.01 Proprietary Cold Patching Material

A copy of the manufacturer's product specification shall be submitted to the Contract Administrator at least 7 Days prior to delivery of the mix.

307.05 MATERIALS

307.05.01 SC-800 Patching Material

SC-800 patching material shall be according to OPSS 1152 and this specification.

307.05.02 Emulsified Asphalt Patching Material

Emulsified asphalt patching material shall be according to OPSS 1153 and this specification.

307.05.03 Proprietary Cold Patching Material

The PCPM shall be according to the manufacturer's product specification and this specification, and shall be either a summer or winter mix category as specified in the Contract Documents. The PCPM shall be supplied directly from the manufacturer's terminal without further blending or modification.

The aggregates used in the PCPM shall consist of clean, hard, durable particles meeting the physical requirements for Superpave 12.5 as specified in OPSS 1003.

All PCPM supplied shall be uniformly coated.

307.06 EQUIPMENT

307.06.01 Placement and Compaction

Suitable method, equipment, and hand tools or according to the Equipment section of OPSS 309 shall be used for placing and compaction of patching materials.

307.07 CONSTRUCTION

307.07.01 Stockpiling

Stockpiles shall be built at locations specified in the Contract Documents to a maximum height of 3 m. Stockpiles shall be constructed in such a manner that compaction, other than by the weight of the material itself, shall not result.

Equipment shall not be run over the surface of the stockpile.

307.07.02 Delivery

The mixture shall be transported in vehicles with smooth metal boxes in good and leak-proof condition, previously cleaned of all foreign materials.

Truck boxes shall be lightly coated with a uniform application of a release agent just prior to loading. If liquid agent is used, the truck boxes shall be drained after each application and prior to loading.

307.07.03 Placement and Compaction

307.07.03.01 General

Asphalt repairs using patching material shall be carried out at the locations identified in the Contract Documents.

At the time of use, stockpiled patching material shall exhibit uniform coating, good cohesion and workability, and be in accordance with the material specification requirements.

The Contractor shall ensure proper adhesion of the mixture placed during the patching operation to the adjacent surfaces.

For repairs, patching material shall be placed in the repair area and compacted as specified in the Contract Documents. Placement and compaction of the patching material shall be sufficient to meet the requirements of the Surface Appearance subsection of this specification.

For repairs exceeding 50 mm in depth, the patching material shall be placed in lift thicknesses of maximum 50 mm in depth and each lift shall be compacted prior to the addition of the next lift.

307.07.03.02 SC-800 Patching Material and Emulsified Patching Material

The surface on which the patching material is placed shall be free of dirt, sand, foreign matter, and loose material and the repair area shall be free of standing water.

307.07.03.03 Proprietary Cold Patching Material

The surface on which the patching material is placed shall be free of dirt, sand, foreign matter, and loose material. Standing water in the repair area shall be removed, if required by the PCPM manufacturer's installation instructions.

307.07.04 Surface Appearance

After placement and final compaction of the patching material, patches shall be free of defective areas, including, but not limited to wheel track marking, ravelling, uneven surface, and fat spots.

307.07.05 Sampling

The Contractor shall provide patching material samples when requested by the Owner. Samples may be requested before or during the construction and from the stockpile, truck, or during placement of the material.

Samples required for stripping resistance, workability, and cohesion testing shall be a minimum 25 kg. Samples required for extraction and gradation testing shall be a minimum 15 kg.

The work shall include sampling, packaging, labelling, and delivery of the samples to the laboratory designated in the Contract Documents. Sample containers shall be supplied by the Contractor and shall be metal containers equipped with a wire handle and a tight fitted lid. Samples shall be labelled with the following information:

- a) Contract No.
- b) Sampling date
- c) Mixture type and name
- d) Sampling location
- e) Manufacturer's name
- f) Contractor's name
- g) Weather conditions at the time of sampling
- h) Sampler's name

307.07.06 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

307.08 QUALITY ASSURANCE

307.08.01 Acceptance

Acceptance of all patching work shall be based on visual observation of the patching material, surface appearance of the patch at the time of patching, continuity with adjacent surfaces, and conformance of the patching materials to the requirements of this specification.

307.08.02 Visual Observation

During the time of patching, the mix used shall exhibit uniform coating, good cohesion, and workability.

307.08.03 Surface Appearance

All patches after final compaction shall be free of defective areas, including, but not limited to wheel track marking, ravelling, uneven surface, and fat spots. Areas showing such defects shall be deemed rejectable.

307.08.04 Sampling

Representative samples of the patching mixture may be taken at any time for testing by the Owner.

307.08.05 Testing

Patching material samples may be tested by the Owner to ensure it meets the requirements of this specification.

The Owner may request the Contractor to provide test results showing that the patching material possesses required property as determined by the following tests.

307.08.05.01 Emulsified Asphalt Patching Material and Proprietary Cold Patching Material

307.08.05.01.01 Stripping Resistance

Stripping resistance of samples shall be determined using the following procedure:

- a) Place 50 g of the patching material in 400 mL of boiling distilled water in a 600 mL glass beaker.
- b) Stir the mixture with a glass rod at one revolution per second for 3 minutes.
- c) Once stirring is complete, visually evaluate the percentage of coating retained.

Samples with retained coatings of less than 75% shall be deemed rejectable

307.08.05.01.02 Workability

Workability of the patching material sample shall be determined according to LS-289.

Patching material with a workability index of more than 2,000 N shall be deemed rejectable.

307.08.05.01.03 Cohesion

Cohesion of the patching material sample shall be determined by LS-290.

Patching material with a cohesion index of less than 60% shall be deemed rejectable.

307.08.05.02 SC-800 Patching Material

307.08.05.02.01 Extraction and Gradation

Residual Asphalt Content and Gradation of SC-800 Patching Material shall be determined according to LS-282.

SC-800 Patching Material not complying within the requirements of the subsection for Tolerances of OPSS 1152 shall be deemed rejectable.

307.08.06 Rejection

All material and patches deemed rejectable by the Contract Administrator shall be removed and replaced. The replaced portion of the work shall meet the requirements of this specification.

307.09 MEASUREMENT FOR PAYMENT

307.09.01 Actual Measurement

**307.09.01.01 SC-800 Patching Material
Emulsified Asphalt Patching Material
Proprietary Cold Patching Material**

Measurement of patch material shall be by mass in tonnes as specified in the Contract Documents.

307.10 BASIS OF PAYMENT

**307.10.01 SC-800 Patching Material - Item
Emulsified Asphalt Patching Material - Item
Proprietary Cold Patching Material - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Replacement of rejected materials and patches shall be at no extra cost to the Owner.

Appendix 307-A, April 2012
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should determine if the following are required and, if so, specify them in the Contract Documents:

- Winter or summer mix category of PCPM. (307.05.03)
- Stockpile locations. (307.07.01)
- Asphalt repair location. (307.07.03.01)
- Compaction requirements. (307.07.03.01)
- Location of laboratory for delivery of samples. (307.07.05)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



**CONSTRUCTION SPECIFICATION FOR
COLD MIXED, COLD LAID, OPEN AND DENSE
GRADED BITUMINOUS MIX**

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309-A	Commentary

309.01 SCOPE

This specification covers the requirements for production and placement of cold mixed, cold laid, open and dense graded bituminous mix and cover aggregate.

309.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

309.01.02

Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

309.02

REFERENCES

When the Contract Documents indicate that provincial-oriented specifications shall be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications shall be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 304	Single and Double Surface Treatment
OPSS 310	Hot Mix Asphalt

Ontario Provincial Standard Specifications, Material

OPSS 1003	Aggregates - Hot Mix Asphalt
OPSS 1006	Aggregates - Surface Treatment
OPSS 1103	Emulsified Asphalt

Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-263	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
LS-265	Percent Air Voids in Compacted Dense Bituminous Pavement Mixtures
LS-266	V.M.A. in Compacted Bituminous Mixtures
LS-281	Percent Compaction of Compacted Bituminous Pavement Mixtures
LS-282	Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
LS-301	Mix Design for Cold Mixed Dense Graded Bituminous Mixtures
LS-302	Coating Dense Graded Aggregates

LS-303	Percent Moisture Pickup in Compacted Dense Graded Bituminous Mixtures
LS-304	Coating Open Graded Aggregates
LS-305	Run Off for Open Graded Mixtures
LS-602	Sieve Analysis of Aggregates

309.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

CL mix means cold mixed, cold laid, open or dense graded bituminous mix.

Fat Spot means an area of pavement substantially blacker than the surrounding pavement.

Segregation means a condition of the pavement characterized by areas with comparatively coarser or finer texture than that of the surrounding pavement.

309.04 SUBMISSION AND DESIGN REQUIREMENTS

309.04.01 Mix Design

The CL mix design shall be the responsibility of the Contractor. The proposed mix proportions corroborated by submission of the design proposed by the Contractor as determined by the supplier of the asphalt emulsion shall be forwarded to the Contract Administrator 5 Business Days before the start of production.

Mix proportions shall be determined using MTO test methods LS-301, LS-302, LS-304, and LS-305.

Aggregate samples shall be representative of the materials to be used and have proven compatibility, workability, and acceptable curing time with the emulsified asphalt selected.

309.05 MATERIALS

309.05.01 Emulsified Asphalt

The emulsified asphalt shall be according to OPSS 1103. The emulsified asphalt content shall be determined by laboratory testing and shall be within the limits set out in Table 1.

309.05.02 Aggregates

Aggregates shall meet the requirements of OPSS 1003 except that the gradations of open graded aggregates shall be according to Table 2 and dense graded aggregates shall be according to Table 3.

Sufficient aggregate to complete the work shall be stockpiled at least one week prior to use.

The cover aggregate shall be Class 4 aggregate according to OPSS 1006.

309.05.03 Cold Mixed, Cold Laid, Open and Dense Graded Bituminous Mix

309.05.03.01 General

The CL mix shall show good asphalt dispersion, uniform coating, and cohesion.

309.05.03.02 Open Graded Mix

The cure time for open graded mix shall be such that the asphalt cement residue in the emulsion will not wash off the aggregate, if water is applied one hour after compaction of the mix.

309.05.03.03 Dense Graded Mix

Dense graded mix shall be according to Table 4.

309.06 EQUIPMENT

309.06.01 Production and Placement

Mobile or stationary mixing plants shall be capable of producing a uniform thoroughly blended CL mix consisting of aggregate and emulsified asphalt. The aggregate feed system to the mixing unit shall be equipped with a means of determining the mass of material being deposited into the mixing unit prior to the addition of the emulsified asphalt. The mixing unit shall be capable of continuously maintaining the amount of emulsified asphalt added within $\pm 0.2\%$ of the aggregate by weight. All measuring devices shall be calibrated according to the manufacturer's specifications at the start of the Contract and whenever deemed necessary by the Contract Administrator. The emulsified asphalt supply system shall be equipped with a flow meter and a total delivery meter.

A Midland Mix Paver or a central mixing plant, according to the Cold Mix Plants subsection, will be considered acceptable equivalents for the production of CL mixes.

Production equipment shall be properly equipped and adjusted to provide a CL mix according to this specification.

Mechanical pavers may be used to place CL mixes produced in a central mix plant and shall be according to the Paving Equipment clause of OPSS 310.

309.06.02 Cold Mix Plants

309.06.02.01 General Requirements

The equipment shall be such that the CL mix produced meets this specification and shall demonstrate adequate control and documentation of the CL mix materials for monitoring and production purposes.

309.06.02.02 Emulsified Asphalt Storage

A suitable holding tank, which has been thoroughly cleaned of any other material, shall be used.

309.06.02.03 Aggregate Feed System

A separate tapered cold feed bin with a minimum capacity of 6.0 m^3 shall be provided for each size, type, or gradation of aggregate. Partitions of sufficient height to eliminate intermingling of the aggregate shall be provided between adjoining bins. Bins shall be a minimum of 0.5 m wider than the width of the loading buckets.

A permanent scalping screen shall cover the top of each bin to remove any oversize aggregate.

Vibratory pan feeders shall not be acceptable for proportioning aggregates.

A calibrated and manually adjustable feed gate shall regulate the flow of aggregate from each bin to a conveyor feeding the pugmill. The conveyor shall be equipped with a scale indicating tonnes per minute of production and total tonnes.

309.06.02.04 Pugmill

The pugmill shall be an approved twin shaft type with a minimum capacity of 0.6 m^3 and capable of producing a uniform mix. The clearance of the blades from the inner surfaces of the pugmill shall not exceed 20 mm.

The paddles shall be of a type adjustable for angular position and reversible to retard the flow of the mix if required.

The mixing time or cycle shall be adjustable.

309.06.02.05 Emulsified Asphalt Pump

The pump shall be a variable speed positive displacement pump that feeds an adjustable spray bar located at the charging end of the pugmill. The pump may also be a positive displacement pump mechanically interlocked to the aggregate feed rate mechanism, in which case, the pump must be equipped with a variable speed control.

The pump shall be equipped with a totalizing type meter with manual reset and shall indicate the flow of emulsion being pumped in litres per minute.

There shall be a satisfactory means of positive control between the flow of aggregate from the hopper and emulsion from the pump. The pump shall be interlocked, either mechanically, electrically, or hydraulically, to the aggregate feed rate control mechanism so that a constant volumetric ratio of emulsion to aggregate is fed to the pugmill.

The system shall be interlocked through a master control switch.

309.06.02.06 Discharge Holding Hopper

The plant shall be equipped with a discharge holding hopper with a minimum capacity of 1.0 tonne. It shall be operated by a control switch on the control station panel.

309.06.03 Rollers

Rollers shall be according to OPSS 310, except that three wheel rollers will not be allowed.

309.06.04 Cover Aggregate Spreaders

Spreaders shall be according to OPSS 304 or shall be an acceptable tailgate type spreader capable of uniform application without displacement of the CL mix.

Spinner type spreaders are not allowed.

309.07 CONSTRUCTION

309.07.01 Emulsified Asphalt

Emulsified asphalt shall be thoroughly mixed with the aggregate.

309.07.02 Cold Mixed, Cold Laid, Open and Dense Graded Bituminous Mixes

309.07.02.01 Operational Constraints

Traffic shall not be permitted on the CL mix until final rolling is completed and the mix can support traffic loading without deformation.

CL mixes shall not be produced prior to May 15th or when rain is imminent. Except by special permission from the Contract Administrator, dense graded mix shall not be produced after September 15th, and open graded mix shall not be produced after September 30th. In no case shall CL mixes be produced unless the ambient temperature is at least 10 °C and rising.

309.07.02.02 Preparation of the Foundation

309.07.02.02.01 Granular Base

The granular base on which the CL mix is to be placed shall be smooth, true to grade, and free of surface float.

309.07.02.02.02 Pavement

Paved surfaces on which the CL mix is to be placed shall be free of dirt, sand, foreign matter, and loose material.

309.07.02.03 Production and Placement

CL mix of the type specified in the Contract Documents shall be produced and placed in accordance with the requirements of this specification.

When a second course is specified in the Contract Documents, any loose cover aggregate shall be swept from the surface. The previously laid course shall be adequately cured prior to placing the second or surface course.

309.07.02.04 Compaction

309.07.02.04.01 General

Initial rolling shall commence once initial breaking of the asphalt emulsion has occurred and the mix can support the roller without shoving.

Final rolling shall be done using a steel tandem roller after the cover aggregate has been applied.

309.07.02.04.02 Open Graded Mix

Each completed course of open graded mix shall have the following percent air voids in the compacted CL mix as determined by LS-265:

CL2 and CL3 - 15-20% Air Voids
CL4 and CL8 - 20-30% Air Voids

309.07.02.04.03 Dense Graded Mix

Each completed course of dense graded mix shall be compacted to at least 94% of laboratory density as determined LS-281.

309.07.02.05 Trial Application

At the start of the Contract, a trial area, 200 m in length and one traffic lane wide, shall be constructed to demonstrate that equipment, personnel, and methods of operation to be used are capable of producing an acceptable CL mix.

If deficiencies are evident during construction of the trial area, work shall be stopped until the deficiencies are corrected.

309.07.02.06 Surface Tolerance

Each course, after final compaction, shall be smooth and true to the established crown and grade and the surface of each course shall be free from deviations exceeding 6 mm as measured in any direction with a 3 m straight edge.

309.07.02.07 Surface Appearance

Each course, after final compaction, shall be of uniform texture and shall be free of segregation, fat spots, oil spills, or any other defect. Defective areas shall be removed and replaced with acceptable mix of the same type and compacted to the satisfaction of the Contract Administrator.

309.07.02.08 Sampling

Samples of the actual CL mix shall be taken by the Contractor at least twice a day and provided to the Contract Administrator. Each sample shall fill a four-litre pail.

Additional samples shall be provided when requested by the Contract Administrator.

309.07.02.09 Tolerances

The mix samples shall be according to the following tolerances:

Residual asphalt content: $\pm 0.3\%$

Aggregate retained on the 4.75 mm sieve:

For open graded mix $\pm 2.0\%$

For dense graded mix $\pm 6.0\%$

309.07.03 Cover Aggregate

After the initial rolling has taken place, cover aggregate shall be spread uniformly at a rate of $5 \pm 1.5 \text{ kg/m}^2$ over the surface of all open graded mixes and then rolled into the CL mix.

309.07.04 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

309.08 QUALITY ASSURANCE

309.08.01 Testing

The Owner may test any samples required by this specification for conformance to specified requirements.

309.09 MEASUREMENT FOR PAYMENT

309.01.01 Actual Measurement

309.09.01.01 Emulsified Asphalt

Measurement shall be by mass in kilograms according to the requirements of the Contract Documents, except that portable and conveyor scales will not be acceptable for use.

309.09.01.02 Open Graded CL 2 Open Graded CL 3 Open Graded CL 4 Open Graded CL 8 Dense Graded CL Cover Aggregate

Measurement shall be by mass in tonnes according to the requirements of the Contract Documents.

309.10**BASIS OF PAYMENT****309.10.01**

Emulsified Asphalt - Item
Open Graded CL 2 - Item
Open Graded CL 3 - Item
Open Graded CL 4 - Item
Open Graded CL 8 - Item
Dense Graded CL - Item
Cover Aggregate - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Defective areas shall be removed, replaced with acceptable mix of the same type, and compacted to the satisfaction of the Contract Administrator at no extra cost to the Owner.

TABLE 1
Emulsified Asphalt and Residual Asphalt Content

Type of Mix	Emulsified Asphalt Content kg/t	Residual Asphalt Content by Mass (Note 1)
CL 2 Open Graded, Surface or Levelling Course	69-122	4.5 - 8.0%
CL3 Open Graded, Surface or Levelling Course	65-115	4.2 - 7.5%
CL4 Open Graded, Binder or Levelling Course	61-107	4.0 - 7.0%
CL8 Open Graded, Binder or Levelling Course	55-77	3.5 - 5.0%
Dense Graded	61-107	4.0 - 7.0%
Note: 1. As determined by test LS-282.		

TABLE 2
Gradation Requirements for Open Graded Aggregates, LS-602

Sieve Designation	% Passing			
	CL 2	CL 3	CL 4	CL 8
26.5 mm				100
19.0 mm			100	95-100
16.0 mm		100	96-100	65-90
13.2 mm	100	96-100	67-86	-
9.5 mm	75-100	50-73	29-52	20-55
6.7 mm	0-40	-	-	-
4.75 mm	0-10	0-10	0-10	0-10
2.36 mm	0-5	0-5	0-5	0-5
75 µm (Note 1)	0-2	0-2	0-2	0-2
Note: 1. Open graded mix aggregates with more than 2.0% passing the 75 µm sieve will be rejected.				

TABLE 3
Gradation Requirements for Dense Graded Aggregates, LS-602

Sieve Designation	% Passing
16.0 mm	100
13.2 mm	75-95
9.5 mm	50-80
4.75 mm	25-50
1.18 mm	10-40
300 µm	2-20
150 µm	0-10
75 µm (Note 1)	0-5

Note:

1. Dense graded mix aggregates can have a maximum variability of 2.0% for material passing the 75 µm sieve.

TABLE 4
Physical Requirements for Cold Mixed Dense Graded Bituminous Mix

Property of Laboratory Compacted Mixtures	Air Cured	Water Cured	MTO Test Method
Marshall Stability, N	4500 Min.	3300 Min.	LS-263
Marshall Flow Units of 0.25 mm	10 Min.	8 Min.	LS-263
% Air Voids	4-12	-	LS-265
% VMA Pass 4.75 mm by Mass			LS-266
25%	12.0	-	
37.5%	13.25	-	
50%	14.5	-	
% by Mass Moisture Pick-up	-	2 Max.	LS-303

Appendix 309-A, November 2013
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Type of CL mix. (309.07.02.03)

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- Second course of CL mix. (309.07.02.03)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR HOT MIX ASPHALT

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310-B	Supplemental Requirements for Using the MTO Performance Graded Asphalt Cement (PGAC) Price Index in Municipal Contracts
310-C	Supplemental Requirements for Using Warm Mix Asphalt in Municipal Contracts

310.01 SCOPE

This specification covers the requirements for the placement and compaction of hot mix asphalt designed using the Marshall or Superpave methods.

310.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

310.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

310.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 914 Waterproofing Bridge Deck with Hot Applied Asphalt Membrane

Ontario Provincial Standard Specifications, Material

OPSS 1003	Aggregates - Hot Mix Asphalt
OPSS 1101	Performance Graded Asphalt Cement
OPSS 1103	Emulsified Asphalt
OPSS 1150	Hot Mix Asphalt
OPSS 1151	Superpave and Stone Mastic Asphalt Mixtures

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-261	Preparation of Marshall Specimens
LS-262	Bulk Relative Density of Compacted Bituminous Mixtures
LS-263	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

LS-264	Theoretical Maximum Relative Density of Bituminous Paving Mixtures
LS-265	Percent Air Voids in Compacted Dense Bituminous Pavement Mixtures
LS-282	Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
LS-287	The Determination of Percent Compaction of Compacted Bituminous Paving Mixture (MRD Method)
LS-292	Quantitative Determination of Asphalt Cement Content by Ignition and Analysis of Remaining Aggregate from Bituminous Paving Mixtures
LS-306	Bulk Relative Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens

ASTM International

D 6752-09	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method

American Association of State Highway and Transportation Officials (AASHTO)

M320-09	Standard Specification for Performance Graded Asphalt Binder
M323-07	Standard Specification for Superpave Volumetric Mix Design
T40-02(2006)	Sampling Bituminous Materials
T166-07	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens
T209-09	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
T275-07	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens

310.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

AMRL means the AASHTO Materials Reference Laboratory.

Anti-Stripping Additive means hydrated lime and liquid anti-stripping additive used to minimize or eliminate stripping of asphalt cement from aggregates in hot mix asphalt (HMA).

Attribute means one of the following: Designated Large Sieve (DLS), 4.75 mm sieve, 600 µm sieve, 75 µm sieve, asphalt cement content, air voids, or compaction.

Binder Course means the lower layer or layers of an asphalt concrete pavement distinguished from the surface course. It supports the surface course, distributes the load to the base, and adds to the strength of the pavement.

CCIL means the Canadian Council of Independent Laboratories.

Designated Large Sieve (DLS) means the sieve size specifically designated for each mix type for gradation testing according to Table 1.

Draindown means that portion of stone mastic asphalt or stone matrix asphalt (SMA) mix, fines, and asphalt cement that separates and flows downwards through the mix.

Fat Spot means an area of pavement substantially blacker than the surrounding pavement.

Hot Mix Asphalt (HMA) means hot mixed, hot laid asphaltic concrete. The terms are used interchangeably. HMA may include recycled or specialty mixes.

Hot Mix Asphalt Miscellaneous means HMA that is placed in areas other than the roadway, as specified in the Contract Documents.

Hot Mix Asphalt Padding means an HMA layer used for correcting crossfall and profile deficiencies in the existing pavement before placing the levelling, binder, or surface course.

Hot Mix Asphalt Patching means an HMA surface course placed over localized areas of distressed pavement, generally for the purpose of improving strength, rideability, or safety.

Job-Mix Formula (JMF) means the percentage passing on each designated sieve of the total mass of aggregate and the amount of asphalt cement as a percentage by mass of the mix that are based on specified mix design procedures that when mixed result in an HMA that is according to this specification.

Joint means a vertical contact between a new HMA pavement course and any HMA pavement or any rigid object that exists at the time the HMA is laid.

Levelling Course means an HMA course of variable thickness used to eliminate transverse and longitudinal irregularities on an existing surface prior to placing an HMA binder or surface course.

Lot means a specific quantity of material or a specific amount of construction normally from a single source and produced by the same process.

Mix Properties means the percent passing the DLS, 4.75 mm sieve, 600 µm sieve, and 75 µm sieve; the asphalt cement content; and the air voids.

Paving in Echelon means two or more pavers are used to pave multiple adjacent lanes simultaneously.

Performance Graded Asphalt Cement (PGAC) means asphalt cement that is produced from petroleum residue, either with or without the addition of non-particulate modifiers, according to AASHTO M320.

Protection Board means a durable panel specifically designed to provide an interface protection barrier between the HMA and the asphalt waterproofing membrane.

Quality Assurance (QA) means a system or series of activities carried out by the Owner to ensure that materials received from the Contractor meet the specified requirements.

Quality Control (QC) means a system or series of activities carried out by the Contractor to ensure that materials supplied to the Owner meet the specified requirements.

Random Sample means a sample from a location chosen by the Contract Administrator based on random numbers such that any portion of a lot or subplot has an equal probability of being selected.

Range means the numerical difference between the maximum and minimum test results within a lot.

Reclaimed Asphalt Pavement (RAP) means the processed HMA material that is recovered by partial or full-depth removal.

Referee Testing means testing by an independent laboratory selected by the Owner and acceptable to the Contractor, the results of which are used for resolving differences between QC and QA testing.

Screed means the unit of the paver that strikes off and imparts initial compaction to the HMA.

Segregation means a condition of the pavement characterized by areas with comparatively coarser or finer texture than that of the surrounding pavement.

Southern Ontario means that area of Ontario south of a line joining Waubaushene, Severn Bridge, Bancroft, and Ottawa.

Stone Mastic Asphalt or Stone Matrix Asphalt (SMA) means HMA consisting of a gap graded, stone-on-stone coarse aggregate skeleton with an asphalt cement-rich mortar.

Sublot means approximately equal divisions or portions of a lot.

Superpave means the method for specifying material components and asphalt mix design using the Superpave gyratory compactor (SGC).

Surface Course means an HMA wearing course of any flexible or composite pavement.

Vertical Surface means all edges of concrete curbs, catch basins and other appurtenances, longitudinal joints, and transverse joints for application of tack coat.

310.05 MATERIALS

310.05.01 Hot Mix Asphalt

The materials used in the production of the HMA shall be according to OPSS 1150 for Marshall mixes and OPSS 1151 for Superpave and SMA mixes.

310.05.02 Tack Coat Material

Tack coat shall consist of SS-1 emulsified asphalt diluted with an equal volume of water. The undiluted material shall be according to OPSS 1103.

The use of an alternate product may be permitted at the Contractor's request, provided that such a request is submitted in writing to the Contract Administrator a minimum of 14 Days prior to the intended use of the alternate product. The Contractor's proposal shall include, but not be limited to, the following:

- a) The reasons for the use of the alternate material.
- b) Material Safety Data Sheets and any other information for the safe handling, transportation, and storage of the product.
- c) Testing protocols to be used in confirming the properties of the material.
- d) Typical test results.
- e) Required application rates.
- f) Cost implications for the use of the alternate product.

The Contract Administrator shall review this proposal and respond in writing within 7 Days of receiving it, either accepting the use of the alternate product or not accepting its use with reasons. The alternate product shall not be used until permission has been granted in writing by the Contract Administrator.

310.06 EQUIPMENT

310.06.01 Tack Coat Distributors

For main lane paving, tack coat shall be applied using self-propelled or tow-along pressure distributors capable of applying the product at the specified rate and in a continuous and uniform manner both longitudinally and transversely for the full lane width. The distributors shall be equipped with a volume-metering system of sufficient sensitivity to measure the quantity of tack coat dispensed, measurable to within four or five litres.

The use of a hand held pressure applicator is acceptable for tack coating protection board and small irregularly shaped areas such as tapers.

310.06.02 Paving Equipment

Asphalt pavers shall be self-propelled and capable of laying a consistent satisfactory mat that is true to the crossfall, profile, cross-section, and alignment specified in the Contract Documents. Pavers shall be equipped with hoppers and distributing augers capable of placing the HMA evenly in front of the screeds. Screeds shall be capable of being heated and being adjustable as to level and crown. Pavers shall be capable of simultaneously placing the shoulder pavement and roadway pavement whether the shoulder pavement is at the same or different crossfall from the roadway pavement.

In all cases, pavers shall be equipped with automatic longitudinal and transverse grade and slope controls capable of being operated from either side of the paver. The longitudinal grade control shall be adjustable for mat thickness in small increments, without the necessity of stopping the paver. The paver shall be equipped to operate from a 12 m ski or floating beam, a 3 m ski, or a joint matching shoe. When the ski is a flexible unit, it shall be equipped with a spring-tensioned wire extending between brackets fitted on and slightly above each end of the ski. The sensing grid shall ride on the wire, not on the ski.

Plows or other edge ramping devices that are attached to or towed by the screed portion of the paver shall not be permitted.

A 3 m straight edge shall be provided on each paver. The straight edge shall be made of metal with a level recessed in its upper surface parallel to the lower edge.

310.06.03 Rollers

310.06.03.01 Classification of Rollers

Rollers shall be classified into categories as follows:

Class S Self-propelled steel-drum, tandem, or three-wheel rollers according to Table 2.

Class R Self-propelled pneumatic-tired rollers according to Table 3.

Class V Self-propelled vibratory rollers specifically designed for HMA compaction having either dual vibratory rolls or a combination of vibratory roll and pneumatic tires with a contact area equal to or greater than 70% of the roll width according to Table 4.

310.06.03.02 Requirements for Rollers

310.06.03.02.01 General

All rollers shall be capable of reversing without backlash.

The Contract Administrator shall be provided with the mass of the rollers and may require the weighing of the rollers in his presence.

The rolls or drums shall be kept moist with water or non-petroleum based release agents to prevent adhesion of HMA to them. Excess water or release agents shall not be permitted.

310.06.03.02.02 Steel-Drum Rollers

The drums of tandem steel-drum rollers shall not be less than 1.20 m in width.

310.06.03.02.03 Pneumatic-Tired Rollers

Pneumatic-tired rollers shall be constructed so that the wheels on either the front or back oscillate either independently or in pairs. The wheels shall be mounted with smooth rubber tires. Tire inflation pressure shall be a minimum of 350 kPa when the tires are cold. All tires shall have equal pressure. Skirts or windbreaks shall be provided at all times to protect all tires from the cooling effects of atmospheric conditions. Each roller shall be equipped with a suitable tire pressure gauge for checking tire inflation pressure.

For SMA mixes, pneumatic-tired rollers are not permitted.

310.06.03.02.04 Vibratory Rollers

Vibratory rollers shall be according to the following requirements:

- a) Frequency of vibrations of the vibratory roller shall be 2,200 vibrations per minute or greater.
- b) Rollers shall be equipped with provision for automatic shut-off of vibrations before coming to a stop.

310.07 CONSTRUCTION

310.07.01 Quality Control

QC procedures shall be conducted to ensure the HMA meets the requirements of the Contract Documents. The Contractor shall be responsible for the interpretation of the QC test results and the determination of any action to be taken to ensure that all materials and work are according to the requirements of the Contract Documents. QC documentation shall be made available to the Contract Administrator upon request. Sampling and testing methods shall be included in the QC documentation.

A laboratory that has current CCIL Type B Certification or AMRL equivalent certification or other equivalent certified laboratory acceptable to the Contract Administrator shall be used. Testing of the samples shall be conducted under the direction and constant supervision of technicians certified to perform the QC tests according to CCIL or equivalent certification.

310.07.02 Preparation of Foundation and Existing Pavement

310.07.02.01 Granular Grade

Prior to placing any course of HMA on a granular grade, a Class S roller of a minimum of 7 tonnes or an equivalent Class V roller with a drum width of at least 1.2 m shall be used to finish roll the grade ahead of the paver to ensure a compacted, smooth, and float-free surface.

310.07.02.02 Existing Pavement

Prior to placing any HMA, all HMA and concrete surfaces shall be clean of all loose, broken, and foreign materials. Milled surfaces shall be swept with a power broom.

310.07.03 Tack Coat

310.07.03.01 Application of Tack Coat

Surfaces to be tack coated shall be free of standing water and contamination, such as mud, loose aggregate, or debris.

Protection board shall be dry and clean when the tack coat is applied.

Tack coat shall be placed sufficiently ahead of the paving operation to allow for curing.

Paving and construction equipment shall not be permitted onto the tack coat until it has broken and set.

Traffic shall be prevented from travelling upon the tack coat.

Tack coat shall be applied to the following:

- a) Protection board.
- b) All pavement surfaces including, but not limited to, hot mix and Portland cement concrete.
- c) Milled pavement surfaces.
- d) Expanded asphalt surfaces.
- e) Cold-in-place recycled surfaces.

Tack coat may also be applied to other surfaces as specified in the Contract Documents.

310.07.03.02 Tack Coat Rate of Application

The diluted emulsion shall be applied at the rate of 0.35 kg/m^2 to all existing pavement surfaces, milled pavement surfaces, expanded asphalt surfaces, and any binder course surface that has been left open to traffic over at least one winter.

For cold-in-place recycled surfaces and new surfaces that have been paved in the same calendar year, the rate of application shall be 0.20 kg/m^2 .

The rate of application on protection board shall be 0.50 kg/m^2 .

310.07.03.03 Tack Coating of Joints

Vertical surfaces at which joints are made shall be tack coated with a thin uniform and continuous coating of tack coat material, except for longitudinal joints between lanes paved in echelon.

The joint between pavement lanes paved with an infrared joint heater shall not be painted.

310.07.04 Transportation of Hot Mix Asphalt

The HMA shall be transported from the asphalt plant to the work in leak proof truck boxes that have been previously cleaned of all foreign materials. If required, truck boxes shall be lightly coated with a uniform

application of a non-petroleum based release agent. Truck boxes shall be drained after each application and before loading. No release agents shall be used that can adversely affect the quality or performance of the HMA. Release agents shall be used according to the proprietary requirements.

Each truck shall use a tarpaulin of sufficient size to completely cover the load at all times.

310.07.05 Sampling

310.07.05.01 Asphalt Cement

310.07.05.01.01 General

When specified in the Contract Documents, the Contractor shall obtain asphalt cement samples according to AASHTO T40 for QA testing.

310.07.05.01.02 Frequency and Location

The asphalt cement sampling frequencies and locations shall be as specified in the Contract Documents. A minimum of one sample shall be randomly chosen for each asphalt cement used on the Contract.

310.07.05.01.03 Labelling

Asphalt cement samples shall be labelled with the following:

- a) Contract number.
- b) Date (i.e., yyyy-mm-dd) and time of sampling.
- c) Performance grade of the asphalt cement.
- d) Supplier's name.
- e) Refinery name.
- f) Waybill number.
- g) Tanker number.
- h) Whether the sample was taken from a delivery tanker or from a storage tank at the plant.
- i) Name and proportions of additives in the asphalt cement.

310.07.05.01.04 Delivery

Samples for the Owner shall be delivered within 4 hours of sampling to the location specified in the Contract Documents.

310.07.05.02 Hot Mix Asphalt

310.07.05.02.01 General

The Contractor is responsible for obtaining QA and referee HMA samples using sample plates for Marshall mixes and other methods approved by the Contract Administrator for Superpave and SMA mixes. The Contractor may obtain a QC sample at the same location of the QA and referee samples. Samples shall be taken in accordance with the Contract Documents under the direction and in the presence of the Contract Administrator. Samples shall be placed in an appropriate container supplied by the Contractor. The Contract Administrator may apply security seals to the samples prior to transportation.

310.07.05.02.02 Frequency and Location

The minimum frequency for sampling and testing shall be as specified in Table 6.

310.07.05.02.03 Labelling

HMA samples shall be labelled with the following:

- a) Contract number.
- b) Location of sampling.
- c) Date (i.e., yyyy-mm-dd) and time of sampling.
- d) Asphalt type.

310.07.05.02.04 Cores

When a coring and testing program is undertaken to resolve a dispute related to HMA compaction, the Contractor shall be responsible for all traffic control required to carry out the coring, obtaining and labelling the core samples, delivery of the samples to a mutually agreed upon third part referee laboratory, and repairing core sample holes.

Cores shall be 150 mm in diameter.

The minimum frequency of sampling and testing shall be as determined by the Contract Administrator.

Core samples shall be labelled with the following:

- a) Contract number.
- b) Location of core sample.
- c) Date (i.e., yyyy-mm-dd) and time of sampling.
- d) Asphalt type.

310.07.05.02.05 Delivery

All samples for the Owner shall be delivered within 4 hours of sampling to the location specified in the Contract Documents.

310.07.05.03 Repair of Sampling Locations

HMA and compaction requirements for filling all sample holes shall be the same as the adjacent undisturbed pavement. All sample holes shall be cleaned, dried, and filled and then compacted using a mechanical, self-powered gas, electric, or air powered compactor immediately after sampling.

310.07.06 Placing Hot Mix Asphalt

310.07.06.01 General

Prior to roller compaction, obvious defects in the HMA material placed shall be corrected. Irregularities in the alignment and grade along the outside edges shall be corrected.

A through lane paving course shall be completed prior to the placement of adjacent side roads, speed change lanes, and other paved areas. For all courses, each adjacent lane shall be completed to approximately the same location at the end of each day's paving.

At the end of each completed portion and prior to opening the lanes to traffic, the completed sections of HMA course shall be ramped transversely to the existing pavement for a minimum distance of 1.5 m. In all cases, the ramps shall not form part of the permanent asphalt pavement and shall be removed prior to continuing paving operations.

The temperature of the HMA prior to placement shall be within the temperature range that corresponds to the PGAC manufacturer's recommended mix temperature.

The temperature of the HMA immediately after spreading and prior to initial rolling shall not be less than 120 °C.

310.07.06.02 Operational Constraints

Paving shall not be carried out if the roadbed is frozen.

The granular grade shall be free of standing water at the time of HMA placement.

The surface of a pavement upon which HMA is to be placed shall be dry at the time of HMA placement. An HMA course shall not be placed on a previously laid course until a minimum 4 hours have elapsed, following final compaction of the previous course, and the temperature of the previous course is 50 °C or less.

Binder courses shall not be placed unless the air temperature at the surface of the road is a minimum of 2 °C and rising.

For surface course, the air temperature at the surface of the road shall be at least 7 °C, except for SMA and Superpave 12.5 FC2, the air temperature at the surface of the road shall be at least 12 °C.

Traffic shall be kept off the SMA surface until it has cooled below 50 °C.

310.07.07 Use of Paving Equipment

Levelling, binder, and surface courses shall be laid by means of mechanical self-propelled pavers.

Pavers working in echelon shall maintain a distance of less than 60 m between them.

The longitudinal alignment of the spreader shall be controlled by the use of a string line placed at each outer edge of the pavement. The spreader shall be directed at all times by the string line and not by the edge of the preceding course, except for the trailing paver when paving in echelon.

The automatic screed controls and all compaction aids on the paver shall be operational while the HMA is being placed, except when placing padding, a levelling course, or paving around appurtenances.

Single pavers or the lead paver when paving in echelon shall be controlled as to longitudinal grade by a 12 m ski or floating beam.

The pavers shall operate continuously at a uniform speed necessary to match the output of the HMA plant. However, in no case shall the speed of the paver exceed 18 m/min.

If the HMA for surface course paving comes from more than one mixing plant, the HMA from each plant shall be placed by a separate paver.

310.07.08 Widening and Irregular Sections

When it is necessary to hand-spread the HMA in sections adjacent to machine-laid areas, such hand-spreading shall be carried out concurrently with machine-laying operations.

a) Widening

The HMA shall be placed in widenings so that the top of the compacted HMA is flush with the top of the existing pavement. When stepped joints are specified in the Contract Documents, the layers placed in the widening shall be placed to the top of each step in separate operations.

HMA shall be placed in the widening using equipment specially designed for this purpose.

b) Irregular Sections

In turn-outs, driveways, and other irregular sections where it is impractical to use machine methods to spread and finish the binder, levelling, or surface courses, the Contractor shall use other spreading equipment or shall spread the HMA by hand.

310.07.09 Hot Mix Asphalt Padding

HMA padding shall be carried out as specified in the Contract Documents.

310.07.10 Hot Mix Asphalt Patching

Prior to HMA patching, temporary patching material shall be removed from the locations designated for such removal in the Contract Documents. The resulting areas shall be filled and compacted with HMA, as specified in the Contract Documents.

The HMA patching material shall be machine laid to the required thickness, grade, and crossfall.

Transverse and longitudinal joints between the existing pavement and the patch shall be perpendicular butt joints formed by a milling process or keyed in, as specified in the Contract Documents.

310.07.11 Longitudinal and Transverse Joints

310.07.11.01 General

All joints shall be made to ensure a full face bond and a smooth riding surface.

Longitudinal and transverse butt or stepped joints between the new HMA pavement and the existing pavement shall be constructed by trimming the existing pavement edge to a straight clean vertical surface of at least 40 mm.

All dirt or other foreign material and all loose material shall be removed from all vertical surfaces.

When matching a compacted joint, the depth of the uncompacted mat shall be set to allow for compaction. The paver screed shall overlap the adjoining mat by no more than 50 mm.

310.07.11.02 Longitudinal Joints

Longitudinal joints shall be properly set up, with the back of a rake or lute, at the proper height and grade prior to rolling, unless the Contractor has demonstrated acceptable joint construction.

For multiple lifts of HMA, the width of subsequent courses shall be staggered to an offset of 150 to 300 mm so that longitudinal joints do not coincide. This shall also apply to the joint between through lanes and speed change lanes and other similar longitudinal joints. The longitudinal joints in the surface course shall correspond to the demarcation between the driving lanes, speed change lanes, and tapers specified in the Contract Documents.

During surface course paving, excess material shall not be cast onto the surface of the freshly laid mat.

When resurfacing against a rigid object, a butt joint shall be constructed by milling the existing pavement to provide an exposed vertical surface of at least 25 mm at the face of the rigid object. The milling shall be feathered out to zero over a minimum length of 1.25 m from and parallel to the exposed face of the rigid object providing a minimum of 40 mm of resurfacing material over the area of removal.

310.07.11.03 Transverse Joints

The paver shall not move more than 15 m from any transverse joint until that joint has been rolled and checked with a straight edge. If the joint is not satisfactory, it shall be corrected immediately before the paver is allowed to proceed.

Joints between HMA pavement laid under this Contract and existing HMA courses not laid under this Contract shall be constructed as follows:

- a) When a binder course is placed flush against an existing HMA pavement and a butt joint is to be made, the existing pavement shall be trimmed back to form a straight vertical surface.
- b) When a surface course is placed flush against an existing HMA pavement, a stepped joint shall be prepared by removing the existing surface course to its full depth for a minimum length of 0.5 m and the remaining face shall be trimmed to form a straight vertical surface.
- c) When a binder course and surface course are not placed flush against an existing HMA pavement, the binder course shall be feathered out and the surface course shall be butt jointed by removing the existing surface course to a minimum depth of 40 mm and for a longitudinal distance not less than 3 m.

310.07.12 Compaction

310.07.12.01 Rolling

310.07.12.01.01 Static Rolling

Compaction shall be accomplished using the minimum combination number of rollers specified in Table 5.

The Contractor shall determine the correct sequence of rollers used for compacting in order to achieve compaction requirements.

The operating speed of steel drum rollers shall not exceed 5 km/h and shall be operated in a manner to avoid undue displacement of the mix. Rollers shall operate with the drive wheel forward in the direction of paving.

Rolling procedures shall be as follows:

a) Breakdown Rolling

The mix shall be uniformly compacted as soon after placing as it can support the roller without checking or undue displacement. Rolling shall start longitudinally at the lower edge and proceed towards the higher edge of the course, overlapping on successive passes. Alternate passes of the roller shall be staggered.

b) Intermediate Rolling

The intermediate roller shall follow the breakdown roller as closely as possible. Passes shall overlap previous passes. The roller shall be operated to prevent pick-up of the HMA on the tires.

c) Finish Rolling

Finish rolling shall start longitudinally at the higher edge and proceed towards the lower edge.

310.07.12.01.02 Vibratory Rolling

For all HMA being compacted on bridge decks, vibratory rollers shall be operated in static mode.

310.07.12.02 Compaction of Irregular Sections and Inaccessible Areas

At all places not accessible to rollers, the mix shall be compacted by mechanical, self-powered gas, electric, or air powered equipment.

310.07.13 Tolerances

After final compaction, each course shall be smooth and true to the established crown and grade. HMA binder and surface courses shall be free from deviations exceeding 6 mm and 3 mm, respectively, as measured in any direction with a 3 m straight edge.

310.07.14 Surface Appearance

Each course after final compaction shall be of uniform texture and shall be free of defects such as segregation, fat spots, oil spills, and roller marks. Defective areas shall be removed and replaced with HMA of the same type and compacted to the satisfaction of the Contract Administrator.

310.07.15 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

310.08 QUALITY ASSURANCE

310.08.01 General

The Contract Administrator is responsible for conducting QA procedures for all HMA aggregates, asphalt cement, and compaction to meet the requirements of the Contract Documents. QA HMA testing shall be conducted at a frequency specified in Table 6 or as specified in the Contract Documents.

Acceptance of hot mix aggregates and asphalt cement shall be according to OPSS 1003 and OPSS 1101, respectively.

All QA testing shall be completed in a certified laboratory that is CCIL Type B and C, or AMRL accredited, or equivalent. Testing of the samples shall be conducted under the direction and constant supervision of technicians certified to perform the QA tests.

The Contract Administrator may reject visually defective HMA areas based on, but not limited to the following defects: flushing, bleeding, segregation, fat spot, surface damage, and surface contamination. Such defective HMA or areas shall be removed from the work and replaced with acceptable HMA.

When the HMA fails to consistently meet the requirements of the Contract Documents, the Contract Administrator may refuse further material until the mix properties are verified for compliance by one of the following methods:

- a) For Marshall mixes, samples shall be used to determine compliance to asphalt cement content, aggregate gradation, air voids, flow, voids in mineral aggregate, and stability requirements.
- b) For Superpave mixes, samples shall be used to determine compliance to asphalt cement content, aggregate gradation, and Superpave mix properties in accordance to AASHTO M323.

310.08.02 Acceptance of Tack Coat Application Rate

Tack coat application shall be visually uniform. Areas of insufficient or non-uniform tack coat coverage shall be re-sprayed. When tack coating is performed using hand held devices, the visual appearance of such areas shall be consistent with the adjacent areas of machine applied material.

310.08.03 Acceptance of Joint Painting Application Rate

The joint painting shall provide a thin, uniform, and continuous coating to the satisfaction of the Contract Administrator.

310.08.04 Aggregate Gradation and Asphalt Cement Content Acceptance

Aggregate gradation and asphalt cement content test results for HMA samples based on LS-282 and LS-292 shall meet the JMF tolerance requirements as specified in Table 7.

If the HMA is deemed borderline for aggregate gradation or asphalt cement content according to Table 7, the Contractor shall be notified in writing by the Contract Administrator and shall take immediate corrective action through process control at the HMA plant. A total of three borderline test results for the same attributes representing up to 5,000 tonnes of HMA production shall result in the work being deemed rejectable.

If the HMA is deemed rejectable according to Table 7, both the Contract Administrator and the Contractor shall review, agree, and identify the limits of rejected HMA that has been placed. Referee samples within the limits of the affected area shall be delivered by the Contractor to a mutually agreed upon third party referee laboratory to verify aggregate gradation or asphalt cement content or both. When the results from the referee samples are deemed rejectable according to Table 7, the HMA pavement shall be removed and replaced with acceptable HMA pavement. Alternatively, the Contract Administrator may accept a guaranteed maintenance bond, an increased maintenance period, or a negotiated price adjustment.

310.08.05 Hot Mix Asphalt Properties Acceptance

Marshall test results for hot mix samples based on LS test procedures shall meet the requirements specified in Table 8. The production air voids for all HMA mixes shall be evaluated according to Table 9.

If the HMA is borderline for air voids as specified in Table 9, the Contractor shall be notified in writing by the Contract Administrator and shall take immediate corrective action through process control at the HMA plant.

If the HMA does not meet Table 8 minimum requirements for Marshall stability or Marshall flow or is deemed rejectable for air voids according to Table 9, both the Contract Administrator and Contractor shall review, agree, and identify the limits of rejected HMA that has been placed. Referee samples within the limits of the affected area shall be delivered by the Contractor to a mutually agreed upon third party referee laboratory to verify Marshall test or air void results or both. When the results from the referee samples do not meet Table 8 minimum requirements or are deemed rejectable according to Table 9, the HMA pavement shall be removed and replaced with acceptable HMA pavement. Alternatively, the Contract Administrator may accept a guaranteed maintenance bond, an increased maintenance period, or a negotiated price adjustment.

310.08.06 Compaction Requirements

310.08.06.01 General

Compaction testing of the placed HMA shall meet the requirements specified in Table 10.

Nuclear density test gauge results shall be used to assess in-place compaction. When compaction test results do not meet the minimum percent compaction specified in Table 10, the Contractor shall be notified in writing and either the affected area of HMA pavement shall be removed and replaced with acceptable HMA pavement or, in the case of a dispute, the Contractor or the Owner may request that a coring and testing program be undertaken to verify compaction percentage of the mix. The cores shall be provided to the Owner and compaction shall be determined according to the Compaction Determined by Core Density Testing clause using a mutually agreed upon third party referee laboratory. When compaction results from core densities do not meet the minimum percent compaction specified in Table 10, the HMA pavement shall be removed and replaced with acceptable HMA pavement.

310.08.06.02 Compaction Determined by Nuclear Density Gauge

Compaction testing shall be conducted randomly at a minimum frequency of every 100 m per lane or 150 m² area.

310.08.06.02.01 Marshall Hot Mix Asphalt

Percent compaction shall be determined by comparing the nuclear density in situ Bulk Relative Density (BRD) according to LS-262 to the average plant produced HMA Maximum Relative Density (MRD) according to LS-264.

310.08.06.02.02 Superpave Hot Mix Asphalt

Percent compaction shall be determined by comparing the nuclear density in situ BRD to the average plant produced HMA MRD both according to AASHTO T209.

310.08.06.03 Compaction Determined by Core Density Testing

310.08.06.03.01 Marshall Hot Mix Asphalt

Density testing of the cores shall be in accordance with LS-287. Percent compaction shall be determined by comparing the core BRD according to LS-262 to the average MRD according to LS-264 of the plant produced HMA.

310.08.06.03.02 Superpave Hot Mix Asphalt

Density testing of the cores shall be according to AASHTO T166. If the percent water absorbed by the specimen is found to exceed 2% by volume as described in AASHTO T166, then the bulk specific gravity shall be according to AASHTO T275, LS-306, or ASTM D 6752. Percent compaction shall be determined by comparing the core BRD to the average MRD both according to AASHTO T209 of the plant produced HMA.

310.09 MEASUREMENT FOR PAYMENT

310.09.01 Actual Measurement

310.09.01.01 Hot Mix Asphalt

Measurement of each type of HMA shall be by mass in tonnes or by area in square metres as specified in the Contract Documents.

310.09.01.01.01 By Mass

When payment is by mass:

All HMA that is delivered to the Work site shall be accompanied by a truck weigh ticket showing the truck number, type of hot mix, Contract number, truck time in and out of the hot mix plant, tare mass to the nearest 50 kg, gross mass to the nearest 50 kg, net mass in kg, and the driver's signature.

The truck weigh ticket shall be printed by an electronic printer interfaced with the truck scale readout and capable of recording the tare mass, gross mass, and net mass. The tare mass for the truck shall include the vehicle, operator, fuel, spare tire, etc. The tare mass of the truck shall be taken at least once per shift.

The Contractor shall be responsible for ensuring that the truck weigh ticket or delivery ticket for each load is handed to the Contract Administrator inspecting the HMA paving operation at the time the delivery truck unloads at the paving site. The Contract Administrator may not accept delivery tickets that are not submitted at the proper time or are submitted in groups after the delivery trucks have left the paving site.

The Contractor shall permit the Contract Administrator to make random checks of the gross mass and tare mass of trucks hauling HMA by requiring them to be driven over an independent certified scale.

310.09.01.01.02 By Area

When payment is by area:

Random pavement cores, maximum 100 mm in diameter, shall be taken to verify the actual thickness approximately every 100 m along the length of the roadway or 300 m² of pavement surface area. The average thickness for a core shall be based on the measurement from each quadrant of the core. The average thickness for the area shall be determined by averaging the core thicknesses.

When the average thickness is more than or equal to 95% of the specified thickness, the payment area shall be the total surface area of the HMA type laid for the course.

When the average thickness is less than 95% of the specified thickness, the surface area for payment purposes shall be calculated as follows:

$$\text{Payment area} = \frac{\text{actual area} \times \text{average thickness}}{\text{specified thickness}}$$

310.09.01.02 Tack Coat

Measurement for tack coat shall be of the area applied in square metres.

310.09.01.03 Hot Mix Asphalt Miscellaneous

Measurement for HMA miscellaneous shall be of the area in square metres, regardless of the number of lifts placed.

310.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

310.10 BASIS OF PAYMENT

**310.10.01 Hot Mix HL (“type”) - Item
Hot Mix HL (“type”) Patching - Item
Heavy Duty Binder Course Mix - Item
Medium Duty Binder Course Mix - Item
Dense Friction Course Mix - Item
Superpave (“type”) - Item
Superpave (“type”) Patching - Item
SMA - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Removal and replacement of the following shall be at no extra cost to the Owner:

- a) Defective areas of HMA, including but not limited to those due to flushing, bleeding, segregation, fat spots, surface damage, and surface contamination.
- b) HMA that does not meet the requirements of the Contract Documents.

Referee testing undertaken to resolve a dispute shall be at no extra cost to the Owner if the referee test results confirm that the HMA does not meet the minimum requirements of Table 8 or is deemed borderline or rejectable according to Table 9.

A coring, testing, and traffic control program undertaken to resolve a dispute shall be at no extra cost to the Owner if the mix compaction is confirmed to be below the minimum specified compaction.

No additional payment shall be made for any delays or costs attributed to verification of the gross mass and tare mass of trucks requested by the Contract Administrator.

310.10.02 Hot Mix Asphalt Miscellaneous - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

310.10.03**Tack Coat - Item**

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Payment for the tack coating of protection board shall be included under the Tack Coat tender item.

Payment for the tack coating of concrete surfaces completed in association with bridge deck waterproofing shall be included in the bridge deck waterproofing item according to OPSS 914.

TABLE 1
Designated Large Sieve for Mix Types

Mix Type	Designated Large Sieve mm
Superpave 25.0	19.0
Superpave 19.0	12.5
Superpave 12.5, 12.5 FC1, and 12.5 FC2, HL 1, HL 3, HL 3F, HL 3HS, DFC, and SMA 12.5	9.5
Superpave 9.5	4.75
Superpave 4.75	2.36
HL 8, MDBC, and HDBC (Note 1)	16.0
HL 4 and HL 4F	13.2
HL 2	2.36
Note:	
1. HDBC is also known as HL 8HS.	

TABLE 2
Requirements for Class S Rollers

Roller	Minimum Mass t	Minimum Mass Per mm Total Roll Width kg
S 1	7	3.5
S 2	9	4.5

TABLE 3
Requirements for Class R Rollers

Roller	Minimum Mass t	Minimum Mass Per Tire kg
R 1	8	900
R 2	18	2,500
R 3	25	3,600

TABLE 4
Requirements for Class V Rollers

Roller	Minimum Roll Diameter m	Minimum Roll Width m	Minimum Static Mass Per mm Total Roll/Tire Width kg
V1	1.00	1.40	2.0
V2	1.20	1.60	2.6
V3	1.40	1.90	2.9

TABLE 5
Maximum Production Rates Per Paver for Combinations of Rollers

Maximum Production t/h	Minimum Roller Combinations	
	Southern Ontario	All Ontario
120	S2 + R1 + S1	S2 + R2 + S1
	V1 + R1	V1 + R2
135	V2 + R1	V1 + R3
	V1 + R2	V2 + R2
150	S2 + 2 x R1 + S1	S2 + 2 x R2 + S1
	S2 + R2 + S1	S2 + R3 + S1
	V2 + R2	
200	V3 + R2	V3 + R2
220	V3 + R3	V3 + R3

TABLE 6
Sampling and Testing Frequency of Hot Mix Asphalt

Quantity Per Day Per HMA Type	Minimum Frequency of Sampling and Testing	Minimum Marshall Sampling Size kg	Minimum Superpave Sampling Size (Note 1) kg
≤ 500 tonnes	One sample	10	20
> 500 and ≤ 1,500 tonnes	One sample per 500 tonnes or part thereof		
> 1,500 tonnes	One sample per 500 tonnes (Note 2), minimum of 3		

Notes:

- One additional 5 kg sample is required for SMA mixes to test for draindown.
- The Contract Administrator may reduce the testing frequency for HMA that is consistently being produced to meet the specification requirements.

TABLE 7
Tolerances for the Job-Mix Formula Aggregate Gradation and Asphalt Cement Content

Mix	Attribute	Tolerances on the Job-Mix Formula (Note 1) %		
		Acceptable	Borderline	Rejectable
Surface Course	DLS, 4.75 mm Sieve size	< 5.0	5.0 to 7.5	> 7.5
	600 µm sieve size	< 3.5	3.5 to 5.0	> 5.0
	75 µm sieve size	< 2.0	2.0 to 3.0	> 3.0
Binder and Levelling Courses	DLS, 4.75 mm sieve size	< 7.0	7.0 to 10.0	> 10.0
	600 µm sieve size	< 4.5	4.5 to 6.0	> 6.0
	75 µm sieve size	< 2.0	2.0 to 3.0	> 3.0
All Mixes	Asphalt Cement Content	< 0.30	0.30 to 0.50	> 0.50

Note:

- Tolerances on the job-mix formula apply as both plus and minus from the job-mix formula percent.

TABLE 8
Marshall Stability and Flow Properties for Hot Mix Asphalt Types

Production Properties and Test Methods	DFC	HL 1, HL 3, HL 3HS, HL 4, HL 8, HDBC, and MDBC	HL 2, HL 3F, and HL 4F
Minimum Marshall Stability: Newtons (N) at 60 °C, LS-261, and LS-263	(Note 1)	(Note 1)	(Note 1)
Marshall Flow at 3.5% Air Voids: LS-261, and LS-263	8.0 minimum	8.0 - 14.0	9.0 - 18.0
Note: 1. Stability requirements shall be according to OPSS 1150.			

TABLE 9
Air Void Criteria for Hot Mix Asphalt Types (LS-265)

Mix	Acceptable %	Borderline %	Rejectable %
DFC	2.5 to 4.5	2.0 to 2.4 and 4.6 to 5.0	< 2.0 and > 5.0
All Other Mixes	3.0 to 5.0	2.0 to 2.9 and 5.1 to 6.0	< 2.0 and > 6.0

TABLE 10
Minimum Pavement Compaction Based on Maximum Relative Density

Mix	Minimum Compaction %
HDBC, Superpave 19.0 and 25.0	91.0
All Other Mixes	92.0

Appendix 310-A, November 2012
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should be aware that excluded from the specification is recycled ratio and Owner specified use of reclaimed asphalt pavement in hot mix asphalt (HMA).

The designer should specify the following in the Contract Documents:

- HMA crossfall, profile, cross-section, and alignment. (310.06.01)
- HMA type requirements. (310.07.01)
- Sampling frequencies and locations for asphalt cement. (310.07.05.01.02)
- Asphalt cement sample delivery location. (310.07.05.01.04)
- Quality assurance (QA) sample requirements. (310.07.05.02.01)
- HMA sample delivery location. (310.07.05.02.04)
- Stepped joints when required. (310.07.08)
- HMA padding requirements. (310.07.09)
- Temporary patching material removal locations. (310.07.10)
- Existing HMA patching locations requirements. (310.07.10)
- Butt joint forming method. (310.07.10)
- Lane demarcation. (310.07.11.02)
- QA HMA testing frequency if different than OPSS 310, Table 6. (310.08.01)
- Unit of measure for each HMA type. (310.09.01.01)

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- Tack coating of surface not listed in this specification and the tack coat application rate for that surface. (310.07.03)

Application rates for tack coat may vary depending on surface characteristics. (310.07.03)

The designer may specify in a special provision when quality control (QC) test results are to be used for acceptance in place of QA test results.

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The designer may consider extending delivery times for samples required on Contracts in remote areas. (310.07.05.01.04)

The designer should be aware that there is a 4 hour delivery requirement for samples and the laboratory should be open to receive them. (310.05.01.04 and 310.07.05.02.05)

The designer may consider specifying a joint heater to address cold joint conditions. (310.06.01)

For smaller projects, the borderline category for tolerances on the job-mix formula in Table 7 may not be appropriate. The designer may consider specifying that all work represented by borderline test results shall be deemed rejectable. (310.08.03.01)

The complete tender item description for HMA should include a “type” of HMA according to Table 1 of OPSS 1150 for Marshall mixes and according to Tables 1 and 2 of OPSS 1151 for Superpave mixes.

For Superpave mixes, the designer should refer to the appropriate lift thickness guidelines according to National Asphalt Pavement Association (NAPA), Information Series 128, HMA Pavement Mix Type Selection Guide, page 10, Figure 5, Recommended Minimum Lift Thickness Ranges for Dense Graded Mixes. Fine and coarse graded mixes as defined using primary control sieves are defined in OPSS 1151.

The designer may refer to the Best Practices for Testing of Superpave Hot Mix Quality Control Samples guidelines developed by the Ontario Superpave Implementation Committee. When the designer is including bonus or penalty clauses or both in relation to OPSS 310, more stringent laboratory procedures should be considered.

In times of volatile asphalt cement prices, on multi-year contracts, and on Contracts with greater than 500 tonnes of machine laid HMA, municipal designers may consider using the MTO PGAC price index for payment adjustment. If the designer wishes to use the PGAC price index, Appendix 310-B should be invoked in the Contract Documents. Appendix 310-B contains information that amends OPSS 310 to include the requirements for using the MTO PGAC price index for payment adjustment on municipal contracts.

The MTO PGAC price index is available on the Ontario Ministry of Transportation website at www.raqs.mto.gov.on.ca, by clicking on Contractor, Contract Bulletin, Asphalt Price Index.

The MTO PGAC price index is only a tool for qualifying hot mix prices and is not intended as a standard asphalt cement price to be incorporated into the contract bid.

The MTO PGAC price index calculation for a given month takes in the average of the 4 weeks of the month and is published on the last day of the month.

If the designer wishes to allow the use of warm mix asphalt, Appendix 310-C should be invoked in the Contract Documents. Appendix 310-C contains information that amends OPSS 310 to include the requirements for using warm mix asphalt on municipal contracts.

The following warm mix asphalt (WMA) processes are available: wax based, chemical based, and foam based.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.

Appendix 310-B, November 2012

FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

Supplemental Requirements for Using the MTO Performance Graded Asphalt Cement (PGAC) Price Index in Municipal Contracts

OPSS 310, Hot Mix Asphalt, is amended as follows:

310.02 REFERENCES

Section 310.02 is modified by the addition of the following to the Ontario Ministry of Transportation Publications:

Contract Bulletin:
Asphalt Price Index

310.10 BASIS OF PAYMENT

Section 310.10 is amended by the addition of the following:

310.10.04 Payment Adjustment for Changes in the MTO Performance Graded Asphalt Cement Price Index

Payment to the Contractor shall be adjusted based on changes to the MTO PGAC price index. The MTO PGAC price index shall be published monthly in the Contract Bulletin. The MTO PGAC price index shall be used to calculate the amount of the payment adjustment per tonne of new asphalt cement accepted into the Work.

The MTO PGAC price index is based on the price, excluding taxes, f.o.b. (free on board) the depots in the Toronto area, of asphalt cement grade PG 58-28 or equivalent. One MTO PGAC price index shall be used to establish and calculate the payment adjustment for all grades. The MTO PGAC price index is published on the last day of the month and shall be applied to the hot mix asphalt placed in the same month.

A payment adjustment per tonne of new asphalt cement shall be established for each month in which paving occurs when the MTO PGAC price index for the month differs by more than 5% from the MTO PGAC price index for the month prior to tender opening. When the MTO PGAC price index differential is less than 5%, there shall be no payment adjustment established for that month. Payment adjustments due to changes in the MTO PGAC price index are independent of any other payment adjustments made to the hot mix asphalt tender items.

The payment adjustment per tonne shall apply to the quantity of new asphalt cement in the hot mix asphalt accepted into the Work during the month for which the payment adjustment is established. A payment adjustment for paving work done after the approved time for completion of the Contract has expired, including the expiration of any extensions of time that have been granted, shall be the lesser of the MTO PGAC price index in the last month of the Contract or the month in which the paving is completed.

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The payment adjustment for the month shall be calculated from one of the following formula:

- a) When I_p is greater than $1.05 I_{TO}$, the payment adjustment per tonne of asphalt cement shall be $(I_p - 1.05 I_{TO})$ and the Contractor shall receive additional compensation of:

$$PA = (I_p - 1.05 I_{TO}) \times \text{quantity of new asphalt cement in tonnes}$$

- b) When I_p is less than $.95 I_{TO}$, the payment adjustment per tonne of asphalt cement is $(.95 I_{TO} - I_p)$ and the Owner receives a rebate of:

$$PA = (.95 I_{TO} - I_p) \times \text{quantity of new asphalt cement in tonnes}$$

where:

- PA = payment adjustment for new asphalt cement, in dollars
 I_{TO} = MTO PGAC price index published for the month prior to Tender opening
 I_p = MTO PGAC price index published for the month in which paving occurs

The quantity of new asphalt cement includes all grades of asphalt cement supplied by the Contractor with and without polymer modifiers. For each month in which a payment adjustment has been established, the quantity shall be calculated using the hot mix quantity accepted into the Work and its corresponding asphalt cement content as required by the job mix formula except for mixes that contain reclaimed asphalt pavement (RAP).

For mixes that contain RAP, the quantity of new asphalt cement shall be determined from the difference between the asphalt cement content required by the job mix formula and the asphalt cement content of the RAP incorporated into the hot mix, as calculated by the Owner.

For mixes containing a liquid anti-stripping additive, the quantity of anti-stripping additive shall be deducted from the quantity of new asphalt cement. No other deductions shall be made for any other additives.

For progress payment purposes, payment adjustments shall be made on the monthly progress payment certificate for the months in which hot mix paving occurs.

Appendix 310-C, November 2012
FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

Supplementary Requirements for Using Warm Mix Asphalt in Municipal Contracts

OPSS 310, Hot Mix Asphalt, is amended as follows:

310.01 SCOPE

Section 310.01 of OPSS 310 is amended by the addition of the following:

This specification covers the requirements for the placement and compaction of warm mix asphalt (WMA) designed using the Marshall or Superpave methods.

310.03 DEFINITIONS

Section 310.03 is amended by the deletion of the definition for Hot Mix Asphalt (HMA) and replaced with the following:

Hot Mix Asphalt (HMA) means hot mixed, hot laid asphaltic concrete and includes mix produced using WMA technologies. The terms are used interchangeably. HMA may include recycled or specialty mixes.

Section 310.03 is amended by the addition of the following:

Warm Mix Asphalt (WMA) means warm mixed, warm laid asphaltic concrete produced using technologies that allow for the mixing, handling, and compaction of the asphaltic concrete mixture at a temperature typically 20 to 50 °C lower than conventional hot mix asphalt.

OPSS 310 is amended by the addition of the following:

310.04 DESIGN AND SUBMISSION REQUIREMENTS

310.04.01 Design Requirements for Warm Mix Asphalt

The Contractor shall be responsible for the following:

- a) Selecting the WMA technology to be used on this Contract from recognized WMA technologies or from the WMA technologies specified in the Contract Documents.
- b) The WMA mix design and the job mix formula at the anticipated WMA production temperature, both of which shall be according to the requirements detailed in the Contract Documents, except as amended by this specification.
- c) Ensuring that, during the development and verification of the WMA mix design, the WMA technology does not adversely affect the asphalt cement performance grade and the WMA mixture performance.

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310.04.02 Submission Requirements for Warm Mix Asphalt

A minimum of 14 Days prior to paving with WMA, the following information shall be submitted to the Contract Administrator in writing:

- a) The name of the WMA technology selected for use on the Contract.
- b) The complete name and address of the WMA technology supplier, if applicable.
- c) Details on how the requirements of this specification shall be met.
- d) If applicable, the type and dosage of WMA additives, how the additives are to be incorporated to produce the WMA, and the WMA technology supplier's established recommendations for usage.

310.05 MATERIALS

Subsection 310.05.01 is deleted in its entirety and replaced with the following:

310.05.01 Warm Mix Asphalt

The materials used in the production of WMA shall be according to OPSS 1150 for Marshall mixes or OPSS 1151 for Superpave and SMA mixes.

The Contractor shall be responsible for the following:

- a) Identifying and using a facility capable of producing the WMA according to the WMA technology supplier's instructions for the use of its WMA technology.
- b) Obtaining from the WMA technology supplier all information required for the proper preparation, handling, storage, and use of the WMA materials, including Material Safety Data Sheets.
- c) Obtaining materials; producing mixes; and the transportation, storage, and use of all materials.
- d) Ensuring that the WMA is produced according to the WMA technology supplier's recommendations to prevent any deleterious effects to the finished product.
- e) Using an anti-stripping additive recommended by the WMA technology supplier when an anti-stripping additive is to be incorporated into the WMA.

The WMA shall be produced within the temperature range recommended by the WMA technology supplier to achieve target compaction in the field and to meet the requirements specified in the Contract Documents.

310.06.02.02 Requirements for Rollers

The last paragraph in clause 310.06.02.02.01, General, is deleted in its entirety and replaced with the following:

The rolls or drums shall be operated according to the WMA technology supplier's requirements to avoid mat segregation or roller pickup or both.

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Subsection 310.07.04 is deleted in its entirety and replaced with the following:

310.07.04 Transportation of Warm Mix Asphalt

The WMA shall be transported from the asphalt plant to the work in leak-proof truck boxes that have been previously cleaned of all foreign materials. If required, truck boxes shall be lightly coated with a uniform application of release agent in accordance with the WMA technology supplier's recommendations. Truck boxes shall be drained after each application and before loading. No release agents shall be used that can adversely affect the quality or performance of the WMA. Release agents shall be used according to the proprietary requirements.

Each truck shall use a tarpaulin of sufficient size to completely cover the load at all times.

310.07.06 Placing Warm Mix Asphalt

310.07.06.01 General

Subsection 310.07.06.01 is deleted in its entirety and replaced with the following:

The Contractor shall provide notice of intent to pave in writing to the Contract Administrator a minimum of 7 Days prior to placing the WMA.

The WMA technology supplier's recommendations for placing the WMA mix shall be followed.

The temperature of the WMA immediately after spreading shall be within the limits identified in Table 11.

Prior to roller compaction, obvious defects in the WMA material placed shall be corrected. Irregularities in the alignment and grade along the outside edges shall be corrected.

A through lane paving course shall be completed prior to the placement of adjacent side roads, speed change lanes, and other paved areas. For all courses, each adjacent lane shall be completed to approximately the same location at the end of each day's paving.

At the end of each completed portion and prior to opening the lanes to traffic, the completed sections of WMA course shall be ramped transversely to the existing pavement for a minimum distance of 1.5 m. In all cases, the ramps shall not form part of the permanent asphalt pavement and shall be removed prior to continuing paving operations.

310.08 QUALITY ASSURANCE

310.08.01 General

Clause 310.08.01 of OPSS 310 is amended by the addition of the following:

When the selected WMA technology requires that additives be added to the asphalt cement, acceptance of the asphalt cement shall be based on the samples that contain the WMA additive. Acceptance of WMA emulsion shall be based on testing the asphalt cement residue obtained from the WMA emulsion.

Appendix 310-C

310.10 BASIS OF PAYMENT

Subsection 310.10.01 is deleted in its entirety and replaced with the following:

310.10.01 **Warm Mix HL ("type") - Item**
Warm Mix HL ("type") Patching - Item
Heavy Duty Binder Course Warm Mix - Item
Medium Duty Binder Course Warm Mix - Item
Dense Friction Course Warm Mix - Item
Superpave Warm Mix ("type") - Item
Superpave Warm Mix ("type") Patching - Item
SMA Warm Mix

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Removal and replacement of the following shall be at no extra cost to the Owner:

- a) Defective areas of WMA, including but not limited to those due to flushing, bleeding, segregation, fat spots, surface damage, and surface contamination.
- b) WMA that does not meet the requirements of the Contract Documents.

Referee testing undertaken to resolve a dispute shall be at no extra cost to the Owner if the referee test results confirm that the WMA does not meet the minimum requirements of Table 8 or is deemed borderline or rejectable according to Table 9.

A coring and testing program undertaken to resolve a dispute shall be at no extra cost to the Owner if the mix compaction is confirmed to be below the minimum specified compaction.

No additional payment shall be made for any delays or costs attributed to verification of the gross mass and tare mass of trucks requested by the Contract Administrator.

Table 11 is added:

TABLE 11
Allowable Limits for WMA Paving Temperature

Minimum Allowable WMA Paving Temperature	Maximum Allowable WMA Paving Temperature
The higher of 60 °C and the minimum temperature recommended by the WMA technology supplier.	The lower of 125 °C and the maximum temperature recommended by the WMA technology supplier.



**CONSTRUCTION SPECIFICATION FOR
ASPHALT SIDEWALK, DRIVEWAY, AND BOULEVARD
AND FOR SIDEWALK RESURFACING**

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311-A	Commentary

311.01 SCOPE

This specification covers the requirements for the construction of asphalt sidewalk, driveway, and boulevard on prepared base and for the resurfacing of existing sidewalk.

311.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

311.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

311.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 510 Removals

Ontario Provincial Standard Specifications, Material

OPSS 1103 Emulsified Asphalt
OPSS 1150 Hot Mix Asphalt

311.05 MATERIALS

311.05.01 Hot Mix Asphalt

The hot mix asphalt (HMA) for this work shall be according to OPSS 1150. The type of HMA shall be as specified in the Contract Documents.

311.05.02 Emulsified Asphalt

The emulsified asphalt shall be undiluted SS-1 according to OPSS 1103.

311.06 EQUIPMENT

311.06.01 Roller

A hand-operated roller weighing not less than 135 kg or a self-propelled roller shall be used.

311.07 CONSTRUCTION

311.07.01 General

The HMA shall be placed on the prepared base or on the surface of the existing sidewalk to the line, grade, dimensions, and thickness shown in the Contract Documents. The prepared base shall be dry, well compacted, and approved by the Contract Administrator before work commences.

HMA shall not be placed unless the surface is dry and the air temperature is at least 7 °C and rising. HMA shall not be placed faster than it can be properly raked and screeded.

Areas inaccessible to a roller shall be compacted with hand operated hot tampers.

The sidewalks, driveways, and boulevards and the resurfaced sidewalks shall not be opened to pedestrians or vehicles until the mix has cooled sufficiently to prevent deformation.

Forms or other approved means shall be used to obtain proper line and neat uniform edges.

311.07.02 Sidewalk Resurfacing

The surface of the existing sidewalk on which asphalt is to be placed shall be thoroughly cleaned. Loose and broken material shall be removed from locations designated in the Contract Documents. Removals shall be according to OPSS 510.

Sound concrete or asphalt surfaces that are to remain shall be uniformly sprayed with emulsified asphalt at the rate of 0.5 kg/m². The emulsified asphalt shall form a continuous film over the surface and shall be allowed to dry until it reaches the required state of tackiness before the resurfacing course is laid.

311.07.03 Tolerances

The surface, after compaction, shall be smooth and true to the established grade and of a uniform texture.

The surface of the finished sidewalk, driveway, and boulevard shall be free from depressions exceeding 5 mm as measured with a 3 m straight edge placed anywhere on the sidewalk, parallel to the centreline.

311.07.04 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

311.09 MEASUREMENT FOR PAYMENT

311.09.01 Actual Measurement

**311.09.01.01 Asphalt Sidewalk
Asphalt Driveway
Asphalt Boulevard
Sidewalk Resurfacing**

Measurement of asphalt placed shall be by area in square metres.

311.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

311.10 BASIS OF PAYMENT

**311.10.01 Asphalt Sidewalk - Item
Asphalt Driveway - Item
Asphalt Boulevard - Item
Sidewalk Resurfacing - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

311.10.02 Hot Mix Asphalt

HMA designated for this work shall be paid for at the Contract price for the appropriate hot mix tender item.

Appendix 311-A, November 2009
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- The type of HMA to be used. The Contract Documents should contain an HMA item for use with this specification. (311.05.01)
- The line, grade, dimensions, and thickness of HMA to be placed. (311.07.01)
- The areas of sidewalk to be removed. (311.07.02)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR ASPHALT CURB AND GUTTER SYSTEMS

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312.09	MEASUREMENT FOR PAYMENT
312.10	BASIS OF PAYMENT

APPENDICES

312-A	Commentary

312.01	SCOPE

This specification covers the requirements for the construction of asphalt curb and gutter, gutter outlets, and spillways.

312.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

312.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

312.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 310	Hot Mix Asphalt
OPSS 314	Untreated Granular, Subbase, Base, Surface Shoulder, and Stockpiling
OPSS 501	Compacting

Ontario Provincial Standard Specifications, Material

OPSS 1103	Emulsified Asphalt
OPSS 1150	Hot Mix Asphalt

312.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Curb and Gutter means asphalt curb, gutter, and combinations of curb with gutter.

Curb and Gutter System means asphalt curb and gutter, gutter outlets, and spillways.

312.05 MATERIALS

312.05.01 Hot Mix Asphalt

The hot mix asphalt (HMA) shall be according to OPSS 1150. The type of HMA shall be as specified in the Contract Documents.

312.05.02 Emulsified Asphalt

The emulsified asphalt shall be undiluted SS-1 according to OPSS 1103.

312.06 EQUIPMENT

312.06.01 Asphalt Paver

An asphalt paver shall be supplied with a template capable of being attached to the paver so that the correct cross-section is provided.

312.06.02 Roller

A hand-operated roller weighing not less than 135 kg or a self-propelled roller shall be used.

312.06.03 Asphalt Curb Machine

An asphalt curb machine shall be supplied with a template attached to the machine so that the correct cross-section is provided.

312.07 CONSTRUCTION

312.07.01 General

HMA placed shall be according to OPSS 310.

The HMA shall be placed on the prepared base to the lines, grade, and dimensions specified in the Contract Documents.

Areas inaccessible to the roller shall be compacted with hand operated hot tampers.

312.07.02 Finishing

After the compacted HMA has cooled to ambient temperature, the exposed surfaces of the asphalt curb and gutter system to 0.15 m beyond the front edge shall be sprayed with emulsified asphalt at a rate of 0.5 kg/m². The emulsified asphalt shall be applied before the surface becomes contaminated by any material that would prevent a proper bond.

312.07.03 Tolerances

The compacted surface shall be of uniform texture and smoothness and true to the established line and grade. The surface of the finished HMA shall be free from depressions exceeding 5 mm, as measured with a 3 m straight edge placed anywhere along the surface of the HMA and parallel to the edge.

312.07.04 Foundation and Backfill

The foundation shall be excavated, backfilled, and compacted to the grade and shape required to allow for placement of the HMA curb and gutter system to the line, grade, and dimension specified in the Contract Documents.

Excavation and embankment construction shall be according to OPSS 206.

Granular base and granular backfill construction shall be according to OPSS 314.

312.07.04.01 Compaction

Compaction shall be according to OPSS 501.

312.07.05 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

312.09 MEASUREMENT FOR PAYMENT

312.09.01 Actual Measurement

312.09.01.01 Asphalt Curb and Gutter

Measurement of curb and gutter shall be by length in metres along the flow line of the gutter. Such measurements shall include the spaces occupied by setbacks, gutter outlets, and frames with grates.

312.09.01.02 Asphalt Spillways

Measurement of asphalt spillways shall be by length in metres along the flow line from the end of gutter outlet to the spillway termination.

312.09.01.03 Asphalt Gutter Outlets

For measurement purposes, a count shall be made of the number of gutter outlets installed, without separation into types, depths, or sizes.

312.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

312.10 BASIS OF PAYMENT

312.10.01 Asphalt Curb and Gutter - Item Asphalt Spillways - Item Asphalt Gutter Outlets - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

312.10.02 Hot Mix Asphalt

HMA designated for this work shall be paid for at the Contract price for the appropriate HMA tender item.

312.10.03 Excavation

Excavation required to set the various components to the required line and grade shall be considered as part of the work of installing the curb and gutter system. When such excavation overlaps excavation required for any other work under the Contract, then payment shall be made in accordance with the specification for such other work as though no excavation were required for curb and gutter construction.

312.10.04 Granular Materials

Granular materials required for the work shall be paid for at the Contract price for the appropriate granular tender item.

Appendix 312-A, November 2009
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- The type of HMA. (312.05.01)
- The lines, grade, and dimensions of the curb and gutter system. (312.07.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 601.010	Asphalt Curb and Asphalt Gutter
OPSD 604.020	90° Asphalt Outlet for Asphalt Gutter
OPSD 605.020	30° and 45° Asphalt Outlet for Asphalt Gutter
OPSD 605.040	Asphalt Spillways



NOTICE TO USERS OF OPSS 313

CONSTRUCTION SPECIFICATION FOR HOT MIX ASPHALT - END RESULT

OPSS 313 has been removed from this
OPS volume and placed in

OPS Volume 5,
Provincial-Oriented
MTO General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.PROV 313

**USE OF THE SPECIFICATION IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**

There is not an OPSS.MUNI 313



NOTICE TO USERS OF OPSS 314

CONSTRUCTION SPECIFICATION FOR UNTREATED SUBBASE, BASE, SURFACE, SHOULDER, SELECTED SUBGRADE, AND STOCKPILING

OPSS 314 has been removed from this
OPS volume

The provincial version of OPSS 314 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 314

The municipal version of OPSS 314 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 314

USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS



CONSTRUCTION SPECIFICATION FOR EXTRUDED EXPANDED POLYSTYRENE FROST HEAVE TREATMENT

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APPENDICES

316-A	Commentary

316.01 SCOPE

This specification covers the requirements for the installation of extruded expanded polystyrene insulation for frost heave treatment of pavements.

316.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

316.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

316.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 314	Untreated Granular Subbase, Base, Surface, Shoulder, and Stockpiling
OPSS 501	Compacting

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1103	Emulsified Asphalt
OPSS 1605	Extruded Expanded Polystyrene Pavement Insulation

316.05 MATERIALS

316.05.01 Extruded Expanded Polystyrene

Extruded expanded polystyrene insulation shall be according to OPSS 1605 and supplied in sheets 600 x 2400 mm.

Grade and compressive strength of the extruded expanded polystyrene insulation shall be as specified in the Contract Documents.

316.05.02 Emulsified Asphalt

The emulsified asphalt shall be undiluted SS-1 according to OPSS 1103.

316.05.03 Tack Coat

Tack coat shall be emulsified asphalt diluted with an equal volume of water.

316.05.04 Granular

Granular base and subbase shall be according to OPSS 1010.

When Granular B is used as backfill, 100% of the material shall pass the 75 mm sieve.

316.07 CONSTRUCTION

316.07.01 General

The site shall be prepared and extruded expanded polystyrene insulation placed and covered with compacted granular material.

316.07.02 Site Preparation

316.07.02.01 Excavation

The excavation shall be carried out to the dimensions specified in the Contract Documents. The tolerance of the earth grade on which the extruded expanded polystyrene is to be placed shall be according to OPSS 206 and the surface shall not deviate by more than 10 mm at any place on a 3 m straight edge.

All protruding material such as cobbles, boulders, and roots exceeding 50 mm in any dimension shall be removed from the surface.

316.07.02.02 Pavement Surface

The pavement surface shall be cleaned of all earth, granular, and any other debris before tack coat is placed.

316.07.03 Placing Extruded Expanded Polystyrene

316.07.03.01 General

Extruded expanded polystyrene sheet treatment shall be placed and secured. The sheets shall be placed lengthwise and parallel to the centreline of the roadway to obtain butt joints and staggered transverse joints. The area to be treated and the insulation thickness shall be as specified in the Contract Documents.

316.07.03.02 Securing

Each sheet of extruded expanded polystyrene may be secured by placing sufficient granular material to ensure that no movement takes place during subsequent operations.

Alternatively, hardwood skewers 10 mm in diameter and 150 mm in length shall be used to secure the extruded expanded polystyrene to the prepared surfaces.

When extruded expanded polystyrene is placed directly on pavement surface, tack coat shall be applied to the existing pavement surfaces to provide a secure bond between the extruded expanded polystyrene and the pavement surface. The tack coat shall be applied at a rate of 0.35 kg/m². The extruded expanded polystyrene shall be placed while the tack coat is still tacky.

316.07.04 Granular Material

Granular base or subbase material shall be placed according to OPSS 314; except, the initial lift of granular material for protection of extruded expanded polystyrene from construction traffic shall be the depth specified in the Contract Documents placed in one lift by end dumping and spreading.

Vehicular traffic shall not be permitted on the extruded expanded polystyrene sections until the full depth of the entire granular base and subbase courses have been placed and compacted according to OPSS 501.

316.07.05 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

316.09 MEASUREMENT FOR PAYMENT

316.09.01 Actual Measurement

316.09.01.01 Extruded Expanded Polystyrene Treatment

Measurement of extruded expanded polystyrene shall be by area in square metres.

316.09.01.02 Tack Coat

Measurement of tack coat shall be by area in square metres.

316.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

316.10 BASIS OF PAYMENT

**316.10.01 Extruded Expanded Polystyrene Treatment - Item
Tack Coat - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

316.10.02 Excavation

Payment for earth and rock excavation shall be according to OPSS 206.

316.10.03 Granular Base and Subbase

Payment for granular base and subbase material placed over the polystyrene shall be according to OPSS 314.

Appendix 316-A, November 2010 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Grade and compressive strength of the insulation. (316.05.01)
- Excavation limits. (316.07.02.01)
- Insulation thickness and area to be treated. (316.07.03.01)
- Depth of the initial lift of granular base or subbase material to be placed over the extruded expanded polystyrene to allow for construction traffic. (316.07.04)

The placing of extruded expanded polystyrene sheets over frost susceptible soil prevents the penetration of frost beyond a predetermined depth. When it is decided to treat a frost heave without excavating, polystyrene is placed right on the surface of the existing pavement and covered with granular.

Typical thicknesses of the extruded expanded polystyrene treatments are 25 mm in Southern Ontario and 40 mm in Northern Ontario. Increasing the thickness of insulation may result in an increased risk of differential icing.

Due to differential icing concerns with extruded expanded polystyrene frost heave treatments, the designer should consider limiting treatment to tangent sections avoiding curves, crests of hills, and intersections.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 514.010	Extruded Expanded Polystyrene Frost Heave Treatment, 25 mm Thickness
OPSD 514.020	Extruded Expanded Polystyrene Frost Heave Treatment, 40 mm Thickness



NOTICE TO USERS OF OPSS 320

CONSTRUCTION SPECIFICATION FOR OPEN GRADED DRAINAGE LAYER

OPSS 320 has been removed from this
OPS volume

The provincial version of OPSS 320 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 320

The municipal version of OPSS 320 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 320

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



NOTICE TO USERS OF OPSS 330

CONSTRUCTION SPECIFICATION FOR IN-PLACE FULL DEPTH RECLAMATION OF BITUMINOUS PAVEMENT AND UNDERLYING GRANULAR

OPSS 330 has been removed from this
OPS volume

The provincial version of OPSS 330 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 330

The municipal version of OPSS 330 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 330

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



NOTICE TO USERS OF OPSS 331

CONSTRUCTION SPECIFICATION FOR FULL DEPTH RECLAMATION WITH EXPANDED ASPHALT STABILIZATION

OPSS 331 has been removed from this
OPS volume

The provincial version of OPSS 331 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 331

The municipal version of OPSS 331 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 331

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



**CONSTRUCTION SPECIFICATION FOR
HOT IN-PLACE RECYCLING AND HOT IN-PLACE RECYCLING
WITH INTEGRAL OVERLAY**

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332.08	QUALITY ASSURANCE
332.09	MEASUREMENT FOR PAYMENT
332.10	BASIS OF PAYMENT

APPENDICES

332-A	Commentary

332.01 SCOPE

This specification covers the requirements for the preparation of the existing pavement surface; heating and scarifying the existing hot mix asphalt (HMA); adding and mixing in one or more of fine aggregates, rejuvenating agent, and beneficiating HMA and redistribution and compaction of the mixture in a single operation.

An HMA overlay is placed as part of the integral overlay process.

332.01.01 Significance and Use of Appendices

Appendices are not a mandatory part of this specification unless invoked by the Owner.

Appendix 332-A is a commentary appendix to provide designers with information on the use of the specification in a Contract.

332.02 REFERENCES

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, General

OPSS 102 Weighing of Materials
OPSS 180 Management and Disposal of Excess Material

Ontario Provincial Standard Specification, Construction

OPSS 313 Hot Mix Asphalt - End Result

Ontario Provincial Standard Specifications, Materials

OPSS 1003 Aggregates - Hot Mix Asphalt
OPSS 1150 Hot Mix Asphalt

Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-100 Rounding-Off of Test Data and Other Numbers
LS-101 Calculation of Per Cent Within Limits
LS-200 Penetration of Bituminous Materials
LS-261 Preparation of Marshall Specimens
LS-265 Percent Air Voids in Compacted Dense Bituminous Pavement Mixtures
LS-284 Recovery of Asphalt from Solution by Abson Method or Rotavapor

Asphalt Institute Publications

Manual Series No. 2, MS-02 Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types

332.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Beneficiating HMA means an HMA designed to assist the final hot in-place recycled mix to conform to material requirements.

Business Day means any Day except Saturdays, Sundays, and statutory holidays.

Heater Scarified Material means the material produced during the heating and scarifying of the existing HMA.

Hot In-Place Recycled (HIR) Mix means the mixture of heater scarified material containing one or more of the following components: fine aggregate, rejuvenating agent, and beneficiating HMA.

Integral Overlay means a conventional HMA placed concurrently prior to compaction over the reprofiled HIR mix.

Rejuvenating Agent means a product designed to be added to the heater scarified material for the purpose of increasing the penetration of the asphalt cement in the HIR mix.

Scarification means the process of uniformly loosening the heated material to the depth specified using mechanical tines or a milling head or both.

332.04 SUBMISSION AND DESIGN REQUIREMENTS

The mix design for the HIR mix shall be submitted in writing for review by the Contract Administrator a minimum of 10 Working Days prior to the start of HIR operations. The submission shall include the following:

- a) The amount, name, manufacturer, and supplier of the rejuvenating agent, fine aggregate, and beneficiating HMA to be used.
- b) The mix proportions, gradation, and source of the materials in the beneficiating HMA, if to be used.
- c) A copy of all calculations that were completed to determine the amount of rejuvenating agent or beneficiating HMA or both to be used.
- d) The air voids laboratory test results and calculations.
- e) A graph of temperature-kinematic viscosity relationship for the combined rejuvenating agent, the recovered asphalt cement present in the existing pavement, and the new asphalt cement in the beneficiating HMA.

332.05 MATERIALS

Materials for HIR mix shall meet the requirements of OPSS 313, except that the Hot Mix Asphalt subsection shall not apply.

332.05.01 Recovered Penetration and Air Voids Requirements

The recovered penetration for the HIR mix produced shall be between 50 and 80 penetration units.

The percent air voids by volume of the HIR mix produced shall be within the range of 2.5 to 5.5%.

332.05.02 Fine Aggregates

The fine aggregates shall be according to the physical requirements for HL 4 Fine Aggregates in OPSS 1003.

332.05.03 Beneficiating Hot Mix Asphalt

The asphalt cement contained in the beneficiating HMA added to the heater scarified material shall be according to OPSS 1150.

The aggregate contained in the beneficiating HMA shall be according to the physical requirements for HL 4 Aggregates in OPSS 1003. Maximum aggregate size contained in the beneficiating HMA shall not exceed the maximum aggregate size of a HL 4 mix.

Reclaimed asphalt pavement shall not be used in the composition of the beneficiating HMA.

The handling, feeding, and drying of aggregates for beneficiating HMA shall be according to OPSS 1003.

The beneficiating HMA shall be produced using equipment according to OPSS 1150. Production of the beneficiating HMA shall be according to OPSS 1150.

332.05.04 Integral Overlay

The integral overlay mix shall be according to the HMA type and layer thickness specified in the Contract Documents.

332.06 EQUIPMENT

332.06.01 Paving Equipment

Requirements for mechanical pavers specified in the Paving Equipment subsection of OPSS 313 shall apply.

Fine aggregates added to the HIR material shall be added using equipment that measures the quantity added by means of a metering system.

332.06.02 Heating Unit

The heating units shall apply heat in a uniform manner to the surface of the existing pavement to be scarified. Direct flame shall not contact the HMA pavement.

The heaters shall be spaced and operated such that sufficient pavement heat penetration to the recycled depth specified in the Contract Documents is obtained to achieve the desired HIR mix temperatures. The pavement shall not be damaged as a result of overheating the asphalt cement and aggregates.

The entire heater assembly shall be designed to be raised or lowered by a single control. The heater assembly shall be adjustable in width from 3.0 to 4.1 m.

332.06.03 Recycling Machine

The recycling machine shall be a self-contained machine specifically designed for hot in-place recycling HMA pavements. Heaters used as part of the recycling machine shall be according to the Heating Unit subsection. The supply of HMA to the recycling machine for an integral overlay and any beneficiating HMA shall be accomplished with no traffic on the uncompacted mat.

The scarifying unit shall be capable of uniformly scarifying the preheated HMA to the depth specified in the Contract Documents and be adjustable in width from 3.0 to 4.1 m.

The scarifier shall have an independent mechanical or hydraulic quick lift device for the purpose of clearing utility maintenance holes and other obstructions in the pavement surface.

The rejuvenating agent storage unit shall be thermostatically controlled and be capable of maintaining the rejuvenating agent at the temperature recommended by the manufacturer.

The spraying system shall supply a uniform spray of rejuvenating agent across the full width of the heater scarified material. The spray bar shall be equipped with drip free nozzles. The system shall incorporate a meter calibrated in ml/m². Delivery of the rejuvenating agent to the spray system shall be by a variable positive displacement pump geared to the speed of the recycling machine or by other means that ensures uniform application proportional to the machines speed. The system shall be capable of dispensing the rejuvenating agent at the specified mix design volume per square metre within a tolerance of $\pm 5.0\%$. The spray shall be protected from the influence of wind by a suitable enclosure.

The blending unit shall be a rotary blending system capable of thoroughly mixing the heater scarified material, fine aggregate, rejuvenating agent, and beneficiating HMA as required to obtain a homogeneous mixture.

When an integral overlay process is selected, the HIR mix shall be uniformly distributed to the required profile and crossfall by the use of reversible augers and a strike-off. The strike-off shall be equipped with an adjustable crown control and each end of the strike-off shall have thickness adjusting screws for providing the required profile and crossfall. The strike-off shall be adjustable in width from 3.0 to 4.1 m.

The final placement of material by the recycling machine shall be uniformly distributed to the required profile and crossfall by the use of reversible augers and a heated vibratory screed. The screed shall be equipped with an adjustable crown control and each end of the screed shall have thickness adjusting screws for providing the required profile and crossfall. For placement of the integral overlay material, the screed may be controlled to the longitudinal grade by a 12 m ski or floating beam. The screed shall be adjustable in width from 3.0 to 4.1 m.

332.07 CONSTRUCTION

332.07.01 Hot In-Place Recycled Mix and Hot In-Place Recycled Mix with Integral Overlay

The work shall meet the requirements of OPSS 313, except that the following in OPSS 313 shall not apply to the Hot In-Place Recycled Mix when placed alone or with an integral overlay:

- a) The Hot Mix Asphalt clause in the Sampling subsection.
- b) Placing Hot Mix Asphalt subsection.
- c) Use of Paving Equipment subsection.
- d) Widening and Irregular Sections subsection.
- e) Field Adjustments to the JMF subsection.

When the Contractor chooses to place the optional overlay, the overlay work shall meet all the requirements of OPSS 313.

332.07.02 Operational Constraints

The hot in-place recycling process shall be carried out between May 15 and October 15, inclusive.

332.07.03 Preparation of Pavement Surface

Materials such as cold mix patching material, crack sealant, and spray patch material shall be removed and disposed of as specified in the Contract Documents, prior to the heating and scarifying process.

332.07.04 Sampling

Samples shall be obtained by the Contractor from the screed or strike-off auger chamber or by coring. Each sample shall be a minimum mass of 10 kg. The Contract Administrator may apply security seals to the samples. When the mass of a sample is less than the desired quantity, the sample shall be discarded and a new one taken immediately.

332.07.04.01 Frequency of Sampling

The sampling frequency for the 10 kg samples shall be two random samples per lot. The Contractor shall deliver the samples to the designated laboratory. When either the process of the HIR mix production or the source of material is changed or terminated, the lot shall be considered to be terminated and the Contract Administrator shall be notified in writing. Minor mix adjustments shall not be considered a change in the process.

332.07.05 Placing Hot In-Place Recycled Mix and Hot In-Place Recycled Mix with Integral Overlay

332.07.05.01 General

The heating and recycling machines shall heat and scarify the HMA pavement across the complete lane width to an average depth of not less than the scarification depth specified in the Contract Documents.

Each successive pass of the HIR machine shall overlap the previously scarified adjacent surface by a minimum of 100 mm with the heaters overlapping an additional 100 mm beyond the section that is scarified.

When testing indicates that the required average depth of heating and scarifying has not been attained, the process shall be immediately corrected. Following the scarifying process, the rejuvenating agent or beneficiating HMA or both shall be added in the amount specified in the mix design. The fine aggregate, rejuvenating agent, and beneficiating HMA shall be mixed with the heater scarified material and the resultant mixture shall be homogeneous.

Areas that are not accessible to the heating and scarifying equipment shall have the HMA removed to a depth that is equal to the scarification depth specified in the Contract Documents. These areas shall be paved with the HMA specified in the Contract Documents for the integral overlay. When an integral overlay is not a requirement, a HMA type shall be as specified in the Contract Documents. The surface of each layer placed and compacted shall be level with the adjacent pavement. The paving of such areas shall be completed prior to the placing of a subsequent course on the HIR mix and as a separate operation from any other paving.

The HIR mix shall be at a minimum temperature of 110°C immediately behind the screed and prior to initial rolling.

332.07.05.02 Placing Hot In-Place Recycled Mix Without Integral Overlay

The HIR mix shall be placed using a heated vibratory screed.

332.07.05.03 Alternate Overlay

The Contractor has the option of placing a 40 mm thick overlay as a separate surface course in lieu of the integral overlay. This alternate overlay shall consist of the same type of HMA specified for the integral overlay.

When the equipment is unable to place an integral overlay or mix design results indicate a beneficiating HMA is required and the equipment is unable to add the beneficiating HMA in addition to placing the integral overlay, a 40 mm overlay shall be placed as a separate course in lieu of the integral overlay specified.

Additional granular shoulder material shall be placed and compacted, as required, to accommodate the new HMA surface.

332.07.06 Requirements of Longitudinal Joints

Longitudinal and transverse joints for HIR mix and HIR mix with integral overlay shall meet the requirements of OPSS 313, except that the following in OPSS 313 do not apply:

- a) Tack Coating of Joints clause.
- b) The first and second paragraphs of the Longitudinal Joints clause.
- c) Transverse Joints clause.

All longitudinal joints at intersecting roads shall be butt joints.

Where the surface of the integral overlay extends up to 25 mm above an adjacent gutter, ramping will be allowed at the gutter. For overlays over 25 mm, the existing pavement shall be milled to provide an exposed gutter face equivalent to the compacted overlay thickness. The pavement removal shall be feathered out to zero thickness along a line a minimum of 1.5 m from and parallel to the exposed face of the gutter to provide for the depth of the overlay material over the area of removal.

332.07.07 Compaction

Compaction for HIR mix and HIR mix with integral overlay shall be according to OPSS 313.

332.07.07.01 Hot In-Place Recycled Mix With Integral Overlay

The HIR mix and the integral overlay mix shall be compacted as a single operation. The acceptance of the compaction for both mixes shall be completed with both mixes being considered as a single layer.

When the Contractor chooses the option to place a 40 mm HMA overlay as a separate surface course in lieu of the integral overlay, the HIR mix and the overlay mix shall be compacted separately. The acceptance of the compaction for both mixes shall be considered as two separate layers.

332.07.07.02 Rolling

Rolling shall be according to OPSS 313.

332.07.08 Determination of Hot In-Place Recycling Scarification Depth

Random tests shall be carried out at mid-lane as follows to determine the depth of scarification:

- a) Four tests will be required for hot in-place recycling and hot in-place recycling with integral overlay for the first 4,000 m² after each days start of operation of the hot in-place recycling equipment.
- b) Two tests shall be done for each subsequent 4,000 m² or portion thereof.

The Contract Administrator shall determine the location of each test.

Holes in the mat that are made during the removal of material for testing shall be filled with appropriate HMA and mechanically compacted.

Testing for the depth of scarification shall be the responsibility of the Contractor.

332.07.09 Testing to Determine Scarification Depth

Testing to determine scarification depth shall be according to the following:

- a) Apparatus
 - i. One circular metal ring with a minimum inside area of 0.1 m² and a minimum depth of 100 mm.
 - ii. One portable balance accurate to 0.1% of the test load and of sufficient capacity to measure the mass of the test sample in one operation.
 - iii. One 5 kg test mass for scale calibration.
 - iv. One metal spoon.
 - v. One smooth metal container of sufficient capacity to hold the test sample.
- b) Procedure
 - i. Set up and level the balance in a firm location protected from the wind.
 - ii. Check the tolerance of the balance with the 5 kg test mass.
 - iii. Obtain the tare mass of the metal container.

- iv. Prior to rolling of the HIR mix, press the circular metal ring manually into the hot in-place recycled mix and integral overlay mix.
- v. Carefully spoon out all the material inside the ring down to the hard unscarified pavement and place the removed material in the metal container.
- vi. Determine the mass of the removed material.
- vii. Clean the metal container, spoon, and ring.

c) Calculation

- i. The scarification depth shall be determined with the following formula.

$$\text{Actual depth of scarification in mm} = 1,000 \times [(M/A) - V - B - C] / E$$

where M = mass of material removed from circular ring, kg.

A = area of test ring, m².

V = mass per m² of integral overlay mix for the thickness specified, kg/m². When using actual distribution rate procedure to calculate overlay thickness, a minimum of 60 tonnes shall be used.

E = mass per m³ of existing HMA pavement, kg/m³.

B = mass per m² of beneficiating HMA added to the HIR mix, kg/m².

C = mass per m² of fine aggregates added to the HIR mix, kg/m². Mass used is to be for the material in a loose dry state.

- ii. Test results shall be determined immediately in the field and reported daily in writing on form OPSP 332-1 to the Contract Administrator and shall include the calculated depth of scarification, contract number, date, and station location and offset from the centreline of the highway for the testing locations.

332.07.10 Management and Disposal of Excess Material

Management and disposal of excess material shall be according to OPSS 180.

332.08 QUALITY ASSURANCE

Quality assurance for HIR mix shall meet the requirements of OPSS 313, except that the following in OPSS 313 do not apply:

- a) The third paragraph of the General subsection in the Quality assurance section.
- b) The Acceptance of Marshall Stability, Flow, and Voids in Mineral Aggregate subsection.
- c) The Acceptance of Performance Graded Asphalt Cement Content and Tack Coat subsection.
- d) The first paragraph of the Lot Size subsection.

Samples shall be used to determine compliance for air voids and recovered penetration.

332.08.01 Acceptance of Scarification Depth

The Contract Administrator shall determine if the hot in-place recycling scarification depth is acceptable based on determination of hot in-place recycling scarification depth tests. Hot in-place recycling scarification depths shall be accepted when the moving average of all groups of four consecutive determination of scarification depth tests are equal to or greater than the depth specified in the Contract Documents.

332.08.02**Lot Size**

Acceptance of hot in-place recycled mixes shall be based on 2,000 m² lots for the first two lots with the remaining lots based on 4,000 m² lots. Lot size may be reduced at the discretion of the Contract Administrator when it is necessary to reduce the lot size because of the sequence of the paving operations.

332.08.03**Acceptance of Air Voids**

When the Contract Administrator performs air void content compliance testing, the testing shall be done in accordance with LS-265 method for briquettes prepared by LS-261 procedures using the Asphalt Institute Manual Series No. 2 using 75 blows per side of test specimen with a manual compaction hammer or a mechanical equivalent.

A moving average of four test results shall be maintained provided that the average remains in the range of 2.5 to 5.5%. All averages shall be reported to one decimal place utilizing the rounding off procedure according to LS-100.

If the moving average of four air void test results is less than 2.5% or greater than 5.5%, the Contractor shall take corrective action to ensure that the air voids return to the acceptable range of 2.5 to 5.5%. When the moving average of four air void test results is less than 2.5% or greater than 5.5%, the next two consecutive test results will be included to determine the average of six results. If the moving average of six test results is less than 2.0% or greater than 5.5%, the HIR mix is rejectable and subject to repair.

332.08.04**Acceptance of Compaction**

Acceptance of compaction shall be according to OPSS 313.

332.08.05**Acceptance of Recovered Penetration**

When the Contract Administrator performs recovered penetration compliance testing, the testing shall be done in accordance with LS-284 and LS-200. Conformance shall be determined on a lot-by-lot basis by testing samples to determine the penetration of the asphalt cement recovered from the HIR mix and comparing the results to the requirements. The Owner will inform the Contractor of the test results for each sample in writing within 7 Business Days commencing the day after the samples have been received at the testing laboratory.

When the mean recovered penetration of a lot, determined by LS-101, is according to the requirements specified in the Contract Documents, the lot will be acceptable for recovered penetration. When the mean recovered penetration of a lot does not conform to the requirements specified in the Contract Documents and the lot mean is within 15 penetration units of the lower or upper limit, the HIR mix shall be considered borderline. When the mean recovered penetration of a lot does not conform to the requirements specified in the Contract Documents and the lot mean is greater than 15 penetration units outside of the lower or upper limit, the HIR mix shall be rejected and subject to repair.

332.08.06**Repairs**

For deficiencies in recovered penetration and air voids, the repair options for all layers placed shall include either of the following:

- a) Processing with hot in-place recycling.
- b) Partial depth removal and replacement to the bottom of the rejected mat.

The surface of the repaired area shall consist of the specified surface HMA.

332.09 MEASUREMENT FOR PAYMENT

332.09.01 Actual Measurement

332.09.01.01 Hot In-Place Recycled Mix and Hot In-Place Recycled Mix With Integral Overlay

Measurement of the existing pavement area to be hot in-place recycled shall be in square metres.

332.09.01.02 Alternate Overlay

The HMA overlay placed as a separate surface course in lieu of the integral overlay shall be weighed for acceptance purposes according to OPSS 102.

The payment quantity P_q shall be in tonnes according to the following formula:

$$P_q = SA - TM$$

where SA = Actual weighed quantity incorporated into the alternate overlay in tonnes.

TM = Theoretical difference in weight in tonnes between the 40 mm separate surface course and the integral overlay depth specified in the Contract Documents.

332.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

332.10 BASIS OF PAYMENT

**332.10.01 Hot In-Place Recycled Mix - Item
Hot In-Place Recycled Mix With Integral Overlay - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

No additional payment shall be made for the work, labour, Equipment, and Material required for the following:

- a) To remove, dispose, and replace pavement not accessible to the heating and scarifying equipment.
- b) To place and compact the HMA type specified for the integral overlay.
- c) For the Contractor to supply, place, and compact the additional alternate overlay HMA and granular shoulder material in lieu of an integral overlay.
- d) For repairs required due to deficiencies in recovered penetration or air voids.

Payment for the HMA overlay placed over the HIR mix to form the integral overlay shall be made at the Contract price for the HMA item designated for the integral overlay.

Payment for the HMA overlay placed as a separate surface course in lieu of the integral overlay shall be made at the Contract price for the HMA item designated for the integral overlay.

For purposes of determining lot sizes and the number of lots for acceptance, the quantity of the overlay to be placed in lieu of the integral overlay shall be used. For purposes of calculating payment adjustments under end result specifications, the lot size and the Contract price for the HMA item designated for the integral overlay shall be used.

No additional payment shall be made for the removal of HMA pavement or for HMA that is required to replace the material removed in areas not accessible to the heating and scarifying equipment.

No additional payment shall be made under this item for HMA required to retrofit partially paved shoulders or for pavement widening. Payment shall be made under the appropriate HMA item.

No additional payment shall be made for repairs required.

DETERMINATION OF SCARIFICATION DEPTH FOR HOT IN-PLACE RECYCLING

Contract No.		Highway		Lot No.		Date Measured	
Region		Item No.		Lot Size		Weather Conditions	

Test No.	Time	Station and Offset from Centreline	Mass of Material, M kg	Mass per m ² of Integral Overlay, V kg/m ²	Mass per m ² of Beneficiating Hot Mix added, B kg/m ²	Mass per m ² of Fine Aggregate added, C kg/m ²	Mass per m ³ of Existing Pavement, E kg/m ³	Scarification Depth mm

A = Area of test ring (m²) = _____

Scarification Depth (mm) = 1,000 x [(M/A) - V - B - C] / E

Note: All entries must be in units specified.

Comments:	Submitted to the Owner's Representative On (date) _____ at (time) _____ Owner Rep. Signature _____ Contractor Rep. Signature _____

OPSF 332-1

Appendix 332-A, Commentary for OPSS 332, April 2004

Note: This appendix does not form part of the standard specification. It is intended to provide information to the designer on the use of this specification in a Contract.

Designer Action/Considerations

Should the designer wish to specify OPSS 310, this specification will require modification.

Specify recovered penetration grade of HIR mix if different than 50 to 80 units specified in the specification. (332.05.01)

The designer should be aware that the current practical maximum depth of scarification is 50 mm and typically averages 40 mm. (332.08.01)

The designer should be aware that the thickness for an integral overlay is typically 20 to 25 mm.

The designer should specify the following in the Contract Documents:

- Depth of scarification. (332.08.01)
- Where an integral overlay is required, the thickness and type of HMA for the integral overlay. (332.05.04)
- Where integral overlay is not a requirement, a HMA type for repairs and areas not accessible to HIR equipment. (332.05.04)
- The quantity of cold mix patching materials, crack sealant, and spray patch material to be removed and document it on quantity sheets and indicate how it is to be disposed of. (332.07.03)
- Where an integral overlay is not a requirement, a HMA type. (332.07.05.01)
- The recycled depth to achieve the desired HIR mix temperatures. (332.06.02)

Any available core data on existing pavement conditions should be included in the bidding documents for information only.

A separate pay item is required for the integral overlay HMA with measurement of payment in tonnes.

Hot in-place recycling is suitable for pavements exhibiting surface pavement distress features and is not recommended for pavements with distress related to structural deficiencies or existing HMA thicknesses less than 70 mm.

Hot in-place recycling Contracts should be tendered such that the HIR work can be carried out between May 15th and October 15th, inclusive.

The specification allows the Contractor to place an alternate 40 mm HMA overlay in lieu of the integral overlay. Additional labour, Equipment, and Material required for this alternate overlay are at the Contractor's expense.

Related Ontario Provincial Standard Drawings

None.



NOTICE TO USERS OF OPSS 333

CONSTRUCTION SPECIFICATION FOR COLD IN-PLACE RECYCLING

OPSS 333 has been removed from this
OPS volume

The provincial version of OPSS 333 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 333

The municipal version of OPSS 333 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 333

USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS



CONSTRUCTION SPECIFICATION FOR COLD RECYCLED MIX

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334-A	Commentary

334.01 SCOPE

This specification covers the requirements for a cold mix paving process incorporating reclaimed asphalt pavement (RAP) from stockpiles. The process includes production and processing of RAP, design and testing, placement, and compaction.

334.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

334.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

334.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 310	Hot Mix Asphalt
OPSS 313	Hot Mix Asphalt - End Result

Ontario Provincial Standard Specifications, Material

OPSS 1102	Liquid Asphalt
OPSS 1103	Emulsified Asphalt

Ministry of Transportation Publications

MTO Laboratory Testing Manual:

- LS-291 Quantitative Extraction of Asphalt Cement and Mechanical Analysis of Extracted Aggregate from Bituminous Paving Mixtures - Ontario Procedure
- LS-300 Preparation of Marshall Specimens for Cold In-Place Recycled Mixture
- LS-306 Bulk Relative Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens

Ontario Traffic Manual (OTM):

Book 7 - Temporary Conditions

SP-024 Manual for the Condition Rating of Flexible Pavements

Field Guide for the Acceptance of Hot Mix and Bridge Deck Waterproofing

334.03 DEFINITIONS

For the purposes of this specification, the following definitions apply:

CCIL means the Canadian Council of Independent Laboratories

Cold Recycled Mix (CRM) means a mix of processed RAP and asphalt modifier produced through a cold mixing process.

Foreign matter means anything other than hot mix aggregate or granular aggregate.

Hot Mix Asphalt (HMA) means hot mixed, hot laid asphaltic concrete. The terms are used interchangeably. HMA may include recycled or specialty mixes.

Reclaimed Asphalt Pavement (RAP) means the processed HMA material that is recovered by partial or full-depth removal.

334.04 DESIGN AND SUBMISSION REQUIREMENTS

334.04.01 Design Requirements

Prior to commencing the work, for mix design purposes, the Contractor shall obtain RAP samples that are representative of the material to be processed. These samples shall be used to establish the design rate of the asphalt modifier as a percentage by mass of the RAP. The design rate of the asphalt modifier shall be a minimum of 1.2%.

The mix design shall be completed by a laboratory with either CCIL Type A certification or equivalent. Each mix design shall include the following:

- a) Information on the type, manufacturer, and supplier of the asphalt modifier.
- b) A copy of the mix design and all calculations performed to determine the mix design.
- c) All calculations performed to determine the design rate of asphalt modifier.
- d) Maximum field rate adjustment allowed to the design rate without adverse affects to mix properties.

334.04.02 Submission Requirements

The mix design shall be submitted to the Contract Administrator a minimum of 7 Days prior to the start of CRM operations.

A new mix design shall be submitted when the asphalt modifier design rate is adjusted by greater than 0.5%. A new mix design shall be submitted if the composition of the existing RAP changes significantly.

334.05 MATERIALS

334.05.01 Reclaimed Asphalt Pavement

The processing operation shall ensure that 100% of the RAP aggregate passes the 26.5 mm sieve. The amount of RAP aggregate passing the 75 μ m sieve shall not exceed 15% by mass. Adequate measures shall be taken to manage the RAP source to ensure consistency and prevent contamination.

RAP containing steel slag or asbestos is not permitted. RAP that has become mixed with foreign matter of any description shall not be used.

334.05.02 Asphalt Modifier

The asphalt modifier shall be emulsified asphalt or liquid asphalt as specified in the Contract Documents.

Emulsified asphalt shall meet the requirements of OPSS 1103 and be either a mixing grade polymer modified high float emulsified asphalt or a mixing grade high float emulsified asphalt, as specified in the Contract Documents.

Liquid asphalt shall be according to OPSS 1102.

334.06 EQUIPMENT

334.06.01 Production and Processing Equipment

Crushing or milling equipment and screening equipment shall be used to generate and process the RAP to the size specified in the mix design. Material shall be handled in such a way as to prevent recompaction of the material before mixing takes place.

334.06.02 Mixing Equipment

The mixing unit shall be capable of producing a uniform thoroughly blended CRM consisting of RAP and asphalt modifier. The RAP feed system to the mixing unit shall be equipped with a means of determining the mass of material being deposited into the mixing unit prior to the addition of the asphalt modifier. The mixing unit shall be capable of continuously maintaining the amount of asphalt modifier added within $\pm 0.2\%$ by weight of the RAP. All measuring devices shall be calibrated according to the manufacturer's specifications at the start of the Contract and whenever deemed necessary by the Contract Administrator.

The asphalt modifier supply system shall identify and display flow and delivery information.

334.06.03 Placing Equipment

Placing of the CRM shall be carried out by means of a self-propelled mechanical paver capable of spreading the mix evenly in front of the screed in one continuous pass to the specified crossfall and grade. The paver shall be equipped with distributing augers for the full width to be paved. The paver shall have a vibratory screed capable of vibrating the full width of mix placed.

334.06.04 Compaction Equipment

The Contractor shall select the appropriate compaction equipment to achieve the required compaction.

334.06.05 Drying Unit

The drying unit shall be specifically designed to provide radiant heat to the CRM mat. Open flame heating shall not be used. The entire heater assembly shall be capable of readily adjusting the intensity of heat on the pavement surface.

334.06.06 Straight Edge

A 3 m commercially made metal straight edge is required. The straight edge shall have a level recessed in its upper surface, parallel to the lower edge.

334.06.07 Pilot Vehicle

The pilot vehicle shall be according to the requirements of the OTM, Book 7.

334.07 CONSTRUCTION

334.07.01 Operational Constraints

The placing of CRM shall not be carried out when the ambient temperature is less than 10 °C or when the overnight low is forecast to be less than 2 °C. After September 1st, written approval must be obtained from the Contract Administrator prior to CRM paving.

The work shall be carried out when the roadway is clean and free of standing water. CRM shall not proceed during periods of rain.

The wearing surface shall not be placed on the CRM mat until the following requirements have been met:

- a) The CRM mix has been allowed to cure for a minimum of 14 Days.
- b) The average in situ moisture content of the CRM is 2% or less with no test value greater than 3% immediately prior to placing the wearing surface.
- c) The specified density has been achieved.
- d) All defective areas in the CRM mat have been repaired to the satisfaction of the Contract Administrator.

The wearing surface shall be placed within 30 Days of placing the CRM mat, provided the CRM mix meets the requirements of this specification.

All traffic, including construction traffic, shall be kept off the freshly placed CRM mat until it is able to carry traffic without damage. The Contractor shall be responsible for repair of the damaged CRM mat.

334.07.02 Mixing

The asphalt modifier shall be added at the design rate. The rate of addition of asphalt modifier may be adjusted as required to within 0.5% of the design rate or to the maximum field rate adjustment of the design rate allowed according to the mix design, whichever is less, to produce a uniformly coated CRM mix that can be compacted to the required density.

334.07.03 Compaction

The CRM shall be compacted to a minimum of 96% of the laboratory bulk relative density as determined by the submitted mix design, according to LS-300.

CRM that cannot be compacted to the required density shall be removed and replaced according to Table 1.

334.07.04 Surface Appearance

The compacted CRM surface shall be smooth and conform to the crossfall and grade specified in the Contract Documents. The surface of the CRM mat shall be of uniform texture and free of segregation, longitudinal streaks, fat spots, oil spills, roller marks, and other defects.

334.07.05 Drying

Prior to the placement of the wearing surface, the Contractor may elect to use a drying unit. Overheating or burning of the CRM shall not be allowed.

334.07.06 Sampling

334.07.06.01 General

The Contract Administrator may apply security seals to the samples taken for Quality Assurance (QA) testing.

All samples, including those handled by a commercial carrier, shall be accompanied by a sample data sheet and any additional documents as specified elsewhere in the Contract Documents. Where not specified or not included on the sample data sheet, samples shall be delivered with a transmittal form identifying the following information:

- a) Contract Number.
- b) Name of Contractor, name of contact person and telephone numbers.
- c) Name of Contract Administrator, and telephone numbers.
- d) Quantity and type of sample. When a sample consists of more than one item, each item shall be individually identified.
- e) Date sampled.
- f) Date shipped.
- g) Sample, lot and subplot number.
- h) Sample location.

The Contractor may carry out quality control sampling and testing of the CRM mat.

Holes resulting from the removal of samples shall be repaired according to the sampling provisions of OPSS 310 or OPSS 313, as appropriate to the Contract, using surface course HMA or other material approved by the Contract Administrator.

334.07.06.02 Compaction

After initial compaction, a minimum of three samples of the compacted CRM shall be obtained by the Contractor, at random locations as determined by the Contract Administrator, for each full day or partial day of production. These samples shall be used for compaction testing.

Samples shall be removed intact from the pavement in sufficient quantities to carry out testing according to the MTO Laboratory Testing Manual.

334.07.06.03 Moisture Content

At least 4 Business Days prior to the planned overlay of the CRM mat, the Contractor shall obtain 2 slab samples of the CRM mix for each subplot taken at random locations, as directed by the Contract Administrator.

The moisture content shall be determined in accordance with LS-291. The Contractor shall test one of the duplicate samples and the other shall be delivered to the testing laboratory designated in the Contract Documents.

Each sample shall be dry cut 150 x 150 mm and removed intact from the pavement. It shall be packaged to protect sample integrity, appropriately labelled, sealed in waterproof containers, and delivered by the Contractor in good condition to the designated testing laboratory within 24 hours of sampling.

If a sample condition is found to be unsuitable for testing by the laboratory, the Contractor will be notified immediately by the Contract Administrator to resample that location.

334.07.06.04 Asphalt Modifier

Samples of the asphalt modifier used in the mix, shall be obtained, labelled, properly identified, and delivered within 5 Business Days of sampling to the testing laboratory designated in the Contract Documents. Each sample of material shall be a minimum of 2 full four-litre containers.

Samples shall be taken at the job site from each tanker load of material. Each sample shall be taken after a minimum of 4,000 kg has been drawn from the tanker, from a sampling spigot on the transfer line, if available, or from the end of the transfer line.

The sample containers supplied by the Contractor shall be new triple tight epoxy lined pails or suitable leak-proof plastic containers. The sample labels shall be obtained from the Contract Administrator.

334.07.07 Traffic Convoy

When specified in the Contract Documents, the Contractor shall convoy traffic according to the OTM, Book 7.

The pilot vehicle shall guide one-way traffic through or around construction. The maximum speed of the convoy shall be 30 km/h. Convoying shall be maintained until such time as the CRM mat is able to carry traffic without damage.

334.07.08 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

334.08 QUALITY ASSURANCE

334.08.01 General

The Contract Administrator shall reject all visually defective material, mix, or work according to Table 1. Such defective material, mixture, and work shall not be incorporated into the finished work.

QA testing shall be carried out at a laboratory currently certified by CCIL with Type A or Type B certification or equivalent. Samples shall be used to determine compliance for moisture content and compaction. Acceptance criteria shall be based on the lot mean computed from QA test results for each subplot within the lot.

If a tested sample fails to meet the Contract requirements, the Contractor shall be notified of the failure by the Contract Administrator within 24 hours of the Contract Administrator receiving the information.

334.08.02 Lot Size

A lot shall consist of a single day's production of CRM processed to a given mix design. Each lot shall be divided into a minimum of 3 equal sublots of 5,000 m² or smaller.

334.08.03 Surface Tolerance

After compaction, the surface of the CRM mat shall be free from deviations exceeding 6 mm, as measured in any direction with a 3 m straight edge.

334.08.04 Acceptance Criteria for Moisture Content

The moisture content shall be determined according to LS-291. The mean moisture content for each lot shall be less than 2.0% with no subplot moisture content exceeding 3.0%.

334.08.05 Acceptance Criteria for Compaction

The compaction of the CRM mix shall be determined according to LS-306. Each lot of CRM mix shall be compacted to a minimum mean of 96.0% of the target density established for the mix with no subplot result falling below 95.0%.

334.08.06 Asphalt Modifier

The supplied emulsified asphalt samples shall be according to OPSS 1103 for the particular type and grade, when tested according to the test methods specified.

The supplied liquid asphalt samples shall meet the requirements of OPSS 1102 for the particular type and grade, when tested according to the test methods specified.

Failure of the sample to conform to any of the material requirements shall be cause for rejection of the material. The CRM that has incorporated asphalt modifier represented by the failed test result shall be unacceptable and remedial measures up to and including removal and replacement of the deficient mix shall be negotiated with the Contract Administrator.

334.08.07 Repair of Unacceptable Cold Recycled Mix Mat

The CRM mat that is unacceptable shall be repaired or removed and replaced as specified in Table 1. Repairs shall be for the full width of recycling to the depth specified in Table 1. Removal shall be for the full depth and lane width of recycling. Reprocessing may be considered as a repair method, upon submission of a proposal by the Contractor and approval by the Contract Administrator.

334.09 MEASUREMENT FOR PAYMENT

334.09.01 Actual Measurement

334.09.01.01 Cold Recycled Mix

Measurement of the CRM placed shall be by area in square metres.

334.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

334.10 BASIS OF PAYMENT

334.10.01 Cold Recycled Mix - Item

Payment at the Contract price for the above items shall be full compensation for all labour, Equipment, and Material to do the work.

Asphalt modifier is included in the cold recycled mix item.

Samples found to be unsuitable for testing upon delivery to the laboratory shall be resampled at no cost to the Owner.

Repair to or removal and replacement of unacceptable CRM mat shall be carried out at no cost to the Owner.

HMA required to replace unacceptable CRM material shall be at no cost to the Owner.

TABLE 1
Unacceptable CRM Mix and Required Repairs

Deficiency Type	Severity	Required Repair
Ravelling/Coarse Aggregate Loss (Note 1)	Very Slight to Slight	No action required.
	Moderate to Severe	Mill 50 mm and replace with same HMA to be used on surface course or an acceptable HMA as specified in the Contract Documents.
	Very Severe	Remove all CRM material and replace with same HMA to be used on surface course or an acceptable HMA as specified in the Contract Documents.
Segregation (Note 2)	Slight to Medium	No action required.
	Severe	Mill 50 mm and replace with same HMA to be used on surface course or an acceptable HMA as specified in the Contract Documents.
Moisture content could not be achieved as per the Acceptance Criteria for Moisture Content subsection.	N/A	Remove all CRM material in the subplot represented by the test and replace with CRM or the same HMA to be used on surface course or an acceptable HMA as specified in the Contract Documents.
Compaction could not be achieved as per the Acceptance Criteria for Compaction subsection.	N/A	Remove all CRM material in the subplot represented by the test and replace with CRM or the same HMA to be used on surface course or an acceptable HMA as specified in the Contract Documents.
Notes: 1. Deficiency and severity definitions according to SP-024. 2. Deficiency and severity definitions according to Field Guide for the Acceptance of Hot Mix and Bridge Deck Waterproofing. A. The HMA shall be placed in compacted lift thicknesses between 40 and 75 mm.		

Appendix 334-A, November 2007
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Type of asphalt modifier (i.e., emulsified asphalt or liquid asphalt modifier). (334.05.02)
- Type of wearing surface. (334.07.01)
- Crossfall and grade. (334.07.04)
- Location of testing laboratory. (337.07.06.01, 334.07.06.02, 334.07.06.03, 334.07.06.04)
- Replacement HMA to be used. (334.08.07)

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- The emulsified asphalt as either a mixing grade polymer modified high float emulsified asphalt or a mixing grade high float emulsified asphalt. (334.05.02)
- Traffic convoy requirements. (334.07.07)

CRM can be a cost-effective paving material for structural improvement of low volume roads.

CRM is susceptible to moisture intrusion and ravelling, and must be sealed with a wearing surface. Typically, cold recycled mix is overlain with a surface treatment or single lift hot mix overlay. For higher traffic volume application, multiple lifts of hot mix may be considered.

Designer should be aware of when setting up quantities, due to the variability of RAP, field adjustment of the quantity of asphalt modifier may be required.

Currently, there is no standardized mix design methodology for CRM.

Designer should address the issue of RAP ownership and quality of RAP during the preparation of contract specifications. Identify who owns the RAP and who is responsible for RAP quality.

CRM contracts should be tendered to allow for placement in warm summer months to achieve proper curing of the CRM mat.

A single contract incorporating placement of CRM and wearing surface is recommended.

Since payment for the CRM is by the square metre, the designer should ensure that grade preparation is part of the CRM contract.

A tack coat is recommended prior to surfacing CRM with HMA.

When specifying liquid asphalts, the designer should consider the environmental aspects of the product.

Appendix 334-A

Contract scheduling should allow for CRM paving and follow-up wearing surface placement to be completed within the time and temperature operational constraints.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

None



NOTICE TO USERS OF OPSS 335

CONSTRUCTION SPECIFICATION FOR COLD IN-PLACE RECYCLING WITH EXPANDED ASPHALT

OPSS 335 has been removed from this
OPS volume

The provincial version of OPSS 335 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 335

The municipal version of OPSS 335 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 335

USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS



CONSTRUCTION SPECIFICATION FOR MICRO-SURFACING

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336.01 SCOPE

This specification covers the requirements for micro-surfacing and includes all surface preparation, material application, tack coating, handwork, joints, protection while curing, clean up, and trial area.

336.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

336.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

336.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 710 Pavement Marking

Ontario Provincial Standard Specifications, Material

OPSS 1001	Aggregates - General
OPSS 1003	Aggregates - Hot Mixed Asphalt
OPSS 1103	Emulsified Asphalt
OPSS 1301	Cementing Materials

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-200	Penetration of Bituminous Materials
LS-202	Kinematic Viscosity of Asphalt
LS-216	Determination of Residue by Distillation of Emulsified Asphalts
LS-601	Materials Finer than 75 µm Sieve in Mineral Aggregates by Washing
LS-602	Sieve Analysis of Aggregates
LS-609	Petrographic Analysis of Coarse Aggregate
LS-625	Guidelines for Sampling of Granular Materials

Ontario Traffic Manual (OTM):

Book 7 - Temporary Conditions

SP-024 Manual for Condition Rating of Flexible Pavements

MTO Forms:

PH-CC-449a	Aggregate Test Data - Hot Mix Asphalt - Physical Properties, Fine Aggregate
PH-CC-449b	Aggregate Test Data - Hot Mix Asphalt - Physical Properties, Coarse Aggregate
PH-CC-449c	Aggregate Test Data - Hot Mix Asphalt - Superpave Consensus Properties

ASTM International

D 36-95 (2000)e1 Softening Point of Bitumen - Ring and Ball Apparatus

International Slurry Surfacing Association (ISSA)

TB-100-90	Test Method for Wet Track Abrasion of Slurry Surfaces
TB-109-90	Test Method for Measurement of Excess Asphalt in Bituminous Mixtures by Use of a Loaded Wheel Tester and Sand Adhesion
TB-113-90	Trial Mix Procedure for Slurry Seal Design
TB-114-90	Wet Stripping Test for Cured Slurry Seal Mix
TB-139-90	Test Method to Classify Emulsified Asphalt/Aggregate Mixture Systems by Modified Cohesion Tester Measurement of Set and Cure Characteristics
TB-144-90	Test Method for Classification of Aggregate Filler - Bitumen Compatibility by Schulze-Breuer and Ruck Procedures
TB-147-90	Test Methods for Measurement of Stability and Resistance to Compaction, Vertical and Lateral Displacement of Multi-layered Fine Aggregate Cold Mixes - Method A

336.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Appurtenances mean maintenance holes, catch basins, valve chambers, and water valve covers and similar Utility access covers located within the paved portion of the roadway.

Micro-Surfacing means a pavement surfacing composed of polymer-modified asphalt emulsion, high quality aggregate, mineral filler, and water.

Rut Filling means a layer of micro-surfacing placed on the existing pavement using a rut box on the longitudinal wheel path rut.

Scratch Coat means a layer of micro-surfacing placed on the existing pavement prior to placing a surface coat.

Siliceous Aggregates means rock particles containing or composed of silica (SiO_2) or minerals with silica in the crystal structure as silicate (SiO_4).

Surface Coat means a layer of micro-surfacing laid on a scratch coat or directly on the existing pavement.

336.04 DESIGN AND SUBMISSION REQUIREMENTS

336.04.01 Design Requirements

336.04.01.01 Mix Design

A laboratory equipped and staffed to carry out micro-surfacing mix designs shall designate the mix proportions and prepare the job mix formula.

The compatibility of the aggregate and the polymer modified emulsified asphalt shall be confirmed by the laboratory designing the mix.

All component materials used in the mix design shall be representative of the material to be used on the Contract.

Micro-surfacing material shall only be placed after the Contract Administrator has issued confirmation in writing within 5 Business Days that the mix design has been reviewed and meets the specified requirements.

The mix design proportions shall be within the following limits.

Residual Asphalt:

6.0 to 11.5% by dry mass of aggregate

Mineral Filler:

0 to 3.0% by dry mass of aggregate

The micro-surfacing material shall be designed to carry traffic within one hour of placement.

336.04.02 Submission Requirements

336.04.02.01 Mix Design

Two weeks prior to the start of micro-surfacing, the mix design shall be submitted in writing to the Contract Administrator together with the results of the tests listed in Table 1.

336.04.02.02 Submission of Test Data

The Contractor shall provide Quality Control (QC) test results of all aggregates and filler used in the Work from a laboratory meeting the requirements of the Laboratory Requirements clause. Test results showing complete conformance with the physical property requirements of this specification shall be provided to the Contract Administrator at the time of submission of the mix design.

QC test results shall be submitted using MTO forms PH-CC-449a, PH-CC-449b, or PH-CC-449c as applicable. Test data forms must be legible and signed by the testing laboratory representative. Faxed copies are acceptable providing the original is submitted to the Contract Administrator within 5 Business Days following receipt of the fax.

Only aggregate sample test data obtained from stockpiled material to be used in the Work and tested within the past 14 months shall be submitted.

336.04.02.03 Laboratory Requirements

An acceptable laboratory conducting tests for physical properties or consensus properties shall be one that holds a certificate from the Canadian Council of Independent Laboratories (CCIL) as Type D for the applicable test methods and also participates in the annual MTO Proficiency Sample Testing Program.

An acceptable laboratory conducting tests for LS-601 and LS-602 shall be one that holds a valid certificate from CCIL as Type C. Testing for LS-601 and LS-602 shall be conducted by qualified laboratory staff who hold a valid certificate from CCIL in aggregate testing. Testing for LS-609 shall be conducted by a person holding a valid certificate from CCIL showing them qualified in petrographic examination.

Equivalent alternate laboratory and technician certifications or laboratory proficiency sample testing programs may be used to demonstrate similar requirements, provided they are acceptable to the Owner.

336.05 MATERIALS

336.05.01 Polymer Modified Emulsified Asphalt

The emulsified asphalt shall be CSS-1H emulsion according to OPSS 1103 with a quick set polymer modifier and meeting the requirements of Table 2.

The polymer modifier shall be a minimum of 3% polymer solids by mass of asphalt cement residue in the emulsion.

The emulsion shall be homogeneous after mixing. To facilitate sampling and testing, the emulsion shall be stable for 14 Days after delivery to the job site. The polymer material shall be milled or blended into the asphalt cement or blended into the emulsifier solution prior to the emulsification process. The addition of polymers or other additives after the manufacture of the polymer modified emulsified asphalt is not permitted.

336.05.02 Aggregates

Aggregates shall be according to OPSS 1001.

Aggregates shall meet the requirements of Table 3. Aggregates for micro-surfacing Type II shall meet the requirements for a high traffic volume application.

Aggregates shall meet the gradation requirements of Table 4.

336.05.03 Mineral Filler

Mineral filler shall be Portland cement, Type GU, according to OPSS 1301.

336.05.04 Water

The water shall be free of harmful salts and contaminants.

336.05.05 Mix Additives

Additives shall be compatible with the other components of the micro-surfacing mix.

336.05.06 Tack Coat

Tack coat shall be the same polymer modified emulsified asphalt used in the micro-surfacing mix and diluted to 1 part emulsion to 3 parts water by volume.

336.06 EQUIPMENT

336.06.01 Rotary Power Brooms

Rotary power brooms shall be capable of cleaning gravel, sand, dirt, and other debris from the roadway surfaces.

336.06.02 Mixing Equipment

The mixing equipment shall be specifically designed and manufactured to mix and place micro-surfacing material. Materials shall be mixed by an automatic sequenced, self-propelled, continuous flow micro-surfacing mixing machine. The mixing unit shall be capable of accurately delivering and proportioning the aggregate, emulsified asphalt, mineral filler, additives, and water to a revolving multi-blade double shaft mixer and discharging the mixed product in a continuous flow. The mixing equipment shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, additives, and water to maintain an adequate supply to meet mix design proportions.

336.06.03 Proportioning Devices

Individual volume or weight controls for proportioning aggregate, mineral filler, emulsified asphalt, additives, and water to be added to the mix shall be provided and properly marked.

336.06.04 Spreading Equipment

The mix shall be spread uniformly by means of a conventional augured surfacing spreader box attached to the mixing machine and equipped with paddles to agitate and spread the mix evenly throughout the box. A front seal shall be provided to ensure no loss of the mix at the pavement contact point. The rear seal shall act as final strike-off and shall be adjustable. The spreader box and rear strike off shall be designed to ensure that a uniform consistency is achieved to produce a free flow of material to the rear strike-off. The spreader box shall be equipped with a suitable means to adjust the box to compensate for variations in the pavement geometry. Rut filling spreader boxes shall be specifically designed for rut filling applications.

The spreading equipment shall be capable of being re-supplied with the micro-surfacing materials within the working lane to continuously place micro-surfacing for a minimum 2-lane-km distance. The machine shall be equipped to allow the operator to have full control of the forward and reverse speeds during application of the micro-surfacing.

336.06.05 Pilot Vehicle

The pilot vehicle shall be according to the requirements of the OTM, Book 7.

336.07 CONSTRUCTION

336.07.01 Operational Constraints

Micro-surfacing shall be placed only when the atmospheric temperature is at least 10 °C and rising and the weather is free of fog or rain and there is no forecast of temperatures below 0 °C within 24 hours from the time of application. The mix proportions shall be adjusted when weather conditions prolong opening to traffic beyond one hour.

Micro-surfacing shall commence no earlier than May 15 and shall be completed no later than September 30.

Traffic, including construction traffic, shall be kept off the freshly placed mixture to prevent damage to the surface and vehicles.

The Contractor shall delineate the centreline with short term pavement markings at the end of each Day of micro-surfacing placement. Short term pavement markings shall be according to OPSS 710.

336.07.02 Trial Area

A trial area 100 m in length and one lane wide shall be placed at the commencement of the micro-surfacing operation to demonstrate the ability to produce micro-surfacing in conformance with this specification. Within 1 hour of placement, the Contract Administrator shall inspect the micro-surfacing for conformance. The trial areas shall be repeated until the micro-surfacing meets the requirements of this specification. The location of the trial area shall be approved by the Contract Administrator.

336.07.03 Surface Preparation

The area to be surfaced shall be thoroughly cleaned using a rotary power broom to remove all sand, dirt, and other debris. Areas inaccessible to a rotary power broom shall be manually cleaned.

Existing crack sealing material shall be removed.

Existing durable pavement markings shall be removed.

Existing pavement surfaces to receive micro-surfacing shall be tack coated. Surfaces to be tack coated shall be free of standing water and contamination, such as mud, loose aggregate, and debris. Tack coat shall be applied at a rate of 0.25 to 0.40 kg/m² as determined by the Contractor based on the condition of the existing pavement surface. Tack coating shall be allowed to cure sufficiently before application of micro-surfacing.

Tack coat shall not be applied to existing pavement surfaces specified in the Contract Documents. Where tack coating is not required, water shall be applied to the pavement surface immediately ahead of the spreader to dampen the pavement surface without allowing any free-standing or free-flowing water.

All roadway appurtenances within the area of micro-surfacing shall be properly covered and protected immediately prior to placement of the micro-surfacing.

336.07.04 Mix Application

Micro-surfacing shall be placed as a scratch and surface coat or a surface coat only, as specified in the Contract Documents.

Additives may be added to the micro-surfacing mix during construction to provide control of the quick-set properties and to increase adhesion.

A sufficient amount of the mixture shall be carried in all parts of the spreader box at all times so that complete coverage is obtained. Water used to spray the spreader box to facilitate spreading shall not harm the mix. Lumping, balling, or unmixed aggregate shall not be permitted in the finished surface. Any oversized aggregate or foreign materials shall be screened from the aggregate prior to delivery to the mixing equipment.

The application rates for individual coats of micro-surfacing shall meet the requirements of Table 5.

Wheel track ruts of 13 mm or greater in depth shall be filled independently with micro-surfacing using a rut-filling spreader box prior to the application of other micro-surfacing. Ruts greater than 25 mm shall be filled with micro-surfacing applied with two passes of the rut filling spreader box. All rut-filling material shall cure under traffic for at least a 24-hour period before additional material is applied. The minimum width of a rut filling micro-surfacing application shall be 1.5 metres.

When specified, micro-surfacing shall be applied as a scratch coat to fill ruts less than 13 mm in depth, cracks and shallow potholes to leave a uniform surface.

336.07.04.01 Handwork

In restricted areas where hand spreading is necessary, adjustments to the mix formula may be made to retard the setting time. The mixture shall be placed along one edge of the surface to be covered and spread uniformly with squeegees or other suitable Hand Tools.

336.07.04.02 Appearance

Following placement, the micro-surfacing shall have a uniform texture free from excessive scratch marks, tears, indentations, or other surface irregularities. Tear marks or other surface irregularities in any 12 m² area per lane are considered excessive if there are:

- a) four or more marks ≥ 12 mm wide and ≥ 100 mm long.
- b) any marks ≥ 25 mm wide and ≥ 25 mm long.

There shall be no transverse ripples or longitudinal streaks of 6 mm or greater in depth when measured by placing a 3 m straight edge over the finished surface in any direction.

The edges of the micro-surfacing shall be finished uniformly, with a neat appearance along the roadway centreline, lane lines, shoulder, pavement edge, and curb lines.

336.07.04.03 Documentation

A summary of the quantity and application rate of micro-surfacing placed and a list of the quantities used for each of the mix components (i.e., aggregate, emulsified asphalt, water, mineral filler, and additive) shall be submitted daily to the Contract Administrator.

A summary of the station-to-station limits, quantity, and application rate of the tack coat shall be submitted daily to the Contract Administrator.

336.07.04.04 Joints

The longitudinal and transverse joints shall be neat and uniform in appearance, with no excessive build-up. Longitudinal joints shall be placed on lane lines.

The longitudinal joints in the scratch coat shall be constructed as a butt joint.

The longitudinal joint in the surface course shall have an overlap of 50 to 100 mm.

336.07.05 Clean Up

All areas not to be micro-surfaced, such as shoulders, ditches, and gutters, shall have the micro-surfacing material removed on a daily basis.

Appurtenances shall be free of micro-surfacing and left in operable condition.

336.07.06 Traffic Convoy

The Contractor shall convoy traffic according to the OTM, Book 7.

The pilot vehicle shall guide one-way traffic through or around construction. The maximum speed of the convoy shall be 30 km/h. Convoying shall be maintained until such time as the micro-surfacing mixture is able to carry traffic without damage.

336.07.07 Repairs

All repairs to address appearance deficiencies described in the Appearance clause shall consist of an additional application of micro-surfacing for the full lane width over the length of deficiency.

The length of repair shall be sufficient to eliminate all appearance deficiencies. If the distance between repair areas is less than 3 m, then the adjacent repairs shall be treated as one repair.

336.07.08 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

336.08 QUALITY ASSURANCE

336.08.01 Sampling and Testing

Sampling shall be conducted by the Contractor according to LS-625. Quality assurance (QA) samples shall be taken from stockpiles of aggregate to be used in the Work. Sampling locations shall be determined by the Contract Administrator.

Duplicate samples shall be obtained and sealed by the Contractor in the presence of the Contract Administrator. One of the duplicate samples shall be randomly selected for testing by the QA laboratory and the remaining sealed sample shall be retained by the QA laboratory for possible referee testing. In the event that the Contractor is unavailable to take the sample, no further material shall be placed in the Work until the QA sample has been taken. Samples shall be of sufficient mass of the material to conduct the necessary gradation and physical property tests.

All QA samples shall be delivered by the Contractor, within 24 hours of sampling, to a location specified in the Contract Documents.

Notwithstanding the requirements for QA sampling as indicated in this specification, the Owner reserves the right to obtain a QA sample at any time without notice.

336.08.02 Warranty Requirements

336.08.02.01 Warranty Period

The Warranty Period shall be 24 months.

336.08.02.02 Completion of Warranty Period

At the end of the Warranty Period, the work shall meet the provisions of the Performance Requirements clause in order for the Contractor to be released from responsibility and ensure return of the performance bond or letter of credit or certified cheque.

336.08.02.03 Distress Survey

The Owner shall complete a distress survey in accordance with the severity and density definitions provided in SP-024 after the end of 1 year and a second distress survey a minimum of 45 Days prior to the end of the Warranty Period. The results of both surveys shall be sent to the Contractor.

If the Owner determines that the distresses pose a hazard to the travelling public at any time during the Warranty Period, the Contractor shall be required to make the repairs in accordance with this specification within 2 weeks of being notified. Repairs shall be made to the approval of the Owner.

336.08.02.04 Performance Requirements

At the end of the Warranty Period, the micro-surfacing shall be free from any aggregate loss or ravelling that is slight to very severe and from flushing that is moderate to very severe. The density of flushing that is very slight to slight shall not be greater than intermittent.

If the micro-surfacing does not meet these performance requirements, the necessary repair or replacement methods shall be according to Table 6. Repairs shall be made to the approval of the Owner.

The length of repair shall be sufficient to eliminate all surficial defects as described. If the distance between repair areas is less than 3 m, then the adjacent repairs shall be treated as one repair.

336.09 MEASUREMENT FOR PAYMENT

336.09.01 Actual Measurement

336.09.01.01 Micro-Surfacing Type II Micro-Surfacing Type III Modified Micro-Surfacing Type III

Measurement of the micro-surfacing placed shall be by area in square metres.

336.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

336.10 BASIS OF PAYMENT

336.10.01 Micro-Surfacing Type II - Item Micro-Surfacing Type III Modified - Item Micro-Surfacing Type III - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

All costs associated with repairing and replacing unacceptable trial areas shall be borne by the Contractor.

The accepted trial area shall be paid for at the Contract unit price for micro-surfacing.

Repair, removal, disposal, and replacement of any damaged or defective micro-surfacing shall be at no extra cost to the Owner.

Any work requirements, as determined by the distress survey for repair or replacement of micro-surfacing, shall be completed at no extra cost to the Owner.

All costs for handling and delivery of samples shall be the responsibility of the Contractor.

TABLE 1
Mix Design Requirements

Test Method	Description	Requirements
ISSA TB-139	Wet cohesion - @ 30 minutes min. (Set) - @ 60 minutes min. (Traffic)	12 kg-cm minimum 20 kg-cm minimum
ISSA TB-109	Excess asphalt by LWT sand adhesion	538 g/m ² maximum
ISSA TB-114	Wet stripping	90% minimum
ISSA TB-100	Wet track abrasion loss-one hour soak Loss-six day soak	538 g/m ² maximum 807 g/m ² maximum
ISSA TB-147 Method A	Lateral displacement Specific gravity after 1000 cycles of 57 kg	5% maximum 2.10 maximum
ISSA TB-144	Classification compatibility	(AAA, BAA) 11 Grade Points minimum
ISSA TB-113	Mix time @ 25 °C	Controllable to 120 seconds minimum

TABLE 2
Tests on Residue

Test Method	Description	Requirements
LS-216	Residue by distillation	62% by mass minimum
ASTM D 36	Softening point	57 °C minimum
LS-200	Penetration at (25 °C, 100 g, 5 s)	40 - 90
LS-202	Kinematic Viscosity @ 135 °C	650 mm ² /s minimum

TABLE 3
Micro-Surfacing Coarse and Fine Aggregates Requirements

Micro-Surfacing Type	Application	Physical Requirements as Specified in OPSS 1003
II	Low Traffic Volume	Superpave 12.5
II	High Traffic Volume	Superpave 12.5 FC1
III Modified	N/A	Superpave 12.5 FC1
III	N/A	Superpave 12.5 FC1
Note: A. Aggregates meeting the physical requirements of Superpave 12.5 aggregates shall be produced from quarried bedrock consisting of 100 % siliceous aggregate determined in accordance with LS-609.		

TABLE 4
Gradation Requirements

Percent Passing, LS-602			
MTO Sieve Designation	Micro-Surfacing Type II	Micro-Surfacing Type III Modified	Micro-Surfacing Type III
9.5 mm	100	100	100
6.7 mm	--	95-100	--
4.75 mm	90-100	80-95	70-90
2.36 mm	65-90	50-75	45-70
1.18 mm	45-70	33-55	28-50
600 µm	30-50	25-40	19-34
300 µm	18-30	15-30	12-25
150 µm	10-21	7-20	7-18
75 µm	5-15	5-15	5-15

TABLE 5
Micro-Surfacing Single Layer Application Rates

Micro-Surfacing Type	Application Rate kg/m²
Type II	5 to 11
Type III and Type III Mod	8 to 16

TABLE 6
Micro-Surfacing Repair and Replacement Methods

Surface Defects	Severity	Density	Repair/Replacement Method
Flushing	Very slight to slight	Frequent to throughout	Resurface with one layer of micro-surfacing for a full lane width
	Moderate to very severe	Few to throughout	Removal by milling of all flushed areas for a full lane width and replace with two layers of micro-surfacing.
Aggregate Loss / Ravelling	Slight to moderate	Few to throughout	Resurface with one lift of micro-surfacing for a full lane width.
	Severe to very severe	Few to throughout	Fill in delaminations/potholes with micro-surfacing and resurface with two layers of micro-surfacing.
Note: A. Surface defect definitions according to SP-024.			

Appendix 336-A, November 2009 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

Micro-surfacing is a thin wearing course that seals the pavement surface and improves frictional resistance. Micro-surfacing does not address structural deficiencies.

The designer should specify the following in the Contract Documents:

- Any existing pavement surfaces not requiring tack coat. (336.07.03)
- If the application is to be one or two coats (i.e., scratch and surface or only surface). (336.07.04)
- Location of testing laboratory for sample delivery. (336.08.01)
- Type of micro-surfacing. (336.10.01)

If verbal confirmation of the mix design review and compliance is acceptable or no mix design review is required, the designer should consider deleting the requirement for the Contract Administrator to issue confirmation in writing that the mix design has been reviewed and meets the specified requirements. (336.04.01.01)

For projects with extensive intersection and urban work, the designer should consider deleting the requirement for equipment capable of continuous placement operations and allowing for a truck mounted unit. (336.06.04)

Crack sealant is typically removed prior to micro-surfacing when the crack sealant shows signs of deterioration or debonding. Crack sealant that has been in place less than 1 year can interfere with the micro-surfacing operations. For projects with existing crack sealant, the designer should determine if the crack sealant should be left in place and if so, delete the requirement for the removal of the existing crack sealing material. (336.07.03)

If a thick scratch coat is anticipated, the designer may consider deleting the requirement for tack coat. (336.07.03)

For projects with ruts greater than 13 mm, the designer should consider specifying the locations for the use of a rut-filling spreader box, including the locations for 2 passes of the rut filling spreader box. (336.07.04) When the average rut depth is greater than 20 mm, the designer should consider requiring a coarse aggregate gradation (Type III gradation) for rut fill mix.

For projects where a traffic convoy is not feasible or desired, the designer should consider deleting the requirement for a traffic convoy. (336.07.06)

If the forms in Appendices 336-B, 336-C, or 336-D are to be used for submission purposes rather than the MTO forms, they need to be invoked by reference in the Contract Documents and a special provision should be written to delete the MTO forms from the specification.

Typically two coats (i.e., scratch and surface coats) are specified to remove severe surface defects.

Appendix 336-A

Type II micro-surfacing with Superpave 12.5 quality aggregate is used on local residential streets and low volume arterial and collectors. Type II micro-surfacing with Superpave 12.5 FC1 quality aggregate is used on higher volume arterials and collectors. Type III micro-surfacing is used on freeways and other high speed, high volume roads. Type III Modified micro-surfacing is used in lieu of Type III micro-surfacing to reduce traffic generated noise.

Micro-surfacing should be carried out in warm dry weather.

Micro-surfacing should be carried out between May 15 and September 30.

Routing and crack sealing should not be carried out prior to micro-surfacing.

Quality of micro-surfacing is critically dependent on appropriate mix design, equipment, and construction experience.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.

Appendix 336-B, November 2009

FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

Hot Mix Asphalt Fine Aggregate Test Data - Physical Properties

Municipality:		Consultant:	
Contract Name:			
Contract No.:	Contractor:	Contract Location:	
Testing Laboratory:		Telephone No.:	Fax No.:
Sampled by:		Date Sampled:	___ QC
Mix Type:	Lot No.:	Quantity (tonnes):	QA: ___ Stockpile ___ Cold Feed
Source Name:			Aggregate Inventory No.:

Laboratory Test and Number	Requirement			Test Result		
	SMA, DFC, OFC, & Superpave 12.5FC2	HL1, HL3, & Superpave 12.5FC1	HL2, HL4, HL8, HDHC, MDHC, & Superpave 9.5, 12.5, 19.0, 25.0, 37.5	Reference Material	Sample	Meets Requirement (Y/N)
Micro-Deval Abrasion loss, % maximum, LS-619 (Note 1)	15	20	25			
Plasticity Index, maximum, LS-704	0	0	0			
Note: 1. For blended aggregates sampled from the cold feed, the Micro-Deval Abrasion loss of each individual fine aggregate in stockpile, prior to blending, shall not exceed 35 percent.						

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Appendix 336-C, November 2009
FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

Hot Mix Asphalt Coarse Aggregate Test Data - Physical Properties

Municipality:		Consultant:	
Contract Name:			
Contract No.:	Contractor:	Contract Location:	
Testing Laboratory:		Telephone No.:	Fax No.:
Sampled by:		Date Sampled:	___QC
Mix Type:	Lot No.:	Quantity (tonnes):	QA: ___Stockpile ___Cold Feed
Source Name:			Aggregate Inventory No.:

Requirement: HL1, SMA, DFC, OFC, and Superpave 12.5FC1, 12.5FC2						Test Result		
Laboratory Test and Number	Gravel	Quarry Rock				Reference Material	Sample	Meets Requirements (Y/N)
	HL1 & 12.5FC1 only	Dolomitic Sandstone (D)	Traprock, Diabase & Andesite (T)	Meta-Arkose & Gneiss (M)	Rock Type (Note 1)			
Wash Pass 75 µm Sieve, % maximum, LS-601 (Note 2)	1.0	1.0	1.0	1.0				
Absorption by mass, % maximum, LS-604	1.0	1.0	1.0	1.0				
Flat and Elongated Particles (4:1), % maximum, LS-608	15	15	15	15				
Petrographic Number (HL), maximum, LS-609	120	145	120	145				
Insoluble Residue, retained 75 µm Sieve, % minimum, LS-613	-	45	-	-				
Unconfined Freeze Thaw Loss, % maximum, LS-614	6	7	6	6				
2 Faces Crushed Particles, % minimum, LS-617 (HL1 only)	80	-	-	-				
Micro-Deval Abrasion Loss, % maximum, LS-618	5	15	10	15				

Appendix 336-C

Requirement: HL3, HL3HS, HL4, HL8, HDBC, MDBC, and Superpave 9.5, 12.5, 19.0, 25.0, 37.5						Test Result		
Laboratory Test and Number	HL3 & HL3HS	HL4 Surface & 12.5 (Note 3)	HL4 Binder, HL8, & 9.5, 19.0, 25.0, 37.5	HDBC	MDBC	Reference Material	Sample	Meets Requirements (Y/N)
Wash Pass 75 µm Sieve, % maximum, LS-601 (Note 4)	1.3/2.0	1.3/2.0	1.3/2.0	1.3/2.0	1.3/2.0			
Absorption by mass, % maximum, LS-604	1.75	2.0	2.0	2.0	2.0			
Percent Crushed Particles, % minimum, LS-607 (Note 5)	60 / 80	60 / 80	60 / 80	-	-			
Flat and Elongated Particles (4:1), % maximum, LS-608 (Note 6)	20	20	20	15	15			
Petrographic Examination, % non-carbonate ret 4.75 mm, LS-609	(Note 7)		-	-	-			
Unconfined Freeze-Thaw loss, % maximum, LS-614	6	6	15	15	15			
2 Faces Crushed Particles, % minimum, LS-617 (Note 8)	-	-	-	95	80			
Micro-Deval Abrasion loss, % maximum, LS-618	17	17	21	21	21			
MgSo ₄ Soundness loss, % maximum, LS-606 (Note 9)	12	12	15	15	15			

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Notes:

- Enter the type of rock or material used in the mix as follows:
D - dolomitic sandstone
T - traprock, diabase, andesite
M - meta-arkose, gneiss
- HL1, SMA, DFC, OFC and Superpave 12.5FC1, 12.5FC2 only: When control charts (n>20) are used for LS-601, the average value shall not exceed the specification maximum (1.0%) with no single value greater than 1.4%.
- These physical requirements for HL4 apply where the asphaltic concrete forms the surface upon which vehicular traffic will directly travel, otherwise, the physical requirements for HL4 Binder apply.
- HL3, HL4, HL8, HDBC, MDBC and Superpave 9.5, 12.5, 19.0, 25.0, 37.5 only: When control charts (n>20) are used for LS-601, the average value shall not exceed 1.3% with no single value greater than 1.7%. When quarried rock is used, a maximum of 2.0% passing the 75 µm sieve is permitted. When control charts (n>20) are used for LS-601 for quarried rock, the average value shall not exceed 2.0%, with no single value greater than 2.4%.
- HL3, HL4, HL8, HDBC, MDBC only: For hot mix aggregates used on 400 series highways and Highways 3, 6, 7, 10, 11, 12, 17, 26, 28, 35, 61, 69, 102, and 115, the minimum percent crushed particles is 80%.
- For Superpave 9.5, 19.0, 25.0, and 37.5 only: Where HDBC and MDBC mixes have historically been used, this requirement is reduced to 15%. Check Contract Documents for this requirement.

Appendix 336-C

7. This requirement is applicable to surface course aggregates in the area to the north and west of a boundary defined as follows: the north shore of Lake Superior, the north shore of the St. Mary's River, the south shore of St. Joseph Island, the north shore of Lake Huron easterly to the north and east shore of Georgian Bay (excluding Manitoulin Island), along the Severn River to Washago and a line easterly passing through Norland, Burnt River, Burleigh Falls, Madoc, and hence easterly along Highway 7 to Perth and northerly to Calabogie and easterly to Arnprior and the Ottawa River.
 - a. When the coarse aggregate for surface course mix is obtained from a gravel pit or quarry containing more than 40% limestone and dolostone in the retained 4.75 mm portion of the coarse aggregate, then blending with aggregate of non-carbonate rock type shall be required. The blend shall be such as to increase the non-carbonate rock type content of the coarse aggregate to 60% minimum of the retained 4.75 mm portion, as determined by petrographic examination (LS-609). The method of blending shall be such as to produce uniform blending and shall be subject to approval by the Owner. In cases of dispute, the acid insoluble residue test shall be used (LS-613) with a minimum acid insoluble residue of 60%.
 - b. When the coarse aggregate for surface course mix is obtained from a non-carbonate source, blending with carbonate rocks (Limestone and dolostone) shall not be permitted.
8. This only applies to HDBC and MDBC coarse aggregate crushed from gravel sources. Maximum allowable amount of uncrushed particles is 5% (MDBC only).
9. Compliance with this requirement is waived if the aggregate meets the alternative unconfined freeze-thaw requirement (LS-614).

Appendix 336-D, November 2009
FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

Hot Mix Asphalt Superpave Aggregate Test Data - Consensus Properties

Municipality:		Consultant:	
Contract Name:			
Contract No.:	Contractor:	Contract Location:	
Testing Laboratory:		Telephone No.:	Fax No.:
Sampled by:		Date Sampled:	___QC
Mix Type:	Lot No.:	Quantity (tonnes):	QA: ___Stockpile ___Cold Feed
Source Name:			Aggregate Inventory No.:

FINE AGGREGATE								
Source Name/Location:						Aggregate Inventory Number (AIN):		
Laboratory Test and Number		Requirement					Test Result	
		Traffic Level Category					Sample	Meets Requirements (Y/N)
		A	B	C	D	E		
Uncompacted Voids, % minimum, AASHTO T304	≤100 mm (Note 1)	-	40	45	45	45		
	>100 mm (Note 1)	-	40	40	40	100/100		
Sand Equivalent, % minimum, AASHTO T176 (Notes 2, 3)		-	40	40	40	45		

COARSE AGGREGATE								
Source Name/Location:						Aggregate Inventory Number (AIN):		
Laboratory Test and Number		Requirement					Test Result	
		Traffic Level Category					Sample	Meets Requirements (Y/N)
		A	B	C	D	E		
Fractured Particles, % minimum, ASTM D 5821 (Note 3)	≤100 mm (Note 1)	55/-	75/-	85/80	95/90	100/100		
	>100 mm (Note 1)	-	50/-	60/-	80/75	100/100		
Flat and Elongated particles (5:1), % minimum, ASTM D 4791		-	10					

Appendix 336-D

Notes:

1. Denotes the depth of the top of lift below final pavement surface. If less than 25% of a layer is within 100 mm of the surface, the layer may be considered to be below 100 mm.
2. This requirement is waived for total fine aggregate containing RAP.
3. A minimum uncompacted void content of 43% is acceptable provided that the selected mix satisfies the mix volumetrics specified elsewhere in the Contract Documents.
4. 85/80 denotes that 85% of the coarse aggregate has one fractured face and 80% has two or more fractured faces.

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CONSTRUCTION SPECIFICATION FOR SLURRY SEAL

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APPENDICES

337-A	Commentary

337.01	SCOPE

This specification covers the requirements for slurry seal and includes all surface preparation, material application, handwork, joints, protection while curing, clean up, and provision for a trial area.

337.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

337.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

337.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Material

OPSS 1001	Aggregates - General
OPSS 1003	Aggregates - Hot Mix Asphalt
OPSS 1103	Emulsified Asphalt
OPSS 1301	Cementing Materials
OPSS 1302	Water

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:
LS 602 - Sieve Analysis of Aggregates

Ontario Traffic Manual (OTM):
Book 7 - Temporary Conditions

ASTM International

D 3910-07 Standard Practices for Design, Testing and Construction of Slurry Seal

International Slurry Surfacing Association (ISSA)

TB 106-90	Measurement of Slurry Seal Consistency
TB 109-90	Test Method for Measurement of Excess Asphalt in Bituminous Mixtures by Use of a Loaded Wheel Tester and Sand Adhesion
TB 114-90	Wet Stripping Test for Cured Slurry Seal Mix
TB 115-90	Determination of Slurry System Compatibility
TB 139-90	Test Method to Classify Emulsified Asphalt/Aggregate Mixture Systems by Modified Cohesion Tester Measurement of Set and Cure Characteristics

337.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Appurtenances mean maintenance holes, catch basins, valve chambers, and water valve covers and similar Utility access covers located within the paved portion of the roadway.

Slurry Seal means a homogeneous mixture of emulsified asphalt, fine aggregates, water, mineral filler, and, if required, additive. This mixture is applied in a cold fluid state on a prepared bituminous surface.

337.04 DESIGN AND SUBMISSION REQUIREMENTS

337.04.01 Design Requirements

A laboratory that is equipped and staffed to carry out slurry seal mix designs with, as a minimum, a current CCIL Type C Certification or an equivalent laboratory shall designate the mix proportions and prepare the job mix formula.

The compatibility of the aggregate and the emulsified asphalt shall be confirmed by the laboratory designing the mix.

All component materials used in the mix design shall be representative of the material to be used on the Contract.

Slurry seal shall only be placed after the Contract Administrator has issued confirmation in writing that the mix design has been reviewed and meets the specified requirements.

The mix design proportions shall be within the following limits:

Residual Asphalt:

Slurry Seal - Type I	10 to 16% by dry mass of aggregate
Slurry Seal - Type II	7.5 to 13.5% by dry mass of aggregate
Slurry Seal - Type III	6.5 to 12% by dry mass of aggregate

Mineral Filler:

0.5 to 2.0% by dry mass of aggregate

The slurry seal material shall be designed to carry traffic within 4 hours of placement.

337.04.02 Submission Requirements

337.04.02.01 Mix Design

Two weeks prior to the start of the slurry seal operation, the mix design shall be submitted in writing to the Contract Administrator together with the results of the tests listed in Table 1.

337.05 MATERIALS

337.05.01 Emulsified Asphalt

The emulsified asphalt shall be specially designed for slurry seal work and shall meet the requirements of OPSS 1103.

337.05.02 Aggregates

The aggregates shall be according to Table 2 and OPSS 1001. The aggregate shall meet the physical requirements of Superpave 12.5 mix for the traffic category specified in the Contract Documents according to OPSS 1003, except that the maximum absorption for coarse aggregate shall not be more than 1.75%.

337.05.03 Mineral Filler

Mineral filler shall be Portland cement, Type GU, according to OPSS 1301.

337.05.04 Water

The water shall be free of harmful salts and contaminants.

337.05.05 Mix Additives

Additives may be added to the slurry seal mix during construction to provide control of the quick-set properties and to increase adhesion. Additives shall be compatible with the other components of the slurry seal mix.

337.05.06 Tack Coat

Tack coat shall be the same emulsified asphalt used in the mix and diluted to 1 part emulsion to 3 parts water by volume.

337.06 EQUIPMENT

337.06.01 Rotary Power Brooms

Rotary power brooms shall be capable of cleaning gravel, sand, dirt and other debris from the roadway surfaces.

337.06.02 Mixing and Spreading Equipment

Mixing equipment shall be specifically designed and manufactured to mix slurry seal material.

Spreading equipment shall be designed to apply a fine mist of water on the road surface immediately prior to placement of slurry seal.

The spreading equipment shall also have a spreader box and rear strike-off and be designed and operated to ensure that a uniform consistency is achieved and to produce a free flow of material to the rear strike-off. The spreader box shall be equipped with a suitable means to adjust the box to compensate for variations in the pavement geometry. The spreader box shall be capable of spreading slurry in one pass at varying widths up to 3.75 m.

337.06.03 Proportioning Devices

Individual volume or weight controls for proportioning aggregate, mineral filler, emulsified asphalt, additives, and water to be added to the mix shall be provided and properly marked.

337.06.04 Pilot Vehicle

The pilot vehicle shall be according to the requirements of the OTM, Book 7.

337.07 CONSTRUCTION

337.07.01 Operational Constraints

Slurry seal shall be placed only when the atmospheric temperature is at least 10 °C and rising and the weather is free of fog or rain and there is no forecast of temperatures below 0 °C within 24 hours from the time of application.

Slurry seal shall commence no earlier than May 15 and shall be completed no later than September 30.

Traffic, including construction traffic, shall be kept off the freshly placed mixture to prevent damage to the surface.

337.07.02 Trial Area

A trial area 100 m in length and one lane wide shall be placed at the commencement of the slurry seal operation, to demonstrate the ability to produce slurry seal according to this specification. Within 4 hours of placement, the Contract Administrator shall inspect the slurry seal for conformance. The trial area shall be repeated until the slurry sealing meets the requirements of this specification. The location of the trial area shall be approved by the Contract Administrator.

337.07.03 Surface Preparation

The area to be surfaced shall be thoroughly cleaned using a rotary power broom. Areas inaccessible to the rotary power broom shall be cleaned manually.

Existing durable pavement markings shall be removed.

When specified in the Contract Documents, all existing pavement surfaces to receive slurry seal shall be tack coated. Surfaces to be tack coated shall be free of standing water and contamination, such as mud, loose aggregate, and debris. Tack coat shall be applied at a rate of 0.25 to 0.40 kg/m² as determined by the Contractor based on the condition of the existing pavement surface. Tack coating shall be allowed to cure sufficiently before application of slurry seal.

All roadway appurtenances within the area to receive slurry seal shall be properly covered and protected immediately prior to the placement of the slurry seal.

337.07.04 Mixture Application

Slurry seal shall be placed according to the application rates specified in Table 3.

337.07.05 Handwork

Areas which cannot be reached with the slurry seal spreading equipment shall be surfaced using hand squeegees to provide complete and uniform slurry seal coverage. The area to be hand worked shall be lightly dampened prior to slurry seal placement and the slurry seal applied concurrent with adjacent machine applied slurry seal.

337.07.06 Appearance

Following placement the slurry seal shall have a uniform texture, free from excessive scratch marks, tears, indentations, or other surface irregularities. Tear marks in any 12 m² area per lane are considered excessive if there are:

- a) Four or more marks ≥ 12 mm wide and ≥ 100 mm long
- b) Any marks ≥ 25 mm wide and ≥ 25 mm long

There shall be no longitudinal ripples, raking, wash-boarding, chatter, or other irregularities that affect the ride quality.

The edges of the slurry seal shall be finished uniformly, with a neat appearance along the roadway centreline, lane lines, shoulder, pavement edge, and curb lines.

337.07.07 Documentation

A summary of the quantity and application rate of slurry seal placed and a list of the quantities used for each of the slurry seal components (i.e., aggregate, emulsified asphalt, mineral filler, and additive) shall be submitted daily to the Contract Administrator.

337.07.08 Joints

The longitudinal and transverse joints shall be neat and uniform in appearance with no excessive build-up. Longitudinal joints shall be placed on lane lines.

The longitudinal joint in the surface course shall have an overlap of 50 to 100 mm.

337.07.09 Clean Up

All areas not to be slurry sealed, such as shoulders, ditches, and gutters, shall have the slurry seal material removed on a daily basis. Appurtenances shall be free of slurry seal and left in operable condition.

337.07.10 Repairs

Damaged slurry sealed surfaces shall be repaired by the Contractor.

Repairs to address appearance deficiencies described in the Appearance subsection shall consist of an additional application of slurry seal for the full lane width over the length of deficiency.

The length of repair shall be sufficient to eliminate all appearance deficiencies. If the distance between repair areas is less than 3 m, these repair areas shall be treated as one continuous repair.

337.07.11 Traffic Convoy

When specified in the Contract Documents, the Contractor shall convoy traffic according to the OTM, Book 7.

The pilot vehicle shall guide one-way traffic through or around construction. The maximum speed of the convoy shall be 30 km/h. Convoing shall be maintained until such time as the slurry seal is able to carry traffic without damage.

337.07.12 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

337.08 QUALITY ASSURANCE

337.08.01 Sampling

The aggregate shall be stockpiled 2 weeks prior to construction for sampling and testing. Samples for gradation testing shall be taken from the stockpile as determined by the Contract Administrator.

337.09 MEASUREMENT FOR PAYMENT

337.09.01 Actual Measurement

**337.09.01.01 Slurry Seal - Type I
Slurry Seal - Type II
Slurry Seal - Type III**

Measurement of the slurry seal placed shall be by area in square metres with no deductions for appurtenances.

337.09.01.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

337.10 BASIS OF PAYMENT

**337.10.01 Slurry Seal - Type I - Item
Slurry Seal - Type II - Item
Slurry Seal - Type III - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Repair, removal, disposal, and replacement of any damaged or defective slurry seal shall be at no extra cost to the Owner.

The accepted trial area shall be paid for at the tender unit price for slurry seal. All costs associated with unacceptable trial areas shall be borne by the Contractor at no extra cost to the Owner.

TABLE 1
Mix Design Requirements

Test Method	Description		Requirements	
			Minimum	Maximum
ISSA TB-106	Slurry Seal Consistency, cm		2	3
ISSA TB-109	Excess Asphalt, g/m ²		550	750
ISSA TB-114	Wet Stripping, % Retained Coating		90	100
ISSA TB-115	Compatibility		Pass Tests (Note 1)	
ASTM D 3910	Wet Track Abrasion, g/m ²		---	800
ISSA TB-139	Set and Cure Characteristics			
	Set Time		12 kg-cm minimum @ 30 minutes	
	Traffic Time		20 kg-cm minimum @ 240 minutes	
Note:				
1. Mixing tests must pass at the maximum expected air temperature.				

TABLE 2
Slurry Seal Aggregate Gradation Requirements, LS-602

MTO Sieve Designation	Type I Percent Passing	Type II Percent Passing	Type III Percent Passing
9.5 mm	100	100	100
4.75 mm	100	90 - 100	70 - 100
2.36 mm	90 - 100	65 - 90	45 - 70
1.18 mm	65 - 90	45 - 70	28 - 50
600 µm	40 - 65	30 - 50	19 - 34
300 µm	25 - 42	18 - 30	12 - 25
150 µm	15 - 30	10 - 21	7 - 18
75 µm	10 - 20	5 - 15	5 - 15

TABLE 3
Slurry Seal Application Rates

Slurry Seal Type	Application Rate kg/m²
Type I	4.3 to 6.5
Type II	5.4 to 9.8
Type III	8.1 to 12.0

Appendix 337-A, November 2008 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Traffic category. (337.05.02)

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- Tack coat. (337.07.03)
- Traffic convoy. (337.07.11)

Slurry seal is specified to seal the surface, prevent ravelling, and improve frictional characteristics. It is not intended to increase the structural strength of pavement. Pavements that are structurally deficient or exhibiting severe distress should be sealed and distortions repaired prior to slurry seal application. A detailed pavement condition investigation should be carried out to determine the appropriateness of specifying slurry seal.

The three generally accepted types of slurry seal are:

Type I - is a fine gradation mix for sealing low volume residential road surfaces.

Type II - is a medium gradation mix used for sealing road surfaces on moderate volume residential road surfaces.

Type III - is a coarse gradation mix used to improve skid resistance on moderate volume municipal road surfaces.

Selection of slurry seal type is dependent on traffic volumes and surface friction requirements.

Where slurry seal is considered for higher volume roadways, the use of a premium aggregate or micro-surfacing is recommended.

Normally, tack coat is not required unless the surface to be covered is extremely dry and ravelled or it is concrete or brick.

Traffic should be prohibited from the finished surface for a period of up to four hours to permit the slurry seal to cure. This may necessitate a separate pay item for traffic control.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR ROUTING AND SEALING CRACKS IN HOT MIX ASPHALT PAVEMENT

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341-A	Commentary

341.01 SCOPE

This specification covers the work of routing existing cracks up to 20 mm in width and cleaning and sealing routed and unrouted cracks in hot mix asphalt pavements with hot poured rubberized asphalt sealant compound.

341.01.01 Specification Significance and Use

This specification has been developed for use in provincial and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

341.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

341.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specification, Material

OPSS 1212 Hot Poured Rubberized Asphalt Joint Sealing Compound

Ministry of Transportation, Ontario, Publication

SP-024 Manual for Condition Rating of Flexible Pavements - Distress Manifestations

341.04 DESIGN AND SUBMISSION REQUIREMENTS

341.04.01 Submission Requirements

The Contract Administrator shall be provided with the following data at least 5 Business Days prior to placement of sealant:

- a) The sealant information from the manufacturer shall include:
- i. Batch numbers.
 - ii. Test results in accordance to OPSS 1212 from each batch on samples that have been subjected to both one heating cycle and two heating cycles.
 - iii. Application recommendations.
 - iv. Recommended heating time and temperature.
 - v. Allowable storage time and temperature after initial heating.
 - vi. Allowable reheating criteria.
 - vii. Application temperature range.
- b) Storage location of sealant pucks.

341.05 MATERIALS

341.05.01 Crack Sealant

Crack sealant shall be hot poured rubberized asphalt sealant according to OPSS 1212.

341.06 EQUIPMENT

341.06.01 Router

All routing equipment shall consist of mechanical routers capable of continually creating well-defined right angled routs and keeping the rout centreline within 8 mm of the centre of the crack and providing a rout width of 40 to 50 mm and a depth of not less than 8 mm. For surfaces that are to be overlaid with hot mix as part of the Contract, rout geometry of 20 x 20 mm shall be used. Such capability shall be demonstrated to the Contract Administrator prior to its use.

When the Contractor cannot demonstrate to the satisfaction of the Contract Administrator that a router is capable of maintaining the specified dimensions and shape of the rout, the Contractor shall then adjust or replace as many cutters in the router's cutting head as necessary until the dimensions and shape of the rout again meets the specification requirements.

341.06.02 Heating Kettle

The heating kettle for joint sealant compound shall be a double boiler oil heat transfer type with built in agitator and equipped with thermometers to measure the temperature of both heat transfer oil and the sealing compound. The heating kettle shall be equipped with a spigot.

The heating kettle shall have automatic thermometric controls that will prevent overheating of the sealant.

341.06.03 Hot Compressed Air Lance

The hot compressed air lance shall have a discharge air temperature of approximately $500^{\circ}\text{C} \pm 100^{\circ}\text{C}$ and an air velocity greater than 1,000 m/s.

341.07 CONSTRUCTION

Cracks shall be routed, cleaned, and sealed or cleaned and sealed as specified in the Contract Documents.

341.07.01 Crack Routing

Cracks up to 20 mm in width shall be routed to the dimensions as specified in the Contract Documents.

All other cracks up to 20 mm in width discovered at the time of routing shall be routed with the exception of any alligator and map cracking as described in SP-024.

The routing of all transverse and skewed cracks shall be terminated within 25 mm of the pavement edge.

Two or more cracks shall not be joined by routing through uncracked pavement or routed in areas where a crack does not exist.

Cracks greater than 20 mm in width do not require routing.

341.07.02 Sealant Preparation

The sealant compound shall be melted slowly with constant agitation until it is in a lump-free, free-flowing state, within the temperature range recommended by the manufacturer for application.

Temperature gauges for both the heating oil and sealant on the kettle melter shall be properly calibrated at all times.

On a daily basis, the heating kettle is to be completely discharged prior to it being charged. The initial charge of the kettle with sealant shall be carried out in the presence of the Contract Administrator at a location acceptable to both the Contract Administrator and the Contractor.

The temperature of the sealant shall be monitored and recorded with the applicable date and time. The temperature records shall be made available to the Contract Administrator upon request.

341.07.03 Cleaning of Routed and Unrouted Cracks

Immediately prior to placing the sealant compound, all routed and unrouted cracks shall be cleaned and dried using a hot compressed air lance.

Before sealant application, all loose debris from the routing and cleaning operation shall be completely removed from the road surface. All moisture, debris, and loose fractured aggregate shall be removed from the routed and unrouted cracks immediately prior to the time the sealant compound is being placed.

341.07.04 Placing Sealant

Immediately following the cleaning of routed and unrouted cracks, the sealant compound shall be placed using either a manual pouring cone filled from a spigot located on the heating kettle itself, or by using a hose and wand fitted with the proper sized tip that allows the sealant to be pumped directly from the heating kettle into the routed or unrouted crack. The tip of the cone or wand shall be placed to the bottom of the crack to ensure uniform application.

For pavements that are to be overlaid with hot mix, all routed and unrouted cracks shall be filled with sealant so that, upon complete cooling, the top of the sealant is 4 to 6 mm below the adjacent pavement surface.

For all other pavements, all routed and unrouted cracks shall be filled with sealant so that, upon complete cooling, the sealant is no more than 1 mm below the adjacent pavement surface.

A squeegee, with its bottom edge trimmed to form the specified dimensions of the finished sealant surface after cooling, shall be used to strike off the sealant after it is poured into the routed or unrouted crack. The

sealant shall be struck off starting from the low side and working towards the high side of the pavement surface.

In order to maintain the sealant surface dimensions, the sealant shall be topped up and struck off again prior to being dusted.

Sealant compound damaged by construction traffic or the Contractor's operation shall be replaced.

341.07.05 Sealant Dusting

Where traffic is to be maintained during crack sealing, the surface of the sealant shall be dusted with Portland cement or alternative materials acceptable to the Contract Administrator prior to allowing traffic on the sealed areas.

341.07.06 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

341.08 QUALITY ASSURANCE

341.08.01 Sampling and Testing Sealant

The Contract Administrator may require the Contractor to provide a sample of the sealant puck, approximately 4 litres in volume, from one or more batches of sealant. Such samples shall be placed in properly labelled suitable containers and submitted to the Contract Administrator.

At least once each hour, the temperature of the sealant shall be independently checked by the Contract Administrator. If the Contract Administrator finds that the temperature of the sealant is not within the manufacturer's recommended range, then the Contractor shall remove all of the sealant that has been placed since the last acceptable temperature verified by the Contract Administrator. Any sealant that is rejected shall be replaced with acceptable material.

During the process of placing, the Contract Administrator may require the Contractor to take samples of the sealant directly from the heating kettle. A minimum of three 4-litre samples shall be taken from the heating kettle spigot at points when approximately 1/4, 1/2, and 3/4 of the proposed volume has been placed on the Contract. Additional samples may be requested by the Contract Administrator. All samples shall be placed in a properly labelled triple tight metal container.

All samples submitted to the Contract Administrator shall be labelled with the following information clearly shown:

- a) Contract number.
- b) Sealant type including the manufacturer and the product designation.
- c) Manufacturer's batch number.
- d) Highway number.
- e) Contractor and subcontractor.
- f) The station and offset in the roadway where the sample was taken.
- g) The point in the Contract at which the sample was taken, e.g., the percentage of work completed.

- h) Sampling date.
- i) Weather conditions.
- j) Persons taking the sample.

341.08.02 Deficiencies and Repairs

Where a routed crack is found to be more than 10% outside the specified rout dimension, geometry, or location, it shall be considered unacceptable and corrected by additional routing.

Where the sealant subsides in the rout by more than 1 mm below the adjacent pavement surface, the surface of the sealant shall be cleaned and topped up. Where pavements are to be overlaid, if the surface of the sealant is greater than 6mm below the adjacent pavement surface, the surface of the sealant shall be cleaned and topped up.

Where the sealant,

- a) contains imbedded foreign material other than dusting material,
- b) contains entrapped air bubbles,
- c) has debonded or pulled away from the routed crack, or,
- d) has been excessively heated,

the sealant shall be removed, the routed crack rerouted at the Contract Administrator's discretion, and resealed.

341.09 MEASUREMENT FOR PAYMENT

341.09.01 Actual Measurement

341.09.01.01 Routing, Cleaning, and Sealing Cracks in Hot Mix Asphalt Pavement

Measurement for payment shall be in linear metres along the routed, cleaned, and sealed crack.

Any portion of the sealed crack where the rout migrates away from the crack shall not be included in the measurement.

341.09.01.02 Cleaning and Sealing Unrouted Cracks in Hot Mix Asphalt Pavement

Measurement for payment shall be measured in linear metres along the cleaned and sealed unrouted crack.

341.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement is based on the units shown in the clauses under Actual Measurement.

341.10 BASIS OF PAYMENT

**341.10.01 Routing, Cleaning, and Sealing Cracks in Hot Mix Asphalt Pavement - Item
Cleaning and Sealing Unrouted Cracks in Hot Mix Asphalt Pavement - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Sealant compound damaged by construction traffic or the Contractor's operation shall be replaced at no extra cost to the Owner.

Work to remove and replace sealant compound due to the sealant not being within the manufacturer's specified temperature range shall be completed at no extra cost to the Owner.

Work to remove and replace sealant compound to correct deficiencies and make repairs shall be completed at no extra cost to the Owner.

Appendix 341-A, November 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Rout dimensions (341.07.01)
- The quantity of routing and sealing of cracks and the quantity of cleaning and sealing of cracks.

Consideration for cracks to be routed and sealed include:

- Transverse and skewed cracks up to 20 mm in width.
- Longitudinal cracks up to 20 mm in width that are further than 150 mm from the pavement edge.

Consideration for cracks to be sealed without routing includes longitudinal cracks in fully or partially paved shoulders, within 150 mm of the pavement edge.

The designer may specify an overfill sealant geometry for transverse and skewed cracks. If overfill is desired, the designer should specify it in the Contract Documents.

Routing and sealing is recommended for the spring and fall months when crack widths are larger and the pavement surface temperature is less than 50°C.

The designer should identify to the Owner the need for full-time inspection of the routing and sealing operations.

A pavement condition survey is recommended to determine the extent of routing and sealing or crack cleaning and sealing required.

The designer should ensure that the Ontario Provincial Standards General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 508.010 Routing and Sealing Cracks Up to 20 mm in Width in Asphalt Pavement



CONSTRUCTION SPECIFICATION FOR CONCRETE PAVEMENT AND CONCRETE BASE

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350.01 SCOPE

This specification covers the requirements for the construction of concrete pavement and concrete base.

350.02 REFERENCES

This specification refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction:

OPSS 314	Untreated Granular Subbase, Base, Surface, Shoulder and Stockpiling
OPSS 360	Full Depth Repair of Concrete Pavement and Concrete Base
OPSS 364	Partial Depth Repairs in Concrete Pavement
OPSS 369	Sealing or Resealing of Joints and Cracks in Concrete Pavement
OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete
OPSS 914	Waterproofing Bridge Decks with Hot Applied Asphalt Membrane
OPSS 919	Formwork and Falsework

Ontario Provincial Standard Specifications, Material:

OPSS 1002	Aggregates - Concrete
OPSS 1302	Water
OPSS 1305	Moisture Vapour Barriers
OPSS 1306	Burlap
OPSS 1308	Joint Filler (Concrete)
OPSS 1315	White Pigmented Curing Compounds for Concrete
OPSS 1350	Concrete - Materials and Production
OPSS 1441	Load Transfer Assemblies
OPSS 1442	Epoxy Coated Steel Reinforcement for Concrete

Canadian Standards Association:

CSA A23.1-94/A23.2-94 Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete

Ministry of Transportation Publication:

MTO Laboratory Testing Manual:

LS-101 Procedures for Calculating Percent Within Limits

350.03 DEFINITIONS

For the purposes of this specification the following definitions shall apply:

Concrete Pavement: means a rigid pavement structure with an exposed concrete surface which may include concrete shoulders.

Concrete Base: means a rigid pavement structure which is overlaid with asphaltic concrete, on the same contract, and may include concrete shoulders.

Percent Within Limits (PWL): means an estimate of the percentage of the lot population that is within specification limits, determined by using the mean and standard deviation of the lot.

Standard Deviation: means the square root of the value found by summing the squares of the difference between each test result and the mean of the test results divided by the number of test results minus one.

350.04 SUBMISSION AND DESIGN REQUIREMENTS

Where concrete pavement or concrete base is to be placed from October 1 to April 1, the Contractor must submit a plan detailing curing and protection plans. The plan shall describe the method by which in-place minimum concrete temperatures shall be maintained. No concrete shall be placed unless the plan is approved by the Contract Administrator.

350.05 MATERIALS

350.05.01 Concrete

Concrete and concrete materials shall be according to OPSS 1350 with the following amendments:

- a. The coarse aggregate for concrete pavement and concrete base shall have a combined gradation of nominal maximum size 37.5 mm and 19.0 mm aggregate and shall be according to the requirements of OPSS 1002.
- b. The class of concrete shall be 30 MPa according to OPSS 1350. The Cementing Materials Content subsection and the Strength Tests and Requirements subsection of OPSS 1350 do not apply.
- c. For all concrete pavement and concrete base, the air content shall be $6.0\% \pm 1.5\%$.
- d. If the concrete is formed, the slump shall be $70 \text{ mm} \pm 20 \text{ mm}$.
- e. Concrete shall be placed with a mix temperature within the range of 10°C and 28°C .

350.05.02 Burlap

Burlap shall be according to OPSS 1306.

350.05.03 Moisture Vapour Barrier for Curing

Moisture vapour barrier for curing shall be according to OPSS 1305.

350.05.04 Curing Compound

White pigmented membrane curing compound for concrete shall be according to OPSS 1315.

350.05.05 Water for Curing

Water for curing shall be according to OPSS 1302.

350.05.06 Tie Bars and Load Transfer Devices

Tie bars shall be according to OPSS 1442 and load transfer devices shall be according to OPSS 1441.

350.05.07 Joint Materials

Expansion joint filler shall be according to OPSS 1308.

Joint sealant material shall be according to OPSS 369.

350.06 EQUIPMENT

350.06.01 Compacting

Concrete shall be consolidated by means of surface vibrators, internal vibrators, or a combination of both that provide full depth consolidation without segregation.

350.06.02 Hot Poured Rubberized Asphalt Joint Sealing

Hot poured rubberized asphalt joint sealing equipment shall be according to OPSS 914.

350.06.03 Forms

Forms shall be according to OPSS 919.

350.06.04 Automatic Dowel Bar Inserter

Where an automatic dowel bar inserter is used, it must be capable of placing dowel bars as specified. The dowel bars shall be inserted to mid-depth of the slab and centred on the transverse joint locations and spaced as shown on the plans. The equipment shall be capable of consolidating the concrete around the dowel bars.

350.06.05 Diamond Grinder

Where a diamond grinder is used, it shall be power-driven, self-propelled equipment specifically designed to grind and texture concrete pavement and concrete base. It shall be equipped with a grinding head with at least 50 diamond blades per 300 mm of shaft. The grinding head shall be at least 0.9 m wide. The grinder shall be equipped with the capability to adjust the depth, slope and crossfall to ensure that concrete is removed to the desired dimensions and uniformly feathered and textured across the width and length of the required area. The equipment shall also include a slurry pick-up system.

350.07 CONSTRUCTION

350.07.01 Preparation Work

350.07.01.01 General

Before placing concrete on granular base, the granular immediately ahead of the concrete placing operation shall be wetted down thoroughly. The wetting down shall be carried out without leaving standing water.

350.07.02 Joints

350.07.02.01 General

Joints shall be of the type and at the location shown in the Contract.

The initial sawcut, for longitudinal and transverse contraction joints, shall be sawn as soon as possible, normally within 12 hours of paving operations. Sawcutting operations shall not result in ravelling or other damage to the concrete. The initial cut shall be for one third the depth of the concrete slab.

The joints shall be cleaned and sealed according to OPSS 369.

Dowel bars at the transverse contraction joints shall be placed using load transfer devices or an automatic dowel bar inserter.

350.07.02.02 Load Transfer Devices

Load transfer devices shall be as shown in the Contract.

350.07.02.03 Transverse Construction Joints

Transverse construction joints shall be made at the end of each day's run or when interruptions occur in the concreting operation. Transverse construction joints shall be formed at a contraction or expansion joint, except in exceptional cases of plant breakdown or adverse weather conditions. In these exceptional cases, a construction joint may be formed in the mid slab area subject to the provision that the portion of the slab placed, and the portion of the slab to be placed, is not less than 2 m in length. Construction joints in adjacent lanes of pavement shall align with joints in the previously placed lane.

350.07.02.04 Position and Alignment Tolerances

350.07.02.04.01 Dowel Bars

The dowel bars shall be placed within a tolerance of ± 6 mm in the vertical and horizontal planes of the pavement.

350.07.02.04.02 Joints

All joints shall be placed within a tolerance of ± 15 mm from the position and alignment of the centre of the dowel bars.

350.07.02.05 Tie Bars

At longitudinal joints, epoxy coated tie bars shall be installed where specified and as detailed in the Contract. Tie bars shall be inserted so that voids are not created around the bar. Tie bars shall not be placed within 600 mm of a transverse joint.

350.07.02.06 Dowel Bars at Transverse Joints

At all expansion and contraction joints, dowel bars shall be installed according to the details in the Contract. The location of dowel bars shall be marked to permit precise joint forming or cutting operations directly over the centre of the dowel bars.

When an automatic dowel bar inserter is used, the Contractor shall be required to remove a 2 m x full paver width section of concrete pavement or concrete base within the first days paving. Additional sections will be required until the Contractor's operations conform to the specification. The joint to be removed will be selected by the Contract Administrator. The section will be inspected by the Contract Administrator to ensure that the placement and alignment of the dowel bars meet requirements. The section removed shall be repaired according to OPSS 360.

350.07.02.07 Protection of Tie Bars and Dowel Bars

Protection of dowel bars shall be according to OPSS 905.

Bars with coating damage greater than 5% of the surface area of each bar shall not be used.

For bars with coating damage of 1% or less of their surface area, all damaged areas of the bar coating shall be repaired.

350.07.03 Concreting

Concrete shall be placed at or near its permanent location in such a manner so as to avoid segregation of the materials. Any excess concrete beyond the pavement edge shall be removed immediately.

Transverse joint load transfer devices shall be placed a minimum of 100 m in advance of the paving operations.

When an interruption in placing concrete of more than 45 minutes occurs, a transverse construction joint shall be formed. Concrete shall not be placed against any material which is at a temperature above 35°C or against any material whose temperature is below 5°C.

The maximum ambient air temperature for placing concrete is 32°C.

350.07.03.01 Consolidating

Concrete shall be thoroughly consolidated against and along the face of all forms and into the face of previously placed concrete.

For fixed-form placement, hand-held vibrators shall be used to supplement consolidation adjacent and along the full length of the form. They shall also be inserted at regularly spaced intervals along both sides of dowel assemblies. Vibrators shall never be operated longer than 15 seconds in any one location.

For slip-form pavers, the concrete shall be consolidated by vibrators of sufficient number, spacing and frequency to provide uniform consolidation to the entire pavement width and depth. The vibrators shall not operate while the paver is stopped.

The vibrators shall not come in contact with the subgrade, subbase, forms, tie bars or dowel assemblies.

350.07.03.02 Finishing

No water or other chemical agents shall be applied to the concrete surface for finishing purposes.

For concrete pavements where fixed forms are being used or where concrete is being placed against an existing pavement and before surface texturing, the edge of the pavement shall be finished with an edging tool having a radius of not more than 6 mm. The finished pavement edge shall be left smooth, true to line and grade.

350.07.03.03 Texturing of Surface

After all finishing operations are completed on concrete pavements and before initial curing and protection of the concrete, the plastic surface of the concrete shall receive an initial and final texturing. Initial texturing shall be performed with a longitudinal burlap drag to produce a uniform textured surface. Burlap shall be kept in a clean and damp condition, free from encrusted mortar. Final texturing shall be achieved using equipment manufactured to produce transverse grooves 3 mm $\pm$ 1 mm wide on 16 mm $\pm$ 3 mm centres with a groove depth of 4 mm $\pm$ 1 mm.

Grooving shall extend to within 75 mm $\pm$ 15 mm of the pavement edge. Grooving for small or irregular areas may be done by hand methods.

The surface shall be free in all cases from displaced aggregate particles and local projections.

350.07.03.04 Surface Tolerance

The surface of the concrete is to be such that when tested with a 3 m long straightedge placed in any location and direction, including the edge of pavement, except across the crown or drainage gutters, there shall not be a gap greater than 3 mm between the bottom of the straightedge and the surface of the pavement.

Diamond grinding will be required to ensure the concrete surface meets these requirements.

350.07.04 Curing

350.07.04.01 General

Curing shall be according to OPSS 904 with the following exceptions:

Curing shall be applied to all exposed surfaces as soon after the texturizing operation as can be achieved without damaging the surface.

As soon as forms are removed, the sides of the exposed concrete faces shall be sprayed with the white pigmented curing compound at the specified rate of application. Curing compound shall not be applied to joint faces receiving sealant or to concrete surfaces to which concrete or mortar is to be bonded.

350.07.05 Joint Sealing

Joint sealing shall be according to OPSS 369.

350.07.06 Miscellaneous Protection

350.07.06.01 Rain

Concrete shall not be placed in the rain. The Contractor shall take all necessary precautions to protect plastic concrete from rain.

350.07.06.02 Traffic

Traffic, other than foot traffic, rubber-tired sawing equipment, and rubber-tired side wheels of form mounted placing and finishing equipment necessary to construct adjacent lanes, shall not be permitted on the concrete until it has attained 20 MPa.

Samples required for early strength determination shall be taken and tested by the Contractor. A minimum of 1 set of two cylinders per 500 m length of paving shall be required for early opening determination. Samples shall remain on site as specified until time of testing.

The concrete pavement shall be protected from damage to the surface at all times when steel-tracked equipment is used.

350.07.06.03 Shoulders

Shouldering operations may commence once the adjacent concrete has attained 20 MPa. Completion of the shoulders shall be according to OPSS 314.

350.07.06.04 Cold Weather

Concrete shall not be placed when the ambient air temperature is below 0°C and shall not be placed against any material whose temperature is below 5°C.

The Contractor shall provide protection to ensure the minimum in-place temperature of the concrete pavement or concrete base is 15°C for the first three days of curing, and at 10°C for the subsequent 4 days.

350.07.06.04.01 Insulation Removal for Sawcutting

When the concrete pavement or concrete base requires protection by insulation, no more than 25 linear metres of concrete pavement or concrete base shall be exposed for sawcutting operations at any one time. In no case shall any concrete pavement or concrete base be exposed for more than one hour during sawcutting.

350.07.07 Concrete Base

350.07.07.01 General

The work required for concrete base includes the work required for concrete pavement except as modified by this subsection.

350.07.07.02 Joints

A final reservoir cut is not required at the joints.

350.07.07.03 Texturing of Surface

Texturing of the surface is not required.

350.07.07.04 Joint Sealing

The sealing of joints in concrete base is not required.

350.07.07.05 Surface Tolerance

The provisions of subsection 350.07.03.04 apply except that the tolerance is increased to 6 mm.

350.07.08 Sampling and Testing

350.07.08.01 Slump and Air Content

Field sampling and testing of plastic concrete for conformance to slump and air content requirements shall be the Contractors responsibility as detailed below.

Slump and air content shall be tested according to OPSS 904 with the following exceptions:

The frequency of slump and air content testing shall be according to Table 1.

Table 1
Sampling and Testing - Minimum Frequencies

Tests	Frequency
Air Content	Each load until satisfactory control is established. Then 1 random test per 5 truck loads
Slump for Fixed Form Paving	Each load until satisfactory control is established. Then 1 random test per 5 truck loads
Notes: Test Procedures shall be according to CSA A23.2-94. Satisfactory control is considered to have been established when tests on five consecutive truck loads or batches of concrete are within specification requirements.	

350.07.08.02 Coring

Coring shall be carried out when the concrete is 28 to 35 days old. The Contractor may elect to core for compressive strength testing prior to 28 days provided the strength testing is performed within two days of coring.

The location of the core in each subplot will be selected by the Owner using a table of random numbers. No core shall be taken within 250 mm of any joint or edge of slab.

The Contractor shall cut one core in each subplot. The cores shall be 100 mm in diameter and shall be drilled through the complete depth of concrete pavement or concrete base perpendicular to the surface of the slab.

350.07.08.03 Filling of Core Holes

Each core hole shall be filled immediately after coring with an approved non-shrink grout. The patch shall be finished flush with the surface of the concrete slab.

Immediately before filling, the vertical surface of each core hole shall be cleaned of the paste left from the coring operation by wire brushing, and all free water shall be removed. After filling each hole, all excess material shall be removed from the surface of the slab.

350.07.08.04 Identification of Cores

Each core shall be legibly marked with durable ink immediately after its removal from the core hole. The core identification numbers will be specified by the Owner.

350.07.08.05 Transportation of Cores

The concrete cores shall be delivered to a laboratory designated by the Owner. The cores shall be delivered on the same day they were obtained.

The Contractor is responsible for transporting these cores in a safe manner to avoid damage to the cores.

350.08 QUALITY ASSURANCE

350.08.01 Acceptance Criteria for Strength and Thickness

350.08.01.01 General

Acceptance of the concrete pavement or concrete base for each lot will be based on the mean and standard deviation of the lot measurements for core compressive strength and slab thickness. The Contract Administrator will calculate the Percent Within Limits for each criteria as described in LS-101.

350.08.01.02 Core Compressive Strength and Slab Thickness

The slab thickness will be determined based on core length for each subplot, each core shall be measured for length prior to trimming. Four measurements rounded to the nearest millimetre shall be made around the perimeter of the core to determine the actual concrete thickness. These measurements shall be taken at the ends of two perpendicular diameters.

Cores will be tested for compressive strength when the concrete is 30 to 42 days old. If the contractor elects to core prior to 28 days, the compressive strength tests will be performed within two days of coring. The cores shall be stored in the laboratory at an ambient air temperature of $\geq 15^{\circ}\text{C}$ and $\leq 25^{\circ}\text{C}$ and moisture conditioned for 40 - 48 hours prior to testing. The testing shall be according to CSA A23.2-9C.

If the lot PWL is greater than or equal to 90%, the lot is acceptable for the criteria. If the lot PWL is greater than 90%, the lot will be accepted with a bonus for the criteria. If the lot PWL is less than 90% and greater than or equal to 50%, the lot is accepted for the criteria with a price adjustment. If the lot PWL is less than 50%, the lot is rejectable and shall be subject to repair and reassessment.

Notwithstanding the overall PWL, if any individual core compressive strength or if any individual length is less than 60% of the specified compressive strength or specified slab thickness, the Contractor shall repair the subplot.

For calculation of PWL, the lower limit is 30 MPa for compressive strength. The lower limit for thickness shall be specified as the design thickness minus 5 mm.

350.08.01.03 Lot Size

350.08.01.03.01 Compressive Strength and Thickness

A lot shall consist of the total quantity of concrete pavement or concrete base on the contract of the same specified thickness.

Each lot will be divided into 1000 m² sublots or a minimum of three sublots for compressive strength and thickness. The Owner will test one core from each subplot to determine the core compressive strength and slab thickness.

350.08.01.04 Re-testing

350.08.01.04.01 Compressive Strength and Thickness

The Contractor or the Contract Administrator may question an individual test result within three working days of receiving the test result for that subplot. The Contractor shall notify the Owner of his intention to re-core. A new core shall be obtained from locations adjacent to the location of the original set of cores. The new core shall be obtained at a maximum age of 56 days and tested not later than 7 days after the coring. The lot will be re-evaluated as specified under basis of payment.

350.08.01.05 Removal of Unacceptable Concrete

If individual subplot results for core compressive strength or thickness of concrete pavement or concrete base dictates removal and replacement of a subplot, additional cores shall be taken by the Contractor to establish the extent of the deficient area.

The cores shall be taken at 3 m intervals along the length of the pavement in both directions starting 3 m from the location of the original core.

The area to be removed shall be bounded by the nearest contraction joint and longitudinal joint or concrete pavement or concrete base edge outside the deficient area so that there shall be no additional joints.

Where the overall subplot results dictate removal and replacement, the Contractor shall remove and replace the entire subplot.

350.08.01.06 Cracking in Concrete Pavement

All cracking, in excess of one third the depth of the slab thickness shall be repaired as a full depth repair according to OPSS 360.

Cracks less than one-third the thickness of the slab shall be repaired according to OPSS 364.

350.09 MEASUREMENT FOR PAYMENT

350.09.01 Actual Measurement

350.09.01.01 Concrete Pavement Concrete Base

Measurement will be the surface area of concrete pavement or concrete base placed in square metres.

350.09.02 Plan Quantity Measurement

350.09.02.01 Concrete Pavement Concrete Base

When measurement is by Plan Quantity, such measurement will be based on the units shown in the clause under Actual Measurement.

350.10 BASIS OF PAYMENT

350.10.01 Concrete Pavement - Item Concrete Base - Item

Payment at the contract price for the above items shall be full compensation for all labour, equipment and material required to do the work except that, where work does not conform to the quality requirements, adjustment for each lot will be made according to the following. The price adjustment will be based on the average of the Pay Factors (PF) for strength and thickness.

When retesting is completed, the test results used to determine the price adjustment shall be as detailed in Table 2. Payment for retesting will be made only when the retest results in an increased payment.

350.10.01.01 Compressive Strength and Slab Thickness

Adjustment of the contract price for compressive strength and slab thickness shall be based on the following formulae and Table 2.

For concrete pavement and concrete base:

$$PF_{\text{strength}} = 55 + 0.5 \text{ PWL}$$

$$PF_{\text{thickness}} = 55 + 0.5 \text{ PWL}$$

Table 2

CRITERIA for PAYMENT when RETESTING		
	Difference Between New and Old Core	Test Core Used for Payment Adjustment
Thickness	$\leq 5 \text{ mm}$	Original Core
	$> 5 \text{ mm}$	New Core
Strength	$\leq 5\%$	Original Core
	$> 5\%$	New Core

350.10.01.02 Additional Coring and Testing

Payment will not be made for additional coring and testing to determine the limits of slab removal. The Owner will pay for reborings and testing for strength and thickness only when the retests result in an increase in payment.



CONSTRUCTION SPECIFICATION FOR CONCRETE SIDEWALK

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351.01 SCOPE

This specification covers the requirements for the construction of concrete sidewalks.

351.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be as specified in the Contract Documents.

351.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

351.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 314	Untreated Granular, Subbase, Base, Surface, Shoulder and Stockpiling
OPSS 408	Adjusting or Rebuilding Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 501	Compacting
OPSS 904	Concrete Structures
OPSS 919	Formwork and Falsework

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1212	Hot Poured Rubberized Asphalt Joint Sealing Compound
OPSS 1308	Joint Filler in Concrete
OPSS 1315	White Pigmented Curing Compounds for Concrete
OPSS 1350	Concrete - Materials and Production

ASTM International

C 171-07	Sheet Materials for Curing Concrete
A 48M-03	Gray Iron Castings
C 1028-07	Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method

351.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Cold Weather means as defined in OPSS 904.

Sidewalk Bay means the area between two transverse joints, regardless of the type of joint.

351.04 DESIGN AND SUBMISSION REQUIREMENTS

351.04.01 Tactile Walking Surface Indicator Plate Submission Requirements

One copy of the manufacturer's installation instructions and Working Drawings for each type of tactile walking surface indicator plates shall be submitted to the Contract Administrator prior to the installation of the plates.

When requested, a certificate from the manufacturer for the tactile walking surface indicator plates that confirms the product was manufactured and met the test requirements according to the Contract Documents shall be submitted to the Contract Administrator. The certificate shall include test results from an independent testing laboratory currently accredited by the Standards Council of Canada.

351.05 MATERIALS

351.05.01 Concrete

Concrete shall be according to OPSS 1350, with a minimum specified 28-Day compressive strength of 30 MPa. Coarse aggregate for the concrete shall have a nominal maximum size of 19.0 mm.

351.05.02 Expansion Joint Material

Expansion joint filler material shall be asphalt impregnated fibreboard having a minimum of 12 mm thickness and shall be according to OPSS 1308, Type A.

Hot poured rubberized asphalt joint sealing compound shall be according to OPSS 1212.

351.05.03 Subgrade Moisture Vapour Barrier

Subgrade moisture vapour barrier shall be according to ASTM C 171.

351.05.04 Granular

Granular base shall be according to OPSS 1010.

351.05.05 Curing Compound

Curing compound shall be according to OPSS 1315.

351.05.06 Tactile Walking Surface Indicator Plates

Gray cast iron tactile walking surface indicator plates shall be as specified in the Contract Documents. Castings shall be according to ASTM A 48M, Class 35B, and shall be bare and not coated with paint or other coatings or substances. Castings shall be sound, free from pouring faults, cracks, blowholes, and other defects.

The surface of each new cast iron plate on both the tops of the truncated domes and the field between the truncated domes shall have a minimum wet and dry static coefficient of friction of 0.8 according to ASTM C 1028.

The initials or trademark of the manufacturer, year of manufacture, and country of manufacture shall be distinctly cast and legible in raised letters on the top side of each plate.

351.06 EQUIPMENT

351.06.01 Forms

Forms shall be according to OPSS 919.

351.06.02 Slip Forming

The equipment used for slip forming shall have automatic horizontal and vertical alignment controls shall be used in conjunction with at least one stringline.

351.07 CONSTRUCTION

351.07.01 General

The work required for concrete sidewalk shall include earthwork, granular base, compaction, preparation work, formwork, Utility adjustment and isolation, concrete placing and finishing, jointing, curing, and protection.

Concrete sidewalk shall be constructed at the locations and to the widths and thicknesses specified in the Contract Documents.

Excavation and embankment construction shall be according to OPSS 206.

351.07.02 Grading Tolerances

351.07.02.01 Subgrade

When the subgrade is prepared for:

- a) granular base, the finished subgrade surface shall be within a 15 mm deviation measured at any point on a 3 m long straight edge.
- b) sidewalk, the finished subgrade surface shall be within a 12 mm deviation from the specified grade and cross-section, with the surface being within a 10 mm deviation measured at any point on a 3 m long straight edge.

351.07.02.02 Granular Base

Placement of granular base material shall be according to OPSS 314.

When a granular base is prepared for sidewalk, the finished granular surface shall be within a 12 mm deviation from the specified grade and cross-section, with the surface being within a 10 mm deviation measured at any point on a 3 m long straight edge.

351.07.03 Compaction

Compaction shall be according to OPSS 501.

351.07.04 Preparation Work

351.07.04.01 General

Before placing concrete on:

- a) subgrade, the subgrade shall be wetted down, except where clays occur.
- b) granular base, the granular immediately ahead of the concrete placing operation shall be wetted down thoroughly.

The wetting down shall be carried out without leaving standing water.

Alternatively, a subgrade moisture vapour barrier may be placed to completely cover the subgrade under the sidewalk. Adjacent strips shall be lapped 100 mm minimum and ends shall be lapped 300 mm minimum.

351.07.05 Form Setting

Throughout their entire length, forms shall be set true to the lines, grades, and thickness specified in the Contract Documents and in direct contact with the subgrade or granular base.

351.07.06 Utility Adjustment

Work done on adjustment of maintenance holes, valve chambers, and catch basins shall be according to OPSS 408. Utility appurtenances shall be adjusted flush with the surface of the new sidewalk.

Appurtenances maintained by Utility companies other than the Owner shall be adjusted by the Utility company concerned under arrangement by the Contract Administrator. The Contractor shall excavate to the edge of the appurtenance and indicate the required grade of the new sidewalk.

351.07.07 Utility Isolation in Sidewalk

The required Utility isolations shall be constructed in the concrete sidewalk to the details and at the locations specified in the Contract Documents.

351.07.08 Placing Concrete

Concrete shall be placed, consolidated, and finished in a manner that ensures uniform consistency. Any excess concrete beyond the sidewalk edge shall be removed. Concrete shall be placed by a continuous pour method. Where concrete placing is interrupted for more than 45 minutes a 12 mm thick asphalt impregnated fibreboard joint filler shall be installed vertically across the sidewalk width before resuming concrete placing.

Concrete shall not be placed against any material which is at a temperature above 35 °C or against any material whose temperature is below 0 °C.

351.07.09 Tactile Walking Surface Indicator Plate Installation

A set of two cast iron tactile walking surface indicator plates shall be set into wet prepared concrete at each concrete sidewalk ramp as specified in the Contract Documents and according to the plate manufacturer's installation instructions.

Plates shall be cleaned after installation.

351.07.10 Concrete Finishing

Finishing of the concrete surface shall take place while the concrete is sufficiently plastic to achieve the desired grades, elevations, and texture.

The surface of the sidewalk shall be uniform, dense, free from undulations and projections, struck off true to grade and cross-section, and finished with a float.

Excessive fines and water shall not be drawn to the surface.

Surface evaporation retardants shall not be used as an aid for finishing concrete.

The application of water, cement, or combination of both to the concrete surface shall not be permitted as a finishing aid.

Localized defects shall be repaired using concrete.

The sidewalk shall be given a broomed texture after finishing with a float.

The presence of footprints or other marks in the completed sidewalk shall require sawcutting, removal, and replacement of the complete sidewalk bay.

351.07.11 Joints

351.07.11.01 General

Longitudinal and transverse joints shall be constructed of the type and at the locations specified in the Contract Documents. The concrete adjacent to all formwork and joints shall be finished with a tool that produces a 5 mm rounded edge and a smooth, horizontal surface with a maximum width of 50 mm. All tooling shall be uniform and straight and shall be depressed to a maximum of 1 mm below the adjacent surface. Any ridges along the tooled marks shall be removed.

351.07.11.02 Dummy Joints

Dummy joints shall be hand formed using a 5 mm radius dummy joint tool.

351.07.11.03 Contraction Joints

Contraction joints shall be placed at every third dummy joint and shall be sawcut or formed to a depth that is one quarter the thickness of the sidewalk.

When the sidewalk width is 2.5 m or greater, a longitudinal contraction joint shall be sawn or formed at a maximum spacing interval of 1.5 m.

351.07.11.04 Expansion Joints

Expansion joints shall be constructed to the full depth of the slab.

Expansion joints shall be filled with expansion joint material and shall be clean and dry at the time of construction.

Expansion joints shall be constructed where the sidewalk abuts a rigid object or changes direction.

351.07.12 Identification Stamp

At the request of the Contract Administrator, the sidewalk shall be clearly and legibly marked with an approved stamp each end of the work, and at other places as directed. The stamp shall be centred on the sidewalk bay next to and parallel to a transverse joint. The stamp shall identify the Contractor's name and the year of construction.

351.07.13 Concrete Curing

Concrete shall be cured using a membrane-curing compound applied according to OPSS 904.

For the purpose of membrane-curing compound application, the application rate shall be 0.2 L/m².

351.07.14 Cold Weather Concreting

The placing and protection of concrete sidewalks in cold weather shall be according to OPSS 904.

351.07.15 Protection of Sidewalk

Vehicular traffic shall be restricted from crossing the sidewalk after the concrete has been placed for a minimum period of three days or until the concrete has reached 75% of the specified 28-Day compressive strength.

351.07.16 Sidewalk Tolerances

The surface of the concrete, after texturing, shall be within a 6 mm deviation measured at any point on a 3 m long straight edge.

The minimum acceptable thickness of the sidewalk shall be the specified thickness minus 8 mm. If the thickness deficiency exceeds 8 mm, the sidewalk shall be removed and replaced.

Core samples of the finished concrete may be taken to establish the actual thickness of the slab at locations determined by the Contract Administrator.

Unacceptable areas of sidewalk identified by the Contract Administrator shall require the sawcutting, removal, and replacement of the complete sidewalk bay by the Contractor.

351.07.17 Tactile Walking Surface Tolerances

Tolerances for the tactile walking surface indicator plates shall be as specified in the Contract Documents. If the tactile walking surface indicator plates are not within the specified tolerances, the plates shall be rejected.

Rejected plates shall be removed and replaced as directed by the Contract Administrator.

351.07.18 Field Sampling and Testing of Concrete

Field sampling and testing of concrete shall be according to OPSS 1350.

351.07.19 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

351.09 MEASUREMENT FOR PAYMENT

351.09.01 Actual Measurement

351.09.01.01 Concrete Sidewalk

Measurement of concrete sidewalk shall be by area in square metres.

351.09.01.02 Tactile Walking Surface Indicators for Concrete Sidewalk Ramps

For measurement purposes a count shall be made for each set of tactile walking surface indicator plates installed at each concrete sidewalk ramp. A set shall consist of two tactile walking surface indicator plates.

351.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

351.10 BASIS OF PAYMENT

351.10.01 Concrete Sidewalk - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Repair or removal and replacement of an unacceptable sidewalk bay shall be completed at no extra cost to the Owner.

351.10.02 Tactile Walking Surface Indicators for Concrete Sidewalk Ramps – Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

351.10.03 Excavation

Payment for excavation shall be under the tender item Earth Excavation, Grading or Rock Excavation, Grading according to OPSS 206.

351.10.04 Utility Adjustment

Payment for the adjustment of Utility appurtenances shall be paid under the appropriate items according to OPSS 408.

No payment shall be made for appurtenances adjusted by the Utility company.

Appendix 351-A, November 2015 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Locations of sidewalks wider than 1.5m in areas with higher pedestrian volumes (see TAC GDG, Section 2.2.6.5 and MTO GDSOH, Section D.8.4) (351.07.01)
- Line, grade, and thickness requirements of concrete sidewalk (351.07.01 and 351.07.05)
- Details and locations of required Utility isolations (351.07.07)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 310.010	Concrete Sidewalk
OPSD 310.020	Concrete Sidewalk Adjacent to Curb and Gutter
OPSD 310.030	Concrete Sidewalk Ramps at Intersections
OPSD 310.031	Concrete Sidewalk Ramps at Signalized Intersections with Intersecting Crosswalks
OPSD 310.033	Concrete Sidewalk Ramps at Unsignalized Intersections
OPSD 310.039	Concrete Sidewalk Ramps Tactile Walking Surface Indicators Component
OPSD 310.040	Utility Isolation in Concrete Sidewalks
OPSD 310.050	Concrete Sidewalk Driveway Entrance Details
OPSD 310.060	Joint Detail for Concrete Pedestrian Crosswalk at Signalized Intersection



CONSTRUCTION SPECIFICATION FOR CONCRETE CURB AND GUTTER SYSTEMS

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353.01 SCOPE

This specification covers the requirements for the construction of concrete curb and gutter, setbacks, gutter outlets, and bullnoses together with the installation of catch basin frames and grates which lie within the flow lines of the curb and gutter system.

353.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

353.01.02

Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

353.02

REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 314	Untreated Granular Subbase, Base, Surface Shoulder, and Stockpiling
OPSS 350	Concrete Pavement and Concrete Base
OPSS 407	Construction of Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber Installation
OPSS 501	Compacting
OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete
OPSS 919	Formwork and Falsework

Ontario Provincial Standard Specifications, Material

OPSS 1212	Hot Poured Rubberized Asphalt Joint Sealing Compound
OPSS 1308	Joint Filler in Concrete
OPSS 1315	White Pigmented Curing Compounds for Concrete
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1850	Frames, Grates, Covers, and Gratings

353.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Concrete Pavement means concrete pavement or concrete base.

Curb and Gutter means curb, gutter, or combinations of curb and gutter.

Curb and Gutter Systems means curb and gutter, setbacks, gutter outlets, concrete spillways, bullnoses, or any combination of them.

353.05 MATERIALS

353.05.01 Concrete

Concrete shall be according to OPSS 1350. For the provincial-oriented specification, concrete shall also be according to the following requirements:

- a) Minimum specified 28-Day compressive strength: 30 MPa
- b) Coarse Aggregate: 19.0 mm nominal maximum size

353.05.02 Catch Basin Frames and Grates

Catch basin frames and grates shall be according to OPSS 1850.

353.05.03 Joint Materials

Expansion joint fillers shall be according to OPSS 1308 for types A or B except that granulated cork fillers shall not be accepted.

Hot rubberized asphalt joint sealing compound shall be according to OPSS 1212.

353.05.04 Curing Compound

Curing compound shall be according to OPSS 1315.

353.05.05 Forms

Forms shall be according to OPSS 919.

353.05.06 Steel Reinforcement

Steel reinforcement shall be according to OPSS 1440.

353.07 CONSTRUCTION

353.07.01 General

The Construction section applies equally to concrete curb and gutter, concrete spillways, and concrete gutter outlets.

353.07.02 Foundation and Backfill

Excavation and embankment construction shall be according to OPSS 206.

Granular base and granular backfill construction shall be according to OPSS 314.

353.07.03 Compaction

Compaction shall be according to OPSS 501.

353.07.04 Steel Reinforcement

Placement of steel reinforcement shall be according to OPSS 905.

353.07.05 Formwork

Formwork shall be according to OPSS 919 and shall be set true to the lines and grades specified in the Contract Documents and in direct contact with the subgrade or granular course.

353.07.06 Slipform

Slipform paving equipment is acceptable for use provided the slipform product meets the specified cross-sectional requirements.

353.07.07 Joints

When concrete curb and gutter is constructed adjacent to concrete pavement, the transverse joint spacing of the curb and gutter shall coincide with that of the concrete pavement. When concrete curb and gutter is constructed adjacent to asphalt pavement, transverse joints shall have a uniform spacing not exceeding 6 m. In addition to the foregoing, joints shall be constructed between the curb structure, including catch basin frames, setbacks, and gutter outlets.

Joints, including those between curb and gutter systems and any abutting sidewalk, catch basin frames, setbacks, gutter outlets, or any structure, shall be formed with 12 mm thick panels of joint filler except as follows:

- a) Contraction joints in extruded curb and gutter and in formed curb and gutter shall be saw cut.
- b) Longitudinal joints, as shown in the Contract Documents, shall be sawn between a curb and gutter system and concrete pavement and shall be according to OPSS 350, when the curb and gutter system is placed adjacent to the concrete pavement. The joint shall be sealed with liquid joint sealer and shall be according to OPSS 350.

Joint filler panels shall be set in a vertical position and, if for transverse joints, shall be set normal to the inside edge of the structure.

Panels shall be precut from a single piece of joint filler to the shape of the curb and gutter cross-section as shown in the Contract Documents, but so as to provide a 6 mm recess on the exposed surfaces. Cutting and tolerances shall be according to OPSS 1308.

Expansion joint material shall be set in place before concrete placement begins and shall be supported by removable forms.

All concrete immediately above the filler material shall be carefully removed to form a 6 mm deep, 12 mm wide recess then finishing both edges of each joint to 5 mm radius with a suitable short edging tool.

Contraction joints shall be formed within a sufficient time of placing of the curb and gutter to prevent uncontrolled cracking. The width of the joint shall be 3 to 5 mm and a minimum depth of 65 mm.

353.07.08 Concrete

353.07.08.01 Placement of Concrete

Concrete shall not be placed until the base course, on which the concrete is to be placed, and the forms or stringline have been inspected by the Contract Administrator.

Before placing concrete, the subgrade immediately ahead of the concrete placing shall be wetted by means of a uniform spray of water sufficient to wet the subgrade thoroughly without leaving standing water.

The concrete shall be placed and consolidated such that segregation of the aggregate does not occur.

Concrete shall be placed continuously. Contact with partially set concrete shall be avoided. When placement of concrete is interrupted, it shall be at a vertical form. A 5 mm bituminous fibre joint filler shall be placed at the point of interruption before recommencing placement of concrete.

The concrete shall be thoroughly consolidated against all formwork and all entrapped air shall be eliminated.

353.07.08.02 Concrete Finishing

The concrete on the upper surfaces shall be floated to a smooth uniform finish of the required cross-section, free of open texturing, plucked aggregate, and local projections. Only hardwood or magnesium trowels shall be used for hand finishing.

Care shall be taken to avoid over finishing or working more mortar to the surface than is actually required. Back edges shall be rounded by use of a 5 mm radius edging tool. Neat cement shall not be used as a drier to facilitate finishing.

Any honeycombed areas occurring along the formed surfaces shall be filled with mortar composed of one part Portland cement and two parts sand with 12% of entrained air.

353.07.08.03 Concrete Curing

Formed and slipformed concrete shall be cured with one or more of the following methods:

- a) Burlap and water.
- b) Moisture vapour barrier.
- c) White pigmented curing compound.

For curing with burlap and water, the burlap shall be presoaked by immersing it in water for a period of 24 hours immediately prior to placing it. Two layers of burlap shall be applied to the surface of the concrete. Strips of burlap shall overlap 150 mm and shall be held down without marring the surface of the concrete. The burlap shall be applied immediately after finishing of the concrete surface, from 2 to 4 m from the finishing operation. The burlap shall be maintained continuously in a wet condition throughout the 96-hour curing period. The burlap shall be covered with a layer of moisture vapour barrier in a manner which shall prevent deformation of the surface of the concrete. Air flow in the space between the moisture vapour barrier and the burlap shall be prevented in conformance with the requirements of curing with moisture vapour barrier. The moisture vapour barrier shall be placed within 12 hours following placement of the concrete.

For curing with only a moisture vapour barrier, the moisture vapour barrier shall be placed immediately after finishing of the concrete surface, from 2 to 4 m from the finishing operation. Strips of moisture vapour barrier shall overlap a minimum of 150 mm. Air flow in the space between the moisture vapour barrier and the concrete surface shall be prevented. To achieve this, the moisture vapour barrier shall be held down at the edges and at all laps to prevent displacement. The material shall be kept in place for a minimum curing period of 96 hours.

Curing with curing compound shall not be used on any construction joint or when cold weather concreting is in effect.

The curing compound shall be agitated by mechanical means to provide a homogeneous mixture immediately prior to application. It shall be applied immediately after finishing of the concrete surface, from 2 to 4 m from the finishing operation, completely covering the surface of the concrete. A second application of curing compound shall be applied within 30 to 60 minutes after the first application. Each application shall be such that the membrane formed is uniform in thickness and colour and free of breaks and pinholes. The surface shall be maintained in this condition for a minimum period of 7 Days. The rate of each application shall not be less than the rate specified by the manufacturer of the compound.

353.07.08.04 Concrete Tolerances

The exposed surfaces of the finished concrete shall be such that, when tested with a 3 m long straight edge placed anywhere along the surface parallel to the edge of curb face, there shall be no deviation greater than 3 mm between the bottom of the straight edge and the surface of the concrete nor shall there be any deviation from alignment in excess of 3 mm.

353.07.09 Cold Weather Concreting

Protection of concrete shall be according to OPSS 904. The components of the curb and gutter system shall be considered as slabs on the ground.

353.07.10 Catch Basin and Maintenance Hole Frames and Grates

Catch basin and maintenance hole frames and grates which lie within the flow lines of the curb and gutter system shall be installed as part of the construction of the various components making up the curb and gutter system. Frames shall be set to their final elevation according to OPSS 407. The exposed surfaces of the mortar bed shall be left in a smooth condition, free of depressions, and projections. All remaining formwork shall be removed.

353.07.11 Identification Stamp

At the request of the Contract Administrator, each end of the work and every 20 m shall be legibly marked with an approved stamp. The mark shall be located in the centre of an exposed face of the curb and gutter systems. The mark shall bear the Contractor's name and the year of construction.

353.07.12 Field Sampling and Testing of Concrete

Field sampling and testing of concrete shall be according to OPSS 1350.

353.07.13 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

353.09 MEASUREMENT FOR PAYMENT

353.09.01 Actual Measurement

353.09.01.01 Concrete Curb and Gutter

Measurement of concrete curb and gutter shall be by length in metres along the flow line of the gutter whether straight or curved, without separation into types. Such measurements shall include the space occupied by setbacks, gutter outlets, and frames with grates.

353.09.01.02 Concrete Spillways

Measurement of concrete spillways shall be by length in metres along the flow line from the end of the gutter outlet to the spillway termination.

353.09.01.03 Concrete Gutter Outlets

For measurement purposes, a count shall be made of the number of setbacks and gutter outlets installed without separation into types.

353.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

353.10 BASIS OF PAYMENT

**353.10.01 Concrete Curb and Gutter - Item
Concrete Spillways - Item
Concrete Gutter Outlets - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

When roadbed granular material is measured in square metres, the Contract price for the above item shall be full compensation for all labour, Equipment, and Material for the material directly below or behind the concrete curb and gutter system.

There shall be no separate payment of concrete used for fillets in bullnoses.

353.10.02 Hot Mix Asphalt

Hot mix asphalt designated for constructing bullnose fillets shall be paid for at the Contract price for the appropriate Hot Mix Asphalt tender item.

353.10.03 Granular

Granular materials required for the work shall be paid for at the Contract price for the appropriate granular tender item.

353.10.04 Excavation

Excavation required to set the various components to the required line and grade shall be considered as part of the work of installing the curb and gutter system. When such excavation overlaps excavation required for any other work under the Contract, then payment will be made in accordance with the specification for such other work as though no excavation were required for curb and gutter construction.

353.10.05 Steel Reinforcement

Costs for supplying and placing steel reinforcement are deemed to be included in the items for concrete curb and gutter systems.

Appendix 353-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Line and grade for curb and gutter systems. (353.07.05)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 600.010	Concrete Barrier Curb with Wide Gutter
OPSD 600.020	Concrete Semi-Mountable Curb with Wide Gutter
OPSD 600.030	Concrete Mountable Curb with Wide Gutter
OPSD 600.040	Concrete Barrier Curb with Standard Gutter
OPSD 600.060	Concrete Semi-Mountable Curb with Standard Gutter
OPSD 600.070	Concrete Barrier Curb with Standard Gutter, Two-Stage Construction
OPSD 600.080	Concrete Barrier Curb with Narrow Gutter
OPSD 600.090	Concrete Semi-Mountable Curb with Narrow Gutter
OPSD 600.100	Concrete Mountable Curb with Narrow Gutter
OPSD 600.110	Concrete Barrier Curb
OPSD 604.010	90° Concrete Outlet for Concrete Curb with Gutter
OPSD 605.010	45° Concrete Outlet for Concrete Curb with Gutter
OPSD 605.030	45° Concrete Outlet for Concrete Curb with Gutter at End of Run
OPSD 606.010	600 mm Radius Barrier Bullnose
OPSD 606.020	600 mm Radius Mountable Bullnose
OPSD 606.030	800 mm Radius Mountable Bullnose, Curb with Gutter Twin Inlet
OPSD 607.010	Over 600 mm Radius Mountable Bullnose
OPSD 607.020	Over 600 mm Radius Barrier Bullnose
OPSD 608.010	Method of Termination for Concrete Curb with Gutter



NOTICE TO USERS OF OPSS 355

CONSTRUCTION SPECIFICATION FOR THE INSTALLATION OF INTERLOCKING CONCRETE PAVERS

OPSS 355 has been removed from this
OPS volume

The provincial version of OPSS 355 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 355

The municipal version of OPSS 355 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 355

USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS



**CONSTRUCTION SPECIFICATION FOR
PERVIOUS CONCRETE PAVEMENT
FOR LOW-VOLUME TRAFFIC APPLICATIONS**

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356-A	Commentary

356.01 SCOPE

This specification covers the requirements for the construction of pervious concrete pavement for low-volume traffic applications. This specification includes requirements for a trial section and special equipment and testing requirements.

356.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

356.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

356.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 919 Formwork and Falsework

Ontario Provincial Standard Specifications, Material

OPSS 1002 Aggregates - Concrete
OPSS 1004 Aggregates - Miscellaneous
OPSS 1305 Moisture Vapour Barriers
OPSS 1308 Joint Filler in Concrete
OPSS 1350 Concrete - Materials and Production

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-443 Method of Test for the Determination of the Void Content of Pervious Concrete Pavement Cores

CSA Standards

A23.2-3C	Making and Curing Concrete Compression and Flexural Test Specimens *
A23.2-9C	Compressive Strength of Cylindrical Concrete Specimens *
A23.2-14C	Obtaining and Testing Drilled Cores for Compressive Strength Testing *
* [Part of A23.1-09/A23.2-09 - Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]	

ASTM International

C 1116/C 1116M-09	Standard Specification for Fibre Reinforced Concrete
C 1688/C 1688M-08	Standard Test Method for Density and Void Content of Freshly Mixed Pervious Concrete

356.03 DEFINITIONS

For the purposes of this specification, the following definitions apply:

Cold Weather means those conditions when the air temperature is at or below 10 °C. It is also considered to exist when the air temperature is at or is likely to fall below 10 °C within 96 hours after pervious concrete placement. Temperature refers to shade temperature.

Construction Joint means the surface where two successive placements of pervious concrete meet or where new pervious concrete is placed against existing concrete across which it is desirable to achieve bond between the two concrete placements.

Control Joint means a joint that is created by scoring or sawcutting to prevent uncontrolled cracking due to drying or thermal shrinkage.

Isolation Joint means a joint that allows relative movement to take place between adjoining parts of a structure or pavement to prevent damage to the concrete.

Pervious Concrete Pavement means a rigid pavement structure that allows water flow into and through the pavement structure.

Surface Ravelling means the loss of coarse aggregate from the surface of the pervious concrete pavement.

356.04 DESIGN AND SUBMISSION REQUIREMENTS

356.04.01 Submission Requirements

356.04.01.01 Mix Design

The Contractor shall be responsible for the concrete mix design and shall submit the concrete mix design to the Contract Administrator according to OPSS 1350, with the following exceptions:

- a) The mix design shall be submitted before the trial section is placed.
- b) The air void system parameters of the hardened concrete shall not be required.
- c) Pervious concrete mix shall meet the material requirements of this specification.
- d) Strength results are not required with the mix design submission.

- e) Mix design supporting documentation shall include a certificate from the National Ready Mixed Concrete Association (NRMCA) verifying that at least one member of the Contractor's team, who is responsible for the supervision of the placement of the pervious concrete, is certified by the NRMCA Pervious Concrete Contractor Certification program.

356.04.01.02 Trial Section

Three Business Days prior to the start of the trial section, the following information shall be submitted to the Contract Administrator:

- a) Date, time, and location of the trial section.
- b) Method and equipment to be used to place and compact the pervious concrete pavement.
- c) Name of the NRMCA certified staff to be present and responsible for supervision of the placement.

356.05 MATERIALS

356.05.01 Forms

Forms, if used, shall be according to OPSS 919. Form materials shall extend the full depth of the pavement. Forms shall be of sufficient strength and stability to support mechanical equipment without deformation. Spacers, if used, shall be made of wood and shall be the same width as the formwork.

356.05.02 Isolation Joint Material

Isolation joint material shall be according to OPSS 1308.

356.05.03 Moisture Vapour Barrier

Moisture vapour barrier shall be according to OPSS 1305.

356.05.04 Pervious Concrete

The pervious concrete shall have a minimum 28-Day core compressive strength of 15 MPa, when tested according to CSA A23.2-9C and this specification.

Pervious concrete shall be according to OPSS 1350 with the following exceptions:

- a) Pervious concrete plastic density shall be measured according to ASTM C 1688 and shall be within $\pm 80 \text{ kg/m}^3$ of the plastic density of the trial section.
- b) The pervious concrete in the hardened state shall have a void content between 15 to 25%, when tested according to LS-443.
- c) Coarse and fine aggregate are not required to meet the gradation requirements of OPSS 1002.
- d) A viscosity modifying admixture (VMA) may be used. The trial section shall be used to observe and test the compatibility of the VMA with other admixtures and cementing materials.
- e) Use of water reducer is not required.
- f) Superplasticizer may be used.
- g) Slump requirements shall not apply.

- h) The testing requirements of OPSS 1350 for plastic and hardened air void testing shall not apply. The paste shall be adequately air entrained to provide freeze thaw resistance, with air entraining admixture dosage based on the dosage level typically used for mix designs with similar water to cement ratio.
- i) The coarse aggregate shall have a maximum nominal aggregate size less than or equal to 13.2 mm.
- j) Type III synthetic fibres according to ASTM C 1116 may be used. If used, synthetic fibres shall be added at the plant.
- k) In addition, for provincial-oriented Contracts, the Material Sampling and Testing subsection requirements shall not apply, with the exception of the testing of Water, Admixtures, and Cementing Materials.

356.06 EQUIPMENT

356.06.01 General

Equipment made of aluminium material shall not come in contact with the plastic pervious concrete.

356.06.02 Placing Equipment

Equipment used for placing the pervious concrete shall be one of the following:

- a) A slipform paver.
- b) A laser screed.
- c) A razorback steel truss screed, with vibratory or Clary screed.
- d) A vibratory steel screed, or steel roller screed with integral internal vibration.

356.06.03 Compaction Equipment

356.06.03.01 Roller Compaction Equipment

Rolling compaction shall be achieved using a steel pipe roller that spans the width of the section to be placed and exerts sufficient pressure to provide the necessary compaction.

356.06.03.02 Hand Tampers

Hand compaction equipment shall have a maximum width of 300 mm.

356.06.04 Edging Tools

Edging tools shall have a 6 mm radius.

356.06.05 Straight Edges

Straight edges shall be 3 m in length and made of metal.

356.07 CONSTRUCTION

356.07.01 General

The Contract Administrator shall be notified in writing of the intent to place the pervious concrete pavement 3 Business Days prior to the start of the placing operation.

356.07.02 Operational Constraints

Placement of pervious concrete during cold weather is not permitted.

Pervious concrete shall not be placed in the rain. The Contractor shall take all necessary precautions to protect placed plastic pervious concrete from rainfall.

Pervious concrete shall not be placed when the ambient air temperature is above 28 °C or likely to rise above 28 °C, throughout the duration of the placing operation.

Pervious concrete shall not be placed against any material that is at a temperature above 35 °C, or against any material that is at a temperature below 5 °C.

Traffic, other than foot traffic, shall not be permitted on the pervious concrete pavement until the pervious concrete has attained a core compressive strength of 15 MPa.

The pervious concrete pavement shall be protected from damage to its surface when steel-tracked equipment is used.

Construction equipment and trucks heavier than 20,000 kg shall not be permitted on the pervious concrete pavement at any time.

When a drainage system is part of the design, it shall be operational prior to the placement of the pervious concrete.

356.07.03 Trial Section

The Contractor shall construct a trial section, in the presence of the Contract Administrator, to demonstrate the Contractor's ability to successfully produce, place, and finish pervious concrete pavement. The trial section shall be placed a minimum of 4 weeks prior to pervious concrete being placed in the work. The Contract Administrator shall be notified of the trial placement date 3 Business Days in advance.

The Contractor shall construct a trial slab 10 metres long, at the paving thickness specified in the Contract Documents. The width of the trial slab shall be the width of the widest section the Contractor intends to place at one time. The location of the trial section shall be proposed by the Contractor and approved by the Contract Administrator. To simulate the effect of travel time, the trial section location shall not be farther from a ready mix plant than the job site. In the event that the trial section location is closer to the plant than the job site, the discharge from the ready mix truck shall be delayed sufficiently to match the estimated travel time.

The trial section shall be constructed with pervious concrete of the same materials and mix design; supplied by the same ready mix plant; and placed, consolidated, and cured using the materials, equipment, and personnel, including NRMCA-certified supervisors that the Contractor intends to use in the work.

The Contractor shall be responsible for all aspects of coring and conducting tests on pervious concrete pavement to determine thickness, compressive strength, and void content.

Plastic density and void content shall be determined according to ASTM C 1688 and the test results shall be submitted to the Contract Administrator.

Thickness, compressive strength, and hardened density and void content, shall be determined by dividing the trial section into 6 sections of equal size and shape, removing one 100 mm diameter full-depth core from each of the 6 sections according to CSA A23.2-14C, and testing the cores as follows:

- a) All cores shall be tested for thickness according to the Acceptance of Thickness subsection.
- b) Three cores shall be tested for hardened density and void content according to LS-443.
- c) The remaining three cores shall be tested for 28-Day compressive strength according to CSA A23.2-9C and this specification.

Test results shall be submitted to the Contract Administrator to determine acceptability of the trial section according to the Table 1. Once acceptability of the trial section is confirmed in writing by the Contract Administrator, placement of pervious concrete may commence. If the trial section is not accepted, another trial section shall be constructed. Unacceptable trial sections in the work shall be removed.

Placement in the work can proceed early if all requirements are met, including meeting the specified core compressive strength.

356.07.04 Placing

A person certified according to the NRMCA Pervious Concrete Contractor Certification program shall be responsible for the supervision of the placement of the pervious concrete.

Before placing pervious concrete on granular base, the granular immediately ahead of the pervious concrete paving operation shall be wetted down thoroughly without leaving standing water.

The granular base material shall not be disturbed or displaced by any equipment used for the placing operations.

During placement, pervious concrete shall be uniform in consistency with no visible signs of segregation and free of lumps.

Placement shall be continuous.

Pervious concrete shall be deposited within 1.5 m of its final position.

Sufficient material shall be in front of the placement equipment to ensure there are no low spots.

Discharge of individual loads of pervious concrete shall be completed within 90 minutes of the introduction of mix water to the cement. If there is an interruption in placement, the pervious concrete shall be covered with a moisture vapour barrier. When an interruption of more than 20 minutes occurs, a construction joint shall be made.

356.07.05 Compaction

Following placement and strike-off, pervious concrete shall be compacted. This compaction process may be done with or without the use of spacers. Spacers, if used, shall be removed after strike-off and before compaction.

The concrete shall be compacted to the level of the top of the forms or to the final elevation, depending on the equipment used for placement, using a steel roller. Longitudinal rolling shall be required, followed immediately by rolling in the transverse direction, if required to remove surface indentation or other

surface irregularities. Care shall be taken during compaction that sufficient compactive force is applied, without excessively working or consolidating the concrete surface such that the void structure of the pervious concrete is closed.

Hand tampers shall be used to compact the concrete along the slab edges immediately adjacent to the forms. After placement and compaction, no further finishing shall be performed on the concrete and no material shall be applied to the concrete.

Finishing and edging shall begin as soon as the pervious concrete is discharged from the truck.

356.07.06 Joints

Control joints shall not be required.

A construction joint should be installed at the end of the day's production or when an interruption of more than 20 minutes occurs in the concrete paving operation.

Isolation joints shall be used when abutting appurtenances and fixed vertical structures, including light pole bases and building foundations. Isolation joint material shall be according to this specification.

Edging and additional compaction with hand tamping tools shall be performed along all form lines and along all isolation joints and construction joints to reduce potential for ravelling under traffic.

356.07.07 Curing

A moisture vapour barrier shall be placed on the surface of the pervious concrete immediately after compacting the pervious concrete surface, within 2 to 4 m of the compacting operation. Air flow in the space between the moisture vapour barrier and the concrete surface shall be prevented. The moisture vapour barrier strips shall overlap 150 mm and shall be held in place at the edges and laps to prevent displacement, without marring the surface of the concrete. Curing shall continue for a minimum period of 7 Days.

356.07.08 Surface Appearance

The finished pervious concrete pavement surface shall have a uniform open texture and shall, over a 100 m² section, be free of:

- a) a single surface appearance deficiency exceeding 1 m², or
- b) the combined area of multiple surface appearance deficiencies exceeding 2 m².

Surface appearance deficiencies include, but are not limited to, the following:

- a) Tears.
- b) Plastic shrinkage cracking.
- c) Streaking.
- d) Accumulation of paste.
- e) Contamination by tracking, spilling, or placing of mud or other contaminants onto the pavement.
- f) Presence of closed surface.

Surface appearance shall be assessed by a visual survey.

356.07.09 Surface Tolerance

Except across the crown or drainage gutters, the surface of the pervious concrete pavement shall be such that when tested with a 3 m long straight edge placed in any location and direction, including the edge of pavement and joints, there shall not be a gap greater than 10 mm between the bottom of the straight edge and the surface profile of the pervious concrete pavement.

356.07.10 Surface Ravelling

The surface of the pervious concrete pavement shall not exhibit any surface ravelling based on a visual review.

356.07.11 Sampling and Testing

356.07.11.01 Plastic Pervious Concrete

The Contractor shall be responsible for all aspects of sampling and testing of the plastic pervious concrete.

Quality control testing shall consist of plastic density and void content testing. Plastic density and void content shall be measured according to ASTM C 1688. The plastic density shall be within 80 kg/m³ of the plastic density of the trial section. Quality control testing shall be performed on each load of pervious concrete.

356.07.11.02 Hardened Pervious Concrete

356.07.11.02.01 General

After a minimum of 8 Days and a maximum of 10 Days, the Contractor shall take two sets of three 100 mm diameter cores per subplot. The locations for the two sets of cores shall be randomly selected by the Contract Administrator. Each set shall be taken within a 1 m² area in each location. No core shall be taken within 250 mm of any joint or edge of slab. Cores shall be drilled through the complete depth of pervious concrete pavement perpendicular to the surface of the slab. Cores shall be drilled according to CSA A23.2-14C.

The Contractor shall deliver the cores to the quality assurance (QA) laboratory designated by the Owner in the Contract Documents for testing. The cores shall be stored at a temperature of 23 °C ± 2 °C in a moist condition, according to the laboratory curing requirements of CSA A23.2-3C, until time of testing.

The cores shall be tested for:

- a) Thickness according to the Acceptance of Thickness clause.
- b) Hardened void content and density according to LS-443.
- c) Compressive strength according to CSA A23.2-9C except that the load shall be applied until complete failure of the specimen.

356.07.11.02.02 Lot Size

A lot shall consist of the total quantity of pervious concrete pavement of the same specified thickness on the Contract. Each lot shall be divided into 500 m² sublots or a minimum of three sublots. If the quantity of pervious concrete placed on one day is less than 500 m², it shall be considered a subplot.

356.07.11.02.03 Filling of Core Holes

Each core hole shall be filled immediately after coring with pervious concrete. When pervious concrete is not available, the Contractor may use 13.2 mm clear stone meeting the requirements of OPSS 1004 to fill the core hole to 35 mm from the concrete pavement surface and cover with hydraulic cement based concrete patching material. The patching material shall be mixed, handled, and cured according to the manufacturer's instructions. Immediately before filling, the inside surface of each core shall be cleaned by nylon brushing. The patch shall be finished flush with the surface of the surrounding pervious concrete pavement. All excess material shall be removed from the surface of the pervious concrete pavement.

356.07.11.02.04 Identification of Cores

Each core shall be legibly labelled immediately after its removal from the slab. The core shall be placed into a sample bag and sealed with a tag provided by the Contract Administrator. The core identification numbers shall be specified by the Contract Administrator.

356.07.11.02.05 Transportation of Cores

The Contractor is responsible for transporting cores in a safe manner that avoids damage to the cores. The cores shall be delivered to the laboratory designated by the Owner. The cores shall be delivered on the same day they are obtained. The cores shall be kept at a temperature above 5 °C and protected from moisture loss during transportation.

356.07.12 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

356.08 QUALITY ASSURANCE

356.08.01 General

Acceptance shall be based on a visual inspection and QA testing of the completed work as outlined below. Pervious concrete pavement deemed unacceptable shall be repaired according to Table 2.

356.08.02 Acceptance Based on Visual Inspection

A visual inspection of the pervious concrete pavement surface shall be conducted by the Contract Administrator to determine if any of the following defects are present:

- a) Surface appearance not meeting the requirements of the Surface Appearance subsection.
- b) Surface tolerance not meeting the requirement of the Surface Tolerance subsection.
- c) Slight, moderate, or severe surface ravelling.

Slight surface ravelling is defined as the loss of the top layer of coarse aggregate in less than 1% of the surface area of the lot. Moderate surface ravelling is defined as the loss of the top layer of coarse aggregate in 1 to 10% of the surface area of the lot. Severe surface ravelling is defined as the loss of the top layer of coarse aggregate in more than 10% of the surface area of the lot or the loss of more than one layer of coarse aggregate, exceeding a depth of 26 mm, in any area of the lot.

Visual inspection for ravelling shall be carried out prior to opening to traffic, at the completion of the Contract and at the Warranty Period inspection.

Pervious concrete pavement not meeting surface appearance or surface tolerance requirements shall be deemed unacceptable.

Pervious concrete pavement sublots with slight ravelling shall be accepted. Pervious concrete pavement sublots with moderate surface ravelling or severe surface ravelling shall be deemed unacceptable.

356.08.03 Acceptance for Thickness

All cores shall be measured for thickness. Untrimmed hardened core samples shall be used to determine placement thickness. For each core, 4 length measurements shall be taken, rounded to the nearest millimetre. The measurements shall be taken at the ends of perpendicular diameters. The thickness of each subplot shall be based on the average length of all cores within the subplot.

Sublots with an average core thickness of more than 6 mm less than the specified thickness or with an individual core thickness of more than 13 mm less than the specified thickness shall be deemed unacceptable.

356.08.04 Acceptance for Void Content and Density

For each subplot, one set of three 100 mm diameter cores shall be measured for void content and density according to LS-443.

Sublots with an average void content less than 15% or more than 25% and any individual void content in excess of 35% shall be deemed unacceptable.

356.08.05 Acceptance for Core Compressive Strength

For each subplot, the second set of three 100 mm diameter cores shall be measured for core compressive strength according to CSA A23.2-9C and this specification.

Sublots with an average core compressive strength less than 15 MPa at 28 Days or an individual core compressive strength less than 11 MPa at 28 Days shall be deemed unacceptable.

356.09 MEASUREMENT FOR PAYMENT

356.09.01 Actual Measurement

356.09.01.01 Pervious Concrete Pavement

Measurement of pervious concrete pavement shall be by surface area in square metres to the nearest 0.1 m² of pervious concrete pavement placed.

356.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

356.10**BASIS OF PAYMENT****356.10.01****Pervious Concrete Pavement - Item**

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work, subject to the payment adjustment specified in Table 2.

The following shall be carried out at no extra cost to the Owner:

- a) Additional trial sections.
- b) Repairs to pervious concrete pavement deemed unacceptable.

TABLE 1
Pervious Concrete Pavement Trial Section Acceptance Requirements

Criteria	Acceptance Requirement
Surface Appearance, m ² per 100 m ²	No single irregularity ≥ 1
	No combined multiple irregularities ≥ 2
Surface Tolerance, mm gap	≤ 10
Surface Ravelling Severity (Note 1)	None or Slight
Thickness, mm less than specified thickness	Single core not more than 13
	Average of 3 cores not more than 6
Thickness, mm more than specified thickness	Single core < 20
28-Day Core Compressive Strength, MPa	≥ 15
Void Content, %	20 ± 5
Note: 1. Surface ravelling severity definitions according to the Acceptance Based on Visual Inspection subsection.	

TABLE 2
Repairs to Unacceptable Pervious Concrete Pavement

Criteria	Repair Requirement	Repair
Surface Tolerance, mm gap	> 10	Submit a proposal for remedial work to the Contract Administrator for approval or remove pervious concrete pavement to full depth as directed by the Contract Administrator and replace with acceptable pervious concrete pavement.
Surface Ravelling Severity (Note 1)	Slight	None.
	Moderate	Sublot represented shall be assessed a payment reduction of 10%.
	Severe	Remove pervious concrete pavement to full depth in the sublot represented and replace with acceptable pervious concrete.
Surface Appearance, m ² per 100 m ²	Single irregularity ≥ 1 Combined multiple irregularities ≥ 2	Remove pervious concrete pavement to full depth in the sublot represented and replace with acceptable pervious concrete.
Thickness, mm less than specified thickness	Single core > 13 Sublot > 6	
28-Day Core Compressive Strength, MPa	Single core < 11 Sublot < 15	
Void Content, %	Single core > 35 Sublot < 15 or > 25	
Note:		
1. Surface ravelling severity definitions according to the Acceptance Based on Visual Inspection subsection.		

Appendix 356-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

Pervious concrete pavement is suitable for low-traffic applications, including parking lots, boulevards, and walkways.

The designer should specify the following in the Contract Documents:

- Thickness of pervious concrete pavement. (356.07.03)
- QA laboratory. (356.07.11.02.05)

Pervious concrete pavement is a part of a site-specific stormwater management system. Pervious concrete pavement can reduce the impact of stormwater by reducing runoff volumes and decreasing and delaying peak flows.

The pavement structure design should follow the guidelines of the StreetPave software distributed by the American Concrete Pavement Association or equivalent.

The designer should be aware pervious concrete pavement requires enhanced maintenance processes to ensure long-term performance.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR FULL DEPTH REPAIR OF CONCRETE PAVEMENT OR CONCRETE BASE

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APPENDICES

360-A	Commentary

360.01 SCOPE

This specification describes the requirements for full depth repair of concrete pavement or concrete base including sawcutting; removal of pavement; installation of epoxy coated tie bars, dowel bars and load transfer devices; forming joints; and placing, texturing and curing of the concrete.

360.01.01 Specification Significance and Use

This specification has been developed for use in provincial and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

360.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

360.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 350 Concrete Pavement, Concrete Base and Lean Concrete Base

Ontario Provincial Standard Specifications, Materials

OPSS 1002 Aggregates - Concrete

360.03 DEFINITIONS

For the purpose of this specification the following definitions shall apply:

Staged Repair means where an area cannot be repaired completely due to traffic or construction sequence requirements, the repair shall be completed in separate stages. Each stage shall be a minimum of one lane in width and 2 m in length.

Diamond Grinding means altering the profile and texture of a concrete pavement surface by utilizing grinding equipment that employs diamond blades.

360.05 MATERIALS

360.05.01 Epoxy Resins

Epoxy resins shall be as specified in the Contract Documents.

360.05.02 Concrete

Concrete for full depth repair of concrete pavement or concrete base shall be according to the Materials section of OPSS 350 except that the nominal maximum size of coarse aggregate can be less than 37.5 mm according to OPSS 1002.

The class of concrete shall be nominal minimum 28-day compressive strength of 30 MPa.

360.06 EQUIPMENT

360.06.01 General

Equipment for full depth repair of concrete pavement or concrete base shall be according to the Equipment section of OPSS 350.

360.06.02 Placing and Finishing Equipment

Equipment used for placing, consolidating and finishing concrete shall be a self-propelled, vibratory steel screed or steel cylinder screed with integral internal vibration including automatic shut-off, levelling auger and shall operate on fixed forms. For repair areas less than 10 m in length, the concrete may be placed with a vibratory steel screed.

360.06.03 Gang Drill

The gang drill shall consist of not less than three independently powered pneumatic drills. Drilling equipment shall be used in such a way so as not to damage the adjacent pavement.

360.07 CONSTRUCTION

360.07.01 Staged Repair

When the operation requires a staged repair, additional dowel bars shall be installed to connect the repair stages, as required.

360.07.02 Concrete Removal

The outer limits of the concrete removal shall be saw cut full depth. The concrete removal method shall ensure that the concrete to be removed is not broken in place and that the adjoining concrete and underlying base remains undisturbed. When the existing granular base is disturbed, the loosened material shall be removed, the surface compacted and replaced with an additional depth of concrete.

360.07.03 Preparation Work

The preparation work for full depth repair of concrete pavement or concrete base shall be according to OPSS 350.

360.07.04 Joints

Joints for full depth repair of concrete pavement or concrete base shall be according to OPSS 350.

360.07.04.01 Dowel Bar and Tie Bar Placement

Gang drills shall be used to drill holes in the existing concrete for insertion of the dowel bars or tie bars. Drill holes shall be thoroughly cleaned. The dowel bars or tie bars shall be secured into the existing concrete with epoxy resin. The epoxy resin shall be injected into the back of the cleaned drill hole and the dowel or tie bar, with grout retention disks attached, shall be inserted to ensure the bars are completely enveloped with epoxy resin.

360.07.04.02 Tie Bars

Tie bars shall be installed at all longitudinal joints as specified in the Contract Documents.

360.07.04.03 Dowel Bars at Transverse Joints

Dowel bars shall be installed at all transverse joints as specified in the Contract Documents. The tolerance for the alignment of dowel bars shall be 6 mm in the length of the dowel bar in both the vertical and horizontal planes of the pavement. When reinforcement is present, dowels may be adjusted 25 mm horizontally, and raised or lowered 10 mm, to avoid drilling the reinforcement.

360.07.04.04 Transverse Joints - Expansion

Expansion joints shall be placed when replacing existing expansion joints or as specified in the Contract Documents.

360.07.04.05 Transverse Joints - Contraction

Transverse contraction joints shall be cut or formed to match existing joints or working cracks and skewed if required. Dowels or load transfer devices shall be installed at mid depth of the concrete slab, in a plane with the pavement surface and parallel to the centreline of the road.

360.07.05 Concreting

360.07.05.01 General

Concreting for full depth repair of concrete pavement or concrete base shall be according to OPSS 350.

360.07.05.02 Placing Concrete

Before placing concrete, it shall be demonstrated that the equipment to be used provides for proper adjustment of screeds, floats, propulsion and control equipment.

Concrete shall be placed at or near its permanent location, at a steady rate and in such a manner to avoid segregation of the materials. Any concrete placed beyond the outer limits of the pavement edge shall be removed immediately.

Concrete shall be placed to avoid disturbing or displacing the load transfer devices.

When an interruption in placing concrete of more than 45 minutes occurs, a transverse construction joint shall be formed.

Concrete shall not be placed against any material which is at a temperature above 35°C or against any material which is at a temperature below 0°C.

360.07.05.03 Texturing of Surface

Texturing of the surface shall be according to OPSS 350 except that manual devices may be used to provide the required tined texture.

Texturing is not required on concrete base or when the concrete surface shall be diamond ground as specified elsewhere in the contract.

360.07.05.04 Surface Tolerance

The surface of the concrete repair shall join flush with the existing concrete pavement or concrete base.

360.07.06 Curing, Joint Sealing, Removal of Forms and Shoulders

Curing, joint sealing and shoulders for full depth repair of concrete pavement or concrete base shall be according to OPSS 350.

360.07.07 Miscellaneous Protection

Miscellaneous protection for full depth repair of concrete pavement or concrete base shall be according to OPSS 350 except that the last sentence of the Traffic clause shall not apply.

360.07.07.01 Traffic

For early opening determination, one set of cylinders shall be taken from the last placement of concrete in the section to be opened to traffic.

360.07.08 Sampling and Testing - Slump, Air Content and Compressive Strength

Sampling and testing for full depth repair of concrete pavement or concrete base shall be according to OPSS 350 except that the compressive strength requirement shall be based on testing of standard cylinders with a frequency of one set of two cylinders 150 X 300mm (or one set of three cylinders 100 X 200mm) for each fifteen cubic metre unit of concrete but not less than one set of cylinders per Day.

360.07.09 Removal of Unacceptable Concrete

Concrete found to be unacceptable shall be removed and replaced with new material.

360.07.10 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

360.08 QUALITY ASSURANCE

360.08.01 Criteria for Determining Unacceptable Concrete

If the tests on cylinders do not show a nominal minimum 28-day compressive strength of 30 MPa, the area represented by the cylinders shall be removed and replaced.

360.09 MEASUREMENT FOR PAYMENT

360.09.01 Actual Measurement

360.09.01.01 Full Depth Concrete Slab Repair

Measurement shall be of the surface area of the concrete repair placed in square metres.

360.09.02 Plan Quantity Measurement

360.09.02.01 Full Depth Concrete Slab Repair

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

360.10 BASIS OF PAYMENT

360.10.01 Full Depth Concrete Slab Repair - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work including dowel bars, tie bars and load transfer devices.

Where the existing granular base is disturbed, the removal of loosened material, compaction of the surface, and replacement with an additional depth of concrete shall be at no extra cost to the Owner. The removal and replacement of unacceptable concrete shall be at no extra cost to the Owner.

Appendix 360-A, November 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Epoxy resins. (360.05.01)
- Tie bars. (360.07.04.02)
- Dowel Bars at Transverse Joints. (360.07.04.03)
- Transverse Joints - Expansion. (360.07.04.04)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



**CONSTRUCTION SPECIFICATION FOR
RUBBLIZING CONCRETE PAVEMENT AND CONCRETE BASE**

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APPENDICES

361-A	Commentary

361.01 SCOPE

This specification covers the requirements for in-place rubblizing of concrete pavement or concrete base and compaction of the rubblized concrete.

361.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

361.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

361.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specification, Construction

OPSS 501 Compacting

Ontario Provincial Standard Specification, Material

OPSS 1010 Aggregates - Base, Subbase, Select Subgrade, and Backfill Material

361.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Concrete Base means a rigid pavement structure that is overlaid with asphaltic concrete on the same Contract and may include concrete shoulders.

Concrete Pavement means a rigid pavement structure with an exposed concrete surface that may include concrete shoulders.

Rubblizing means the thorough fracturing of plain or reinforced concrete slabs with or without dowels to produce an in-place material for use as a base or subbase.

361.05 MATERIAL

361.05.01 Granular A

Granular A shall be according to OPSS 1010.

361.06 EQUIPMENT

361.06.01 Rubblizing

The rubblizing equipment shall be a self-contained, self-propelled, resonant frequency pavement-breaking unit capable of producing high frequency, low amplitude blows with a minimum impact energy of 8,000 Newtons at a rate of not less than 44 impacts per second. The equipment shall be capable of rubblizing concrete pavement and concrete base in-place.

The compactor shall be a self-propelled, vibratory, single smooth steel drum grade roller with a minimum weight of 9,200 kg.

The equipment shall apply water for dust suppression, as required.

361.07 CONSTRUCTION

361.07.01 Operational Constraints

All new and existing pavement drainage systems shall be fully operational for two weeks prior to rubblizing.

Prior to rubblizing, adequate lateral support shall be provided against the existing concrete slab, either by the existing or the new granular shoulders or base.

All overlying bituminous material shall be fully removed prior to rubblizing.

Only construction traffic shall be permitted on the rubblized surface. Construction traffic shall be limited on the rubblized surface, and the compacted condition of the rubblized pavement shall be maintained prior to placing the overlying material.

The rubblizing operation shall not damage exposed road appurtenances and fixtures.

A full depth saw cut shall be made along an existing joint at all ramps and mainline pavement where rubblized concrete abuts pavement that is to remain in place. All dowels between the planned rubblizing and concrete pavement to remain in place shall be severed.

In areas where the roadway is to be overlaid with hot mix asphalt one lane at a time, rubblizing shall extend a minimum of 15 cm beyond the edge of pavement to be overlaid

361.07.02 Compaction of Granular A

Compaction of Granular A shall be according to OPSS 501.

361.07.03 Gradation Requirement for Rubblized Concrete

The rubblized concrete shall meet the following gradation requirements:

- a) No particles shall exceed 150 mm in the largest dimension.
- b) A maximum of 10%, by mass, shall pass the 75 µm sieve.

Any pieces of rubblized concrete greater than 150 mm shall be removed or reduced to an acceptable size. The resulting void shall be replaced with compacted Granular A material.

361.07.04 Test Section

The proposed rubblizing operation shall be demonstrated by the Contractor over a 100 m full width test section. The test section location shall be subject to the approval of the Contract Administrator.

The resultant rubblized concrete shall meet the specified requirements. When the rubblizing operation does not conform to the specification, appropriate adjustments shall be made to the operation to ensure conformance to the specification and an additional test section shall be performed.

361.07.05 Compaction and Proof Rolling

The rubblized concrete shall be compacted with a minimum of two passes, each pass being up and back, of the self-propelled, vibratory, single smooth steel drum grade roller. The roller shall be operated at a speed not exceeding 5 km/h. Where deflections and associated movement of the rubblized concrete surface are apparent, remedial action shall be taken as directed by the Contract Administrator.

361.07.06 Sampling

A minimum of one sample per day of production shall be taken on a random basis by the Contractor at locations determined by the Contract Administrator. The sample size shall be a minimum of one square metre for the full depth of the rubblized concrete, including the embedded steel. The sampling frequency may be reduced at the discretion of the Contract Administrator. The removed rubblized material shall be visibly inspected by the Contract Administrator for conformance to the specification.

After sampling, the sampled area shall be backfilled and compacted with Granular A material.

361.07.07 Embedded Steel

All embedded steel reinforcement in the rubblized concrete shall be left in place. Where reinforcement is present, the bond between the concrete and the reinforcement shall be broken. Any steel exposed or protruding above the surface shall be cut off flush with the surface and removed from the site.

361.07.08 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

361.09 MEASUREMENT FOR PAYMENT

361.09.01 Actual Measurement

**361.09.01.01 Rubblizing of Concrete Pavement
Rubblizing of Concrete Base**

Measurement of rubblizing of concrete pavement and concrete base shall be by area in square metres.

361.09.02 Plan Quantity Payment

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

361.10 BASIS OF PAYMENT

**361.10.01 Rubblizing of Concrete Pavement - Item
Rubblizing of Concrete Base - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Asphalt removal shall be paid for under a separate item.

Appendix 361-A, November 2011 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

Other concrete pavement rehabilitation treatments should be considered prior to specifying rubblizing. For effective rubblizing, the concrete slab shall be free of delamination and material deterioration.

This specification is written as a method specification identifying a unique process incorporating a resonant frequency pavement breaker. Gradation control of the final product is based on visual assessment of the rubblized material. When greater gradation control is required of the final product, full depth removal of the concrete pavement and off-site crushing is recommended.

All overlying bituminous material shall be fully removed prior to rubblizing. Payment for removal of bituminous material shall be under separate items.

The designer should ensure that areas previously repaired with full depth asphalt are removed to ensure uniform performance of the rubblized material.

Proper subgrade support for the rubblizing operation shall be assessed during precontract engineering.

Granular A material for backfill purposes may be substituted with an alternate crushed granular material. When paving directly on the rubblized surface, a hot mix asphalt levelling course is recommended. If an alternate material is required, this must be indicated in the Contract Documents.

The designer should identify the thickness of the concrete slab to be rubblized and identify the type of embedded steel in the concrete slab.

Pavement drainage systems including ditch, sub-drains, and outlets are to be staged so that they are installed and operational prior to rubblizing operations beginning.

Operations should be staged so that the lateral pavement edge support remains in place until the rubblizing operations are completed. This is to ensure that the maximum impact energy is transferred to the concrete slab.

Since only construction traffic is permitted on the rubblized surface, traffic staging should be shown in the Contract Documents.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR FAST TRACK FULL DEPTH REPAIRS TO CONCRETE PAVEMENT

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APPENDICES

362-A	Commentary

362.01 SCOPE

This specification covers the requirements for full depth repair of concrete pavement or concrete base including saw-cutting; removal of pavement; installation of epoxy coated tie bars, dowel bars and load transfer devices; forming joints; and placing, texturing, curing, sampling and testing of concrete to permit opening to traffic within a specified time period of 24 hours or less.

362.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

362.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

362.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications or publications:

Ontario Provincial Standard Specification, Construction

OPSS 360 Full Depth Repair of Concrete Pavement or Concrete Base

Ontario Provincial Standard Specifications, Materials

OPSS 1315 White Pigmented Membrane Curing Compounds for Concrete
OPSS 1350 Concrete - Materials and Production

CSA Standards

A23.2-1C Sampling Plastic Concrete*
A23.2-17C Temperature of Freshly Mixed Hydraulic Cement Concrete*
A23.2-4C Air Content of Plastic Concrete by the Pressure Method*
A23.2-5C Slump and Slump Flow of Concrete*
CSA A283-1980 Qualification Code for Concrete Testing Laboratories
* Part of A23.1-09/A23.2-09-Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]

362.03 DEFINITIONS

For the purpose of this specification the following definition shall apply:

Fast Track Repair means a process in which a section of concrete pavement or concrete base is closed to traffic, repairs are completed, and the section reopened within a specified time period of 24 hours or less.

362.04 SUBMISSION AND DESIGN REQUIREMENTS

362.04.01 Concrete Mix

At least three weeks prior to the placement of the concrete, a calibration chart for the mix design strength versus concrete temperature and a copy of the mix design proportions together with all supporting technical data shall be submitted to the Contract Administrator for review.

362.05 MATERIALS

362.05.01 Concrete

A rapid setting concrete mix shall be designed according to OPSS 1350 with the following specific requirements:

Compressive Strength - 15 MPa minimum prior to opening to traffic
- 30 MPa minimum at 28 days

Air Content - $6.5 \pm 1.5\%$

The use of a concrete superplasticizer, Type 30 Portland cement and calcium chloride based accelerators are permitted.

362.05.02 Curing Compound

Curing compound shall be according to OPSS 1315.

362.06 EQUIPMENT

362.06.01 Placing and Finishing Equipment

Equipment for placing and finishing concrete shall be according to OPSS 360.

362.07 CONSTRUCTION

362.07.01 General

Construction shall be according to OPSS 360.

362.07.02 Operational Constraint

Fast track full depth repairs shall be completed at each repair location within the time frames specified.

If the repair is not progressing at a rate that shall permit the restoration of traffic within the specified time period, appropriate temporary measures, acceptable to the Contract Administrator, shall be taken to open the road to traffic.

A full depth concrete repair shall replace the above temporary work during the next scheduled closure.

362.07.03 Testing of Concrete

Field sampling and testing of concrete shall be performed according to OPSS 1350.

Field sampling and testing of concrete shall be performed by a person holding either of the following certifications:

- a) CCIL Certified Concrete Testing Technician, or
- b) Concrete Field Testing Technician - Grade 1.

This person shall have a valid, original card issued by the certifying agency in their possession at all times. Samples for determining acceptance of concrete for air and slump shall be grab samples taken according to CSA A23.2-1C after approximately 10% of the load has been discharged. The discharge shall be stopped and no additional concrete shall be discharged or placed into the work until samples have been tested and found acceptable.

Temperature shall be measured according to CSA A23.2-17C. Slump shall be measured according to CSA A23.2-5C. Air content shall be measured according to CSA A23.2-4C. The air meter shall be calibrated at least once a year according to CSA A23.2-4C and a copy of the calibration certificate shall be with the air meter and available for review, when requested by the Contract Administrator.

Thermocouples shall be installed potentiometers shall be provided at a minimum of two test locations per truck load. The time when the concrete pavement has attained a minimum compressive strength of 15 MPa shall be determined based on the calibration chart.

Test results which verify 15 MPa concrete at each test location shall be submitted immediately, on site, to the Contract Administrator.

At each repair area, a minimum of three sets of two autogenous test cylinders shall be made. The cylinders shall be tested at times and temperatures which correlate insitu and design strengths with relation to the calibration chart. Testing of cylinders shall be carried out at a CSA certified laboratory.

362.07.04 Curing

Immediately after finishing, the concrete surface shall be sprayed with a white pigmented membrane curing compound at a rate of 0.2 litres per square metre, then covered with a polyethylene sheet.

The temperature of the concrete at the time of placing shall be less than or equal to 35°C. The use of insulation to retain heat in the concrete is permitted.

362.07.05 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

362.08 QUALITY ASSURANCE

Quality assurance shall be according to OPSS 360.

362.09 MEASUREMENT OF PAYMENT

362.09.01 Actual Measurement

362.09.01.01 Fast Track Full Depth Repairs to Concrete Pavement

Measurement for fast track full depth repairs to concrete pavement shall be made in square metres without deduction for appurtenances.

362.09.02 Plan Quantity Payment

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

362.10 BASIS OF PAYMENT

362.10.01 Fast Track Full Depth Repairs to Concrete Pavement - Item

Payment at the contract price for the above work shall be full compensation for all labour, Equipment, and Material required to do the work including tie bars, load transfer devices and sampling and testing of concrete.

Temporary measures to open the road to traffic shall be at no extra cost to the Owner.

Appendix 362-A, November 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here



NOTICE TO USERS OF OPSS 363

CONSTRUCTION SPECIFICATION FOR REPAIRING RIGID PAVEMENT WITH PRECAST CONCRETE SLABS

OPSS 363 has been removed from this
OPS volume

The provincial version of OPSS 363 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 363

The municipal version of OPSS 363 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 363

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



CONSTRUCTION SPECIFICATION FOR PARTIAL DEPTH REPAIRS IN CONCRETE PAVEMENT

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364.10	BASIS OF PAYMENT

APPENDICES

364-A	Commentary

364.01	SCOPE

This specification covers the requirements for partial depth repairs in concrete pavement and includes removal of concrete, preparation of surfaces, placement of concrete and forming joints associated with the repairs.

364.01.01 Specification Significance and Use

This specification has been developed for use in provincial and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

364.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

364.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 350	Concrete Pavement, Concrete Base and Lean Concrete Base
OPSS 360	Full Depth Repair of Concrete Pavement or Concrete Base
OPSS 929	Abrasive Blast Cleaning - Concrete Construction

Ontario Provincial Standard Specifications, Material

OPSS 1002	Aggregates - Concrete
OPSS 1301	Hydraulic Cementing Materials
OPSS 1350	Concrete, Materials and Production

364.03 DEFINITIONS

Partial Depth Repairs means areas of concrete pavement repair to a minimum depth of 50 mm and a maximum depth of one-third the thickness of the existing concrete slab.

Working Cracks means full depth cracks which are subject to horizontal and or vertical movement.

364.05 MATERIALS

364.05.01 Coarse Aggregate

Coarse aggregates shall be according to OPSS 1002 with a nominal maximum aggregate size of 19 mm.

364.05.02 Cement Paste for Surface Preparation

Cement paste shall consist of normal Portland cement according to OPSS 1301 and sufficient water to produce a paste that can be applied with a brush. Cement paste not used within 30 minutes shall be discarded.

364.05.03 Concrete

Concrete shall be according to OPSS 1350 and the following specific requirements:

Class of concrete	30 MPa at 28 days
Maximum slump	60 mm
Air content	$6.0 \pm 1.5 \%$

364.07 CONSTRUCTION

364.07.01 General

The Contract Administrator shall clearly delineate the limits of the repair area. The perimeter of the concrete pavement repair area shall be sawcut vertically to a depth of 50 mm. The concrete within the sawcut area shall be removed to a minimum depth of 50 mm and a maximum depth of one-third the thickness of the existing concrete slab using equipment that prevents the fracture of the underlying sound concrete. Wire mesh in the concrete shall be removed to the edge of the repair.

The area shall be abrasive blast cleaned according to OPSS 929. Immediately prior to filling the repair area with concrete, the surface area of the repair shall be uniformly coated with cement paste. The repair area shall then be filled with concrete, finished flush with the adjacent surface and cured according to OPSS 350.

364.07.01.01 Joints and Working Cracks

When the partial depth repair area includes an existing pavement joint or working crack, a joint shall be formed in the repair area to match the existing pavement joint or working crack. The joint shall be formed by placing a compressible joint material along the cut line in such a manner that prevents the plastic concrete from infiltrating the existing joint or crack. The width of compressible material shall match the existing joint or working crack. Prior to placement of compressible material, joints or working cracks shall be blown clean with compressed air.

364.07.02 Miscellaneous Protection

Miscellaneous protection for partial depth repairs in concrete pavement shall be according to OPSS 350 except that the requirement of two samples per lot shall not apply.

364.07.02.01 Traffic

For early opening determination, one set of test cylinders shall be taken from the last load of concrete placed in the pavement section to be opened to traffic. The test cylinders shall be field cured adjacent to the repair area. Early opening to traffic shall be according to OPSS 360.

364.07.03 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

364.09 MEASUREMENT OF PAYMENT

364.09.01 Actual Measurement

Measurement shall be in square metres of the horizontal area repaired.

364.10 BASIS OF PAYMENT

364.10.01 Partial Depth Repairs in Concrete Pavement - Item

Payment at the contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 364-A, November 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here



NOTICE TO USERS OF OPSS 365

CONSTRUCTION SPECIFICATION FOR CROSS-STITCHING LONGITUDINAL CRACKS IN CONCRETE PAVEMENT AND CONCRETE BASE

OPSS 365 has been removed from this
OPS volume

The provincial version of OPSS 365 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 365

The municipal version of OPSS 365 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 365

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



**CONSTRUCTION SPECIFICATION FOR
SEALING OR RESEALING OF JOINTS AND CRACKS
IN CONCRETE PAVEMENT AND CONCRETE BASE**

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APPENDICES

369-A	Commentary

369.01 SCOPE

This specification covers the requirements for sealing or resealing of joints and cracks up to 25 mm in width in concrete pavement and concrete base.

369.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

369.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

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The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

369.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 350 Concrete Pavement and Concrete Base
OPSS 929 Abrasive Blast Cleaning - Concrete Construction

Ontario Provincial Standard Specifications, Material

OPSS 1212 Hot Poured Rubberized Asphalt Joint Sealing Compound

ASTM International

D 2628-91(2005) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

369.03 DEFINITIONS

For the purpose of this specification, the following definitions shall apply:

Backer Rod means a compressible material inserted into the reservoir to achieve the required shape factor for the sealant and prevent loss of sealant.

Reservoir means a saw cut cavity of specific dimensions designed to receive the backer rod and sealant or seal.

Shape Factor means the ratio of width to depth of a field poured liquid sealant within the reservoir.

369.05 MATERIALS

369.05.01 Sealants

Hot poured rubberized asphalt joint sealing compound shall be according to OPSS 1212.
Silicone sealant shall be as specified in the Contract Documents.

369.05.02 Seals

Preformed compression seals shall meet the manufacturer's requirements according to ASTM D 2628.

369.05.03 Backer Rods

Backer rods shall be made of polyethylene foam, cross-linked polyethylene foam, or polyurethane foam.

369.06 EQUIPMENT

369.06.01 Saw Cutting Equipment

Saw cutting equipment shall be capable of following the path of random cracks to create a sealant reservoir to the dimensions specified in the Contract Documents, without causing spalling or damage to the adjacent concrete.

The saw shall be power driven and equipped with a diamond blade having a diameter of 200 mm or less.

369.06.02 Heating Kettle

When required, the heating kettle shall be designed and operated to ensure uniform heat and to agitate and prevent overheating of the sealant.

369.06.03 Hot Compressed Air Lance

The hot compressed air lance shall have an oil free discharge of air at a temperature greater than 1,000 °C and an air velocity greater than 1,000 m per second.

369.07 CONSTRUCTION

369.07.01 General

Joints and cracks identified in the Contract Documents and in the field by the Contract Administrator shall be filled with hot poured rubberized joint sealing compound. Preformed compression seals or silicone sealant shall be used when specified in the Contract Documents.

The maximum width of repair shall be 25 mm for both transverse and longitudinal cracks and joints. Cracks and joints exceeding the maximum repair width shall be repaired as directed by the Contract Administrator.

369.07.02 Operational Constraints

Grinding and milling operations shall be completed prior to sealant installation.

Sealant or seals shall not be placed until new concrete has cured for a minimum of 7 Days.

Cracks and joints shall be kept in a dry condition for a minimum period of 24 hours prior to sealant or seal installation.

Sealant shall not be placed when the ambient air and pavement surface temperatures are less than 5 °C. Seals shall be placed according to the manufacturer's recommendations.

369.07.03 Removal of Existing Sealant and Seals

All existing sealant and seals shall be removed without damaging the adjacent joint or crack faces.

369.07.04 Reservoir

Saw cutting equipment shall be used to create a reservoir with dimensions specified in the Contract Documents. Routers shall not be used for creating the reservoir.

The shape factor shall be 1H:1V for hot poured rubberized sealant and 2H:1V for silicone sealant.

When resealing cracks or joints, if the existing reservoir is determined by the Contract Administrator to be in an acceptable condition with minimal spalling and to have the proper dimensions, saw cutting shall not be required, but cleaning shall be required.

369.07.05 Cleaning

Immediately after the sawing operation, reservoirs shall be flushed with water in one direction to remove the slurry. Immediately prior to sealing operations, all joint and crack faces shall be abrasive blast cleaned according to OPSS 929. The reservoir shall then be blown clean and dried using a hot compressed air lance.

369.07.06 Backer Rod Installation

Backer rods shall have a minimum diameter of 25% greater than the reservoir width. They shall be installed immediately after cleaning and drying and before sealant installation. Backer rods shall be inserted uniformly to the required depth to achieve the required shape factor.

Backer rods shall be inserted using a double wheel steel roller and shall not be punctured or stretched during the installation process.

369.07.07 Sealant and Seal Installation

369.07.07.01 General

Prepared transverse joints and cracks shall be filled prior to longitudinal joints and cracks.

Sealant and seals shall be installed according to the manufacturer's recommendations.

369.07.07.02 Hot Poured Rubberized Joint Sealing Compound

The sealant shall be placed by a manual pouring cone or hose and wand fitted with a proper sized tip from a low pressure pump connected to the heating kettle.

The tip of the cone or wand shall be placed to the top of the backer rod to ensure uniform application.

The reservoir shall be filled with sealant so that upon cooling, the sealant is recessed 3 to 6 mm below the adjacent pavement surface. If the initial placement of material subsides below the required recess depths, additional sealant shall be placed.

Sealant damaged by construction traffic or by the Contractor's operations shall be replaced.

Any spilled material or excess material in the joints or cracks shall be removed immediately and the pavement surface cleaned.

369.07.07.03 Compression Seal

After final cleaning of the reservoir, the lubricant adhesive shall be applied to the seal and the seal shall be installed according to the manufacturer's specifications. During installation, twisting, nicking, or other damage to the seal shall be avoided.

369.07.07.04 Silicone Sealant

Installation of silicone sealant shall be as specified in the Contract Documents and according to manufacturer's recommendations.

369.07.08 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

369.08 QUALITY ASSURANCE

During the process of sealant or seal installation, upon request, the Contractor shall provide a sample of the seal or seal for testing to the Contract Administrator.

Sealant samples shall be stored in triple-tight epoxy-lined pails or suitable leak-proof plastic containers.

Seal samples shall be a minimum 1 m in length.

All samples shall be accompanied by a sample data sheet and any additional documents as specified in the Contract Documents. When not specified or not included on the sample data sheet, samples shall be delivered with a transmittal form identifying the following information:

- a) Contract number.
- b) Name of Contractor and a contact person's name and telephone numbers.
- c) Contract Administrator's name and telephone numbers.
- d) Quantity and type of sample. When a sample consists of more than one item, each item shall be individually identified.
- e) Date sampled (i.e., yyyy-mm-dd).

- f) Date shipped.
- g) Sample location.

369.09 MEASUREMENT FOR PAYMENT

369.09.01 Actual Measurement

369.09.01.01 Resealing of Joints and Sealing or Resealing of Cracks in Concrete Pavement and Concrete Base

Measurement of resealing of joints and sealing or resealing of cracks in existing concrete pavement or concrete base shall be by length in metres measured along the centreline of the crack or joint.

369.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

369.10 BASIS OF PAYMENT

369.10.01 Resealing of Joints and Sealing or Resealing of Cracks in Concrete Pavement and Concrete Base - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Sealant or seals damaged by construction traffic or by the Contractor's operations shall be replaced at no extra cost to the Owner.

Removal of excess or spilled sealant shall be at no extra cost to the Owner.

Payment for the sealing of joints in new concrete pavement shall be paid according to OPSS 350.

Appendix 369-A, November 2008 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The specification is appropriate for use on cracks and joints up to 25 mm in width. For widths greater than 25 mm in width, the designer should consider alternative remedial treatments.

The designer should specify the following in the Contract Documents:

- Sealant reservoir dimensions. (369.06.01)
- Installation requirements for silicone sealant. (369.07.07.04)

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- Material requirements for silicone sealant. (369.05.01)
- Joint sealing using preformed compression seals or silicone sealant. (369.07.01)

The designer should estimate tender quantities for resealing of cracks and existing joints and sealing of cracks required under this item. The tender quantity should not include the sealing of joints in new concrete pavement.

A pavement condition survey is recommended to determine the extent of the joint and crack sealing or resealing required.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 508.020	Sealing or Resealing of Joints and Cracks in Concrete Pavement and Concrete Base
OPSD 552.010	Concrete Pavement, Joint Details



NOTICE TO USERS OF OPSS 401

CONSTRUCTION SPECIFICATION FOR TRENCHING, BACKFILLING, AND COMPACTING

OPSS 401 has been removed from this
OPS volume

The provincial version of OPSS 401 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 401

The municipal version of OPSS 401 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 401

USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS



**CONSTRUCTION SPECIFICATION FOR
EXCAVATING, BACKFILLING, AND COMPACTING
FOR MAINTENANCE HOLES, CATCH BASINS,
DITCH INLETS, AND VALVE CHAMBERS**

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APPENDICES

402-A	Commentary

402.01	SCOPE

This specification covers the requirements for excavating, backfilling, and compacting for the installation of storm and sanitary pipe sewer maintenance holes, storm sewer catch basins and ditch inlets, and valve chambers for watermains and forcemains.

402.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

402.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

402.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 403	Rock Excavation for Pipelines, Utilities, and Associated Structures in Open Cut
OPSS 404	Support Systems
OPSS 490	Site Preparation for Pipelines, Utilities, and Associated Structures
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 501	Compacting
OPSS 510	Removal
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1359	Unshrinkable Backfill

402.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Additional Excavation means all excavation ordered in writing by the Contract Administrator beyond excavation specified in the Contract Documents.

Backfilling means the operation of filling the excavation with bedding and backfill material.

Backfill Material means approved fill material used above the bedding and below the lower of the subgrade or finished grade or original ground.

Bedding Material means the material used to support the maintenance hole, catch basin, ditch inlet, or valve chamber.

Excavation, Earth and Rock means the excavation classified as earth and rock according to OPSS 206.

Imported Material means material obtained from a source other than the Work Area.

Native Material means the material removed to form an excavation within the Work Area for return to the same or other excavation.

Over-Excavation means all excavation beyond that specified in the Contract Documents, performed without the written order of the Contract Administrator.

Structure means maintenance hole, catch basin, ditch inlet, or valve chamber.

Unshrinkable Fill means a controlled density cement treated aggregate material.

402.05

MATERIALS

402.05.01

Granular Material

Granular material shall be according to OPSS 1010.

402.05.02

Backfill Material

402.05.02.01

General

Backfill material shall be as specified in the Contract Documents.

402.05.02.02

Native and Imported Material

Native and imported material shall be material approved by the Contract Administrator. All material shall be free from frozen lumps, cinders, ashes, refuse, vegetable or organic matter, rocks, and boulders over 150 mm in any dimension, and other deleterious material.

402.05.03

Unshrinkable Fill

Unshrinkable fill shall be according to OPSS 1359.

402.07 CONSTRUCTION

402.07.01 General

Excavations shall be stable and dry, unless designated as subaqueous Work.

402.07.02 Site Preparation

Site preparation shall be according to OPSS 490.

402.07.03 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

402.07.04 Removals

Removals shall be according to OPSS 510.

402.07.05 Dewatering

Dewatering shall be according to OPSS 517.

402.07.06 Support Systems

Support systems shall be according to OPSS 404.

402.07.07 Removal of Frozen Ground

Written permission shall be obtained from the Contract Administrator prior to starting an excavation in frozen ground. The method used for removal of frozen ground shall not cause damage to adjacent structures or Utilities.

402.07.08 Excavation

402.07.08.01 General

Excavation shall be performed to the lines, elevations, and dimensions specified in the Contract Documents plus an allowance for support systems, where required.

Rock excavation for maintenance holes, catch basins, ditch inlets, or valve chambers shall be according to OPSS 403.

402.07.08.02 Additional Excavation

Structures shall not be placed or constructed on an unsuitable foundation as may be determined by the Contract Administrator.

Unsuitable material shall be excavated and the resulting excavation shall be backfilled and compacted to obtain a suitable foundation.

402.07.08.03 Over-Excavation

Corrective measures ordered by the Contract Administrator to rectify deficiencies caused by over-excavation shall be performed. Soil that has become disturbed by construction methods or procedures shall be removed and replaced with granular material compacted to 95% maximum dry density where the excavated surface is below or beside the proposed structure.

402.07.09 Backfilling and Compacting

402.07.09.01 Bedding

A 150 mm layer of granular bedding material shall be placed on the bottom of the excavation and compacted according to OPSS 501, prior to the placing of a structure.

402.07.09.02 Backfill

Backfill material shall be placed simultaneously on all sides of the structure in layers not exceeding 300 mm in thickness, loose measurement, and compacted according to OPSS 501, prior to the placement of a subsequent layer.

Backfill material shall not commence around cast-in-place concrete structures until approval has been obtained from the Contract Administrator.

402.07.10 Additional Excavating, Backfilling, and Compacting

Additional excavating, backfilling, and compacting shall be as described in the Excavation and Backfilling and Compacting subsections.

The volume of the excavation that is in addition to the limits specified in the Contract Documents shall be determined.

402.07.11 Site Restoration

Site restoration shall be according to OPSS 492.

402.07.12 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

402.09 MEASUREMENT FOR PAYMENT

402.09.01 Actual Measurement

402.09.01.01 Additional Excavating, Backfilling, and Compacting

Additional excavating, backfilling, and compacting shall be based on the volume of the additional excavation measured in cubic metres prior to installation of a structure.

The volume of the additional excavation shall be determined beyond the limits specified in the Contract Documents.

402.10 BASIS OF PAYMENT

402.10.01 Excavating, Backfilling, and Compacting for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

Payment at the Contract price for the appropriate tender items for the installation of maintenance holes, catch basins, ditch inlets, and valve chambers shall be full compensation for all labour, Equipment, and Material to do the work.

When the Contract contains separate items for work required by this specification, payment shall be at the Contract prices and according to the specifications for such work.

Any expenses for remedial work resulting from over-excavation shall be borne by the Contractor.

402.10.02 Additional Excavating, Backfilling, and Compacting - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

402.10.03 Rock Excavation for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

Payment for rock excavation for maintenance holes, catch basins, ditch inlets, and valve chambers shall be according to OPSS 403.

Appendix 402-A, November 2013 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer may consider including soil boring data, a geotechnical report, a subsurface report, or a soils report in the tender documents.

The designer should specify the following in the Contract Documents:

- Type of backfill material. (402.05.02)
- Lines, elevations, and dimensions of structure excavation. (402.07.08.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 701.010 to 701.015	Precast Concrete Maintenance Holes, 1,200 mm to 3,600 mm in Diameter
OPSD 701.030 to 701.081	Precast Concrete Maintenance Hole Components, 1,200 mm to 3,600 mm in Diameter
OPSD 702.040 to 702.050	Precast Concrete Ditch Inlet Maintenance Hole, 1,200 mm x 1,200 mm
OPSD 703.011 to 703.015	Precast Concrete Single Inlet Flat Cap, 1,500 mm to 3,600 mm in Diameter
OPSD 703.021 to 703.024	Precast Concrete Twin Inlet Flat Cap, 1,500 mm to 3,000 mm in Diameter
OPSD 705.010 to 705.020	Precast Concrete Catch Basins
OPSD 705.030 to 705.040	Precast Concrete Ditch Inlets
OPSD 706.010 to 706.041	Precast Concrete Ditch Inlets with 1,500 mm to 3,000 mm Diameter Flat Cap
OPSD 1100.010	Cast-In-Place Chamber for Valves up to 350 mm Diameter
OPSD 1101.010	Precast Valve Chamber, 1,200 mm and 1,500 mm Diameter
OPSD 1101.012 to 1101.015	Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 1,800 mm x 2,400 mm
OPSD 1101.016 to 1101.019	Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 2,400 mm x 3,000 mm



**CONSTRUCTION SPECIFICATION FOR
ROCK EXCAVATION FOR PIPELINES, UTILITIES,
AND ASSOCIATED STRUCTURES IN OPEN CUT**

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403-A	Commentary

403.01 SCOPE

This specification covers the rock excavation requirements for the installation of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, and watermains and associated appurtenances; underground Utilities; and maintenance holes, catch basins, ditch inlets, and valve chambers in open cut.

403.01.01 Specification Significance and Use

This specification has been developed for use in provincial and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

403.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

403.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 412	Sewage Forcemain Installation in Open Cut
OPSS 441	Watermain Installation in Open Cut

403.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Associated Appurtenances means as defined in OPSS 412 and OPSS 441.

Associated Structures means a maintenance hole, catch basin, ditch inlet, or valve chamber.

Rock means rock as defined in OPSS 206.

403.07 CONSTRUCTION

403.07.01 General

Rock excavation to install sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, and watermain and associated appurtenances; underground Utilities; and maintenance holes, catch basins, ditch inlets, and valve chambers in open cut shall be performed to the lines and grades specified in the Contract Documents.

403.07.02 Use of Explosives

The requirements for the use of explosives shall be as specified in the Contract Documents.

403.07.03 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

403.09 MEASUREMENT FOR PAYMENT

403.09.01 Actual Measurement

403.09.01.01 Rock Excavation for Pipelines, Utilities and Associated Structures

Measurement shall be in cubic metres.

The volume of rock excavation for pipelines, Utilities, and associated structures shall be determined by the product of the relevant following dimensions measured in place:

a) Height

The height of rock excavation for pipelines, Utilities, and associated structures is the difference in elevation between the theoretical bottom of bedding and the lower of the top of the original rock or the top of shatter.

The top of the original rock shall be determined using one of the following methods:

- i. Elevations taken after the overburden has been removed but before rock excavation.
- ii. From rock surface elevations on both sides of the excavation after rock excavation has been completed.

b) Width

The width of rock excavation for pipelines and Utilities is the actual width of trench measured horizontally to a maximum of the specified trench width.

c) Length

The length of rock excavation for pipelines and Utilities is measured horizontally along the centreline of the trench to the outside limits of the backfill for the associated structures or to the outlet end of a pipe where it emerges from the rock.

d) Horizontal

The horizontal measurement for associated structures is the:

- i. diameter at the external surfaces of a circular structure plus 300 mm all around; or
- ii. the length and width to the external surfaces of a rectangular or square structure plus 300 mm on all sides.

Where the excavation for this item overlaps rock excavation for other items there shall be no deduction for the overlap.

The volume of boulders in an excavation shall be determined by the product of the three maximum rectilinear dimensions. Where boulders classified as rock are measured for payment, only the amount actually removed shall be considered for payment, the total volume of rock considered for payment shall not exceed the volume of excavation within the theoretical lines.

403.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

403.10 BASIS OF PAYMENT

403.10.01 Rock Excavation for Trenches and Associated Structures - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

**Appendix 403-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer may consider including soil boring data, a geotechnical report, a subsurface report, or a soils report in the tender documents.

The designer should specify the following in the Contract Documents:

- Line and grade requirements of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, and watermains and associated appurtenances; underground Utilities; and maintenance holes, catch basins, ditch inlets, and valve chambers. (403.07.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR SUPPORT SYSTEMS

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404.10	BASIS OF PAYMENT

APPENDICES

404-A	Commentary

404.01 SCOPE

This specification covers the requirements for supplying, placing, maintaining, and removing support systems required to permit the excavation and backfilling of trenches or excavations for the installation of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, watermains and associated appurtenances, and other underground Utilities; maintenance holes, catch basins, ditch inlets, and valve chambers; and any other specified subsurface construction.

404.01.01 Specification Significance and Use

This specification has been developed for use in provincial and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

404.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

404.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

Ontario Provincial Standard Specifications, Construction

OPSS 412 Sewage Forcemain Installation in Open Cut
OPSS 441 Watermain Installation in Open Cut

Provincial Statute

Occupational Health and Safety Act
R.S.O. 1990,
c. O.1, as amended
Ontario Regulations 213/91 - Regulations for Construction Projects, as amended

404.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Associated Appurtenances mean as defined in OPSS 412 and OPSS 441.

Sheathing means the vertical members of the support system that are placed up against the walls of an excavation to directly resist the pressure exerted from the walls of the excavation. Sheathing may be either wood or steel sheet piling.

Support Systems means as described in the *Occupational Health and Safety Act* and Regulations for Construction Projects.

Trench means the definition as provided in the *Occupational Health and Safety Act* and Regulations for Construction Projects.

404.04 DESIGN AND SUBMISSION REQUIREMENTS

404.04.01 Submission Requirements

404.04.01.01 Pre-Condition Survey

When specified in the Contract Documents, a pre-condition survey shall be prepared for all buildings, Utilities, structures, roadway infrastructure, and facilities within 30 m of the location where the support system is to be installed. The pre-condition survey shall include, as a minimum: existing structural and cosmetic damage or defects.

A copy of the pre-condition survey shall be provided to the Contract Administrator upon request.

404.07 CONSTRUCTION

404.07.01 General

Support systems shall be supplied, placed, and maintained at the locations and elevations that are necessary or required to:

- a) support and protect the sides and bottom of the excavation.
- b) prevent undue disturbance or weakening of the supporting material below or beside the works.
- c) prevent movement of ground which may disturb or damage the works, adjacent pavements, property, structures, or other works.

404.07.02 Installation

Support systems shall be placed so they can be removed as backfilling takes place without damage to the works and without settlement of or damage to adjacent pavements, property, structures, or other works.

404.07.03 Removal, Backfilling, and Compacting

As the excavation is backfilled, the support system shall be removed, unless it is specified in the Contract Documents to be left in place or approved by the Contract Administrator.

Support systems shall be withdrawn gradually as backfilling progresses. Backfill shall be placed and compacted in a manner that fills the voids left by pulled support systems. The procedure for extracting the support system and placing backfill shall ensure the backfill load is applied gradually and disturbance of the works or foundation material is avoided.

Backfill shall be placed and compacted around and over the support systems left in place. Support systems left in place shall be cut off as specified in the Contract Documents.

404.07.04 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

404.09 MEASUREMENT FOR PAYMENT

404.09.01 Actual Measurement

404.09.01.01 Support System Left in Place

Measurement for support systems left in place shall be based on the sheathing area for all sides of the excavation in square metres according to the following:

a) Height

The vertical distance of the sheathing actually left in place. If the sheathing is cut off less than 1,200 mm from its top then the actual vertical height placed shall be used.

b) Length

The horizontal distance along the line of the supported excavation from the beginning to the end of the sheathing left in place.

404.10 BASIS OF PAYMENT

404.10.01 Support Systems

Payment at the Contract price for the appropriate tender items for the installation of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, watermain and associated appurtenances, and other underground Utilities; maintenance holes, catch basins, ditch inlets or valve chambers; and any other specified subsurface construction shall include full compensation for all labour, Equipment, and Material to do the work.

404.10.02 Support Systems Left in Place - Item

Payment at the Contract price for the above tender item shall be full compensation for all Material left in place.

No additional payment shall be made for support systems left in place at the Contractor's option.

Appendix 404-A, November 2010 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer may consider including soil boring data, a geotechnical report, a subsurface report, or a soils report in the Tender Documents.

The designer should specify the following in the Contract Documents:

- If the support system is to be left in place and the cut-off elevation. (404.07.03)

The designer should determine if a pre-condition survey is required and, if so, the need should be specified in the Contract Documents. (404.04.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 802.010 to 802.014	Flexible Pipe Embedment and Backfill
OPSD 802.020 to 802.024	Flexible Pipe Arch Embedment and Backfill
OPSD 802.030 to 802.034	Rigid Pipe Bedding, Cover, and Backfill
OPSD 802.050 to 802.054	Horizontal Elliptical Rigid Pipe Bedding, Cover, and Backfill



CONSTRUCTION SPECIFICATION FOR PIPE SUBDRAINS

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405.10	BASIS OF PAYMENT

APPENDICES

405-A	Commentary

405.01 SCOPE

This specification covers the requirements for the installation of pipe subdrains.

405.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

405.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

405.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 320	Open Graded Drainage Layer
OPSS 409	Closed-Circuit Television Inspection of Pipelines
OPSS 421	Pipe Culvert Installation In Open Cut
OPSS 501	Compacting

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1801	Corrugated Steel Pipe Products
OPSS 1840	Non-Pressure Polyethylene Plastic Pipe Products
OPSS 1841	Polyvinyl Chloride (PVC) Pipe Products
OPSS 1860	Geotextiles

Canadian Standards Association (CSA)

G164-M92 (R2003) Hot Dip Galvanizing of Irregularly Shaped Articles

Bureau De Normalisation Du Quebec (BNQ)

3624-115 (2007) Polyethylene (PE) Pipe and Fittings - Flexible Corrugated Pipes for Drainage - Characteristics and Test Methods.

Water Research Centre (WRc) Publication

MSCC Manual of Sewer Condition Classification, 4th Edition, December 2003

405.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Backfilling means the operation of filling the trench with embedment and backfill material.

Backfill Material means the material used to fill the trench above the embedment material and below the lower of the subgrade or finished grade or the original ground.

Bedding means the embedment material placed in the subdrain and outlet pipe trenches below the pipe.

CCTV means closed-circuit television.

Embedment Material means the material used to fill the trench from the bottom of bedding to the height specified in the Contract Documents.

Knitted Sock Geotextile means a textile structure produced by knitting in a continuous tube specifically intended to cover perforated subdrain. Knitted geotextiles are suitable only for wrapping of perforated subdrain pipe.

OGDL means open graded drainage layer.

Outlet means the terminal 2.5 m of the outlet pipe.

Outlet Pipe means a non-perforated 100 or 150 mm diameter pipe that is placed for the purpose of conveying subsurface water from a subdrain to a proper outlet.

Subdrain means a perforated 100 or 150 mm diameter pipe that is placed for the purpose of collecting subsurface water and conveying it to a proper outlet pipe.

405.04 DESIGN AND SUBMISSION REQUIREMENTS

405.04.01 Submission Requirements

Upon request, prior to the placement of subdrain or outlet pipe, documentation from the manufacturer verifying that the material supplied meets the Contract requirements shall be submitted to the Contract Administrator.

405.05 MATERIALS

405.05.01 General

Subdrain shall be a perforated polyvinyl chloride pipe, polyethylene pipe, or corrugated steel pipe.

Outlet pipe shall be a non-perforated corrugated steel pipe or a non-perforated smooth inside wall pipe constructed of high density polyethylene or polyvinyl chloride.

Outlets shall be constructed of non-perforated corrugated steel pipe or double-walled polyethylene or polyvinyl chloride pipe having a minimum stiffness of 300 kPa.

405.05.02 Corrugated Steel Pipe Products

Corrugated steel pipe products shall be according to OPSS 1801 and as specified in the Contract Documents.

405.05.03 Polyethylene Pipe Products

Polyethylene pipe products shall be according to OPSS 1840 or BNQ 3624-115 and as specified in the Contract Documents.

405.05.04 Polyvinyl Chloride Pipe Products

Polyvinyl chloride pipe products shall be according to OPSS 1841 and as specified in the Contract Documents.

405.05.05 Geotextiles

Geotextiles shall be according to OPSS 1860 and as specified in the Contract Documents.

405.05.06 Fittings

Fittings shall be suitable for and compatible with the class and type of pipe with which they will be used.

Caps shall be polyethylene.

Galvanizing of rodent gates shall be according to CSA G164.

405.05.07 Granular

Granular material shall be according to OPSS 1010 and as specified in the Contract Documents.

405.05.08 Clear Stone

Clear stone shall be 19 mm, Type I or Type II, according to OPSS 1004.

405.05.09 Open Graded Drainage Layer Aggregate

OGDL aggregate shall be according to OPSS 320.

405.07 CONSTRUCTION

405.07.01 General

Contractor inspection reports shall confirm the following at each outlet pipe connection and at the midpoint between outlets:

- a) Trench alignment, grade, and width.
- b) Grade of bedding material.
- c) Condition of subdrain, outlet pipe, and geotextile.
- d) Compaction.

Contractor inspection reports shall be submitted to the Contract Administrator upon request.

Geotextile, subdrain, or outlet pipe damaged by exposure to sunlight or damaged by any other means shall be replaced.

The stability of the subdrain and outlet pipe trenches shall be maintained at all times during excavation and backfilling.

405.07.02 Excavation

Trenches shall be excavated to the lines, grades, and dimensions specified in the Contract Documents.

The excavation shall be inspected with grade checks and certified by the Contractor prior to placement of the pipe bedding.

405.07.03 Unstable Foundations

When unstable foundation conditions are encountered, the Contractor shall take the necessary steps to ensure a stable foundation as directed by the Contract Administrator. An inspection report to verify the foundation stability shall be submitted to the Contract Administrator upon request.

405.07.04 Geotextile

Subdrain shall be wrapped with a knitted sock geotextile.

When a geotextile wrapped trench is specified in the Contract Documents, wrapping of the subdrain with a knitted sock geotextile shall not be required, and the geotextile shall be installed as specified in the Contract Documents.

When OGD or 19 mm clear stone embedment are specified in the Contract Documents, the subdrain trench and outlet pipe trench shall be wrapped with geotextile.

When granular embedment and backfill material are specified for an outlet pipe connection to a catch basin, the outlet pipe trench shall not require geotextile wrap.

405.07.05 Bedding

Bedding shall be placed in the trench to the depth specified in the Contract Documents prior to laying the subdrain or outlet pipe.

The pipe bedding grade shall be inspected with grade checks and certified by the Contractor prior to laying the subdrain or outlet pipe.

405.07.06 Laying Subdrain and Outlet Pipe

405.07.06.01 General

Pipe installation shall be according to OPSS 421 and as specified below.

The pipe shall be placed firmly on the bedding and secured in place to prevent any movement or disturbance during backfilling. Pipe with perforations on only one side shall be installed with perforations down. Pipe shall not be laid in water or on saturated bedding. Pipe shall not be used as a drain for the Contractor's operation.

Connections between the subdrain and outlet pipe shall be made with prefabricated 45° elbows or pre-manufactured pipe curves as required.

Outlet pipe shall be installed at all low lying areas, at the end of subdrain, and at a uniform spacing of 100 m along the length of the subdrain.

Subdrain and outlet pipe installation shall be inspected and approved by the Contractor prior to backfilling.

405.07.06.02 Outlets

405.07.06.02.01 General

The outlet shall have an internal diameter that is slightly larger than the outlet pipe diameter so that the outlet pipe can be inserted into the outlet a minimum distance of 300 mm.

Outlets shall extend beyond the front of the ditch or fill slope for a distance of 300 mm.

The ends of all outlets shall be fitted with galvanized rodent gates.

The joint between the outlet pipe and the outlet shall be wrapped with a 0.5 m width of geotextile.

405.07.06.02.02 Marking of Outlets

Each outlet location shall be marked with a 25 x 25 mm square galvanized steel bar, 2.2 m long, embedded from 0.6 to 1.0 m into the ground, adjacent to the outlet, clearly visible from the driving portion of the roadway.

405.07.06.03 Connection to Drainage Structures

Subdrain shall be connected to maintenance holes, catch basins, and ditch inlets by a 1 m section of non-perforated pipe. Subdrain and outlet pipe connections to concrete maintenance holes, catch basins, and ditch inlets shall be cored and grouted as specified in the Contract Documents.

405.07.07 Embedment and Backfill Material

Embedment material shall be clear stone, granular, or open graded drainage layer aggregate as specified in the Contract Documents.

Backfill material shall be as specified in the Contract Documents.

The Contractor shall ensure that the subdrain and outlet pipe are not damaged or dislodged during the placement and compaction of embedment and backfill material. Damaged or dislodged subdrain and outlet pipe shall be removed and replaced.

Any earth from cave-ins and all other unsuitable material shall be removed from embedment and backfill material.

Compaction of embedment and backfill material shall be according to OPSS 501.

At the termination of a day's work, backfilling shall be complete over all subdrain and outlet pipe placed.

405.07.07.01 Winter Grading of Material

All ice and snow shall be removed from all portions of the work area. Frozen material shall not be incorporated into the work. Material shall not be placed over frozen ground, ice or snow, except, at the Contractor's option, a single lift may be placed over frozen ground in which case final grading and compaction shall be done after the underlying materials have thawed.

405.07.08 Closed-Circuit Television Inspection

When specified in the Contract Documents, the Contractor shall inspect the drainage system using CCTV inspection to ensure that the subdrain and outlet pipes are intact and were not crushed or damaged during construction. CCTV inspection shall be according to OPSS 409.

CCTV inspection shall be based on selected sampling at locations identified by the Contract Administrator. A minimum of 5% of the entire length of subdrain pipe and 100% of the outlet pipes shall be video inspected and recorded. Where defective, damaged, or improperly installed pipe is encountered, the Contract Administrator may request additional CCTV inspection. The inspection shall be conducted following the placement of the granular course and prior to the placement of the pavement surface.

The equipment used for CCTV inspection of the drainage system shall be according to OPSS 409 with the following exceptions:

- a) The system shall be capable of providing CCTV inspection of subdrain and outlet pipes of minimum 100 mm inside diameter within a wet environment and shall be capable of negotiating a minimum 45° bend.
- b) The system shall be capable of inspecting a length of pipe up to 90 m by push rodding, pull cabling, jetting, or tractoring the camera through the pipe.
- c) The system shall be capable of recording the distance traversed by the camera to within 150 mm.

When the CCTV inspection report shows any of the following defects, as defined by the MSCC manual, they shall be identified to the Contract Administrator and the defective, damaged, or improperly installed subdrain and outlet pipe sections shall be removed and replaced:

- a) Fracture.
- b) Broken.
- c) Large joint displacement.
- d) Large open joint.

- e) Deformed pipe such that the camera is not able to navigate through the pipe.
- f) Ponding water.

Replaced subdrain and outlet pipes shall be re-inspected by CCTV to verify installation.

405.07.09 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

405.08 QUALITY ASSURANCE

The Contractor shall demonstrate the outlet pipe is on grade and unobstructed for its full length after backfilling.

405.08.01 Acceptance Criteria

Acceptance of the subdrain and outlet pipes shall be installation according to the requirements of the Contract Documents and no damage or defects as defined in this specification. Subdrain and outlet pipe with damage or defects or that is improperly installed shall be removed and replaced.

405.09 MEASUREMENT FOR PAYMENT

405.09.01 Actual Measurement

405.09.01.01 Pipe Subdrain

Measurement of pipe subdrain shall be by length in metres horizontally along the centreline of the pipe between the ends of the pipe subdrain, including outlets, or between the upstream end of the pipe subdrain and the centre of a maintenance hole, catch basin, or ditch inlet.

405.09.01.02 CCTV Inspection

Measurement for a CCTV inspection of subdrain and outlet pipe shall be by length in metres on the ground surface along the centreline of the subdrain from the centre of one drainage structure to the centre of another drainage structure or the outlet end of the subdrain.

405.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

405.10 BASIS OF PAYMENT

405.10.01 Pipe Subdrain - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

When excavation and backfilling of subdrain and outlet pipe overlaps the excavation and backfilling required for other work, payment for overlapping excavation and backfilling shall be made in accordance with the specifications for such other work as though no excavation and backfilling were required for pipe subdrain.

When subdrain and outlet pipe are placed below subgrade and the embedment and backfill material are the same material used in the road base or subbase, the embedment and backfill material shall be paid for with the road base or subbase item. When embedment or backfill material or both are different than the material used for the road base or subbase, payment for the embedment and backfill material shall be included in the Contract price for the pipe subdrain.

When unstable foundations are encountered, payment for stabilization shall be as Extra Work.

Maintenance of the stability of the trench shall be at no extra cost to the Owner.

Correction of any defective workmanship and defective or damaged material shall be at no extra cost to the Owner.

405.10.02 Closed-Circuit Television Inspection - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Re-inspection by CCTV inspection to verify the installation of replaced subdrain or outlet pipe shall be at no extra cost to the Owner.

Appendix 405-A, November 2008 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Pipe size, metal thickness, corrugation profile, and coating requirements of corrugated steel pipe. (405.05.02)
- Pipe size, type, and stiffness requirements of polyethylene and polyvinyl chloride pipe products. (405.05.03 and 405.05.04)
- The width, grade, and alignment of trench excavation. (405.07.02)
- Bedding depth. (405.07.05)

The designer should determine if the following is required and, if so, it should be specified in the Contract Documents:

- Type, Class, and Filtration Opening Size (FOS) of geotextile trench wrap. (405.05.05)
- Whether the subdrain trench and outlet are to be wrapped with geotextile. (405.07.04)
- Installation details of the geotextile trench wrap. (405.07.04)
- Material type(s) for embedment and backfill of subdrain and outlet pipes. (405.05.07 and 405.07.07)
- Tender item for the inspection of subdrain and outlet pipes by CCTV. (405.07.08 and 405.10.02)

In specifying material types for embedment material, the designer should be aware that certain granulars may have lower permeability and may not be suitable as a drainage medium.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 206.050	Subdrain Pipe Connections and Outlet Details - Rural
OPSD 207.044	Subdrain Pipe Connections and Outlets for Open Graded Drainage Layer
OPSD 216.021	Subdrain Pipe Connections and Outlet Details - Urban



**CONSTRUCTION SPECIFICATION FOR NEW
MAINTENANCE HOLE, CATCH BASIN, DITCH INLET,
AND VALVE CHAMBER INSTALLATION**

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407.01	SCOPE

This specification covers the requirements for the installation of maintenance holes, catch basins, ditch inlets, and valve chambers.

407.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

407.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

407.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications shall be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications shall be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 353	Concrete Curb and Gutter Systems
OPSS 402	Excavating, Backfilling, and Compacting for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 404	Support Systems
OPSS 408	Adjusting or Rebuilding Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 490	Site Preparation for Pipelines, Utilities, and Associated Structures
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 510	Removal
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS 904	Concrete Structures
OPSS 920	Deck Joint Assemblies, Preformed Seals, Joint Fillers, Joint Seals, Joint Sealing Compounds, and Waterstops - Structures

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production
OPSS 1351	Precast Reinforced Concrete Components for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1850	Frames, Grates, Covers, and Gratings
OPSS 1853	Rubber Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers
OPSS 1854	High Density Polyethylene (HDPE) and Expanded Polystyrene (EPS) Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers

Canadian General Standards Board (CGSB)

1.181-99	Ready-Mixed Organic Zinc-Rich Coating

ASTM International

C 923M-08	Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

407.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Adjustment Units means circular and rectangular units used between the structure and the frame to adjust the elevation of the frame for grates and covers.

Structure means cast-in-place and precast maintenance holes, catch basins, ditch inlets, and valve chambers.

407.04 DESIGN AND SUBMISSION REQUIREMENTS

407.04.01 Submission Requirements

The Contract Administrator shall be notified in writing a minimum of 10 Days prior to precast components for structures being delivered to the site of the works giving the following information:

- a) Name of the company that shall be supplying the materials.
- b) The schedule for the delivery of each component to the site of the works.

407.05 MATERIALS

407.05.01 Concrete

Concrete for cast-in-place structures shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 30 MPa.

407.05.02 Steel Reinforcement

Steel bar reinforcement, bar mats, and wire fabric for cast-in-place structures shall be according to OPSS 1440.

407.05.03 Precast Concrete Components for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

Precast units shall be according to OPSS 1351 and as specified in the Contract Documents.

407.05.04 Steps and Ladders

Steps shall be according to OPSS 1351 and as specified in the Contract Documents.

Ladders shall be as specified in the Contract Documents.

407.05.05 Adjustment Units

Precast concrete adjustment units shall be according to OPSS 1351.

Rubber adjustment units shall be according to OPSS 1853.

High density polyethylene (HDPE) and expanded polystyrene (EPS) adjustment units shall be according to OPSS 1854.

407.05.06 Mortar and Grout

Mortar shall consist of a mixture of one part Portland cement according to OPSS 1301 and three parts mortar sand according to OPSS 1004, wetted with sufficient water to make the mixture plastic. Water shall be according to OPSS 1302.

Grout shall consist of a mixture of one part Portland cement according to OPSS 1301 and two parts mortar sand according to OPSS 1004, wetted with sufficient water to make the mixture plastic. Water shall be according to OPSS 1302.

407.05.07 Frames With Covers or Grates

Frames with covers or grates shall be according to OPSS 1850 and as specified in the Contract Documents.

407.05.08 Aluminum Safety Platforms

Aluminum safety platforms shall be according to OPSS 1351 and as specified in the Contract Documents.

407.05.09 Joint Seal Systems

Joint seal systems for precast concrete structures shall be according to OPSS 1351.

407.05.10 Zinc Rich Paint

Zinc rich paint shall be according to CAN/CGSB 1.181.

407.05.11 Resilient Connectors

Resilient connectors between pipes and structures shall be according to ASTM C 923M.

407.07 CONSTRUCTION

407.07.01 General

Structures of the type specified in the Contract Documents shall be installed on undisturbed and competent foundations at the locations and to the elevations specified in the Contract Documents and shall be constructed plumb and true to alignment.

The top of structures shall be installed below the final grade to allow for the placement of adjustment units to facilitate the placement of the top of the frame with grate or cover to the final grade.

407.07.02 Restrictions

The following restrictions shall apply:

- a) Precast concrete maintenance hole tees may be used only when the mainline pipe sewer is concrete.
- b) Precast concrete maintenance hole tees may not be used when a change in pipe size, longitudinal grade, or direction is required.

407.07.03 Site Preparation

Site preparation shall be according to OPSS 490.

407.07.04 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

407.07.05 Protection Against Floatation

Damage to the structure due to floatation shall be prevented during construction and until completion of the work.

407.07.06 Cold Weather Work

All work shall be protected from freezing. Structures shall not be installed on frozen ground.

407.07.07 Transporting, Unloading, Storing, and Handling

Manufacturer's recommendations for transporting, unloading, storing, and handling shall be followed.

Materials that are unsound or damaged shall be rejected.

407.07.08 Excavating, Backfilling, and Compacting

Excavating, backfilling, and compacting for the installation of structures shall be according to OPSS 402.

407.07.09 Support Systems

Support systems shall be according to OPSS 404.

407.07.10 Dewatering

Dewatering shall be according to OPSS 517.

407.07.11 Cast-In-Place Structures

Concrete placement shall be according to OPSS 904.

All inside wall protuberances shall be removed once the forms are stripped.

407.07.12 Precast Structures

Precast or mono bases shall be placed level. Subsequent sections complete with joint seal systems shall be installed according to the manufacturer's recommendations. Joint seal systems for special site conditions (infiltration/exfiltration) shall be as specified in Contract Documents.

Adjustment of the structure shall be carried out by lifting the affected sections free of the excavation, re-leveling the base, if necessary, and re-installing the sections. Damaged sections and gaskets shall be replaced.

Lift holes shall be plugged with mortar.

407.07.13 Installation of Inlet and Outlet Pipes Into Concrete Structures

Inlet and outlet pipes shall be securely set into the structure's concrete base or walls using grout or approved pipe connectors so that the structure is watertight.

One of the following connections shall be provided where a pipe connects to a structure:

- a) A flexible pipe joint shall be provided within 300 mm of the outside face of the structure for flexible and rigid pipe.
- b) A concrete cradle to the first joint for rigid pipe.
- c) A resilient connector (i.e., a flexible, watertight connector) in the structure opening for flexible and rigid pipe.
- d) A special approved structure designed for pipe support.

Installation of pipe connectors shall be according to the manufacturer's recommendations.

All pipes, except in valve chambers, shall be flush with the inside walls of the structure.

When specified in the Contract Documents, cast iron or medium density polyethylene goss traps shall be placed at the outlet pipe of the catch basin.

When a subdrain is specified in the Contract Documents, the opening for the connection of the subdrain outlet shall be formed by coring. The subdrain outlet pipe shall be sealed into place using non-shrink grout. A 50 mm diameter weep hole shall be cored into the same wall as the subdrain connection and at the same invert elevation.

407.07.14 Benching and Channelling

When specified in the Contract Documents, the inside concrete bottom of the structures shall be benched and channelled to accommodate the pipe.

Where benching is hand finished, it shall have a wood float finish and channelling shall have a steel trowel finish. Channelling shall be smooth and flush with adjacent pipe inverts.

407.07.15 Installation of Adjustment Units

Installation of adjustment units shall be according to OPSS 408.

407.07.16 Installation of Frames with Grates or Covers

When precast concrete adjustment units are used, frames with grates or covers shall be set in a full bed of mortar on the precast concrete adjustment units.

When HDPE or EPS adjustment units are used, frames with grates or covers shall be installed and sealed according to the HDPE or EPS adjustment unit manufacturer's instructions.

When rubber adjustment units are used, frames with grates or covers shall be set firmly in place on the rubber adjustment unit by laying a continuous strip of butyl tape on the top surface of the rubber adjustment units and on the bottom of the frame.

Ditch inlet grates shall be installed as specified in the Contract Documents.

Installation of frames with grates or covers which lie within the flow lines of a curb and gutter system shall be according to OPSS 353.

407.07.17 Installation of Aluminum Safety Platforms

Aluminum safety platforms shall be installed as specified in the Contract Documents.

407.07.18 Installation of Extension Stems and Boxes for Valve Chambers

Extension stems and boxes shall be installed as specified in the Contract Documents.

Caps for valve boxes shall be installed flush with the final grade. Guides for the valve extension stems shall be securely anchored to the valve chamber.

407.07.19 Installation of Ladders and Steps

Ladders shall be installed as specified in the Contract Documents.

Steps shall be installed according to OPSS 1351. Steps shall be accurately set in the forms and supported to prevent their displacement if they are being cast-in-place during the placing of concrete for the structure.

407.07.20 Installation of Frost Straps

Frost straps shall be installed as specified in the Contract Documents.

407.07.21 Valve Chamber Insulation

Insulation for the roof, wall, or access way of the valve chamber shall be installed as specified in the Contract Documents.

407.07.22 Catch Basin Apron

Curb and gutter with concrete aprons on existing catch basins shall be constructed at the locations as specified in the Contract Documents.

The work shall include, but not be limited to, the following:

- a) Remove existing curb and gutter and existing pavement by saw cutting to the limits shown in the Contract Documents.
- b) Disposal of all materials designated for removal shall be according to OPSS 510.
- c) Construction of concrete curb and gutter shall be according to OPSS 353.
- d) Adjustment of frame and grate to suit final pavement elevations shall be according to OPSS 408.
- e) Placement of concrete for concrete apron shall be according to OPSS 904.
- f) Concrete for curb and gutter and apron shall be poured in place as one structure.
- g) Placement of hot-poured rubberized asphalt joint sealing compound and joint filler in construction joints shall be according to OPSS 920.
- h) The horizontal limits of the concrete apron to fit local conditions.

407.07.23 Clean Out of Structures

During the progress of the work and until completion and acceptance of the work, structures shall be kept clean and free of all foreign material.

407.07.24 Site Restoration

Site restoration shall be according to OPSS 492.

407.07.25 Leakage Test

Sanitary sewer maintenance holes and storm sewer maintenance holes shall be tested for leakage when specified in the Contract Documents. Leakage shall not exceed a rate of 3 litres per hour per metre of head above the lowest pipe invert in the maintenance hole.

The test shall be performed by plugging all pipe openings in the maintenance hole and filling the maintenance hole with water. After one hour has elapsed, the distance the surface of the water has dropped shall be measured and the leakage determined by calculating the volume of that portion of the maintenance hole formerly occupied by the water.

Maintenance holes failing the initial test shall have the leaks repaired and be re-tested until the leakage is below the allowable limit.

There shall be no visible infiltration.

407.07.26 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

407.09 MEASUREMENT FOR PAYMENT

407.09.01 Actual Measurement

407.09.01.01 Maintenance Holes, Catch Basins, Apron, Ditch Inlets, and Valve Chambers

For measurement purposes, a count shall be made of the number of structures installed and adjusted.

407.09.01.02 Maintenance Hole Leakage Testing

For measurement purposes, a count shall be made of the number of maintenance holes passing the leakage test.

407.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

407.10 BASIS OF PAYMENT

**407.10.01 Maintenance Holes, “type, size” - Item
Catch Basins “type, size” - Item
Ditch Inlets “size” - Item
Valve Chambers “size” - Item
Maintenance Hole Leakage Testing - Item
Catch Basin Apron - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

The horizontal limits of the concrete apron to fit local conditions shall be at no additional cost to the Owner.

When the Owner raises or lowers the depth of a maintenance hole by up to and including 150 mm, it shall not constitute a Change in the Work and adjustment shall not be made to the payment. Where the depth of a maintenance hole is raised or lowered by more than 150 mm, this shall then constitute a Change in the Work for the full extent of the change from the original grade.

Appendix 407-A, November 2015 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer may consider including soil boring data, a geotechnical report, a subsurface report, and/or a soils report in the Contract Documents.

The designer should specify the following in the Contract Documents:

- Material requirements for:
 - Precast units. (407.05.03)
 - Steps and ladders. (407.05.04)
 - Frames with covers or grates. (407.05.07)
 - Aluminum safety platforms. (407.05.08)
- Structure type, location, and elevation. (407.07.01)
- Type and location of goss traps. (407.07.13)
- Subdrains. (407.07.13)
- Benching. (407.07.14)
- Installation of:
 - Ditch inlet grates. (407.07.16)
 - Aluminum safety platforms. (407.07.17)
 - Extension stems and boxes. (407.07.18)
 - Ladders and steps. (407.07.19)
 - Frost straps. (407.07.20)
 - Valve chamber insulation. (407.07.21)
 - Curb and gutter with concrete aprons. (407.07.22)

The Contractor may use any of the connections shown in subsection 407.07.13 d). If a specific connection is required, it shall be specified in the Contract Documents.

Designer should determine if leakage testing for storm and sanitary sewer maintenance holes is required. If it is required, it shall be specified in the Contract Documents. Ground water conditions shall determine the type of test required and shall be specified in the Contract Documents. Alternative leakage test method(s) can be considered such as air or CCTV inspection. (407.07.25)

The tender item description for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers should include reference to one or more of the attributes shown (i.e., type of structure or size of structure, to be complete). (407.10.01)

Appendix 407-A

The tender item description for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers should include reference to one or more of the attributes shown (i.e., type of structure or size of structure, to be complete). (407.10.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 400.001	Hoisting Hook Rib for Cast Iron Frames for Catch Basins, Maintenance Holes, and Valve Chambers
OPSD 400.010 to 400.120	Cast Iron Catch Basin Frames With Grates
OPSD 401.010 to 401.060	Cast Iron Maintenance Hole Frames With Covers
OPSD 402.010 to 402.021	Cast Iron Valve Chamber Frames With Covers
OPSD 403.010	Galvanized Steel Honey Comb Grating for Ditch Inlets
OPSD 404.010 to 404.022	Aluminum Safety Platforms
OPSD 405.010 to 405.020	Maintenance Hole Steps
OPSD 610.010 to 610.030	Catch Basin Frame With Grate Installation
OPSD 701.010 to 701.015	Precast Concrete Maintenance Holes, 1,200 to 3,600 mm in Diameter
OPSD 701.021	Maintenance Hole Benching and Pipe Opening Details
OPSD 701.030 to 701.081	Precast Concrete Maintenance Hole Components, 1,200 to 3,600 mm in Diameter
OPSD 701.100	Frost Strap Installation
OPSD 702.040 to 702.050	Precast Concrete Ditch Inlet Maintenance Hole
OPSD 703.011 to 703.015	Precast Concrete Single Inlet Flat Cap, 1,500 to 3,600 mm in Diameter
OPSD 703.021 to 703.024	Precast Concrete Twin Inlet Flat Cap, 1,500 to 3,000 mm in Diameter
OPSD 704.010 to 704.012	Maintenance Hole, Catch Basin, and Valve Chamber Adjustment Units
OPSD 705.001 to 705.002	Concrete Catch Basin Apron
OPSD 705.010 to 705.020	Precast Concrete Catch Basins
OPSD 705.030 to 705.040	Precast Concrete Ditch Inlets
OPSD 706.010 to 706.041	Precast Concrete Ditch Inlets Types A and B with 1,500 to 3,000 mm Diameter Flat Cap
OPSD 707.010	Precast Maintenance Hole Manufactured Tee
OPSD 708.020	Support for Pipe at Catch Basin or Maintenance Hole
OPSD 1100.010	Cast-In-Place Chamber for Valves Up to 350 mm Diameter
OPSD 1101.010	Precast Valve Chamber 1,200 mm and 1,500 mm Diameter
OPSD 1101.020	Valve Operator



**CONSTRUCTION SPECIFICATION FOR
ADJUSTING OR REBUILDING MAINTENANCE HOLES,
CATCH BASINS, DITCH INLETS, AND VALVE CHAMBERS**

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408.01 SCOPE

This specification covers the requirements for adjusting or rebuilding maintenance holes, catch basins, ditch inlets, and valve chambers and the installation of safety platforms.

408.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

408.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

408.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 402	Excavating, Backfilling, and Compacting for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 404	Support Systems
OPSS 407	Maintenance Hole, Catch Basis, Ditch Inlet, and Valve Chamber Installation
OPSS 490	Site Preparation for Pipelines, Utilities, and Associated Structures
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 904	Concrete Structures

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production

OPSS 1351	Precast Reinforced Concrete Components for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1850	Frames, Grates, Covers, and Gratings
OPSS 1853	Rubber Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers
OPSS 1854	High Density Polyethylene (HDPE) and Expanded Polystyrene (EPS) Adjustment Units for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

Canadian General Standards Board (CGSB)

1.181-99 Ready-Mixed Organic Zinc-Rich Coating

408.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Adjusting means changing the final grade of the frame with cover or grate on an existing structure,

- a) upwards by the addition of adjustment units, or
- b) downwards by removal of existing adjustment units or bricks and mortar, regardless of the size or type of structure.

Adjustment Units means circular and rectangular units used between the structure and the frame to adjust the elevation of the frame for grates and covers.

Lift Rings means circular and rectangular pre-fabricated metal or high density polyethylene units used to adjust the elevation of the grates and covers only. They are inserted between the frame and the grate or cover.

Rebuilding means changing the final grade of the frame with grate or cover on an existing structure,

- a) upwards by the addition of precast concrete sections, concrete, and adjustment units; or
- b) downwards by the removal of precast concrete sections, concrete, and adjustment units or bricks and mortar, regardless of the size or type of structure.

Structure means cast-in-place and precast maintenance holes, catch basins, ditch inlets, and valve chambers.

408.05 MATERIALS

408.05.01 Concrete

Concrete for cast-in-place structures shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 30 MPa.

408.05.02 Steel Reinforcement

Steel bar reinforcement, bar mats, and wire fabric for cast-in-place structures shall be according to OPSS 1440.

408.05.03 Precast Concrete Components for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

Precast units shall be according to OPSS 1351 and as specified in the Contract Documents.

408.05.04 Steps and Ladders

Steps shall be according to OPSS 1351 and as specified in the Contract Documents.

Ladders shall be as specified in the Contract Documents.

408.05.05 Adjustment Units

Precast concrete adjustment units shall be according to OPSS 1351.

Rubber adjustment units shall be according to OPSS 1853.

High density polyethylene (HDPE) and expanded polystyrene (EPS) adjustment units shall be according to OPSS 1854.

408.05.06 Mortar

Mortar shall consist of a mixture of one part Portland cement according to OPSS 1301 and three parts mortar sand according to OPSS 1004, wetted with sufficient water to make the mixture plastic. Water shall be according to OPSS 1302.

408.05.07 Frames With Covers or Grates, and Lift Rings

Frames with covers or grates, and lift rings shall be according to OPSS 1850.

408.05.08 Aluminum Safety Platforms

Aluminum safety platforms shall be according to OPSS 1351 and as specified in the Contract Documents.

408.05.09 Joint Seal Systems

Joint seal systems for precast concrete structures shall be according to OPSS 1351.

408.05.10 Zinc Rich Paint

Zinc rich paint shall be according to CAN/CGSB 1.181.

408.07 CONSTRUCTION

408.07.01 General

The work of adjusting or rebuilding structures shall include the removal and subsequent replacement of the frame with grate or cover.

All structures shall be adjusted or rebuilt plumb, true to alignment and grade, and as specified in the Contract Documents.

During the progress of the work and until the final acceptance, all structures in service shall be kept clean and free of all extraneous material.

Prior to adjusting or rebuilding a structure, the existing frame with cover or grate shall be carefully removed and salvaged. Suitability of the salvaged frame with cover or grate for reuse shall be determined by the Contract Administrator.

The installation of adjustment units, frames, covers, grates, lift rings, precast concrete components, and cast-in-place aprons shall be according to OPSS 407 and of the type as specified in the Contract Documents.

Additional steps or ladder extensions are required when the distance from the adjusted cover or grate reference elevation to the first step exceeds 450 mm. Additional steps shall be placed according to OPSS 1351.

Alterations to ladders, valve extension stems and boxes, and frost straps shall be as specified in the Contract Documents.

After having been raised, any structure that has a total height of 5.0 m or more shall have a safety platform installed in it. The aluminum safety platforms shall be installed as specified in the Contract Documents.

After adjusting or rebuilding a valve chamber, insulation shall be installed according to the manufacturer's recommendations on the roof, wall, or access way of the valve chamber, when specified in the Contract Documents.

408.07.02 Site Preparation

Site preparation shall be according to OPSS 490.

408.07.03 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

408.07.04 Cold Weather Work

All work shall be protected from freezing.

408.07.05 Transporting, Unloading, and Storing and Handling

Transporting, unloading, storing, and handling shall be according to manufacturer's recommendations.

Materials that are unsound or damaged shall be rejected.

408.07.06 Excavating, Backfilling, and Compacting

Excavating, backfilling, and compacting for the adjustment or rebuilding of structures shall be according to OPSS 402.

408.07.07 Support Systems

Support systems shall be according to OPSS 404.

408.07.08 Adjusting

All existing brickwork and mortar shall be removed from the top of the existing structure.

When there are adjustment units on an existing structure, adjustment units shall be added or removed as required so when the adjustment is completed there is a minimum of one to a maximum of three adjustment units on the top of the structure prior to placing the frame with grate or cover.

408.07.08.01 Precast Concrete Adjustment Units

Precast concrete adjustment units shall be used to set the frame with grate or cover at the required position and elevation.

A minimum of one adjustment unit, but not more than three adjustment units are required at each structure to a maximum height of 300 mm.

The first adjustment unit shall be laid in a full bed of mortar and aligned with the opening in the structure. Successive adjustment units shall be laid plumb to the first adjustment unit and sealed according to manufacturer's recommendations.

408.07.08.02 High Density Polyethylene (HDPE) and Expanded Polystyrene (EPS) Adjustment Units

When specified in the Contract Documents, HDPE or EPS adjustment units shall be used to set the frame with grate or cover at the required position and elevation.

A minimum of one adjustment unit is required at each structure up to a maximum height of 100 mm.

HDPE or EPS adjustment units shall be installed and sealed according to manufacturer's recommendations.

Rubber adjustment units shall not be used in conjunction with HDPE or EPS adjustment units.

408.07.08.03 Rubber Adjustment Units

Rubber adjustment units shall be used when specified in the Contract Documents. One rubber adjustment unit is used to replace the top precast concrete adjustment unit per structure and shall be used in conjunction with one or two precast concrete adjustment units. More than one rubber adjustment unit may be placed when wedge shaped rubber units are used to provide slope to the frame with grate or cover. In either instance, the total height of the rubber units shall be greater than 25 mm and less than 75 mm. The rubber unit is to be placed on the precast concrete adjustment unit so it provides the surface on which the frame rests.

The rubber adjustment unit shall be bonded firmly in place on the precast concrete adjustment unit by laying a continuous strip of butyl tape on the top surface of the precast concrete unit. If more than one rubber unit is used, a continuous strip of butyl tape is to be laid between each rubber adjustment unit.

408.07.09 Rebuilding

408.07.09.01 General

All existing brickwork and mortar or adjustment units shall be removed from the top of the existing structure.

The completed rebuilt structure shall have a minimum of one to a maximum of three adjustment units on the top of the structure prior to placing the frame with grate or cover.

408.07.09.02 Cast-In-Place Structures

When the top of the structure is to be lowered, the concrete shall be carefully removed to the required elevation and exposed steel reinforcement shall be cut off as specified in the Contract Documents. The upper section of the structure shall then be rebuilt to its original configuration using cast-in-place concrete and steel reinforcement as specified in the Contract Documents.

To raise the top of structures with a tapered upper section, the concrete in the structure shall be removed for the entire depth of the taper. The upper section, including straight walls and taper shall then be rebuilt to the original configuration using cast-in-place concrete and steel reinforcement as specified in the Contract Documents.

To raise the top of straight walled structures, the existing roof section, if any, shall be removed. The existing walls shall then be extended upward and the roof section rebuilt to the original configuration using cast-in-place concrete and steel reinforcement as specified in the Contract Documents.

When cast-in-place units are to be raised or lowered with cast-in-place concrete, the top surface of all existing walls shall be roughened and a bonding agent shall be applied to the joint before the walls are extended upwards.

Concrete shall be placed according to OPSS 904.

All inside wall protuberances shall be removed once the forms are stripped.

408.07.09.03 Precast Concrete Structures

Where precast concrete structures having either a tapered or flat slab top section are to be raised or lowered, the top section shall be carefully removed and salvaged and riser sections of suitable height shall be carefully removed from, substituted for, or added to the existing riser sections. The top section shall then be replaced. All of the above work shall be performed according to OPSS 407.

The procedure described for lowering a cast-in-place structure shall be followed as an alternative to the method described above for lowering a precast structure.

408.07.10 Restoration

Restoration shall be according to OPSS 492.

408.07.11 Leakage Test

Sanitary sewer maintenance holes and storm sewer maintenance holes shall be tested for leakage according to OPSS 407.

408.07.12 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

408.09 MEASUREMENT FOR PAYMENT

408.09.01 Actual Measurement

408.09.01.01 Adjusting or Rebuilding Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

For measurement purposes, a count shall be made of the number of structures adjusted or rebuilt. When more than one adjustment or rebuild is specified for a structure, each adjustment or rebuild shall be counted separately.

408.09.01.02 Installation of Safety Platforms

For measurement purposes, a count shall be made of the number of safety grates installed.

408.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

408.10 BASIS OF PAYMENT

408.10.01
Adjusting Maintenance Holes - Item
Rebuilding Maintenance Holes - Item
Adjusting Catch Basins - Item
Rebuilding Catch Basins - Item
Adjusting Ditch Inlets - Item
Rebuilding Ditch Inlets - Item
Installation of Lift Rings - Item
Adjusting Valve Chambers - Item
Rebuilding Valve Chambers - Item
Installation of Safety Platforms - Item
Rebuilding Catch Basin Apron - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 408-A, November 2015 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Material requirements for:
 - Precast units. (408.05.03)
 - Steps and ladders. (408.05.04)
 - Aluminum safety platforms. (408.05.08)
- Adjustment and rebuilding requirements. (408.07.01)
- Use of HDPE or EPS adjustment units. (407.07.08.02)
- Rubber adjustment units. (407.07.08.03)
- Alterations to ladders, valve extension stems and boxes, and frost straps. (408.07.01)
- Installation of:
 - Aluminium safety platforms. (408.07.01)
 - Valve chamber insulation. (408.07.01)
- Additional adjustments required. (408.09.01.01)
- Cut-off of exposed steel reinforcement. (408.07.09.02)
- Concrete and steel placement requirements. (408.07.09.02)

The designer should consider determining the number of salvageable frames with covers or grates. If there are frames with covers or grates that are not suitable for salvage, then an item should be added to the Contract Documents to ensure there are a sufficient number of new frames with covers or grates to fill the Contract needs.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 400.001	Hoisting Hook Rib for Cast Iron Frames for Catch Basins, Maintenance Holes, and Valve Chambers
OPSD 400.010 to 400.120	Cast Iron Catch Basin Frames With Grates
OPSD 401.010 to 401.060	Cast Iron Maintenance Hole Frames With Covers
OPSD 402.010 to 402.021	Cast Iron Valve Chamber Frames With Covers
OPSD 403.010	Galvanized Steel Honey Comb Grating for Ditch Inlets
OPSD 404.020 to 404.022	Aluminum Safety Platforms
OPSD 405.010 to 405.020	Maintenance Hole Steps
OPSD 406.010	Aluminum Ladder for maintenance Holes
OPSD 610.010 to 610.030	Catch Basin Frame With Grate Installation

OPSD 701.010 to 701.015	Precast Concrete Maintenance Holes, 1,200 to 3,600 mm in Diameter
OPSD 701.030 to 701.081	Precast Concrete Maintenance Hole Components, 1,200 to 3,600 mm in Diameter
OPSD 701.100	Frost Strap Installation
OPSD 702.040 to 702.050	Precast Concrete Ditch Inlet Maintenance Hole
OPSD 703.011 to 703.015	Precast Concrete Single Inlet Flat Cap, 1,500 to 3,600 mm in Diameter
OPSD 703.021 to 703.024	Precast Concrete Twin Inlet Flat Cap, 1,500 to 3,000 mm in Diameter
OPSD 704.010 to 704.012	Maintenance Hole, Catch Basin, and Valve Chamber Adjustment Units
OPSD 705.001 to 705.002	Concrete Catch Basin Apron
OPSD 705.010 to 705.020	Precast Concrete Catch Basins
OPSD 705.030 to 705.040	Precast Concrete Ditch Inlets
OPSD 706.010 to 706.041	Precast Concrete Ditch Inlets Types A and B with 1,500 to 3,000 mm Diameter Flat Cap
OPSD 1100.010	Cast-In-Place Chamber for Valves Up to 350 mm Diameter
OPSD 1101.010	Precast Valve Chamber 1,200 mm and 1,500 mm Diameter
OPSD 1101.020	Valve Operator



CONSTRUCTION SPECIFICATION FOR CLOSED-CIRCUIT TELEVISION (CCTV) INSPECTION OF PIPELINES

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APPENDICES

409-A	Commentary

409.01 SCOPE

This specification covers the requirements for inspecting new and existing storm and sanitary sewers, watermains, pipe culverts or other accessible conduits by closed-circuit television (CCTV).

409.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities.

Use of this specification or any other specification shall be according to the Contract Documents.

409.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

409.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

CSA Standards

PLUS 4012 (2010) Technical Guide: Visual Inspection of Sewer Pipe

Water Research Centre (WRc) Publication

MSCC Manual of Sewer Condition Classification, Third Edition, 1993.

409.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Business Day means any day except Saturdays, Sundays, and statutory holidays.

CCTV means closed-circuit television.

Digital Storage Device means compact disc (CD), digital videodisc (DVD), flash memory card, hard drive, or other industry-standard digital storage mediums.

Drainage Structure means a catch basin, maintenance hole, or ditch inlet.

DVD means digital videodisc.

MPEG means movie photographic experts group.

NASSCO means North American Society of Sewer Service Companies.

PACP means Pipeline Assessment and Certification Program.

Pipeline means storm, sanitary, watermain, or other accessible conduit pipe culverts.

USB means universal serial bus.

409.04 DESIGN AND SUBMISSION REQUIREMENTS

409.04.01 Submission Requirements

The following information shall be submitted to the Contract Administrator two weeks prior to the start of the CCTV inspection operations:

- a) A copy of the CCTV operator's NASSCO Certification Certificate. A copy of said certificate is required for each CCTV operator working on the Contract. Operators shall have been certified or re-certified within the three years prior to the start of the Contract.
- b) A sample inspection report, resolution tests of digital video recording format, and digital data file. One submission is required for each camera proposed for use on the work. The camera make, model, and serial number shall be clearly identified on each video recording.
- c) The details of the coding accuracy verification system that is to be used to verify inspection accuracy shall be submitted for approval.

409.05 MATERIALS

409.05.01 General

Media storage shall be as specified in the Contract Documents.

Digital storage device with minimum USB 2.0 or higher compatibility shall be placed inside envelopes with labels displaying the following information.

- a) Owner's Name
- b) Contract Number or Project Name
- c) Sewer Identification Number
- d) City or Town
- e) Street Name

f) Inspection Date

The digital storage device shall include a file in either Word or text format including the information provided above. The digital storage device shall be labelled. The label shall include the information in points a) and b) above to identify the content. CD and DVD shall be placed in a 5.2 mm slim-line clear jewel case with permanent labels displaying all the information above or as specified in the Contract Documents.

409.05.01.01 Photographs

Digital photograph files shall meet or exceed a resolution of at least 640 x 480 pixels. Printed photographs shall be in colour with a minimum image size of 90 x 70 mm and shall be reproduced on premium glossy photo quality paper.

409.06 EQUIPMENT

409.06.01 General

Survey and camera equipment used to inspect watermain shall have been used exclusively for work in watermain only.

409.06.02 Survey Vehicle

The survey vehicle shall contain a separate area for viewing, recording, and controlling the CCTV operation.

The viewing and control area shall be insulated against noise and extremes in temperature. Cooling and heating units shall be independent from the main vehicle engine and in good working order. External and internal sources of light shall be controlled in a manner as to ensure the light does not impede the view of the monitor screen. Seating accommodation for one person shall be provided in addition to the operator seating to clearly view the monitor screen.

All equipment used within the pipeline shall be stored outside the viewing, recording, and control area.

The vehicle shall include a cell phone or suitable alternative as agreed by the Contract Administrator for the duration of the work.

409.06.03 Survey Equipment

The surveying equipment shall be capable of surveying a length of pipeline up to:

- a) 300 m when entry to the pipeline may be obtained at each end of the pipeline.
- b) 30 m when rodding is used.
- c) 150 m when a self-propelled unit is used when entry is at only one end of the pipeline.
- d) 200 m when being towed.

Work shall not commence in a work shift until the Contract Administrator is satisfied that all items of the survey equipment have been provided and are in full working order.

Each survey unit shall contain a means of transporting the CCTV camera in a stable condition through the pipeline.

When the CCTV camera is towed by winch and cable through the pipeline, all winches shall be stable during the entire CCTV inspection. All cables shall be of steel or of an equally non-elastic material to ensure the smooth and steady progress of the CCTV camera.

Each unit shall carry sufficient number of guides and rollers so that, when surveying, all cables are supported away from pipe and maintenance hole edges. All CCTV cables and lines used to measure the camera's location within the pipeline shall be maintained in a taut manner and set at right angles, when possible, to run through or over the measuring equipment.

409.06.04 Video Equipment Quality

The electronic systems, television camera, and monitor shall be of adequate quality to enable the following to be achieved.

409.06.04.01 Camera

The pan and tilt camera shall have the capability of panning the pipe at 360° with tilt capability of 275° to ensure complete inspections and view of all laterals and deficiencies.

Resolution:

The live picture shall be visible with no interference and capable of registering a minimum number of lines of resolution at the periphery as indicated below:

- a) Fixed view camera 350 lines of resolution.
- b) Pan and tilt camera 400 lines of resolution.

Colour Constancy:

The lighting shall be set prior to commencing the survey to ensure the camera provides optimum results when used with its own illumination source. To ensure colour constancy, no variation in illumination shall take place during the survey.

Focus, Iris, and Illumination:

The adjustment of focus and iris shall allow optimum picture quality to be achieved and shall be remotely operated. The illumination shall be such as to allow an even distribution of the light around the pipeline perimeter without the loss of contrast or flare out of picture shadowing.

409.06.04.02 Monitor

Monitors shall be a minimum size of 21 inches and shall support resolution equal to or greater than the corresponding video camera resolution.

409.06.04.03 Digital Video Recorder

Digital video recorders shall be able to capture in colour from the live video source with the following requirements:

- a) MPEG-2 or higher or as required by Owner.
- b) NTSC 720 x 480 @ 29.97 frames per second.

409.07 CONSTRUCTION

409.07.01 Pipeline Cleaning

When specified in the Contract Documents, pipelines shall be cleaned and flushed immediately prior to CCTV inspection.

409.07.02 Resolution of Videotape and Digital MPEG Video Recordings

Prior to the start of the CCTV inspection, the resolution of digital MPEG video playback for each camera shall be confirmed by recording a resolution chart approved by the Contract Administrator, using the following procedure:

- a) Set up the camera as is done for the actual inspection.
- b) Show the camera being introduced and reaching its final position for the test.
- c) Fill the monitoring screen with the resolution chart.
- d) Illuminate the resolution chart evenly and uniformly without reflections ensuring that the illumination source accurately simulates the lighting used in the sewer.
- e) Record a test video for 30 seconds.
- f) Identify the camera make, model, and serial number on the recording.
- g) Record the test at the start of a digital recording.

The resolution test shall be submitted to the Contract Administrator.

409.07.03 Coding Accuracy

Prior to commencement of the CCTV inspection, a formal coding accuracy verification system shall be developed and submitted to the Contract Administrator and implemented when approved. The coding accuracy shall be based on accuracy as a function of the number of defects or construction features not recorded, and the correctness of the coding and classification shall be recorded.

Verification of coding accuracy shall be completed on a random basis on a minimum of 10% of the inspection reports. A minimum of two accuracy verifications shall be completed for each operator for each week working.

Inspections not satisfying the accuracy requirements shall be re-coded to meet the accuracy requirements and the accuracy of the inspections, immediately preceding and following the non-compliant inspection, shall be verified. This process shall be repeated until the preceding and subsequent inspections meet the accuracy requirements.

Coding accuracy checks shall be submitted to the Contract Administrator along with the corresponding video recording.

409.07.04 CCTV Inspection

409.07.04.01 General

The work shall include a CCTV inspection of the pipeline and the preparation of all video, digital, and written reports.

A certified, trained, and competent CCTV operator shall be used to operate the inspection equipment and code the inspection.

A fixed camera may be used for pipelines less than 300 mm in diameter. For pipelines equal to or greater than 300 mm, a pan and tilt camera shall be used. Each camera shall have an accepted sample submissions report prior to being used for inspection work. The camera lens shall be kept clean at all times during the inspection.

Flow control measures as specified in the Contract Documents shall be implemented to ensure a minimum of 80% of the height of the pipeline is visible for the entire inspection and shall be approved by the Contract Administrator.

All fog shall be evacuated from the pipeline and the pipeline kept clear of fog during the inspection.

At the start of each pipeline being surveyed, the length of pipeline from zero chainage up to the cable calibration point shall be recorded and reported in order to obtain a full record of one of the following:

- a) Pipe sewer length from the inside face of the maintenance hole to the inside face of the next maintenance hole or outlet end of the pipe sewer
- b) Pipe culvert length from one end of the pipe culvert to the other
- c) Watermain length from the valve pit entry point to the valve pit exit point or termination of the cement mortar lining.

The position meter-reading entered on to the data display at the cable calibration point shall allow for the distance from the start of the survey to the cable calibration point so that the meter-reading at the start of the survey is zero.

In the case of surveying through a maintenance hole when a new header sheet is required, the meter-reading shall be set at zero with the camera focused on the outgoing pipe entrance.

At the start of each maintenance hole length, a data generator shall electronically generate and clearly display on the viewing monitor and video recording a record of data in alphanumeric form containing the following minimum information:

- a) Automatic update of the camera's meter-reading position in the pipeline from adjusted zero.
- b) Pipeline dimensions.
- c) Maintenance hole and pipe length reference numbers.
- d) Date of survey.
- e) Road name and location.
- f) Direction of survey.
- g) Time of start of survey.
- h) Pipeline use.

Once the survey of the maintenance hole length is underway, an automatic update of the camera's meter-reading position in the pipeline from zero in metres and tenths of a metre shall be continually displayed.

The camera shall be stopped when defects are being noted on the coding sheet.

Defects in each pipeline length shall be coded according to the standard being used (i.e., CSA Plus 4012, NASSCO Canadian Edition of the Pipeline and Assessment Certification Program (PACP), or WRc) or as specified in the Contract Documents. Any variation from the manual shall be noted in the survey report.

The survey shall be restarted at the opposite end of the pipeline if a blockage or obstruction is encountered.

Inspections shall be recorded in colour.

Digital video recordings may be saved to a computer hard drive and transferred to a portable hard disk drive, compact disc, or digital video for submission.

A digital format video recording of an inspection shall be produced in colour from a first generation recording by one of the following methods:

- a) A computer system and a video capture card shall be used to capture the recording continuously, regardless of the progression of the inspection. Prior to submission, the raw digital data shall be edited to remove pauses when the inspection progress was not continuous.
- b) A computer system and a video capture card shall be used to intermittently capture the recording. Prior to submission, the raw digital file shall be edited to form one continuous file.
- c) Specialized video recording equipment capable of pausing and resuming live recording shall be used to capture original recording. A single file is to be produced for submission.

Video capture equipment shall be capable of capturing digital video from first generation recordings with no frame loss.

Non-linear video editing software shall be used to edit digital videos. Edited digital files shall not be recompressed.

409.07.04.02 Camera Position

The camera lens shall be positioned centrally in a circular pipeline and at two-thirds of the vertical dimension in a non-circular pipeline with a positioning tolerance of $\pm 10\%$ of the vertical pipeline dimension.

In all instances, the camera lens shall be positioned looking along the longitudinal axis of the pipeline.

409.07.04.03 Camera Travel Speed

The travelling speed of the camera in the pipeline shall be limited to:

- a) 0.1 m/s for pipeline of diameter less than 200 mm.
- b) 0.15 m/s for diameters exceeding 200 mm but not exceeding 310 mm.
- c) 0.20 m/s for diameters exceeding 310 mm.

409.07.04.04**Camera Position Meter-Reading Device**

A suitable meter-reading device shall be used that enables the cable length to be accurately measured to indicate the location of the camera. The meter-reading device shall be accurate to $\pm 1\%$ of the length of the sewer being surveyed. The tolerance shall be demonstrated using one or both of the following methods in conjunction with a linear measurement audit form that shall be completed each day during the survey:

- a) Cable calibration device.
- b) Tape measurement of the surface distance between maintenance holes.

If the accuracy of the measuring device fails, it is to be replaced. The Contract Administrator may require that the lengths of pipeline first inspected with the original measuring device be resurveyed using the new measuring device.

409.07.05**Final Documentation****409.07.05.01****Survey Reporting**

Survey reports shall be submitted to the Contract Administrator in the following formats, with the noted number of copies, within 10 Business Days of the completion of the fieldwork:

- a) 3 copies of the printed survey report.
- b) 2 portable hard disk drives, other digital storage devices and software database as specified in the Contract Documents, each containing the identical survey report information as in the printed copies.
- c) 2 copies of the digital video recording.

Entire inspections shall be contained within one digital file on a digital storage device, as applicable. When possible, reverse set-up inspections shall be recorded immediately after the original inspection.

Each digital file shall contain the file name, as specified by the Owner and may include the following:

- a) Tender number
- b) E<Entity number>
- c) F<From entity number>
- d) T<To entity number>
- e) Street Name
- f) M<Measured length>
- g) I<Inspected length>
- h) <Inspection direction:DS or US>
- i) <Letter designating inspection sequence> .MPEG

For example: 910-200 E5329 F5328 T5350 BERRY M100.0 I39.2 US B.MPEG indicates that this is the second or "B" partial inspection of this entity, 39.2 m long.

All required header information fields shall be completed and verified for correctness. The software used to produce the survey report shall not allow the operator to continue inputting information until the preceding field has been completed. The report shall be machine printed and presented according to the standard used.

All dimensions in the survey report shall be metric.

The survey report shall identify major defects and shall include photographs when the need for photographs is specified in the Contract Documents.

409.07.05.02 Drawings

One clean set of the Owner's drawings showing maintenance hole numbers that coincide with the coding sheets and videotapes shall be returned to the Contract Administrator on completion of the survey. The drawings shall be clearly annotated to show any discrepancies between the drawings and the survey report. Such discrepancies shall be brought to the attention of the Contract Administrator during the survey.

409.07.06 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

409.08 QUALITY ASSURANCE

Upon submission, printed and digital inspection reports, and digital MPEG video recordings, magnetic data files, and coding accuracy checks shall be reviewed to ensure compliance with the Contract Documents.

Submittals shall be reviewed by the Contract Administrator and their acceptance confirmed within 10 Business Days of submission. Only inspections with minimum accuracy for header information of 95% and minimum detail accuracy for defects and features of 85% will be accepted. Non-compliant submissions will be returned for correction. Corrected submissions shall be returned to the Contract Administrator for review within 5 Business Days.

Operators failing to meet the coding accuracy requirements on two occasions shall not be permitted to code on the remainder of the Contract, unless they successfully re-attain NASSCO qualification based on the standard being used (i.e., Canadian Edition of PACP or WRC).

409.09 MEASUREMENT FOR PAYMENT

409.09.01 Actual Measurement

Measurement for a CCTV inspection of pipeline shall be measured in metres on the ground surface along the centreline of the pipe sewer from the centre of one drainage structure to the centre of another drainage structure or outlet end of the pipe sewer. Measurement for pipe culverts shall be from one end of the pipe culvert to the other end of the pipe.

Measurement for a CCTV inspection of watermain shall be measured in metres on the ground surface along the centreline of the watermain from the valve pit entry point to the valve pit exit point or termination of the cement mortar lining.

In the event that a CCTV inspection is terminated due to a blockage or collapsed pipe or the pipe is inaccessible, measurement shall be in metres for the actual length of pipeline inspected as determined from the chainage indication on the record media.

409.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

409.10 BASIS OF PAYMENT

409.10.01 CCTV Inspection - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

When the Contract does not contain a separate tender item for CCTV inspection, the Contract price for the appropriate tender item for the installation of pipe sewers, pipe culverts, or the lining of watermain shall include full compensation for all labour, Equipment, and Material to do the work of CCTV inspection.

Non-compliant submissions returned for correction shall be corrected and resubmitted at no expense to the Owner.

Appendix 409-A, November 2013 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- The type of media storage. (409.05.01)
- Additional or different labelling information for cases. (409.05.01)
- Flow control measures. (409.07.04.01)

Flow control measures may include such things as scheduling work for off-peak flow times, plug or block flow at upstream manhole, and temporary by-pass pump flow around inspection section. (409.07.04.01)

- Which standard of coding classification will be followed throughout the CCTV inspection and reference the standard being used, when applicable. (409.07.04.01)
- Disc type for survey report information. (409.07.05.01)

The designer should determine if the following is required and if so, specify it in the Contract Documents:

- If the Contractor is to clean and flush pipelines prior to commencement of CCTV inspection. (409.07.01)
- If photographs are required as part of the CCTV inspection. (409.07.05)
- If payment for CCTV inspection is to be included in the Contract price for installing storm or sanitary pipe sewers, or pipe culverts, or if payment will be a separate CCTV item or items. (409.10.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



NOTICE TO USERS OF OPSS 410

CONSTRUCTION SPECIFICATION FOR PIPE SEWER INSTALLATION IN OPEN CUT

OPSS 410 has been removed from this
OPS volume

The provincial version of OPSS 410 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 410

The municipal version of OPSS 410 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 410

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



**CONSTRUCTION SPECIFICATION FOR
THE CLEANING AND FLUSHING OF PIPE SEWERS, CATCHBASINS,
MAINTENANCE HOLES, DITCH INLETS, AND OIL-GRIT SEPARATORS**

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APPENDICES

411-A	Commentary

411.01	SCOPE

This specification covers the requirements for the cleaning and flushing of pipe sewers, catchbasins, maintenance holes, ditch inlets, and oil-grit separators.

411.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

411.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

411.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 409	Closed-Circuit Television Inspection of Sewers
OPSS 410	Pipe Sewer Installation in Open Cut

411.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Air Gap Method means a clear vertical separation between the pressurized potable water supply and a non-pressurized, non-potable water receiving vessel.

Backflow Prevention means a device used to protect potable water supplies from contamination or pollution due to backflow.

Cleaning means suction and vacuuming removal of debris within pipe sewers, catchbasins, maintenance holes, ditch inlets, and oil-grit separators.

Combination Hydro-Jet Cleaner means a service vehicle or equipment capable of pressure washing, suction vacuum cleaning of debris.

Debris means sludge, dirt, sand, gravel, rocks, bricks, other solid and semi-solid materials, and roots, grease, and encrustations and other materials that may cause restriction to flow in pipe sewers, catchbasins, maintenance holes, ditch inlets, and oil-grit separators.

Flushing means hydraulic pressure washing using various nozzles, pressure and flow rates to flush debris within pipe sewer systems downstream.

Oil-grit separator means a device designed to separate oil and suspended solids from water.

Pipe Sewer means as defined in OPSS 410.

411.04 DESIGN AND SUBMISSION REQUIREMENTS

When Equipment requiring an environmental compliance approval for a waste management system, issued by the Ontario Ministry of Environment and Climate Change, will be used for the work, a copy of the environmental compliance approval shall be submitted to the Contract Administrator a minimum of two weeks prior to commencement of the work.

411.05 MATERIALS

411.05.01 Water Source

Water source shall be as specified in the Contract Documents. When the source is not specified, water shall be clean and free from oil, acid, alkali, organic matter, or other deleterious substances.

Backflow prevention and air gap methods shall be used when water is taken from potable water systems.

411.06 EQUIPMENT

411.06.01 Combination Hydro-Jet Cleaner

A combination hydro-jet cleaner specifically designed for the purpose of cleaning pipe sewers, catch basins, maintenance holes, ditch inlets, oil-grit separators, and similar facilities, using a selection of nozzles and attachments to permit reaming and root cutting as required, shall be used for the work. The equipment shall be sufficient to clear blockages and remove debris from pipe sewer systems with varied sizes and downstream constraints.

411.07 CONSTRUCTION

411.07.01 General

The work shall commence at the upstream end of pipe sewer systems and progress to the downstream end.

The conditions of the site and the pipe sewer system shall be thoroughly assessed, including the degree of pipe blockage and types of debris. The equipment, nozzles, flow rates, and pressures necessary to complete the work shall be determined. Any supplemental information regarding the sewer network and the assessment method shall be as specified in the Contract Documents.

For post installation inspections, sewers requiring cleaning and flushing shall be as specified in the Contract Documents.

The Owner may request additional documentation of findings after cleaning and flushing operations as specified in the Contract Documents.

Prior to using any mechanical equipment, verify with CCTV inspections if any utility clearance is required.

Water flow volumes and pressures shall not cause damage to the pipe sewer system or flooding of property. Water flow volumes and pressures shall be appropriate for the age and condition of the pipe sewer system.

Debris that cannot be removed by flushing shall be loosened and broken up using reamers and root cutters as required.

No blockage to service connections shall occur as a result of the cleaning and flushing or cleanout operation.

Protection of waterbodies and waterbody banks shall be as specified in the Contract Documents.

411.07.02 Pipe Sewer Cleaning and Flushing

Flushing shall be used to transport debris from each section of pipe sewer to the downstream maintenance hole or catchbasin. Each section of pipe sewer between maintenance holes, catch basins, ditch inlets shall be cleaned and flushed before cleaning and flushing the next downstream section. Debris shall be continuously cleaned from the downstream maintenance hole or catchbasin as flushing occurs.

The passage of debris from one section of pipe sewer to another shall not be permitted, unless specified in the Contract Documents. A weir or sediment trap shall be placed in the maintenance hole to prevent passage of debris from the upstream pipes. When cleaning and flushing is completed for each section, the weir or sediment trap shall be removed.

Cleaning and flushing shall continue for each section of pipe sewer until no further debris is flushed from the pipe, and the pipe sewer section is free of impediments to flow. A minimum of 90% of the pipe sewer circumference shall be free of debris.

If cleanout cannot be completed due to damaged or broken pipe sewer, catchbasin, maintenance hole, or ditch inlet, the Contract Administrator shall be immediately notified.

411.07.03 Catchbasin, Maintenance hole, and Ditch Inlet Cleanout

A combination hydro-jet cleaner shall remove debris from catchbasins, maintenance holes, and ditch inlets separately.

411.07.04 Oil-Grit Separator Cleanout

Oil-grit separators shall be cleaned out by closing or blocking off the inlet and outlet pipes, dewatering the system, removal of debris by vacuum or other mechanical means, and cleaning and flushing to remove sediment. The inlet and outlet pipes shall not be reopened or unblocked until after the separator has been inspected by the Contract Administrator.

411.07.05 Closed-Circuit Television Inspection

Unless otherwise specified in the Contract Documents, pipe sewers shall be inspected after cleaning by closed-circuit television (CCTV) according to OPSS 409. The Contract Administrator shall be notified a minimum 24 hours prior to the inspection.

When specified in the Contract Documents, water shall be added immediately prior to CCTV inspection to the upstream end of the sewer system for minimum flow to the system low point by gravity.

411.07.06 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

Debris removed from pipe sewers, catchbasins, maintenance holes, ditch inlets, and oil-grit separators shall be managed as excess material according to the Contract Documents.

Liquid shall be decanted or filtered and returned to the sewer of origin. The decanted or filtered liquid shall comply with Provincial Water Quality Objectives and local municipal bylaws.

411.09 MEASUREMENT FOR PAYMENT

411.09.01 Actual Measurement

411.09.01.01 Pipe Sewer Cleaning and Flushing

Measurement for pipe sewer cleaning and flushing shall be by length in metres, by time in hours, or by volume in cubic metres, as specified in the Contract Documents.

411.09.01.01.01 By Length

Measurement shall be in metres and along the centreline of the pipe sewer from the centre of the maintenance hole, catch basin, or ditch inlet at each end of the pipe sewer system to be cleaned out.

When cleaning and flushing is incomplete due to a collapsed pipe or immovable blockage, the length of collapsed pipe or blockage shall be deducted from the length measured for payment.

411.09.01.01.02 By Time

Measurement shall be by time in hours that the combination hydro-jet cleaner is in effective operation.

411.09.01.01.03 By Volume

Measurement shall be by volume in cubic metres of decanted debris, in predetermined truck box capacities.

411.09.01.02 Catchbasin, Maintenance Hole, Ditch Inlet, and Oil-Grit Separator Cleanout

For measurement purposes, a count shall be made of the number of structures cleaned.

411.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

411.10

BASIS OF PAYMENT

411.10.01

**Pipe Sewer Cleaning and Flushing – Item
Catchbasin, Maintenance Hole, Ditch Inlet Cleanout, and Oil-Grit Separator
Cleanout – Item**

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 411-A, November 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- The owner shall provide any available information on the condition of the sewer network (e.g. size, age, constraints, material, known defects, vulnerable sections). (411.07.01)
- The owner may choose to evaluate, specify or approve the assessment method of pipe prior to work. (411.07.01)
- For post installation inspections, the owner shall identify sewers requiring flushing and cleaning (411.07.01)
- If access to the waterbody or a waterbody bank is required, necessary protection measures shall be specified (411.07.01)
- The individual owners may request documentation of findings after flushing completion (e.g. presence of grease, roots, construction debris, pipe defect and; an estimate of the light/medium/heavy level of material removed, where applicable; and submission of inspection reports and maps) (411.07.01)
- The owner shall identify if passing material between maintenance holes will be permitted (411.07.02)
- The owner shall designate if CCTV inspection is not required (411.07.05)
- The owner shall designate if additional water for minimum flow is required prior to the camera inspection (411.05)
- The owner shall designate water source where applicable including any metering or tracking if required (411.07.05.01)
- The owner shall designate disposal sites where applicable, designating as temporary or permanent, as necessary, including any additional environmental requirements (411.07.06)
- Method of measurement for pipe sewer cleaning and flushing. (411.09.01.01)

Related Ontario Provincial Standard Drawings

No information provided here.



**CONSTRUCTION SPECIFICATION FOR
SEWAGE FORCEMAIN INSTALLATION IN OPEN CUT**

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APPENDICES

412-A	Commentary

412.01 SCOPE

This specification covers the requirements for the installation of storm water and sanitary forcemains and associated appurtenances in open cut.

412.01.01 Specification Significance and Use

This specification has been developed for use in provincial and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

412.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

412.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 490	Site Preparation for Pipelines, Utilities, and Associated Structures
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS 539	Temporary Protection Systems

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production
OPSS 1842	Pressure Polyethylene Pipe Products

CSA Standards

B137.1-09	Polyethylene (PE) Pipe, Tubing, and Fittings for Cold Water Pressure Services [Part of B137 Series-09, Thermoplastic Pressure Piping Compendium]
B137.2-09	Polyvinylchloride (PVC) Injection-Moulded Gasketed Fittings for Pressure Applications [Part of B137 Series-09, Thermoplastic Pressure Piping Compendium]
B137.3-09	Rigid Polyvinylchloride (PVC) Pipe and Fittings for Pressure Applications [Part of B137 Series-09, Thermoplastic Pressure Piping Compendium]

ASTM International

A 153/A 153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 276-10	Stainless Steel Bars and Shapes
A 307-10	Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
B 633-11	Electrodeposited Coatings of Zinc on Iron and Steel
B 766-86 (R2008)	Electrodeposited Coatings of Cadmium
C 361-11	Reinforced Concrete Low-Head Pressure Pipe (Metric)
D 3139 (2011)	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

American Water Works Association (AWWA)

C104/A21.3-08	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
C110/A21.10-12	Ductile-Iron and Gray-Iron Fittings for Water
C111/A21.11-07	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
C151/A21.51-09	Ductile-Iron Pipe, Centrifugally Cast, for Water
C153/A21.53-11	Ductile-Iron Compact Fittings for Water Service
C200-05	Steel Water Pipe - 6 in. (150 mm) and Larger
C205-12	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. (100 mm) and Larger, Shop Applied
C206-11	Field Welding of Steel Water Pipe
C208-07	Dimensions for Fabricated Steel Water Pipe Fittings
C301-07	Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids
C302-11	Reinforced Concrete Pressure Pipe, Noncylinder Type
C303-11	Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type
C504-10	Rubber-Seated Butterfly Valves
C509-09	Resilient-Seated Gate Valves for Water Supply Service

American Society of Mechanical Engineers (ASME)

B18.2.1-96 (R2010)	Square and Hex Bolts and Screws - Inch Series

412.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Associated Appurtenance means structures, devices, and appliances, other than pipe and conduit that are used in connection with a forcemain, such as valves and thrust restraints.

Backfilling means as defined in OPSS 401.

Excavation, Earth and Rock means the excavation classified as earth and rock according to OPSS 206.

Fitting means connections, appliances, and adjuncts designed to be used in connection with pipes (e.g., elbows and bends to alter the direction of a pipe; tees and crosses to connect a branch with a sewer main; plugs and caps to close a pipe end; and bushings, diminishers, or reducers to couple two pipes of different diameters).

Forcemain means an installation designed for the conveyance of sanitary or storm sewage under pressure, using pre-formed or pre-cast circular pipe sections that are laid end to end and joined using suitable methods.

412.05 MATERIALS

412.05.01 General

Pipe size, material, and class shall be according to the requirements specified in the Contract Documents.

Fittings shall be suitable for and compatible with the pipe size, material, and class with which they will be used.

412.05.02 Ductile Iron Pipe

Ductile iron pipe shall be according to AWWA C151/A21.51.

Fittings shall be gray iron according to AWWA C110/A21.10 or ductile iron according to AWWA C 110/A21.10 or AWWA C153/A21.53.

Ductile iron pipe and fittings shall be cement lined according to AWWA C104/A21.3.

Rubber gaskets for push-on or mechanical joints shall be according to AWWA C111/A21.11.

412.05.03 Concrete Pressure Pipe

Concrete cylinder pipe, including joints and fittings, shall be according to AWWA C301 or AWWA C303.

Non-cylinder pipe and joints shall be according to AWWA C302 or ASTM C 361. Fittings shall be according to AWWA C302.

412.05.04 Polyvinyl Chloride (PVC) Pressure Pipe

Polyvinyl chloride pressure pipe and fittings shall be according to CSA B137.3 and supplied from a plant approved by an organization accredited by the Standards Council of Canada (SCC).

Flexible elastomeric seals for bell and spigot joints shall be according to ASTM D 3139.

Fittings shall be either:

- a) Gray iron according to AWWA C110/A21.10.
- b) Ductile iron according to AWWA C110/A21.10 or AWWA C153/A21.53 and cement lined according to AWWA C104/21.4.
- c) Injection moulded polyvinyl chloride plastic according to CSA B137.2.
- d) Prefabricated polyvinyl chloride plastic for pipe diameters 200 mm and larger according to CSA B137.3.

412.05.05 Polyethylene (PE) Pressure Pipe

Polyethylene pressure pipe shall be according to OPSS 1842.

Fittings shall be either:

- a) Flanged gray iron according to AWWA C110/A21.10.
- b) Flanged ductile iron according to AWWA C110/A21.10 or AWWA C153/A21.53 and cement lined according to AWWA C104/A21.4.
- c) Polyethylene according to OPSS 1842.
- d) Heat fusion or insert or compression type fittings according to CSA B137.1.

412.05.06 Steel Pipe

Steel pipe shall be according to AWWA C200.

Fittings shall be according to AWWA C208.

Steel pipe shall have a cement-mortar protective lining and coating according to AWWA C205.

412.05.07 Valves

412.05.07.01 General

All valves shall open by operating in a counter clockwise direction.

Valves shall be designed for a minimum cold water working pressure of 1,035 kPa.

Valve types shall be one of the following:

- a) Valves less than 75 mm shall be brass or bronze gate valves.
- b) Valves greater than or equal to 75 mm and less than or equal to 300 mm shall be cast iron or ductile iron gate valves.
- c) Valves greater than 300 mm up to and including 500 mm shall be gate or butterfly valves.
- d) Valves greater than 500 mm shall be butterfly valves.
- e) Knife gate valves shall be installed when specified in the Contract Documents.

Fasteners shall be made from material meeting the strength requirements of ASTM A 307 with dimensions according to ASME B18.2.1. Bolts, studs, and nuts shall be cadmium plated according to ASTM B 766 or zinc coated according to ASTM A 153/A 153M or ASTM B 633. Fasteners for mechanical joints shall be ductile iron according to AWWA C111/A21.11.

412.05.07.02 Gate Valves

Gate valves shall be according to AWWA C509.

Stem sealing on non-rising stem valves shall use O-Ring type seals that do not require adjustment. The end configuration shall be as specified in the Contract Documents.

412.05.07.03 Butterfly Valves

Butterfly valves shall be according to AWWA C504.

Valves shall be short body flanged or mechanical-joint, class 150B.

Valve shafts shall be stainless steel, and when they project through the body, shall have seals that do not require adjustment.

A vertical operating nut shall be provided. Valves shall be provided with an external indicator showing valve position by means of a pointer operating through a 90° arc from open to close.

412.05.07.04 Knife Gate Valves

Valves shall be made of Type 304 or Type 316 stainless steel.

Valves shall have full port area and wafer face to face. The valves shall have face to face welded parts, including packing chest and packing stuffer and stem, complete with a resilient seat.

412.05.07.05 Air Release and Air/Vacuum Valves

Air release and air/vacuum valves shall be single acting type.

412.05.08 Concrete

Concrete for thrust blocks and fitting and appurtenance supports shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 20 MPa.

412.05.09 Mortar

Mortar for joints shall consist of one part Portland cement and three parts mortar sand, and wetted with sufficient water to the consistency of a thick cream. The mortar sand shall be according to OPSS 1004, the Portland cement shall be according to OPSS 1301, and the water shall be according to OPSS 1302.

412.05.10 Stainless Steel Straps, Tie-Rods, Angles, Nuts, and Bolts

Stainless steel straps, tie-rods, angles, nuts, and bolts used with concrete thrust blocks shall be according to ASTM A 276, Type 316 stainless steel.

412.07 CONSTRUCTION

412.07.01 Site Preparation

Site preparation shall be according to OPSS 490.

412.07.02 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

412.07.03 Protection Against Floatation

Damage to the pipeline due to floatation shall be prevented during construction and until completion of the work.

412.07.04 Cold Weather Work

All work shall be protected from freezing. Pipes and bedding material shall not be installed on frozen ground.

412.07.05 Transporting, Unloading, Storing, and Handling Pipe

Manufacturer's recommendations for transporting, unloading, storing, and handling of pipe shall be followed.

All pipes, fittings, and gaskets that are unsound or damaged shall be rejected.

412.07.06 Excavation

Excavation for placing forcemains shall be according to OPSS 401.

412.07.07 Support Systems

Support systems shall be according to OPSS 404.

412.07.08 Dewatering

Dewatering shall be according to OPSS 517.

412.07.09 Temporary Protection Systems

The construction of all temporary protection systems shall be according to OPSS 539. When the stability, safety, or function of an existing roadway, railway, other works, or proposed works may be impaired due to the method of construction, such protection as may be required shall be provided. Protection may include sheathing, shoring, and the driving of piles, where necessary, to prevent damage to such works or proposed works.

412.07.10 Backfilling and Compacting

Backfilling and compacting shall be according to OPSS 401.

412.07.11 Installation of Pipe

Pipe shall be laid in a dry trench.

Ends of pipe shall be kept clean.

Pipe shall be laid within the alignment and grade tolerances specified in the Contract Documents. The barrel of each pipe shall be in contact with the shaped bed throughout its full length.

Pipe shall be kept clean as work progresses. Water shall not be allowed to flow through the pipe during construction. A removable watertight bulkhead shall be installed at the open end of the last pipe laid whenever work is suspended.

Pipe shall not be laid until the preceding pipe joint has been completed and the pipe carefully embedded and secured in place.

412.07.12 Jointing

412.07.12.01 General

Joint surfaces shall be clean. Pipe ends shall be lubricated with material recommended by the pipe manufacturer.

Manufacturer's instructions for jointing pipes shall be followed.

Joints and all connections shall be made watertight.

All bolts, nuts, couplings, rubber rings, and connecting pieces shall be cleaned thoroughly prior to installation.

Pipes shall be aligned on centreline to previously laid pipe.

Pipe shall be pulled or pushed into the previously laid pipe by hand or by a hand operated winch. A backhoe or other equipment shall not be used to push the pipe.

Joints shall be prevented from opening after the pipe has been laid.

412.07.12.02 Ductile Iron Pipe

Mechanical Joints:

The gland shall be positioned on the pipe with the lip extension toward the joint. The gasket shall be slipped on the pipe with the thick edge towards the gland. The spigot end shall be pushed to its seat in the bell. The gasket shall be pressed to seat it evenly around the joint.

The gland shall be positioned for bolting and the bolts shall be inserted. All nuts shall be hand tightened.

The nuts shall be tightened half a turn at a time with a calibrated torque wrench. All nuts shall be tightened uniformly to the torque specified in AWWA C111/A21.11.

Bell and Spigot Joints:

The gasket shall be lubricated and placed in the groove of the bell making certain it is properly seated.

Pipes to be joined shall be aligned and the spigot shall be carefully entered into the bell until the spigot end just makes contact with the gasket.

The entry of the spigot into the bell shall continue until the second reference mark is flush with the face of the bell.

412.07.12.03 Concrete Pressure Pipe

Bell and Spigot Joints:

A cotton or burlap diaper shall be placed around the bell end of the pipe already in place.

A rubber gasket shall be placed on the spigot end of the pipe to be laid ensuring that the stretch and volume of the gasket is equalized around the entire circumference of the pipe. The gasket and spigot shall be lubricated prior to the spigot end being inserted home into the bell end.

The pipe shall be aligned and the spigot end shall be inserted into the bell of the pipe already in place. Steel inserts shall be placed in the joints to prevent the spigot from entering the full depth of the bell. The

location of the rubber gasket shall be checked around the entire circumference of the joint. The steel insert shall be removed and the pipe pushed until the spigot enters the full depth of the socket and is retained in position.

The diaper shall be carefully placed around the joint recess. Cement mortar shall be poured around the assembled joint.

412.07.12.04 Polyvinyl Chloride (PVC) Pressure Pipe

Joints shall be bell and spigot with rubber gaskets. If gaskets are supplied separately, they shall be inserted in the groove of the bell end of the pipe.

The spigot shall be lubricated. The spigot end shall be inserted and pushed into the bell until the second reference mark is flush with the face of the bell.

412.07.12.05 Polyethylene (PE) Pressure Pipe

Polyethylene pressure pipe 100 mm diameter and larger shall be joined by the thermal butt fusion process. Procedures recommended by the pipe manufacturer shall be followed.

Polyethylene pressure pipe that is smaller than 100 mm shall be joined with heat fusion or insert or compression type fittings that are recommended by the pipe manufacturer and that prevent pull out and resist creep deformation at full test pressure.

Connections to non-polyethylene fittings and appurtenances that are 50 mm diameter and larger shall be made with flanged joints according to manufacturer's recommendations. Bolts shall be tightened to the torque specified by the manufacturer for the particular size and type of stub end.

412.07.12.06 Steel Pipe

Steel pipe shall be jointed according to AWWA C200. Field welding for joints shall be according to AWWA C206.

412.07.13 Cutting of Pipe

Whenever cutting of pipe is required, the pipe shall be cut according to the recommendations of the pipe manufacturer.

412.07.14 Change in Line and Grade

412.07.14.01 Ductile Iron Pipe

Fabricated bends shall be provided for changes in line and grade of 11.25° or more.

Deflections of less than 11.25° may be made using a series of pipe joint deflections. The manufacturer's recommendation in deflecting any single pipe joint shall not be exceeded.

412.07.14.02 Concrete Pressure Pipe

Fabricated bends, bevel adapters, or elbows shall be used for changes in line or grade greater than 5°. Changes in line or grade less than 5° shall be made using a manufactured joint or bevel connection or may be made over several joints, but at no time shall the manufacturer's joint deflection recommendations be exceeded.

412.07.14.03 Polyvinyl Chloride (PVC) Pressure Pipe

Polyvinyl chloride pressure pipe joints may be deflected, but shall not exceed manufacturer's recommendations. Otherwise, fabricated bends shall be used.

412.07.14.04 Polyethylene (PE) Pressure Pipe

Use of pipe flexibility may be allowed, but shall not exceed manufacturer's recommendations.

412.07.14.05 Steel Pipe

Fabricated bends shall be used at all changes in line or grade, unless the change can be accomplished by deflections at pipe joints without exceeding the manufacturer's recommendations for deflection at pipe joints.

412.07.15 Installation of Valves

412.07.15.01 General

The work of installing valves shall include the valves and couplings, and when specified in the Contract Documents, valve boxes. Valves shall be installed in locations and of the type specified in the Contract Documents. Valves and connecting pipes shall be aligned accurately and supported as specified in the Contract Documents.

412.07.15.02 Air Release and Air/Vacuum Valves

Air release and air/vacuum valves shall be installed at locations specified in the Contract Documents.

Each air release and air/vacuum valve shall be provided with an isolating valve.

412.07.16 Thrust Restraints

All connections, caps, and bends shall be restrained by concrete blocking or restrained joints as specified in the Contract Documents. Concrete for thrust blocks shall be placed against undisturbed ground. Joints and couplings shall remain free from concrete.

412.07.17 Hydrostatic Testing

412.07.17.01 General

Hydrostatic testing shall be conducted under the supervision of the Contract Administrator.

A test section shall be either a section between valves or the completed forcemain. The forcemain that is to be tested shall be backfilled before testing commences.

Test pressure shall be as specified in the Contract Documents.

The test section shall be filled slowly with water and all air shall be removed from the pipeline. A 24-hour absorption period may be allowed before starting the test. The test section shall be subjected to the specified continuous test pressure for two hours.

412.07.17.02 Polyethylene (PE) Pressure Pipe

The test procedure shall consist of initial expansion and test phases.

During the initial expansion phase, the test section shall be pressurized to the test pressure, and sufficient make-up water shall be added each hour for 3 hours to return to the test pressure. After the initial expansion phase, the test phase begins.

The test phase shall be 2 hours after which a measured amount of make-up water is added to return the test pressure. If the amount of make-up water added does not exceed the value in Table 1, leakage is not indicated. If the amount of make-up water exceeds the Table 1 value, all leaks shall be located and repaired and the test section shall be retested until a satisfactory result is obtained.

The test procedure duration should not exceed 8 hours. If the pressure test is not completed, the test section shall be de-pressurized and allowed to relax for at least 8 hours prior to bringing the test section up to pressure again.

412.07.17.03 Other Pipe

The test section shall be subject to the specified continuous test pressure for 2 hours.

The leakage shall be the amount of water added to the test section to maintain the specified test pressure for the test duration. The measured leakage shall be compared with the allowable leakage as calculated for the test section. The allowable leakage shall be 0.082 litres per millimetre of pipe diameter per kilometre of pipe for the 2 hour test period.

If the measured leakage exceeds the allowable leakage, all leaks shall be located and repaired and the test section shall be retested until a satisfactory result is obtained.

412.07.18 Cleaning and Flushing Force mains

All force mains shall be cleaned and flushed.

412.07.19 Site Restoration

Site restoration shall be according to OPSS 492.

412.07.20 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

412.09 MEASUREMENT FOR PAYMENT

412.09.01 Actual Measurement

412.09.01.01 Force mains

Measurement of force mains shall be by length in metres horizontally along the centreline of the pipe from the point of connection to a chamber, or existing force main to a point vertically above the end of the new force main.

412.09.01.02 Valves

For measurement purposes, a count shall be made of the number of valves installed regardless of the type or size.

412.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

412.10 BASIS OF PAYMENT

**412.10.01 Forcemains - Item
 Valves - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

When the Owner raises or lowers the invert of a forcemain by up to 150 mm, it will not constitute a Change in the Work and no adjustment shall be made to the payment. When the invert of a forcemain is raised or lowered by 150 mm or more, this shall then constitute a Change in the Work for the full extent of the change from the original grade.

TABLE 1
Test Phase Make-Up Amount for Pressure Polyethylene Pressure Pipe

Pipe Diameter Mm	Make-Up Water litre/km
30	12.38
40	12.38
50	13.62
75	18.60
100	31.00
150	74.50
200	124.20
250	161.40
275	248.30
300	285.60
350	335.20
400	409.70
450	533.90
500	682.90
550	869.10
600	1,105.00
700	1,378.20
800	1,775.50
900	2,234.90
1,000	2,731.60
1,050	3,104.00
1,200	3,973.20
1,350	5,152.70
1,600	7,449.70

Appendix 412-A, November 2012 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer may consider including soil boring data, a geotechnical report, a subsurface report, or a soils report in the Tender Documents.

The designer should specify the following in the Contract Documents:

- Pipe size, material, and class. (412.05.01)
- Gate valve end configuration. (412.05.07.02)
- Alignment and grade tolerances for the pipe installation. (412.07.11)
- Valve type, location, and support. (412.07.15.01)
- Location of air release and air/vacuum valves. (412.07.15.02)
- Type of thrust restraints. (412.07.16)
- Test pressure for hydrostatic testing. (412.07.17.01)

The requirement for valve boxes should be determined. If they are required, they should be specified in the Contract Documents. (412.07.15.01)

Corrosion protection system provisions should be specified, if appropriate.

Tracer wire and marker tape should be specified if appropriate. Designer may wish to add identifier codes or markings to identify the use of the pipe (e.g., sanitary or storm vs. watermain or gas).

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 1103.010	Concrete Thrust Blocks for Tees, Plugs, and Horizontal Bends
OPSD 1103.020	Concrete Thrust Blocks for Vertical Bends



CONSTRUCTION SPECIFICATION FOR MANURE PIPELINE INSTALLATION IN OPEN CUT

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413.01 SCOPE

This specification covers the requirements for installing permanent manure pipelines in open cut.

413.01.01 Specification Significance and Use

This specification has been developed for use in provincial and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be as specified in the Contract Documents.

413.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

413.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications shall be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications shall be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 490	Site Preparation for Pipeline, Utilities, and Associated Structures
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS 539	Temporary Protection Systems

Ontario Provincial Standard Specifications, Material

OPSS 1350	Concrete - Materials and Production
OPSS 1842	Pressure Polyethylene Pipe Products

CSA Standards

- B137.2-13 PVC Injection-Moulded Gasketed Fittings for Pressure Applications
[Part of CAN/CSA-B137-02, Thermoplastic Pressure Piping Compendium - B137 Series]
- B137.3-13 Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications
[Part of CAN/CSA-B137-02, Thermoplastic Pressure Piping Compendium - B137 Series]

ASTM International

- A 153/A 153M-09 Zinc Coating (Hot Dip) on Iron and Steel Hardware
- A 276-13a Stainless Steel Bars and Shapes
- A 307-12 Carbon Steel Bolts, Studs, and Threaded Rods 60,000 PSI Tensile Strength
- B 633-13 Electrodeposited Coatings of Zinc on Iron and Steel
- B 766-86 (2008) Electrodeposited Coatings of Cadmium
- D 3139-98 (2011) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

American Water Works Association (AWWA)

- C104/A21.4-13 Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
- C110/A21.10-12 Ductile-Iron and Gray-Iron Fittings
- C111/A21.11-12 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- C153/A21.53-11 Ductile-Iron Compact Fittings
- C509-09 Resilient-Seated Gate Valves for Water-Supply Service

American Society of Mechanical Engineers (ASME)

- B18.2.1-2012 Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series), Includes Errata (2013)

413.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Associated Appurtenance means structures, devices, and appliances, other than pipe and conduit that are used in connection with a manure pipeline system, such as valves, riser, and thrust restraints.

Backfilling means as defined in OPSS 401.

Excavation, Earth and Rock means the excavation classified as earth and rock according to OPSS 206.

Fitting means connections, appliances, and adjuncts designed to be used in connection with pipes. Examples are: elbows and bends to alter the direction of a pipe; tees and crosses to connect a branch with a sewer main; plugs and caps to close a pipe end; and bushings, diminishers, or reducers to couple two pipes of different diameters.

Manure Pipeline means an installation designed for the conveyance of liquid manure under pressure using circular pipe.

413.05 MATERIALS

413.05.01 General

Pipe size shall be according to the requirements specified in the Contract Documents. Pipe material and class shall be as specified in the Contract Documents.

Pipe smaller than 100 mm in diameter shall not be used.

Fittings shall be suitable for and compatible with the pipe material and class with which they will be used.

413.05.02 Polyvinyl Chloride Pipe Products

Polyvinyl chloride pipe and fittings shall be according to CSA B137.3 and supplied from a plant approved by an organization accredited by the Standards Council of Canada.

Flexible elastomeric seals for bell and spigot joints shall be according to ASTM D 3139.

Fittings shall be either:

- a) gray iron according to AWWA C110/A21.10;
- b) ductile iron according to AWWA C110/A21.10 or AWWA C153/A21.53, and shall be cement lined according to AWWA C104/A21.4;
- c) injection moulded polyvinyl chloride according to CSA B137.2; or
- d) prefabricated polyvinyl chloride pipe diameters 200 mm and larger according to CSA B137.3.

413.05.03 Polyethylene Pipe Products

Polyethylene pressure pipe shall be according to OPSS 1842.

Fitting shall be either:

- a) flanged gray iron according to AWWA C110/A21.10;
- b) flanged ductile iron according to AWWA C110/A21.10 or AWWA C153/A21.53 and shall be cement lined according to AWWA C104/A21.4; or
- c) polyethylene according to OPSS 1842.

Ductile iron pipe and fittings shall be cement lined according to AWWA C104/A21.4.

413.05.04 Valves

413.05.04.01 General

All valves shall open by operating in a counter-clockwise direction.

Valves shall be designed for a minimum cold water working pressure of 1,035 kPa.

Valves shall be cast or ductile iron gate valves.

Fasteners shall be made from material meeting the strength requirements of ASTM A 307 with dimensions according to ANSI ASME B18.2.1. Bolts, studs, and nuts shall be cadmium plated according to ASTM B 766 or zinc coated according to ASTM A 153M or ASTM B 633. Fasteners for mechanical joints shall be ductile iron according to AWWA C111/A21.11.

413.05.04.02 Gate Valves

Gate valves shall be according to AWWA C509.

Stem sealing on non-rising stem valves shall utilize O-ring type seals that do not require adjustment.

The gate valve end configuration shall be as specified in the Contract Documents.

413.05.04.03 Air Release and Air/Vacuum Valves

Air release and air/vacuum valves shall be sewage type.

413.05.05 Risers

Riser type shall be as specified in the Contract Documents.

413.05.06 Concrete

Concrete for thrust blocks and fitting and appurtenance supports shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 20 MPa.

413.05.07 Straps, Tie-Rods, Angles, Nuts, and Bolts

Stainless steel straps, tie-rods, angles, nuts, and bolts used with concrete thrust blocks shall be according to ASTM A 276, Type 316 stainless steel.

413.07 CONSTRUCTION

413.07.01 Site Preparation

Site preparation shall be according to OPSS 490.

413.07.02 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

413.07.03 Protection Against Floatation

Damage to the pipeline due to floatation shall be prevented during construction and until completion of the work.

413.07.04 Cold Weather Work

All work shall be protected from freezing. Pipe and bedding material shall not be installed on frozen ground.

413.07.05 Transporting, Unloading, Storing, and Handling Materials

All pipes, fittings, and gaskets that are unsound or damaged shall be rejected.

Manufacturer's recommendations for transporting, unloading, storing, and handling of materials shall be followed.

413.07.06 Excavation

Excavation for the placement of forcemains shall be according to OPSS 401.

413.07.07 Support Systems

Support systems shall be according to OPSS 404.

413.07.08 Dewatering

Dewatering shall be according to OPSS 517.

413.07.09 Temporary Protection Systems

The construction of all temporary protection systems shall be according to OPSS 539. Where the stability, safety, or function of an existing roadway, railway, other works, or proposed works may be impaired due to the method of construction, such protection as may be required shall be provided. Protection may include sheathing, shoring, and the driving of piles where necessary to prevent damage to such works or proposed works.

413.07.10 Installation of Pipe

Pipe shall be laid in a dry trench.

Ends of pipe shall be kept clean.

Pipe shall be laid within the alignment and grade tolerances specified in the Contract Documents. The barrel of each pipe shall be in contact with the shaped bed throughout its full length.

Pipe shall be kept clean and dry as work progresses. A removable watertight bulkhead shall be installed at the open end of the last pipe laid whenever work is suspended.

Pipe shall not be laid until the preceding pipe joint has been completed and the pipe carefully embedded and secured in place.

413.07.11 Jointing

413.07.11.01 General

Joint surfaces shall be clean. Pipe ends shall be lubricated with material recommended by the pipe manufacturer.

Manufacturer's instructions for jointing of pipe shall be followed.

Joints and all connections shall be made watertight.

All bolts, nuts, coupling, rubber rings, and connecting pieces shall be cleaned thoroughly prior to installation.

Pipe shall be aligned on centreline to previously laid pipe.

Pipe shall be pulled or pushed only by a hand-operated winch. A backhoe shall not be used for pushing pipe.

Joints shall be prevented from opening after the pipe has been laid.

413.07.11.02 Polyvinyl Chloride Pressure Pipe

Joints shall be bell and spigot with rubber gaskets. If gaskets are supplied separately, they shall be inserted in the groove of the bell end of the pipe.

The spigot shall be lubricated. The spigot end shall be inserted and pushed into the bell until the second reference mark is flush with the face of the bell.

413.07.11.03 Polyethylene Pressure Pipe

Polyethylene pipe 100 mm diameter and larger shall be joined by the thermal butt fusion process. Procedures recommended by the pipe manufacturer shall be followed.

Connections to non-polyethylene fittings and appurtenances shall be made with flanged joints according to the manufacturer's recommendations. Bolts shall be tightened to the torque specified by the manufacturer for the particular size and type of stub end.

413.07.12 Cutting of Pipe

Whenever cutting of pipe is required, the pipe shall be cut according to the recommendations of the pipe manufacturer.

413.07.13 Change in Line and Grade

413.07.13.01 Polyvinyl Chloride Pipe

Polyvinyl chloride pressure pipe joints may be deflected, but shall not exceed manufacturer's recommendations. Otherwise, fabricated bends shall be used.

413.07.13.02 Polyethylene Pipe

Use of pipe flexibility may be allowed, but shall not exceed manufacturer's recommendations.

413.07.14 Installation of Valves

413.07.14.01 General

The work of installing valves shall include the valves and couplings, and when specified in the Contract Documents, valve boxes. Valves shall be installed at locations and be of the type specified in the Contract Documents. Valves and connecting pipes shall be aligned accurately and supported as specified in the Contract Documents.

413.07.14.02 Air Release and Air/Vacuum Valves

Air release and air/vacuum valves shall be installed at locations specified in the Contract Documents.

Each air release and air/vacuum valve shall be provided with an isolating valve.

413.07.15 Installation of Riser Sets

The work of installing riser sets shall include the placing of risers, riser isolating valves, riser tees, restraining devices, riser caps, and safety and support devices.

Riser sets shall be installed at locations specified in the Contract Documents.

413.07.16 Thrust Restraints

All connections, caps, and bends shall be restrained by concrete blocking or restrained joints as specified in the Contract Documents. Concrete for thrust blocks shall be placed against undisturbed ground. Joints and couplings shall remain free from concrete.

413.07.17 Backfilling and Compacting

Backfilling and compacting shall be according to OPSS 401.

413.07.18 Hydrostatic Testing

413.07.18.01 General

Hydrostatic testing shall be conducted under the supervision of the Contract Administrator upon completion of the pipeline, including backfilling.

A test section shall be either a section between valves or the completed pipeline.

Test pressure shall be 1,035 kPa.

The test section shall be filled slowly with water and all air shall be removed from the pipeline. A 24-hour absorption period may be allowed before starting the test. The test section shall be subjected to the specified continuous test pressure for two hours.

413.07.18.02 Polyethylene Pipe

The test procedure shall consist of initial expansion and test phases.

During the initial expansion phase, the test section shall be pressurized to the test pressure and sufficient make-up water added each hour for 3 hours to return to test pressure. After the initial expansion phase, the test phase shall begin.

The test phase shall be 2 hours after which a measured amount of make-up water is added to return the test pressure. If the amount of make-up water added does not exceed the values shown in Table 1, leakage is not indicated.

If the amount of make-up water exceeds the values shown in Table 1, all leaks shall be located and repaired and the test section shall be retested until a satisfactory result is obtained.

The test duration should not exceed 8 hours. If the pressure test is not completed, the test section shall be de-pressurized and allowed to relax for 8 hours prior to bringing the test section up to pressure again.

413.07.18.03 Other Pipe

The test section shall be subject to the specified continuous test pressure for 2 hours.

The leakage is the amount of water added to the test section to maintain the specified test pressure for the test duration. The measured leakage shall be compared with the allowable leakage as calculated for the test section. The allowable leakage is 0.082 litres per millimetre of pipe diameter per kilometre of pipe for the 2-hour test period.

If the measured leakage exceeds the allowable leakage, all leaks shall be located and repaired and the test section shall be retested until a satisfactory result is obtained.

413.07.19 Cleaning and Flushing Pipe

All pipe shall be cleaned and flushed.

413.07.20 Site Restoration

Site restoration shall be according to OPSS 492.

413.07.21 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

413.09 MEASUREMENT FOR PAYMENT

413.09.01 Actual Measurement

413.09.01.01 Pipeline

Measurement of pipeline shall be by length in metres along the horizontal centreline of the pipe from the point of connection to portable equipment or existing pipeline to a point vertically above the end of the new pipeline.

413.09.01.02 Valves

For measurement purposes, a count shall be made of the number of valves installed regardless of the type and size.

413.09.01.03 Riser Sets

For measurement purposes, a count shall be made of the number of riser sets installed regardless of the type.

413.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

413.10 BASIS OF PAYMENT

**413.10.01 Pipeline - Item
Valves - Item
Riser Sets - Item
Connections to Existing Pipelines - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

When the Owner raises or lowers the invert of a pipeline by up to 150 mm, it shall not constitute a Change in the Work and adjustment shall not be made to the payment. Where the invert of a pipeline is raised or lowered by more than 150 mm, this shall then constitute a Change in the Work for the full extent of the change from the original grade.

TABLE 1
Test Phase Make-Up Amount for Pressure Polyethylene Pipe

Pipe Diameter mm	Make-Up Water litre/km
100	31.0
150	74.5
200	124.2
250	161.4
300	285.6
350	335.2

Appendix 413-A, November 2014 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer may consider including soil boring data, a geotechnical report, a subsurface report, or a soils report in the Tender Documents.

The designer should include the following in the Contract Documents:

- Pipe size, material, and class. (413.05.01)
- Gate valve end configuration. (413.05.04.02)
- Type of risers. (413.05.05)
- Alignment and grade tolerances for the pipe installation. (413.07.10)
- Valve type, location, and support. (413.07.14.01)
- Air release and air/vacuum valve locations. (413.07.14.02)
- Locations of riser sets. (413.07.15)
- Type of thrust restraints. (413.07.16)

The pipe diameter should be adequate to develop a flow velocity of 0.8 to 2.5 m/s in the pumping system.

Corrosion protection system provisions should be specified, if appropriate.

Tracer wire or tracer tape should be specified, if appropriate

Under conditions of high ground water, external fluids may enter via air release and air/vacuum release valves; therefore, appropriate measures should be taken.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 1103.010	Concrete Thrust Blocks for Tees, Plugs, and Horizontal Bends
OPSD 1103.020	Concrete Thrust Blocks for Vertical Bends



CONSTRUCTION SPECIFICATION FOR PIPELINE INSTALLATION BY TUNNELLING

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APPENDICES

415-A	Commentary

415.01 SCOPE

This specification covers the general requirements for pipeline installation by tunnelling.

415.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

415.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

415.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 517 Dewatering of Pipeline, Utility, and Associated Structure Excavation

Ontario Provincial Standard Specifications, Material

OPSS 1350 Concrete - Materials and Production
OPSS 1440 Steel Reinforcement for Concrete

415.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Engineer means a professional engineer licensed by the Professional Engineers of Ontario to practice in the Province of Ontario.

Pipeline means to include sewers, culverts, watermains, and forcemains.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Rock means natural beds or massive fragments, or the hard, stable, cemented part of the earth's crust, igneous, metamorphic, or of sedimentary origin, which may or may not be weathered and includes boulders having a volume of 0.5 m³ or greater.

415.04 DESIGN AND SUBMISSION REQUIREMENTS

415.04.01 Design Requirements

The primary liner shall be designed to support all soil and hydrostatic pressures and to withstand any additional loads caused by grouting or jacking thrusts. The primary liner design and access shaft details shall bear the seal and signature of an Engineer.

415.04.02 Submission Requirements

When any of the following information is not specified in the Contract Documents, it shall be submitted to the Contract Administrator for review a minimum of 14 Days prior to commencing tunnelling operations:

- a) Design criteria.
- b) Materials.
- c) Construction shaft and portal details.
- d) Tunnelling method.
- e) Face support and other temporary support details.
- f) Primary liner and support design details.
- g) Material mixture for filling voids and procedures.
- h) Tunnel boring machine information, if applicable.
- i) Type and strength of rock bolts, if applicable.
- j) Lighting and ventilation details.
- k) Settlement monitoring plan.
- l) Excavation and dewatering plan.
- m) Testing and monitoring plan.

415.05 MATERIALS

415.05.01 Concrete

Concrete shall be according to OPSS 1350 and with a nominal minimum 28-Day compressive strength of 30 MPa.

415.05.02 Steel Reinforcement

Steel reinforcement for concrete work shall be according to OPSS 1440.

415.05.03 Primary Liner

The primary liner shall be as specified in the Contract Documents or according to the Contractor's submission.

415.05.04 Rock Bolts

Rock bolts and nuts shall have a minimum tensile strength of 400 MPa.

415.06 EQUIPMENT

The Contractor shall select and use Equipment and associated methods compatible with the selected dimensions of the tunnel and with the subsurface and groundwater conditions at the site.

415.07 CONSTRUCTION

415.07.01 General

The location of tunnels shall be established from the plan, lines, elevations, and tolerances as specified in the Contract Documents.

All reference points necessary to construct the tunnel and appurtenances shall be laid out prior to commencement of the tunnelling operation.

The Contract Administrator shall be provided with the assistance and access necessary to check the layout of the tunnel and associated appurtenances.

415.07.02 Construction Shafts

Construction shafts shall be provided at locations as specified in the Contract Documents or according to the Contractor's submission.

Shafts shall be maintained in a drained condition.

A secure fence shall be installed around the perimeter of the construction shaft area with gates and truck entrances. The fence shall be removed upon completion of the work.

415.07.03 Stability of Excavation

The construction methods, plant, and procedures employed shall ensure that the excavations are stable, free from disturbance, and maintained in a drained condition.

The construction methods, plant, and materials employed shall prevent the migration of soil material into tunnels or shafts.

415.07.04 Tunnelling

An individual with previous experience in the construction of tunnels shall supervise the work at all times.

The tunnelling method shall be suitable to deal with changing ground conditions that may be encountered during the progress of the work.

Methods of excavating the tunnel shall be capable of fully supporting the face and shall accommodate the removal of boulders and other oversize objects from the face.

The tunnel shall be kept sufficiently dry at all times to permit work to be performed in a safe and satisfactory manner.

415.07.05 Dewatering

Dewatering shall be according to OPSS 517.

415.07.06 Primary Liner

The primary liner shall be installed so that the exterior is as tight as possible to the excavated surface of the tunnel and allows the placement of the full design thickness of the secondary lining.

All voids between the primary lining and the surface of the excavation shall be filled. If an unexpanded liner is used, the space outside the liner plates shall be grouted at least daily.

Tunnels excavated in sound rock shall be supported in a manner that prevents scaling and unravelling of the rock and also protects the rock from weathering or deterioration.

Tunnels excavated in unstable rock shall be supported by means of rock bolts or an anchoring system in a manner that safely sustain the tunnel crown and walls.

415.07.06.01 Primary Liner Support Systems

Primary liner support systems shall minimize ground movement into the excavation, ensure stability, and maintain strength of the ground surrounding the excavation.

Primary liner support systems shall be compatible with encountered ground conditions, method of excavation, method of groundwater control, and with the placement of permanent liners.

Primary liner support systems shall prevent weathering, deterioration, loosening, or unravelling of ground surfaces exposed by excavation.

415.07.06.02 Single Liner Systems

Single liner systems shall be as specified in the Contract Documents.

415.07.07 Secondary Liner

The secondary liner shall be as specified in the Contract Documents.

The void outside the finished secondary liner shall be filled as specified in the Contract Documents or according to the Contractor's submission.

415.07.08 Testing and Monitoring

Testing and monitoring shall be as specified in the Contract Documents or according to the Contractor's submission.

415.07.09 Certificate of Conformance

A completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Quality Verification Engineer shall affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:

- a) Work
- b) Material and installations
- c) Inspection, testing, and test results

415.07.10 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

415.09 MEASUREMENT FOR PAYMENT

415.09.01 Actual Measurement

415.09.01.01 Tunnel

Measurement of tunnel shall be by length in metres along the centreline of the tunnel from centre to centre of maintenance holes or chambers or to the ends of the tunnel, where no maintenance hole or chamber is installed.

415.09.01.02 Rock Excavation in Tunnelling

Measurement of rock excavation in tunnelling shall be by volume in cubic metres based on the neat lines of the tunnel as shown in the Contract Documents.

415.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

415.10 BASIS OF PAYMENT

415.10.01 Tunnel - Item Rock Excavation in Tunnelling - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 415-A, November 2013 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

This specification was written to encompass the requirements for the construction of pipelines, drainage conduits, or other utility pipe installations by the tunnelling method. It is not intended to be a specification for other tunnelling applications such as the transportation industry, mining, hydro electric, petroleum exploration industry, etc.

Engineering design based on geotechnical pre-design information is essential prior to the use of this specification for tunnelling projects.

The experience of the tunnelling Contractor is of prime importance. The designer may recommend prequalification of bidders.

The designer should specify the following in the Contract Documents:

- Primary liner requirements. Alternatively, the designer may elect that the Contractor is responsible for determining the primary liner design details. (415.05.03)
- The plan, lines, elevations, and tolerances required for the tunnelling project. (415.07.01)
- Location of required construction shafts. Alternatively, the designer may elect to specify that the Contractor is responsible for determining shaft locations to suit the method of construction. (415.07.02)
- The appropriate single liner systems type, class, dimensions, etc. (415.07.06.02)
- The appropriate secondary liner type, class, dimensions, etc. (415.07.07)
- The method of verifying the product installation. This may include reporting information from the tunnelling machine, daylighting, trace wire, survey, acoustic or magnetic location, GPS, closed-circuit television (CCTV) inspection, or mandrel tests. The designer should also specify the applicable leakage, infiltration, exfiltration, or pressure test requirements for the installation. This may apply to either the primary and secondary liner or just the secondary liner. (415.07.08)

The designer should provide benchmark and reference points for laying out the project.

The designer should specify if the shafts are to remain in place or be removed upon completion of the project. If the shafts are to remain in place, further details should be provided as to how they should be covered or remain accessible for future use.

The designer may wish to consider including a process regarding payment for failed tunnelling attempts in the Contract Documents.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR PIPELINE AND UTILITY INSTALLATION BY JACKING AND BORING

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APPENDICES

416-A	Commentary

416.01 SCOPE

This specification covers the requirements for the installation of pipeline, which shall be used as carrier pipe or casing pipe, by jacking and boring method, and includes removal of material by either manual or mechanical means.

416.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

416.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

416.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications shall be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications shall be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 517 Dewatering of Pipeline, Utility, and Associated Structure Excavation

Ontario Provincial Standard Specifications, Material

OPSS 1802 Smooth Walled Steel Pipe

OPSS 1820 Circular and Elliptical Concrete Pipe

American Water Works Association (AWWA)

C206-03 Field Welding of Steel Water Pipe

416.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Carrier Pipe means a final pipe in direct contact with the material being conveyed.

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Pipeline means to include sewers, culverts, watermains, and forcemains.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

416.04

DESIGN AND SUBMISSION REQUIREMENTS

416.04.01

Submission Requirements

When any of the following information is not specified in the Contract Documents, it shall be submitted to the Contract Administrator for review a minimum of 14 Days prior to commencing jacking and boring operations:

- a) Work area layout.
- b) Work schedule.
- c) Access shaft or pit design details.
- d) Jacking and boring procedure.
- e) Face support and other temporary support details.
- f) Material and Equipment.
- g) Settlement monitoring plan.
- h) Excavation and dewatering plan.
- i) Method for the removal of boulders and cobbles.
- j) Grouting operation.
- k) Testing and monitoring plan.

The access shaft or pit details shall bear the seal and signature of an Engineer.

416.05 MATERIALS

416.05.01 Casing Pipe

The casing pipe shall be concrete or steel pipe as specified in the Contract Documents.

Concrete pipe shall be according to OPSS 1820.

Steel pipe shall be according to OPSS 1802 with welded joints.

416.07 CONSTRUCTION

416.07.01 General

An individual with previous experience in jacking and boring shall supervise the work at all times.

416.07.02 Method of Jacking and Boring Procedure

The jacking and boring procedure to be used shall be submitted to the Contract Administrator prior to commencing the work and shall be subject to the following limitations:

- a) Hydraulically operated jacks of adequate number and capacity shall be provided to ensure smooth and uniform advancement without over-stressing of the pipe.
- b) A jacking head or collar shall be provided to transfer and distribute jacking pressure uniformly over the entire end bearing area of the pipe.
- c) The casing pipe shall be fully supported in the jacking pit at the lines and grades as specified in the Contract Documents.
- d) The jacking and boring procedure shall be compatible with the subsurface and groundwater conditions at the site.

416.07.03 Construction Shafts

Construction shafts shall be provided at the locations specified in the Contract Documents.

Shafts shall be maintained in a drained condition.

A secure fence shall be installed around the perimeter of the access shaft or pit area with gates and truck entrances. The fence shall be removed upon completion of the work.

416.07.04 Dewatering

Dewatering shall be according to OPSS 517.

416.07.05 Pipeline Installation

The pipeline shall be installed to the lines, grades, and tolerances as specified in the Contract Documents.

When steel pipe is used as a carrier pipe, butt-welding of pipe joints shall be according to AWWA C206.

When steel pipe is used solely as a casing pipe, the welds shall be sufficient to support the jacking forces of the pipeline installation.

The work area shall be kept sufficiently dry at all times to permit work to be performed in a safe and satisfactory manner.

The space between the casing pipe and the wall of the excavation shall be filled according to the Contractor's submission on grouting operations.

The space between the casing pipe and the carrier pipe shall be filled according to the Contractor's submission on grouting operations.

416.07.06 Removal of Boulders and Cobbles

Methods for the removal of boulders and cobbles shall be as detailed in the Contractor's submission. The Contract Administrator shall be informed immediately of any obstructions encountered.

416.07.07 Cathodic Protection

When specified in the Contract Documents, cathodic protection on the casing pipe shall be provided.

416.07.08 Testing and Monitoring

Testing and monitoring shall be as specified in the Contract Documents or in accordance to the Contractor's submission.

416.07.09 Certificate of Conformance

A completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Qualification Verification Engineer shall affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:

- a) Work
- b) Material and installations
- c) Inspection, testing, and test results

416.07.10 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

416.09 MEASUREMENT FOR PAYMENT

416.09.01 Actual Measurement

416.09.01.01 Jacking and Boring

Measurement of jacking and boring shall be by length in metres along the centreline of the casing pipe from the start to the end of the installed pipe.

416.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

416.10 BASIS OF PAYMENT

416.10.01 Jacking and Boring - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

The removal of boulders having a volume in excess of 0.5 cubic metres shall be paid for as Extra Work.

Appendix 416-A, November 2013 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

This specification was written to encompass the requirements for the construction of pipelines and or casings by the jacking and boring method. The primary application includes the construction of pipelines, and drainage conduits under highways, urban roads, and railway crossings.

Engineering design based on geotechnical pre-design information is essential to the use of this specification for jacking and boring projects.

The experience of the jacking and boring Contractor is of prime importance. The designer may recommend prequalification of bidders.

The designer should specify the following in the Contract Documents:

- The size and type of pipeline material to be used for the pipeline installation. This should include the required yield strength of steel pipe or the appropriate class or reinforcement of concrete pipe. (416.05.01)
- Lines and grades for casing pipe. (416.07.02)
- The construction shaft locations. This may include the access shaft to initiate the jacking and boring, and if required, the access shafts at both ends of the jacking. Also, the requirement for temporary shafts and whether they shall be removed or remain in place for other portions of the work. (416.07.03)
- The lines, grades, and tolerances required for the jacking and boring project. (416.07.05)
- The method of testing and monitoring the product installation. (416.07.08)

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- Cathodic protection of steel pipe or casing and the details thereof. (416.07.07)

The designer may wish to consider including a process for the grouting operation between the casing pipe and the carrier pipe, taking into account the high grout pressures that may occur.

The designer may wish to consider including a process regarding payment for failed jacking and boring attempts in the Contract Documents.

The designer may wish to specify a process and payment criteria to deal with rock obstructions that are encountered with jacking installation.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



NOTICE TO USERS OF OPSS 421

CONSTRUCTION SPECIFICATION FOR PIPE CULVERT INSTALLATION IN OPEN CUT

OPSS 421 has been removed from this
OPS volume

The provincial version of OPSS 421 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 421

The municipal version of OPSS 421 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 421

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



**CONSTRUCTION SPECIFICATION FOR
PRECAST REINFORCED CONCRETE BOX CULVERTS
IN OPEN CUT**

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422.10	BASIS OF PAYMENT

APPENDICES

422-A	Commentary

422.01 SCOPE

This specification covers the requirements for the installation of precast reinforced concrete box culverts and box in open cut, and includes the requirements for excavation, bedding, backfilling, and cover material.

422.01.01 Specification Significance and Use

This specification has been developed for use in provincial and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

422.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

422.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, General

OPSS 180 Management and Disposal of Excess Material

Ontario Provincial Standard Specifications, Construction

OPSS 209	Embankments Over Swamps
OPSS 404	Support Systems
OPSS 501	Compacting
OPSS 517	Dewatering of Pipeline, Utility and Associated Structure Excavation
OPSS 539	Temporary Protection Systems
OPSS 902	Excavating and Backfilling - Structures
OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete

Ontario Provincial Standard Specifications, Material

OPSS 1002	Aggregates - Concrete
OPSS 1004	Aggregates - Miscellaneous
OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1205	Clay Seal
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1821	Precast Reinforced Concrete Box Culverts
OPSS 1860	Geotextiles

MTO Laboratory Testing Manual

LS-706	Moisture - Density Relationship of Soils Using 2.5 kg Rammer and a 305 mm Drop

ASTM International

D 2487-00	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
D 2488-00	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
D 2922-01	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D 3017-01	Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

422.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Backfill means earth, rock, or granular material used as fill within the excavation placed beyond the limits of bedding and cover below the subgrade elevation, including frost tapers.

Bedding means the material used to support the bottom of the box unit.

Box Culvert means a culvert constructed of precast reinforced concrete box units rectangular in cross-section.

Box Unit means a single precast reinforced concrete box unit of a box culvert.

Concrete Appurtenances means head walls, cut-off walls, aprons, collars, and any other concrete fixtures associated with the box culverts, excluding concrete bedding or concrete structures covered elsewhere in the Contract Documents and specified as such.

Cover means the material placed as a protective layer around the box unit to prevent damage to the box unit.

Distribution Slab means a reinforced concrete slab placed directly on the top slab of a box culvert to distribute loading.

Excavation, Earth and Rock means the excavation material classified as earth and rock according to OPSS 902.

Excavation, Swamp means swamp excavation as defined in OPSS 209.

Geotechnical Engineer means a professional engineer licensed by the Professional Engineers of Ontario to practice in the Province of Ontario who is responsible for the work related to earth and rock, including site investigation, foundation recommendations, inspection, and quality control with respect to the design and installation of box culverts.

Native Material means the original material removed to form an excavation and which is acceptable to the Contract Administrator for return to the same or other excavation as backfill or cover.

Soil means soil as defined in OPSS 902.

422.04 DESIGN AND SUBMISSION REQUIREMENTS

Six copies of the fabrication and assembly drawings, including handling details, shall be submitted to the Contract Administrator two weeks prior to delivery of the box units.

422.05 MATERIALS

422.05.01 Concrete

Concrete for appurtenances and distribution slab shall be according to OPSS 1350.

422.05.02 Granulars

Granulars shall be according to OPSS 1010.

422.05.03 Fine Aggregates for Levelling Course

Fine aggregate for levelling courses shall be according to OPSS 1002.

422.05.04 Precast Reinforced Concrete Box Units

Precast reinforced concrete box units for spans not greater than 3 metres shall be according to OPSS 1821. Box unit reinforcement shall be consistent throughout a culvert as specified in the Contract Documents.

422.05.05 Clay Seal

Clay seal shall be according to OPSS 1205.

422.05.06 Steel Reinforcement

Steel reinforcement for concrete appurtenances and concrete distribution slab shall be according to OPSS 1440.

422.05.07 Mortar

Mortar for joints shall be composed of one part Portland cement type GU and two parts mortar sand wetted with only sufficient water to make the mixture plastic. The Portland cement type GU shall be according to OPSS 1301, mortar sand shall be according to OPSS 1004, and water shall be according to OPSS 1302.

422.05.08 Preformed Gasket

Preformed gaskets shall be as specified by the manufacturer of the box units.

422.05.09 Joint Sealing Compound

Joint sealing compound shall be butyl mastic as specified by the manufacturer of the box units.

422.05.10 Grout

Grout shall be non-shrink and non-staining.

422.05.11 Geotextile

Geotextile type shall be as specified in the Contract Documents and according to OPSS 1860.

422.05.12 Native Material

Native material shall be classified according to the Unified Soil Classification System using the procedures prescribed in ASTM D 2488. When precise classification of native material is required, ASTM D 2487 shall be used.

422.05.13 Bedding

Bedding shall be as specified in the Contract Documents. Earth bedding shall be classified as Group I or Group II according to Table 1.

The maximum particle size for bedding shall not exceed 25 mm in diameter, unless the bedding layer has a thickness of 150 mm or greater, in which case the maximum particle size shall not exceed 38 mm in diameter.

422.05.14 Backfill

Backfill shall be as specified in the Contract Documents. Earth backfill shall be classified as Group I, Group II, or Group III according to Table 1.

Earth backfill shall be free of boulders over 100 mm in diameter, topsoil, frozen materials, organic matter, and other deleterious material.

422.05.15 Cover

Cover shall be as specified in the Contract Documents. Earth cover shall be classified as Group I or Group II according to Table 1.

Cover shall be free of boulders having a diameter greater than 100 mm, debris, organic matter, or frozen materials.

422.07 CONSTRUCTION

422.07.01 Selection of Box Units

The box units shall be selected from Table 1 in OPSS 1821 based on the dimensions and height of fill specified in the Contract Documents.

422.07.02 Excavation

The excavation for the installation of the box units shall be according to OPSS 902, including frost tapers and culvert end treatments.

422.07.03 Support Systems

Support systems shall be according to OPSS 404.

422.07.04 Dewatering

Dewatering shall be according to OPSS 517.

422.07.05 Temporary Protection Systems

Temporary protection systems shall be according to OPSS 539.

422.07.06 Foundations

The foundation shall be comprised of firm to hard in situ soil or compacted backfill.

When unsuitable or unstable material is encountered during the excavation for the foundation, the unsuitable or unstable material shall be removed to firm to hard in situ soil and replaced to the foundation grade with compacted backfill meeting the requirements of Group I or Group II, according to Table 1. The foundation on each side of the box unit, for a minimum distance equal to the inside width of the box unit shall be at least as stable as the foundation below the box unit.

422.07.07 Bedding

Bedding shall be placed to the dimensions shown in the Contract Documents.

The bedding shall be placed as uniformly as possible. Bedding under the middle third of the box unit base shall be loosely placed and uncompacted. Bedding requiring compaction shall be placed in layers not exceeding 200 mm in thickness, loose measurement, and each layer shall be compacted according to OPSS 501.

Bedding shall not be placed on frozen earth grade.

422.07.08 Levelling

The surface prepared to support the box units shall have a 75 mm minimum thickness top levelling course of uncompacted Granular A or fine aggregates.

422.07.09 Installing Box Units

422.07.09.01 Box Units

Box units shall be installed to the alignment and grade specified in the Contract Documents.

Box units shall not be installed on bedding containing frozen material.

End units to accommodate concrete appurtenances shall be as specified in the Contract Documents.

The box units shall be installed to make a continuous line forming a box culvert. The gap at box unit joints shall not exceed 20 mm.

For box units placed in parallel for multiple cell installations, a 60 mm $\pm$ 10 mm gap filled with grout between adjacent cells shall be provided.

Installation of the box units shall commence at the outlet end and proceed in the upstream direction with the bell ends of the box units facing upgrade. The box units shall be placed with the base of each box unit in uniform contact with the prepared bedding throughout its full length. The ends of the box units shall be joined so there is no unevenness along the inside. The box units and joint surfaces shall be kept clean as work progresses. Water shall not be allowed to flow through the box units during installation. The excavation shall be kept dry and the box units shall not be installed in water.

422.07.09.02 Geotextile at Joints

A 600 mm wide strip of geotextile shall be placed to form a continuous barrier centered around the exterior of all buried joints not covered by a distribution slab.

Geotextile shall be free of folds, tears, and wrinkles. The geotextile shall be joined so that the material laps a minimum of 500 mm and shall be pinned together. Alternatively, the geotextile shall be joined according to the seam requirements of OPSS 1860.

Geotextile shall not be placed between the top slab of box units and distribution slabs. Where a distribution slab is required, the geotextile shall be held in place by cover and geotextile ends shall be secured to the box units.

422.07.09.03 Mortared Joints

When mortared joints are specified in the Contract Documents, all joints shall be thoroughly cleaned and wetted. Mortar shall then be applied over the joint around the inner and outer perimeter. After the mortar joint is complete the joint inside shall be wiped clean and smooth.

422.07.09.04 Preformed Gasket

When a preformed gasket is specified in the Contract Documents for sealing the joint between the box units, it shall be placed according to the manufacturer's recommendations.

422.07.09.05 Joint Sealing Compound

When joint sealing compound is specified in the Contract Documents for sealing the joint between the box units, it shall be applied according to the manufacturer's recommendations.

422.07.09.06 Lift Holes

All lift holes shall be filled with mortar after installation of the box unit.

422.07.10 Concrete Appurtenances and Concrete Distribution Slab

Concrete placement, sampling, and testing shall be according to OPSS 904. Reinforcing steel shall be placed according to OPSS 905. Steel grating shall be provided as specified in the Contract Documents.

422.07.11 Backfill

Backfill shall be placed in layers not exceeding 200 mm in thickness, loose measurement. Compaction shall be according to OPSS 501.

Backfilling on each side of the box units shall be completed simultaneously. At no time shall the levels on each side differ by more than 400 mm.

When native material is specified as backfill in the Contract Documents, earth material may be substituted, when approved by the Contract Administrator. In areas within the roadway, for a depth equal to the frost treatment, earth backfill shall have frost susceptibility characteristics similar to the native material. The Contract Administrator shall decide on the suitability of the earth backfill that the Contractor proposes to substitute.

Rock may be used as backfill provided the installed box units are protected by a minimum thickness of cover material as specified in the Contract Documents.

Box unit installation and backfill shall be completed prior to the start of any subbase and base course construction over the box unit location.

Shoring and bracing shall be withdrawn and removed as the excavation is being backfilled.

422.07.12 Cover

Cover shall be placed in layers not exceeding 200 mm in thickness, loose measurement, and each layer shall be compacted according to OPSS 501.

Cover in trenches and in other locations where pavements require controlled differential settlement shall be of a type and compaction level to control pavement differential settlement within acceptable limits for the specified type of pavement.

422.07.13 Clay Seal

When a clay seal is specified in the Contract Documents, the clay seal shall be placed to the dimensions specified in the Contract Documents and compacted to a minimum of 95% of the maximum dry density (MDD). The MDD shall be determined from LS-706, carried out on a single representative sample. Field density and field moisture determinations shall be made according to ASTM D 2922 and ASTM D 3017.

422.07.14 Geotechnical Testing

When specified in the Contract Documents, compliance of earth backfill material type and compaction with the requirements of this specification shall be verified by a Geotechnical Engineer approved by the Contract Administrator.

422.07.15 Management and Disposal of Excess Material

Management and disposal of excess material shall be according to OPSS 180.

422.09 MEASUREMENT FOR PAYMENT

422.09.01 Actual Measurement

422.09.01.01 Precast Reinforced Concrete Box Culverts

Measurement of the actual length of box culvert installed shall be made in metres along the centreline of the invert of the box culvert.

422.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

422.10 BASIS OF PAYMENT

422.10.01 “size” Precast Concrete Box Culvert - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

422.10.02 Clay Seal - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

422.10.03 Granular

Granular material used for bedding and levelling courses, backfill, cover, and frost tapers shall be paid for under the appropriate granular items specified in the Contract Documents.

Payment will not be made for granular used to fill any area excavated beyond the lines specified in the Contract Documents or used as cover when acceptable earth cover is available.

422.10.04 Steel Reinforcement in Concrete Appurtenances

Payment for steel reinforcement in concrete appurtenances shall be according to OPSS 905.

422.10.05 Concrete in Appurtenances

Payment for concrete appurtenances shall be according to OPSS 904.

422.10.06 Excavation for Box Culverts

Payment for earth and rock excavation shall be according to OPSS 902.

422.10.07 Swamp Excavation

Where swamp excavation is required to place precast concrete box culverts, payment for the swamp excavation shall be under the tender item covering the swamp excavation for earth embankment construction.

TABLE 1
Group Classification for Earth Bedding, Backfill and Cover Materials

Group	Grain Size	Description	Symbols
I	Coarse	Well-Graded Gravel, Gravel-Sand Mixtures, little or no fines	GW
		Poorly-Graded Gravel, Gravel-Sand Mixtures, little or no fines	GP
		Well-Graded Sand, Gravelly Sand, little or no fines	SW
		Poorly-Graded Sand, Gravelly Sand, little or no fines	SP
II	Medium	Clayey Gravel or Gravel-Sand-Clay Mixtures	GC
		Clayey Sand or Sand-Clay Mixtures	SC
		Silty Sand or Sand-Silt Mixtures	SM
		Silty Gravels or Gravel-Sand-Silt Mixtures	GM
		Inorganic Silts and Very Fine Sands, Silty or Clayey Fine Sands, Clayey Silts	ML
III	Fine	Clayey Gravel or Gravel-Sand-Clay Mixtures	GC
		Clayey Sand or Sand-Clay Mixtures	SC
		Inorganic Clay, Gravelly Clay, Sandy Clay, Silty Clay, Lean Clay	CL
		Inorganic Silts, Micaceous or Diatomaceous Fine Sandy or Silty Soil	MH

Appendix 422-A, November 2015 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The design should specify the following in the Contract Documents:

- Geotextile type. (422.05.11)
- Bedding. (422.05.13)
- Backfill. (422.05.14)
- Cover. (422.05.15)
- Dimensions of box units and height of fill. (422.07.01)
- Bedding dimensions. (422.07.07)
- Alignment and grade of the box units. (422.07.09.01)
- Minimum cover material requirements for installation protection against rock backfill. (422.07.11)
- Clay seal. (422.07.13)

The designer should determine if the following is required and if so, specify in the Contract Documents:

- Concrete appurtenances. (422.07.09.01)
- Mortared joints. (422.07.09.03)
- Preformed gasket. (422.07.09.04)
- Joint sealing compound. (422.07.09.05)
- Steel grating. (422.07.10)
- Native backfill. (422.07.11)
- Geotechnical testing. (422.07.14)

To be complete, the tender item descriptions for Precast Concrete Box Culvert should include the size of the box unit.

Related Ontario Provincial Standard Drawings

OPSD 803.010	Backfill and Cover for Concrete Culverts
OPSD 3920.100	Precast Reinforced Concrete Box Culvert With Height Of Fill $\geq 0.6\text{m}$
OPSD 3920.110	Precast Reinforced Concrete Box Culvert With Height Of Fill $< 0.6\text{m}$
OPSD 4040.05	Culverts Warning Message Layout Details
OPSD 4040.06	Culverts Warning Message Lettering Details



CONSTRUCTION SPECIFICATION FOR WATERMAIN INSTALLATION IN OPEN CUT

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441.01 SCOPE

This specification covers the requirements for the installation of watermains, service connections, and associated appurtenances in open cut.

441.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

441.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

441.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 490	Site Preparation for Pipeline, Utilities, and Associated Structures
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 493	Temporary Potable Water Supply Services
OPSS 510	Removal
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS 539	Temporary Protection Systems

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1301	Cementing Materials
OPSS 1302	Water

OPSS 1350 Concrete - Materials and Production
OPSS 1842 Pressure Polyethylene Pipe Products

CSA Standards

B64.5-11 Double Check Valve (DCVA) Backflow Preventers
[Part of B64 Series-11, Backflow Preventers and Vacuum Breakers Compendium]
B137.1-09 Polyethylene Pipe, Tubing and Fittings for Cold-Water Pressure Services
[Part of B137-09, Thermoplastic Pressure Piping Compendium]
B137.2-09 Polyvinyl Chloride (PVC) Injection-Moulded Gasketed Fittings for Pressure Applications
[Part of B137-09, Thermoplastic Pressure Piping Compendium]
B137.3-09 Rigid Polyvinyl Chloride (PVC) Pipe and Fittings for Pressure Applications
[Part of B137-09, Thermoplastic Pressure Piping Compendium]
B137.3.1-09 Molecularly Oriented Polyvinyl Chloride (PVCO) Pipe and Fittings for Pressure Applications
[Part of B137-09, Thermoplastic Pressure Piping Compendium]
B137.10-09 Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene Composite Pressure-Pipe Systems [Part of B137-09, Thermoplastic Pressure Piping Compendium]

ASTM International

A 153M-09 Zinc Coating (Hot Dip) on Iron and Steel Hardware
A 276-10 Stainless Steel Bars and Shapes
A 307-10 Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
B 88-09 Seamless Copper Water Tube
B 633-11 Electrodeposited Coatings of Zinc on Iron and Steel
B 766-86 (2008) Electrodeposited Coatings of Cadmium
C 361-11 Reinforced Concrete Low-Head Pressure Pipe
D 3139-98 (2011) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

American Water Works Association (AWWA)

C104/A21.4-08 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
C110/A21.10-08 Ductile-Iron and Gray-Iron Fittings for Water
C111/A21.11-07 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
C151/A21.51-02 Ductile-Iron Pipe, Centrifugally Cast, for Water
C153/A21.53-06 Ductile-Iron Compact Fittings for Water Service
C200-05 Steel Water Pipe - 6 In. (150 mm) and Larger
C205-07 Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. (100 mm) and Larger
C206-11 Field Welding of Steel Water Pipe
C208-07 Dimensions for Fabricated Steel Water Pipe Fittings
C301-07 Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids
C302-11 Reinforced Concrete Pressure Pipe, Non-Cylinder Type
C303-08 Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type
C502-05 Dry-Barrel Fire Hydrants
C504-10 Rubber-Seated Butterfly Valves
C509-09 Resilient-Seated Gate Valves for Water Supply Service
C510-07 Double Check Valve Backflow Prevention Assembly
C800-05 Underground Service Line Valves and Fittings
C900-07 Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 in.-12 in. (100 mm - 300 mm), for Water Transmission and Distribution
C905-10 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 350 mm Through 1,200 mm (14 in. Through 48 in.) for Water Transmission and Distribution

C907-12	Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 in.-12 in. (100 mm - 300 mm), for Water Distribution
C909-09	Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 100 mm Through 600 mm (4 in. Through 24 in.), for Water Distribution

American Society of Mechanical Engineers (ASME)

B18.2.1-2010	Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

NSF International

61-2008	Drinking Water System Components - Health Effects

441.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Associated Appurtenance means structures, devices, and appliances, other than pipe and conduit, which are used in connection with a water distribution system, such as valves, hydrants, corporation cocks, services, and thrust restraints.

Backfilling means the operation of filling a trench with bedding, cover, and backfill material, or embedment and backfill material.

End Covers means temporary cover installed at the factory over both ends of uninstalled watermain pipe to prevent the entry of contaminants during shipping and storage.

Excavation, Earth and Rock means the excavation classified as earth and rock according to OPSS 206.

Fitting means connections, appliances, and adjuncts designed to be used in connection with pipe: for example, elbows and bends to alter the direction of a pipe; tees and crosses to connect a branch with a main; plugs and caps to close an end; and bushings, diminishers, or reducers to couple two pipes of different diameters.

Service Connection means the system used to supply water from the watermain to the property line.

Service Connection Appurtenance Set means the main stop, curb stop, couplings, service box, service box support, and service saddle used in the installation of a service connection.

Watermain means an installation designed for the conveyance of water under pressure using circular pipe.

441.05 MATERIALS

441.05.01 General

The pipe size shall be according to the size specified in the Contract Documents. Pipe type and class shall be as specified in the Contract Documents.

Fittings shall be suitable for and compatible with the pipe material and class with which they are used.

All material for watermains shall be NSF/ANSI 61 compliant.

441.05.02 Ductile Iron Pipe

Ductile iron pipe shall be according to AWWA C151/A21.51.

Fittings shall be gray iron according to AWWA C110/A21.10 or ductile iron according to AWWA C110/A21.10 or AWWA C153.

Ductile iron pipe and fittings shall be cement lined according to AWWA C104/A21.4.

Rubber gaskets for push-on or mechanical joints shall be according to AWWA C111/A21.11.

441.05.03 Concrete Pressure Pipe

Concrete cylinder pipe including joints and fittings shall be according to AWWA C301 or AWWA C303.

Non-cylinder pipe and joints shall be according to AWWA C302 or ASTM C 361. Fittings shall be according to AWWA C302.

441.05.04 Polyvinyl Chloride Pipe

441.05.04.01 General

Flexible elastomeric seals for bell and spigot joints shall be according to ASTM D 3139.

Fittings for polyvinyl chloride (PVC) and molecularly oriented polyvinyl chloride (PVCO) pipe shall be either:

- a) Gray iron according to AWWA C110/A21.10.
- b) Ductile iron according to C110/A21.10 or AWWA C153 and shall be cement lined according to AWWA C104/A21.4.
- c) Injection moulded polyvinyl chloride, blue in colour and according to AWWA C907 and CSA B137.2.
- d) Prefabricated polyvinyl chloride, blue in colour and according to AWWA C905 and CSA B137.3.

441.05.04.02 Polyvinyl Chloride Pipe (PVC)

Polyvinyl chloride pipe shall be according to AWWA C900 or AWWA C905 and CSA B137.3, and shall be blue in colour and supplied complete with gaskets.

441.05.04.03 Molecularly Oriented Polyvinyl Chloride Pipe (PVCO)

Molecularly oriented polyvinyl chloride pipe shall be according to AWWA C909 and CSA B137.3.1, and shall be blue in colour and supplied complete with gaskets.

441.05.05 Polyethylene Pipe

Polyethylene pressure pipe shall be according to OPSS 1842.

Fittings shall be either:

- a) Flanged gray iron according to AWWA C110/A21.10.
- b) Flanged ductile iron according to AWWA C110/A21.10 or AWWA C153 and shall be cement lined according to AWWA C104/A21.4.

- c) Polyethylene according to OPSS 1842.
- d) Heat fusion or insert or compression type fittings according to CSA 137.1.

441.05.06 Steel Pipe

Steel pipe shall be according to AWWA C200. Fittings shall be according to AWWA C208. Steel pipe shall have a cement-mortar protective lining and coating according to AWWA C205.

441.05.07 Copper Pipe

Copper pipe for service connections shall be according to ASTM B 88 and shall be type K soft copper.

441.05.08 Composite Pipe

Crosslink polyethylene/aluminum/crosslink polyethylene composite pressure pipe for service connections shall be according to CSA B137.10.

441.05.09 Valves

441.05.09.01 General

All valves shall open by operating in a counter clockwise direction.

Valves shall be designed for a minimum cold water working pressure of 1,035 kPa.

Valve types shall be one of the following:

- a) Valves less than 75 mm shall be brass or bronze gate valves.
- b) Valves greater than or equal to 75 mm, and less than or equal to 300 mm, shall be cast or ductile iron gate valves.
- c) Valves greater than 300 mm up to and including 500 mm shall be gate or butterfly valves.
- d) Valves greater than 500 mm shall be butterfly valves.

Fasteners shall be made from material meeting the strength requirements of ASTM A 307 with dimensions according to ASME B18.2.1. Bolts, studs, and nuts shall be cadmium plated according to ASTM B 766 or zinc coated according to ASTM A 153 or ASTM B 633. Fasteners for mechanical joints shall be ductile iron according to AWWA C111/A21.11.

441.05.09.02 Service Line Valves

Valves shall be according to AWWA C800. Type, pressure class, and end connections shall be as specified in the Contract Documents.

441.05.09.03 Gate Valves

Gate valves shall be according to AWWA C509.

Stem sealing on non-rising stem valves shall use O-ring type seals that do not require adjustment.

The gate valve end configuration shall be as specified in the Contract Documents.

441.05.09.04 Butterfly Valves

Butterfly valves shall be according to AWWA C504.

Valves shall be short body flanged or mechanical-joint, class 150B.

Valve shafts shall be stainless steel and, when they project through the body, shall have seals that do not require adjustment.

A vertical operating nut shall be provided. Valves shall be provided with an external indicator showing valve position by means of a pointer operating through a 90% arc from open to close.

441.05.09.05 Air Release and Air/Vacuum Valves

Air release and air/vacuum valves shall be single acting type.

441.05.10 Hydrants

Hydrants shall be according to AWWA C502. The type shall be as specified in the Contract Documents.

441.05.11 Double Check Valve Backflow Preventers

Double check valve backflow preventers shall be according to CSA B64.5 or AWWA C510.

441.05.12 Service Connection Fittings and Appurtenances

Main stops, curb stops, couplings, service boxes, and service saddles shall be as recommended by the manufacturer of the service connection pipe.

441.05.13 Concrete

Concrete for thrust blocks and fitting and appurtenance supports shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 20 MPa.

441.05.14 Mortar

Mortar for joints shall be composed of one part Portland cement and three parts mortar sand, wetted with sufficient water to make the mixture plastic.

The mortar sand shall be according to OPSS 1004, the Portland cement shall be according to OPSS 1301, and the water shall be according to OPSS 1302.

441.05.15 Straps, Tie-Rods, Angles, Nuts, and Bolts

Stainless steel straps, tie-rods, angles, nuts, and bolts used with concrete thrust blocks shall be according to ASTM A 276, Type 316 stainless steel.

441.07 CONSTRUCTION

441.07.01 General

The work for the installation of watermains shall include all watermain pipe, bends, tees, fittings, and thrust restraints and the testing of the watermain system.

The interior of all pipe, fittings, and other accessories shall be kept clean and free from undesirable material at all times.

441.07.02 Site Preparation

Site preparation shall be according to OPSS 490.

441.07.03 Removals

Removals shall be according to OPSS 510.

441.07.04 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

441.07.05 Protection Against Floatation

Damage to the pipeline due to floatation shall be prevented during construction and until completion of the works.

441.07.06 Cold Weather Work

All work shall be protected from freezing. Pipe and bedding material shall not be placed on frozen ground.

441.07.07 Transporting, Unloading, Storing, and Handling Pipe

All pipe, fittings, and gaskets that are unsound or damaged shall be rejected.

All pipe up to and including 600 mm diameter shall be delivered to the Work Area with end covers and a tamper evident seal on only the bell end. These components shall adhere sufficiently to withstand the stresses caused during shipment.

A waterproof seal is not required on the end covers.

Tamper evident seals shall display the manufacturers name or logo or both. Seals shall straddle the end cover and the pipe. Removal of the cover shall render the tamper evident seal unusable either by breaking the seal or by leaving a message such as "VOID" on the pipe. Tamper evident seals are not required for non-reusable heat shrink plastic covers or foam plugs with punch-out centres.

Pipe delivered to the construction site with damaged or missing end covers shall be field cleaned to remove all undesirable material along the entire length of the interior of the pipe and the end covers reinstalled.

Manufacturer's recommendations for transporting, unloading, storing, and handling of materials shall be followed.

441.07.08 Excavation

Excavation for the installation of watermain shall be according to OPSS 401.

441.07.09 Support Systems

Support systems shall be according to OPSS 404.

441.07.10 Dewatering

Dewatering shall be according to OPSS 517.

441.07.11 Temporary Protection Systems

The construction of temporary protection systems shall be according to OPSS 539.

When the stability, safety, or function of an existing roadway, railway, watercourse, other works, or proposed works may be impaired due to the method of operation, protection shall be provided. Protection may include sheathing, shoring, and piling when necessary to prevent damage to such works or proposed works.

441.07.12 Temporary Potable Water Supply Services

Temporary potable water supply services shall be according to OPSS 493.

441.07.13 Backfilling and Compacting

Backfilling and compacting shall be according to OPSS 401.

441.07.14 Installation of Pipe

Pipe shall be laid in a dry trench.

Pipe shall be laid within the alignment and grade tolerances specified in the Contract Documents. The barrel of each pipe shall be in contact with the shaped bed throughout its full length.

When the Owner raises or lowers the invert of a watermain by up to 150 mm, it shall not constitute a Change in the Work and no adjustment shall be made to the payment. When the invert of a watermain is raised or lowered by more than 150 mm, then this shall constitute a Change in the Work for the full extent of the change from the original grade.

Pipe shall be kept clean and dry as work progresses. A removable watertight bulkhead shall be installed at the open end of the last pipe laid whenever work is suspended.

Pipe shall not be laid until the preceding pipe joint has been completed and the pipe carefully embedded and secured in place.

441.07.15 Jointing

441.07.15.01 General

End covers shall be removed immediately prior to jointing. Joint surfaces shall be clean. Pipe ends shall be lubricated with material recommended by the pipe manufacturer.

Manufacturer's instructions for jointing pipe shall be followed.

Joints and all connections shall be made watertight.

All bolts, nuts, couplings, rubber rings, and connecting pieces shall be cleaned thoroughly before installation.

Pipe shall be aligned on centreline to previously laid pipe.

Pipe shall be pulled or pushed only by a hand-operated winch. A backhoe shall not be used for pushing pipe.

Joints shall be prevented from opening after the pipe has been laid.

441.07.15.02 Ductile Iron Pipe

Mechanical Joints:

The gland shall be positioned on the pipe with the lip extension toward the joint. The gasket shall be slipped on the pipe with the thick edge towards the gland. The spigot end shall be pushed to its seat in the bell. The gasket shall be pressed to seat it evenly around the joint.

The gland shall be positioned for bolting and the bolts shall be inserted. All nuts shall be hand tightened.

The nuts shall be tightened half a turn at a time with a calibrated torque wrench. All nuts shall be tightened uniformly to the torque specified in AWWA C111/A21.11.

Bell and Spigot Joints:

The gasket shall be placed in the groove of the bell making certain it is properly seated.

The gasket shall be lubricated.

Pipe to be joined shall be aligned and the spigot shall be carefully entered into the bell until the spigot end just makes contact with the gasket.

The entry of the spigot into the bell shall be completed by hand or by the use of a hand operated winch until the second reference mark is flush with the face of the bell.

441.07.15.03 Concrete Pressure Pipe

Bell and Spigot Joints:

A cotton or burlap diaper shall be placed around the bell end of the pipe already in place.

A rubber gasket shall be placed on the spigot end of the pipe to be laid ensuring that the stretch and volume of the gasket is equalized around the entire circumference of the pipe. The gasket and spigot shall be lubricated prior to the spigot end being inserted home into the bell end.

The pipe shall be aligned and the spigot end shall be inserted into the bell of the pipe already in place.

Steel inserts shall be placed in the joints to prevent the spigot from entering the full depth of the bell. The location of the rubber gasket shall be checked around the entire circumference of the joint. The steel insert shall be removed and the pipe pushed until the spigot enters the full depth of the socket and is retained in position.

Ensure that the diaper is carefully placed around the joint recess. Cement mortar shall be poured around the assembled joint.

441.07.15.04 Polyvinyl Chloride Pressure Pipe - PVC and PVCO

Joints shall be bell and spigot with rubber gaskets. If gaskets are supplied separately, they shall be inserted in the groove of the bell end of the pipe.

The spigot shall be lubricated. The spigot end shall be inserted and pushed into the bell up to but not beyond the depth of the stop reference mark.

441.07.15.05 Polyethylene Pressure Pipe

Polyethylene pipe 100 mm diameter and larger shall be joined by the thermal butt fusion process. Procedures recommended by the pipe manufacturer shall be followed.

Polyethylene pipe 75 mm diameter and smaller shall be joined with heat fusion or insert or compression type fittings that are recommended by the pipe manufacturer and that prevent pull-out and resist creep deformation at full test pressure.

Connections to non-polyethylene fittings and appurtenances 50 mm diameter and larger shall be made with flanged joints according to the manufacturer's recommendations. Bolts shall be tightened to the torque specified by the manufacturer for the particular size and type of stub end.

441.07.15.06 Steel Pipe

Steel pipe shall be jointed according to AWWA C200. Field welding for joints shall be according to AWWA C206.

441.07.15.07 Service Connection Pipe

Service connection pipe shall be jointed as recommended by the manufacturer.

441.07.16 Cutting of Pipe

Whenever cutting of pipe is required, the pipe shall be cut according to the recommendations of the pipe manufacturer. After cutting the pipe, the interior of the pipe shall be cleaned and the end cover replaced until the pipe is installed.

441.07.17 Change in Line and Grade

441.07.17.01 Ductile Iron Pipe

Fabricated bends shall be provided for changes in line and grade of 11.25° or more.

Deflections of less than 11.25° may be made using a series of pipe joint deflections. The manufacturer's recommendation in deflecting any single pipe joint shall not be exceeded.

441.07.17.02 Concrete Pressure Pipe

Fabricated bends, bevel adaptors, or elbows shall be used for changes in line or grade greater than 5°. Changes in line or grade less than 5° shall be made using a manufactured joint or bevel connection or may be made over several joints. The manufacturer's joint deflection recommendations shall not be exceeded.

441.07.17.03 Polyvinyl Chloride Pipe - PVC and PVCO

Polyvinyl chloride pipe joints may be deflected but shall not exceed the manufacturer's recommendations. Otherwise, fabricated bends shall be used.

441.07.17.04 Polyethylene Pipe

Use of pipe flexibility may be allowed but shall not exceed the manufacturer's recommendations.

441.07.17.05 Steel Pipe

Fabricated bends shall be used at all changes in line or grade, unless the change can be accomplished by deflections at pipe joints without exceeding the manufacturer's recommendation for deflection at pipe joints.

441.07.18 Installation of Valves and Fittings

441.07.18.01 General

The work for the installation of valves and fittings shall include the valves and couplings and valve boxes, when valve boxes are specified in the Contract Documents. Valves and fittings shall be installed in locations and be of the type specified in the Contract Documents. Valves and connecting pipe shall be aligned accurately and supported as specified in the Contract Documents. Valves and fittings do not require end covers but shall be field cleaned prior to installation.

441.07.18.02 Air Release and Air/Vacuum Valves

Air release and air/vacuum valves shall be installed at locations specified in the Contract Documents.

Each air release and air/vacuum valve shall be provided with an isolating valve.

441.07.19 Installation of Hydrant Sets

The work for the installation of hydrant sets shall include the placing of hydrants, hydrant isolating valves, hydrant leads, restraining devices, and support devices.

Hydrant sets shall be installed at locations specified in the Contract Documents.

The hydrant shall be plumb with the nozzles parallel to the edge of pavement or curb line and the pumper connection facing the roadway.

441.07.20 Installation of Service Connections

A service connection shall consist of a service connection pipe and a service connection appurtenance set and shall be installed at locations and be of the size specified in the Contract Documents.

Service connection pipe shall be installed by pressure tap connection or saddles. Service connections on plastic watermain shall be installed using service saddles or tapped couplings.

Curb stop valve boxes shall be installed vertically and flush with the final grade elevation.

441.07.21 Shutting Down or Charging Mains

At no time shall watermain be shut down or charged or valves operated without permission from the Contract Administrator.

441.07.22 Connections to Existing Watermain

The work of connecting to existing watermain shall include the removal of all plugs, caps, blow offs, and thrust blocks from an existing watermain or fitting, and the installation of the connection.

All connections to existing watermain shall be made under the supervision of the Contract Administrator.

441.07.23 Thrust Restraints

All connections, caps, and bends shall be restrained by concrete blocking and/or restrained joints as specified in the Contract Documents. Concrete for thrust blocks shall be placed against undisturbed ground. Joints and couplings shall remain free from concrete. Only restrained joint products specifically designed for use with the pipe material shall be used.

441.07.24 Hydrostatic Testing

441.07.24.01 General

Hydrostatic testing shall be conducted under the supervision of the Contract Administrator upon completion of the watermain, including services and backfilling.

A test section shall be either a section between valves or the completed watermain.

Test pressure shall be 1,035 kPa.

The test section shall be filled slowly with water and all air shall be removed from the pipeline. A 24-hour absorption period may be allowed before starting the test. The test section shall be subjected to the specified continuous test pressure for 2 hours.

441.07.24.02 Polyethylene Pipe

The test procedure shall consist of initial expansion and test phases.

During the initial expansion phase, the test section shall be pressurized to the test pressure and sufficient make-up water added each hour for 3 hours to return to test pressure. The test phase begins after the initial expansion phase.

The test phase shall be 2 hours after which a measured amount of make-up water is added to return the test pressure. If the amount of make-up water added does not exceed the value in Table 1, leakage is not indicated.

If the amount of make-up water exceeds the Table 1 value, all leaks shall be located and repaired and the test section shall be retested until a satisfactory result is obtained.

The test duration should not exceed 8 hours. If the pressure test is not completed, the test section shall be de-pressurized and allowed to relax for at least 8 hours before bringing the test section up to pressure again.

441.07.24.03 Other Pipe

A period of 24 hours shall be allowed before starting the test.

The test section shall be subject to the specified continuous test pressure for 2 hours.

The leakage is the amount of water added to the test section to maintain the specified test pressure for the test duration. The measured leakage shall be compared with the allowable leakage as calculated for the test section. The allowable leakage is 0.082 litres per millimetre of pipe diameter per kilometre of pipe for the 2-hour test period.

If the measured leakage exceeds the allowable leakage, all leaks shall be located and repaired and the test section shall be retested until a satisfactory result is obtained.

441.07.25 Flushing and Disinfecting Watermains

Flushing and disinfecting operations shall be conducted under the supervision of the Contract Administrator. The watermain shall be flushed to achieve a minimum velocity of 0.76 m/sec otherwise the watermain shall be swabbed. The Contract Administrator shall be notified at least 2 Business Days in advance of the proposed date on which flushing and disinfecting operations are to commence.

Watermains shall be flushed in a sequence approved by the Contract Administrator. The Contract Administrator may permit or require the flushing to be carried out in stages as sections of the system are completed. Flushed sections shall be protected from contamination.

After flushing is completed, water from the existing distribution system shall be allowed to flow at a controlled rate into the new pipeline. Liquid chlorine solution shall be introduced so that the chlorine is distributed throughout the section being disinfected. The chlorine shall be applied so that the chlorine concentration is 50 mg/litre minimum throughout the section. The system shall be left charged with the chlorine solution for 24 hours.

Sampling and testing for chlorine residual shall be carried out by the Contract Administrator. The chlorine residual shall be tested in the section after 24 hours. If tests indicate a chlorine residual of 25 mg/litre minimum, the section shall be flushed completely and recharged with water normal to the operation of the system. If the test does not meet the requirements, the chlorination procedure shall be repeated until satisfactory results are obtained.

Twenty-four hours after the system has been recharged, the Contract Administrator shall take samples for bacteriological tests. Samples shall be collected from every 350 m of the new watermain plus one sample from the end of each of the line and at least one sample from each branch. If there is indication of contamination, the disinfection procedure shall be repeated.

The system shall not be put into operation until approval has been given by the Contract Administrator.

441.07.26 Site Restoration

Site restoration shall be according to OPSS 492.

441.07.27 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

All chlorinated water used for testing, flushing, or disinfecting watermains shall be disposed of safely.

The method of disposal of chlorinated water is subject to the approval of the Contract Administrator.

441.09 MEASUREMENT FOR PAYMENT

441.09.01 Actual Measurement

441.09.01.01 Watermains

Measurement of watermains shall be by length in metres along the horizontal centreline of the pipe from the point of connection to a chamber, water treatment plant, or existing watermain to a point vertically above the end of the new watermain.

441.09.01.02 Valves

For measurement purposes, a count shall be made of the number of valves installed, regardless of the type and size.

441.09.01.03 Hydrant Sets

For measurement purposes, a count shall be made of the number of hydrant sets installed, regardless of the type.

441.09.01.04 Service Connection Pipe

Measurement of service connection pipe shall be by length in metres along the horizontal centreline of the pipe from the point of connection at the watermain to a point vertically above the end of the service connection.

441.09.01.05 Service Connection Appurtenance Sets

For measurement purposes, a count shall be made of the number of service connection appurtenance sets installed.

441.09.01.06 Connections to Existing Watermains

For measurement purposes, a count shall be made of the number of connections made to existing watermains.

441.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

441.10 BASIS OF PAYMENT

- 441.10.01 Watermains - Item**
Valves - Item
Hydrant Sets - Item
Service Connection Pipe - Item
Service Connection Appurtenance Sets - Item
Connections to Existing Watermains - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

TABLE 1
Test Phase Make-Up Amount for Pressure Polyethylene Pipe

Pipe Diameter mm	Make-Up Water litre/km
30	12.38
40	12.38
50	13.62
75	18.60
100	31.00
150	74.50
200	124.20
250	161.40
275	248.30
300	285.60
350	335.20
400	409.70
450	533.90
500	682.90
550	869.10
600	1,105.00
700	1,378.20
800	1,775.50
900	2,234.90
1,000	2,731.60
1,050	3,104.00
1,200	3,973.20
1,350	5,152.70
1,600	7,449.70

Appendix 441-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer may consider including soil boring data, a geotechnical report, a subsurface report, or a soils report in the Tender Documents.

The designer should include the following in the Contract Documents:

- Pipe size, type, and class. (441.05.01)
- Service line valve type, pressure class, and end connections. (441.05.09.02)
- Gate valve end configuration. (441.05.09.03)
- Type of hydrants. (441.05.10)
- Alignment and grade tolerances for the pipe installation. (441.07.14)
- Valve type and location. (441.07.18.01)
- Air release and air/vacuum valve locations. (441.07.18.02)
- Location of hydrant sets. (441.07.19)
- Location and size of service connections. (441.07.20)
- Thrust restraints. (441.07.23)

The designer should determine if valve boxes are needed and, if so, they should be specified in the Contract Documents. (441.07.18.01)

Corrosion protection system provisions should be specified, if appropriate.

Tracer wire or tracer tape should be specified, if appropriate.

Under conditions of high ground water, external fluids may enter via air release and air/vacuum release valves; therefore, appropriate measures should be taken.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Appendix 441-A

Related Ontario Provincial Standard Drawings

OPSD 1101.012	Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 1800 x 2400 mm, Components
OPSD 1101.013	Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 1800 x 2400 mm, Riser and Base
OPSD 1101.014	Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 1800 x 2400 mm, Thrust Blocks
OPSD 1101.015	Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 1800 x 2400 mm, Chimney and Cap
OPSD 1101.016	Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 2400 x 3000 mm, Components
OPSD 1101.017	Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 2400 x 3000 mm, Riser and Base
OPSD 1101.018	Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 2400 x 3000 mm, Thrust Blocks
OPSD 1101.019	Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 2400 x 3000 mm, Chimney and Cap
OPSD 1101.020	Valve Operator
OPSD 1101.030	Precast Concrete Valve Chamber With Poured-in-Place Thrust Blocks, 3000 x 3000 mm Components
OPSD 1101.031	Precast Concrete Valve Chamber With Poured-in-Place Thrust Blocks, 3000 x 3000 mm Riser and Base
OPSD 1101.032	Precast Concrete Valve Chamber With Poured-in-Place Thrust Blocks, 3000 x 3000 mm Thrust Blocks
OPSD 1101.033	Precast Concrete Valve Chamber With Poured-in-Place Thrust Blocks, 3000 x 3000 mm Chimney and Cap
OPSD 1101.040	Precast Concrete Valve Chamber With Poured-in-Place Thrust Blocks, 3600 x 3000 mm Components
OPSD 1101.041	Precast Concrete Valve Chamber With Poured-in-Place Thrust Blocks, 3600 x 3000 mm Riser and Base
OPSD 1101.042	Precast Concrete Valve Chamber With Poured-in-Place Thrust Blocks, 3600 x 3000 mm Thrust Blocks
OPSD 1101.043	Precast Concrete Valve Chamber With Poured-in-Place Thrust Blocks, 3600 x 3000 mm Chimney and Cap
OPSD 1103.010	Concrete Thrust Blocks for Tees, Plugs, and Horizontal Bends
OPSD 1103.020	Concrete Thrust Blocks for Vertical Bends
OPSD 1104.010	Water Service Connection, 19 and 25 mm Diameter Sizes
OPSD 1104.020	Water Service Connection, 32, 38, and 50 mm Diameter Sizes
OPSD 1104.030	25 mm Blow Off Installation
OPSD 1105.010	Hydrant Installation
OPSD 1107.010	Piping Layout for Water Meters 50 mm and Smaller in Chambers
OPSD 1107.020	Piping Layout for Water Meters 75 to 250 mm in Chambers with By-Pass
OPSD 1107.030	Piping Layout for Water Meters in Building with By-Pass
OPSD 1108.010	Cast-In-Place Water Meter Chamber for 75 to 250 mm Meters
OPSD 1109.010	Cathodic Protection for Metallic Watermain Systems
OPSD 1109.011	Cathodic Protection for PVC Watermain Systems
OPSD 1109.012	Cathodic Protection off Existing Metallic Watermains, Exposed Service or Pipe Method
OPSD 1109.013	Anode Installation Over Pipe Method for Existing Metallic Watermains
OPSD 1109.014	Horizontal Anode Bank at Service
OPSD 1109.015	Vertical Anode Bank at Service
OPSD 1109.025	Waterproofing of Splices



**CONSTRUCTION SPECIFICATION FOR
CORROSION PROTECTION OF NEW AND
EXISTING WATERMAINS**

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442-A	Commentary

442.01 SCOPE

This specification covers the requirements for providing corrosion protection to watermains and their metallic components using galvanic anodes, or petrolatum or petroleum wax tape coating systems, or both methods in typical soil conditions on new PVC watermains, new metallic watermains, and existing metallic watermains. Galvanic anode methods include the over pipe method, anode bank method, and exposed watermain methods.

This specification also covers the requirements for corrosion monitoring for concrete pressure pipe.

442.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

442.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

442.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 441	Watermain Installation in Open Cut
OPSS 490	Site Preparation for Pipelines, Utilities, and Associated Structures
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures

CSA Standards

C22.2 No. 197-M1983 (2008) PVC Insulating Tape

ASTM International

B 418-09 Cast and Wrought Galvanic Zinc Anodes
B 843-07 Magnesium Alloy Anodes for Cathodic Protection
G 97-97(2007) Standard Test Method for Laboratory Evaluation of Magnesium Sacrificial Anode Test Specimens for Underground Applications

American Water Works Association (AWWA)

C217-09 Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel water Pipelines

Underwriters Laboratories of Canada (ULC)

UL 467-09 Grounding and Bonding Equipment

442.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Anode means the electrode of an electrochemical cell where corrosion occurs and metal ions enter solution. An anode refers to a packaged anode consisting of the casting, chemical packing material, lead wire, tube, and label.

Anode Chemical Packing means select materials used to surround an anode in its tube in order to improve current efficiency, reduce local corrosion of the anode casting, help keep the anode moist, and increase the effective anode size and, for zinc, prevent the passivation of the anode.

Anode Type means both the material and the size of the anode shown in Table 1, which is included in the A-WW-LL label on the outside of the anode. The A location indicates the casting alloy material, Z for zinc and M for magnesium. The WW indicates the weight of the casting in pounds and the LL indicates the length of the casting in inches.

Associated Appurtenances means structures, devices, and appliances, other than pipe and conduit that are used in connection with a water distribution system, such as valves, hydrants, saddles, corporation and main stops, curb stops, services, and thrust restraints.

Backfill means material placed in a hole to fill the space around the anodes and other portions of the project.

Bonding means the joining of metallic components together to ensure complete electrical continuity throughout the piping system.

Cathodic Protection means a technique to control the corrosion of a metal surface by making that surface the cathode of an electrochemical cell.

Certified Cathodic Protection Specialist means a person that has received Cathodic Protection Specialist Certification by NACE International.

Coating means a dielectric material applied to a structure to separate it from the environment.

Corrosion Protection means corrosion control of a metal surface either by coatings or cathodic protection or both.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Fittings means as defined in OPSS 441.

Galvanic Anode means a metal that provides protection to metals that are more noble in the galvanic series when coupled in an electrolyte. This is in contrast to impressed current anode systems that use an external direct current power source between the cathode and anode bed.

Ground Clamp means a copper clamp device used to connect a wire to copper service tubing in order to create an electrical connection to earth.

Holiday means a discontinuity in the coating.

Mastic means a cold applied self-supporting petrolatum compound containing beads of closed cell polymer and flow control additives for molding irregular shapes.

Metallic Components means metallic hydrants, valves, fittings and associated appurtenances designed to be used in connection with pipes.

Metallic Watermain or Pipe means a ductile iron, cast iron, or steel watermain pipe, excluding copper services.

Negative Lead means the wire running from the watermain or service pipe to the test station.

Petrolatum means a purified mixture of semisolid hydrocarbons obtained from petroleum jelly.

Petroleum Wax means a refined mixture of solid hydrocarbons, paraffinic in nature, obtained from petroleum. It may be prepared as a refined paraffin wax or as a microcrystalline wax.

Primer means a soft compound of petrolatum or petroleum wax containing moisture displacing corrosion inhibiting compounds.

Tape means a cold applied saturant tape made from either petrolatum or petroleum wax and a noncellulosic synthetic fiber fabric.

Tape Coating System means the finished product consisting of the petrolatum or petroleum wax primer, mastic, where applicable, and tape.

Test Station means a pole or flush mounted terminal that is used to conveniently monitor electrical currents and potentials associated with galvanic cathodic protection systems.

Thermite Weld means a permanent low resistance electrical connection made by a powder welding process using an exothermic copper-depositing mixture ignited in a graphite mold.

Watermains means as defined in OPSS 441.

442.05 MATERIALS

442.05.01 Zinc and Magnesium Anodes

442.05.01.01 Zinc Anode Castings

Zinc anode castings shall have a high potential alloy composition according to ASTM B 418, Type II.

442.05.01.02 Magnesium Anode Castings

Magnesium anode castings shall have a composition according to ASTM B 843, Type M1-C, and have a minimum current efficiency of 50% and shall be according to ASTM G 97.

442.05.01.03 Steel Core of Anode Castings

The steel core of the anode castings shall be electro-galvanized and extend 75% of the anode length.

442.05.02 Anode Packaging

The magnesium and zinc anode castings shall be supplied complete with an anode lead wire and shall be centred in and surrounded by chemical packing material. The anode casting and chemical packing shall be contained within a biodegradable, water permeable cardboard tube of sufficient durability to permit normal handling without appreciable damage. Anode castings and overall packaging shall meet the requirements specified in Table 1.

442.05.02.01 Anode Chemical Packing Composition

The chemical packing material shall have an electrical resistivity of less than 45 ohm-cm when saturated with distilled water, a compacted density of 1.5 g/cm³, and the following composition:

<u>Chemical Packing Component</u>	<u>% by Volume</u>
Gypsum	77 ± 2%
Bentonite	15 ± 1%
Sodium Sulphate	8 ± 1%

442.05.02.02 Labelling

All anodes shall be labelled on the outside of the cardboard tube indicating the type and the specification designation OPSS 442, as follows:

a) For each zinc anode, each tube shall be labelled as follows:

A-WW-LL Anode According to OPSS 442 (e.g., Z-6-12 Anode According to OPSS 442)

b) For each magnesium anode, each tube shall be labelled as follows:

A-WW-LL Anode According to OPSS 442 (e.g., M-17-20 Anode According to OPSS 442)

The letters shall be a minimum of 25 mm in height.

442.05.03 Petrolatum and Petroleum Wax Tape Coatings

Petrolatum and petroleum wax tape coating system components shall be according to the material requirements of AWWA C217.

442.05.04 Wires

Bond wires shall be 450 mm in length with TWU or RWU-90 black insulation with AWG #4/7 strand copper wire or, when specified, AWG #1/0 - 19 strand copper wire.

Anode wires shall be 3.0 m in length of AWG #10/7 strand copper wire having RWU-90 insulation, blue for magnesium anodes, and white for zinc anodes, and shall be silver soldered to the steel core of the anode casting.

Anode header wires for anode banks shall be AWG #10/7 strand wire with red RWU-90 insulation.

Negative wires from test stations to ground clamps or pipe shall be AWG #10/7 strand wire with RWU-90 black insulation.

Wire for corrosion monitoring probes for concrete pressure pipe shall be AWG #10/7 strand wire with RWU-90 black insulation.

Wire for connecting the watermain negative wires from the pipe joint bonding wire of concrete pressure pipe to the test station shall be AWG #4/7 strand wire with RWU-90 black insulation.

442.05.05 Test Stations

Each test station shall consist of a non-conductive housing and lid and shall be either flush-mounted or post-mounted as specified in the Contract Documents. The lid shall be supplied with a stainless steel locking bolt and an Allen key head and shall be blue in colour. The terminal board shall include 5 stainless steel terminals and one nickel plated copper bonding or shorting strap. All terminals shall have two stainless steel nuts for locking purposes.

- a) Flush-mounted test stations shall be mounted on a 300 mm length of 150 mm diameter UV stabilized polyethylene or polycarbonate pipe.
- b) Post-mounted test stations shall be mounted on a 1,500 mm length of 32 mm diameter PVC or UV stabilized polyethylene pipe and fastened securely to a suitable support.

442.05.06 Thermite Welds

The thermite weld material shall be as follows:

Thermite Molds or Welders:

- a) Shall be suitable for the wire, connection type, and orientation.
- b) Shall have a handle and lid.
- c) Shall be made of graphite or synthetic graphite, be able to withstand high temperatures, and be designed to provide an average life of not less than 50 separate exothermic welds.
- d) Shall be from the same manufacturer as the weld metal.

Thermite Powder Cartridges:

- a) Shall be suitable for the pipe material.
- b) Weld metal shall contain vanadium, but not tin.
- c) Weld metal shall be sealed in a suitable capsule and be identified with the part number and size and type of metals to be connected, such as copper to steel or copper to ductile iron.
- d) The batch control numbers shall be packaged with the product prior to shipment from the factory.

Starting Material:

- a) When used, shall consist of aluminum, copper, and iron oxide materials. It shall not contain phosphorous or any caustic, toxic, or explosive substances.

- b) When used, shall be electrical igniters that have a lead length of 1.83 m or greater and use an electric ignition system that does not use spark ignition material.

Thermite Weld Protective Barrier Covers:

- a) Shall be moulded plastic domes filled with corrosion resistant compound on a base of thick elastomeric tape.
- b) Shall use an integrated primer in its adhesive.

Thermite Weld Protective Barrier Coatings:

- a) Shall bond firmly to surfaces without the use of primers and form a tough coating resistant to oxidizing, cracking, alligatoring, checking, loosening, or scaling.
- b) Shall be composed of heavy mastic with synthetic elastomeric additives in mixed solvent.

442.05.07 Miscellaneous Materials

Ground clamps for copper water services shall be UL 467 listed for direct burial, high strength, high conductivity, and a minimum of 80% copper alloy.

Direct Bury Lugs:

- a) Shall be one piece, high impact housing, pre-filled with silicone providing waterproof and corrosion proof protection and be designed for long term direct bury applications.
- b) Shall be able to connect to header wire without cutting the header wire.
- c) Shall tighten with a screwdriver.
- d) Shall have high impact housing without sharp edges to prevent cuts or handling discomfort.
- e) Shall be designed for use with wires from #14 to #10 AWG or larger and under 50 volts.

Wire splicing kits for cathodic protection systems shall be waterproof and suitable for direct bury applications.

C Taps shall be as specified in the Contract Documents.

The solder shall be 60% tin and 40% lead mix, resin core type.

Moisture proofing shall be fast drying sealant and bonding compound specifically designed for coating electrical connections.

Insulating putty shall be dielectric, easy to handle and apply, have excellent adhesion to surfaces, and be suitable for filling voids and irregular surfaces.

Self-amalgamating tape shall be made using modified silicone rubber compound that forms a moisture-proof abrasion-resistant bond. Tape shall have high dielectric strength, adhering to itself creating an immediate permanent bond even when wet.

Rubber splicing tape shall be 25 mm wide waterproof neoprene.

Electrical tape shall be 25 mm wide PVC electrical tape, rated for 600 V with a working temperature of -10 to 90 °C, and according to CSA C22.2 No. 197.

442.07 CONSTRUCTION

442.07.01 General

The methods for corrosion protection shall be as specified in the Contract Documents.

Anodes shall be installed complete with their cardboard tube container and enclosed chemical packing.

442.07.02 Site Preparation

Site preparation shall be according to OPSS 490.

442.07.03 Transporting, Unloading, Storage, and Handling Materials

Anodes and other materials that can be damaged by exposure to the elements shall be stored in a clean dry secured enclosure until installation.

Anodes shall not be carried or lowered by their lead wires.

442.07.03 Anode Installation

442.07.03.01 Existing Metallic Watermains - Over Pipe Method

Prior to installation, the location for each anode and test station shall be marked with a white stake or white paint on paved areas and shall be approved by the Contract Administrator.

Anodes shall be of the type and spacing specified in Table 2. The first anode at each end of the watermain shall be within 3.0 m of the end of the watermain.

Anode locations may be shifted a maximum of 3.0 m to avoid driveways and other paved areas.

Each anode site shall be excavated with an auger or a vacuum excavator to expose the top of the pipe and accommodate the anode to be installed. The diameter of the hole shall be a maximum of 500 mm.

The anode wire shall be thermite welded to the metallic pipe and the connection protected.

The excavation shall be partially backfilled with native backfill so that the anode shall reside 300 mm above the watermain.

The excavation shall be backfilled with material matching the existing subgrade that shall be manually compacted and thoroughly watered. Granular subbase and base profiles shall be reinstated above the subgrade.

442.07.03.02 Existing Metallic Watermains - Anode Bank Method

The anode bank method applies to both vertical and horizontal anode banks for the purpose of retrofitting existing metallic watermains with cathodic protection.

Anodes and anode banks shall be of the type and spacing specified in Table 3.

Anode banks shall be installed on the side of the street opposite to the watermain. Anodes shall be installed so the centre of the anode is at the same depth as the service to which they are being attached or a minimum of 2.0 m below the finished grade, whichever is greater.

The anode leads shall be spliced to the header wires using one of the approved wire splicing methods.

442.07.03.03 Existing Metallic Watermains - Exposed Pipe or Service Method

When an existing watermain is not cathodically protected, anodes shall be installed wherever the existing watermain or associated services are exposed during the course of other work (e.g., another Utility installation or watermain break repair).

Anodes to be used for this application shall be magnesium type M-32-22.

Anodes shall be installed at least 1.5 m horizontally away from the watermain pipe and as deep as the bottom of the excavation. Anodes shall be spaced as far apart in the trench as the wires and trench permit.

The anode lead shall be electrically connected to the water piping by connecting to either:

- a) A copper or lead service pipe using a ground clamp.
- b) The watermain using the thermite weld procedure.

442.07.03.04 New Metallic Watermains and Copper Services

Anodes shall be of the type and spacing specified in Table 4.

Anodes shall also be installed as follows:

- a) On the lateral piping of each hydrant.
- b) At each metallic component.

Anodes shall be installed at least 1.0 m horizontally away from the watermain or service pipes and as deep as the bottom of the pipes. The minimum distance between anodes shall be 1.0 m.

442.07.03.05 New Polyvinyl Chloride Watermains with Metallic Components

Anodes shall be of the type and spacing specified in Table 5.

Anodes shall be installed at least 1.0 m horizontally away from the metallic component and as deep as the bottom of the metallic component. The minimum distance between anodes shall be 1.0 m.

442.07.03.06 New Watermains with Metallic Components

All metallic components specified in the Contract Documents shall be protected using corrosion protection methods as specified in the Contract Documents.

442.07.04 Corrosion Monitoring for Concrete Pressure Pipe

The locations for corrosion monitoring test stations shall be as specified in the Contract Documents.

All concrete watermains shall include bonding wires connected by thermite weld to provide electrical continuity. Anodes shall not be required.

All concrete pressure pipe sections, including pipe within jacking and boring encasement pipe and all bevel and bend fittings shall have two electrical bonding connections on each side, located 45° off the vertical.

Corrosion test monitoring stations for concrete pressure pipe shall include three probes or pipe coupons at each station. The probes shall be connected to the test monitoring station with approved wire.

442.07.05 Test Station Installation - General

Test stations shall be installed at locations as follows:

- a) Where they do not interfere with or present a hazard to pedestrian or vehicular traffic and at the nearest property line, whenever possible.
- b) For new metallic watermain, over pipe method, and concrete pressure pipe, at each hydrant and, if there are no hydrants, start within 20 m of the project limit and locate at 150 m intervals along the watermain.
- c) At each anode bank.

Flush-mounted test stations shall be installed flush with the ground, sidewalk, or pavement surface. Post-mounted test stations shall be mounted so that the top of the cover is 600 mm above the surface.

The anode lead may be extended using an additional length of the same type of wire spliced with an approved splice connection method.

Except for corrosion monitoring applications, test station connections shall be as follows:

- a) The two negative leads shall be brought into the test station and connected to terminals 2 and 3.
- b) Terminal 1 shall be connected to Terminal with a bonding strap.
- c) No bonding strap shall be connected to terminal 3 or 4.

Sufficient wire slack of 0.5 m in the housing below the panel shall be left in the wires to prevent any stress on either during backfilling and subsequent soil settlement and for withdrawing the terminal panel, if necessary during test work.

442.07.05.01 Test Station Connections for New Metallic Watermains

The lead wire of the anode nearest to the test station shall not be welded directly to the pipe, but instead shall be brought into the test station and connected to terminal 1.

Two watermain negative wires shall be thermite welded to the crown of the watermain pipe 150 mm apart and the other ends of the wires shall be connected according to the Test Station Installation - General subsection.

442.07.05.02 Test Station Connections for Anode Banks

The header wires shall be brought into the test station and connected to terminal 1.

Two watermain negative wires shall be attached to the metallic service line, each with their own ground clamp and the other ends of the wires shall be connected according to the Test Station Installation - General subsection.

442.07.05.03 Test Station Connections for Corrosion Monitoring

Two watermain negative wires shall be connected to the concrete pressure pipe joint bonding wires with an approved splice connection method. The other ends of the wires shall be connected to terminals 1 and 2 of the test station. The three probe or pipe coupon wires shall be brought into the test station and connected to terminals 3, 4, and 5.

442.07.06 Thermite Weld Connections

All wire connections to metallic surfaces shall be made by means of a thermite weld method according to the following procedure:

- a) Remove all coating, and clean bright and thoroughly dry a 75 mm² metal welding surface.
- b) Select the proper mould for the application.
- c) Insert bared end of wire into mould. A reinforcing sleeve may be required, depending on flexibility of wire. Manufacturer's instructions shall be followed.
- d) Thermite weld the anode lead to the metallic surface in accordance with the manufacturer's instructions.
- e) Remove all slag from the weld-on wire connection and file smooth all sharp edges.
- f) The integrity of each weld shall be tested by giving a sharp pull on the lead wire.

Sufficient slack shall be left in the wires to prevent any stress on either the anode or the wire-to-pipe connection during backfilling and subsequent soil settlement.

For new watermain and where practical for existing watermain, the anode lead wire shall be wrapped around the pipe and secured with a knot. The free end of the wire shall then be thermite welded to the watermain, metallic component, or valve.

442.07.07 Thermite Weld Protection

The cleaned metallic surfaces, thermite weld, and the exposed copper wire surfaces shall all be protected with an approved thermite weld protective barrier coating or cover. Both must overlap existing coating and insulation on wire to prevent holidays in the protection.

Coating and cover shall be installed according to the manufacturer's instructions.

442.07.08 Anode and Header Wire Splicing and Waterproofing

Wire splicing to the header wire shall be accomplished without cutting the header wire.

Wire to wire splicing shall be accomplished by one of the following methods as specified in the Contract Documents:

- a) Approved C Taps.
- b) Approved direct bury lugs with built-in waterproof protection.
- c) Soldered splices.
- d) Wire-to-wire thermite weld.

Splicing products shall be suitable for the size of wire being spliced.

Prior to backfilling, all splices and connections without built-in waterproof protection shall be rendered waterproof by either careful application of the waterproof tape method or by use of a wire splicing kit designed for cathodic protection.

Waterproof tape method shall be performed as follows:

- a) Apply moisture proofing over connector and exposed wire.
- b) Apply insulating putty to break sharp corners at the connection.
- c) Apply tape in accordance with one of the following methods:
 - i. Two half-lapped layers of approved self-amalgamating tape overlapping the wire insulation.
 - ii. Four half-lapped layers of approved rubber splicing tape overlapping the wire insulation and apply four half-lapped layers of approved self-adhesive electrical tape.

When using splicing kits designed for cathodic protection systems, the kits shall be applied in accordance with manufacturer's instructions.

442.07.08.01 C Tap Splices

Prior to cutting the wire for splicing, the wire shall be loose to avoid stretching.

The wire shall be stripped about the length of the electrical connector using an appropriate stripping tool. The exposed copper wire shall be free of nicks or scores.

An approved C Tap shall then be placed over the exposed area of the wire. The connecting wire shall be carefully inserted into the C Tap up to the insulation and tightened using an approved compression tool specifically designed for C Taps. Vice-grips, pliers, battering with a hammer, etc. shall not be permitted.

The splice shall be inspected for exposed copper and snugness. Splices that fail inspection shall be cut and redone.

442.07.08.02 Direct Bury Lug Splices

Splices using direct bury lugs shall be performed in accordance with the manufacturer's instructions.

442.07.08.03 Soldered Splices

Soldered connections shall be performed in accordance with industry practices.

442.07.08.04 Tape Coating Systems

Petrolatum and petroleum wax tape coating systems shall be applied according to the procedures described in AWWA C217.

442.07.09 Electrical Bonding of Joints

442.07.09.01 New Metallic Pipe

All new metallic pipe joints, valves, and components shall be connected together with a bond wire to ensure complete electrical continuity throughout the metallic piping system. Bond wires shall be connected to the metallic surfaces using a thermite weld.

Bare copper bond straps, conductivity screws, and conductivity wedges shall not be used to provide electrical continuity. If bare copper bond straps are supplied with the piping, they shall be removed.

442.07.09.02 Existing Metallic Pipe

Bond wires shall be installed by thermite welding between all metallic components and across all joints that are exposed within the excavation.

Where a repair clamp is installed across a break, a bond wire shall be installed across the break after repair clamp installation.

Where a cut-out is required, a bond wire shall be installed.

442.07.10 Wire Connections to Copper Services

The anode lead shall be connected to copper services using a ground clamp. Ground clamps shall be attached to copper services in accordance with the manufacturer's instructions. Wires shall be connected to the ground clamps in accordance with the manufacturer's instructions.

442.07.11 Anode Backfilling

In all cases, the anode shall be placed in native soil, not in granular bedding material. The Contract Administrator shall inspect the anode installation prior to backfilling. Backfill shall be packed uniformly around the anode container to eliminate voids adjacent to the anode.

442.07.12 Testing and Evaluation

For applications using test stations, the following procedures shall be performed and recorded between 90 and 120 Days after the installation:

- a) Pipe potentials shall be measured with respect to a copper sulfate electrode at maximum intervals of 30 m throughout the route of the piping. The voltmeter employed to measure these potentials shall have an input impedance not less than 10 megohms.
- b) Potential measurement connection locations shall be made at the nearest test station to the electrode. The reference electrode and pipe connection locations employed for the potential measurements shall be identical for both the pre-construction and post-construction testing procedures. The electrical continuity of the piping shall be verified by comparison of pipe potential.
- c) During post construction testing, the following measurements shall be made at the test stations:
 - i. Anode output current.
 - ii. Pipe potential with anode connected.
 - iii. Pipe potential with anode disconnected.

All testing data and associated recommendations pertinent to the continued effectiveness of the cathodic protection system shall be included in a comprehensive written report. This report shall be prepared by an Engineer or a Certified Cathodic Protection Specialist, and shall be submitted to the Contract Administrator.

442.07.13 Site Restoration

Site restoration shall be according to OPSS 492.

442.07.14 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

442.08**QUALITY ASSURANCE**

The Contractor shall ensure that the anodes supplied are in accordance to this specification.

Prior to installing each shipment of anodes, the Contractor shall forward a copy of a certificate to the Owner from the anode manufacturer indicating that the shipment of anodes complies with the requirements of this specification.

The Owner may randomly select samples of anodes supplied by the Contractor for testing by an independent laboratory.

Any batch of anodes found not to be in accordance to this specification shall be replaced immediately by the Contractor. No additional work shall take place until such time that the anodes are approved and accepted by the Owner.

Any installed anodes found not to be in accordance to the required specifications shall be replaced by the Contractor.

442.09**MEASUREMENT FOR PAYMENT****442.09.01****Actual Measurement****442.09.01.01****Individual Anodes**

For measurement purposes, a count shall be made of the number of each anode type installed, other than in an anode bank, and of the number of anodes supplied for testing.

442.09.01.02**Anode Banks**

For measurement purposes, a count shall be made of the number of each anode bank type installed.

442.09.01.03**Test Stations**

For measurement purposes, a count shall be made of the number of each test station type installed.

442.09.02**Plan Quantity Measurement**

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

442.10**BASIS OF PAYMENT****442.10.01**

***"type"* Individual Anode - Item**

***"type"* Anode Bank - Item**

***"type"* Test Station - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

When an existing unprotected watermain or service is exposed during the construction of other work, payment for the labour, Equipment, and Material for such work shall be full compensation for the excavation, backfill, and compaction required to install anodes on the exposed watermain or service.

Replacement of anodes that do not meet the requirements of this specification shall be the responsibility of the Contractor at no extra cost to the Owner.

TABLE 1
Table of Casting and Anode Weights and Dimensions

ANODE TYPE	CASTING		OVERALL PACKAGE	
	Minimum Weight kg	Nominal Length mm	Nominal Weight kg	Nominal Dimensions Diameter x Length mm
ZINC				
Z-6-12	2.7	305	7.7	127 x 510
Z-12-24	5.4	610	12.7	127 x 760
Z-24-48	10.9	1,220	24.5	127 x 1,520
MAGNESIUM				
M-9-14	4.0	340	13.0	160 x 430
M-17-20	7.7	640	22.0	160 x 760
M-32-22	14.5	560	40.0	210 x 760

TABLE 2
Anode Spacing for Over Pipe Method

Pipe Diameter mm	Anode Type	Spacing m
100	M-32-22	22.0
150	M-32-22	15.0
200	M-32-22	11.5
250	M-32-22	10.0
300	M-32-22	8.0
400	M-32-22	6.0
600	M-32-22	4.5

TABLE 3
Anodes Per Location for the Horizontal and Vertical Anode Bank Method

Pipe Diameter mm	Anode Type	Number of Anodes Per Location	Spacing m
150	M-32-22	8	70 ± 5
200	M-32-22	10	70 ± 5
250	M-32-22	12	70 ± 5
300	M-32-22	14	70 ± 5

TABLE 4
Anode Spacing for Metallic Pipe and Copper Services

Diameter mm	Anode Size	Maximum Spacing m
Less than 50 mm Copper Service	Z-12-24	20.0
50 mm Copper Service	Z-12-24	16.0
100	Z-24-48	12.0
150	Z-24-48	8.0
200	Z-24-48	6.0
250	Z-24-48	5.0
300	Z-24-48	4.0
400	Z-24-48	3.0

TABLE 5
Anode Locations and Spacing for New PVC Pipe with Metallic Components

Location	Anode Type	Maximum Spacing and Quantity
Less than 50 mm Copper Service	Z-12-24	20.0 m
50 mm Copper Service	Z-12-24	16.0 m
100 - 300 mm Metallic Fittings and Valves	Z-12-24	1 per fitting and valve
400 mm Metallic Fittings and Valves	Z-24-48	1 per fitting and valve
Hydrant Bases	Z-24-48	1 per hydrant
Tracer Wire	Z-12-24	1 per every 1,000 m of tracer wire

Appendix 442-A, November 2010 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- The test station to be flush-mounted or post-mounted. (442.05.05)
- Type of C Taps. (442.05.07)
- Methods of corrosion protection. (442.07.01)
- Locations of concrete pressure pipe corrosion monitoring stations. (442.07.04)
- Splice connection method. (442.07.08)

Type and spacing of anodes are dependent on the soil conditions. Soil conditions should be verified before specifying the anode type and spacing. Assumptions used for anode spacings provided for new metallic watermain are as follows:

- i. Soil resistivity of 2,000 ohm-cm.
- ii. Bitumen coatings on pipe or other components are of no value (i.e., essentially bare).
- iii. 150 mm main with copper services should require about 2 mA of cathodic protection current per lineal foot and so in 2,000 ohm-cm soil 50 mA from a 24 lb zinc anode should cover 8.0 m of pipe.
- iv. 6.0 m spacing would allow for one anode per joint so discontinuities should not be a problem.
- v. A 24 pound zinc anode has a capacity of about 1,000 ma years so the anodes should have a life of about 20 years.

The anode items are titled "*type*" Individual Anode-Item and "*type*" Anode Bank-Item. The reference to "*type*" is to indicate that the complete item title for tender should include the type of anode (i.e., zinc or magnesium) required. (442.10.01)

The test station item is titled "*type*" Test Station-Item. The reference to type is to indicate that the complete item title for tender should include the type of test station (i.e., flush-mounted or post-mounted) required. (442.10.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 1109.010	Cathodic Protection for Metallic Watermain Systems
OPSD 1109.011	Cathodic Protection for PVC Watermain Systems
OPSD 1109.012	Cathodic Protection of Existing Metallic Watermains, Exposed Service or Pipe Method
OPSD 1109.013	Anode Installation Over Pipe Method for Existing Metallic Watermains
OPSD 1109.014	Vertical Anode Bank at Service
OPSD 1109.015	Horizontal Anode Bank at Service
OPSD 1109.025	Waterproofing of Splices



**CONSTRUCTION SPECIFICATION FOR
PIPELINE AND UTILITY INSTALLATION IN SOIL
BY HORIZONTAL DIRECTIONAL DRILLING**

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450-A	Commentary

450.01 SCOPE

This specification covers the requirements for the installation of underground pipelines, conduits, cable, or ducts using the trenchless technology known as horizontal directional drilling.

450.01.01 Significance and Use of Appendices

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

450.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

450.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 409	Closed-Circuit Television Inspection of Pipelines
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities and Associated Structures
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS 539	Temporary Protection Systems

450.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Active Interference means electrical interference created by magnetic fields and radio frequencies such as power lines.

Backreamer means a cutting head designed for the soil conditions and is attached to the leading end of a drill string to enlarge the pilot bore during a pullback operation to enable installation of the product.

Bore Path means a drilled path according to the grade and alignment tolerances specified in the Contract Documents.

Drilling Fluid Fracture or Frac Out means a condition when the drilling fluid's pressure in the bore is sufficient to overcome the in situ vertical confining stress, thereby fracturing the soil and allowing the drilling fluids to migrate to the surface at an unplanned location.

Drill Fluid Control Points means locations along the bore path when control points are constructed to manage drill fluids.

Drilling Fluids means a mixture of water and additives, such as bentonite, polymers, surfactants, and soda ash, designed to block the pore space on a bore wall, reduce friction in the bore, and to suspend and carry cuttings to the surface.

Entry Point means the location or excavation from which the bore is initiated for the installation of the product.

Exit Point means the location or excavation to which the bore is directed for the installation of the product.

Guidance System means an electronic system capable of indicating the position, depth, and orientation of the drill head during the drilling process.

Horizontal Directional Drilling (HDD) means directional boring or guided horizontal boring.

Inadvertent Returns means the flow of unexpected fluids encountered during the drilling process.

Loss of Circulation means the discontinuation of the flow of slurry in the bore back to the entry or exit point or at drill fluid control points.

Multi Product Installation means two or more products installed in the same bore path. The products may or may not have the same diameters.

Passive Interference means electrical interference created by adjacent structures, buried metal, salt water, and minerals in the soil.

Pilot Bore means the initial bore to set horizontal and vertical alignment between the connecting points.

Product means pipelines, conduits, cable, or ducts.

Pullback means that part of the HDD method in which the drill string is pulled back through the bore path to the entry point, usually installing the product at the same time.

Reamer means a cutting tool specifically designed for in situ ground conditions. It is attached to the leading end of a drill string to enlarge the pilot bore prior to or during a pullback operation to enable installation of the product, and deliver drill fluids into the bore and mix bore cuttings to form flowable slurry.

Reaming means a process for pulling or pushing a tool attached to the end of the drill string through the bore path to enlarge the bore and mix the cuttings with the drilling fluid. This could include multiple passes prior to product pullback.

Rock means natural beds or massive fragments of the hard, stable, cemented part of the earth's crust that are igneous, metamorphic, or sedimentary in origin, that may or may not be weathered and includes boulders having a volume of 0.5 m³ or greater.

Single Product Installation means a single product installed into a bore path. The product may or may not have a tracer wire attached to it.

Slurry means a mixture of soil cuttings and drilling fluid.

Soil means all soils, except those defined as rock, and excludes stone masonry, concrete, and other manufactured materials.

Staging Area means an area set aside for the Contractor's drilling and pipe assembly operations.

Strike Alert means a system, audio or visual or both, that is intended to alert and protect the operator in the case of inadvertently drilling into an electrical Utility cable.

450.04 DESIGN AND SUBMISSION REQUIREMENTS

450.04.01 Submission Requirements

- a) A work plan outlining the procedure and schedule to be used to execute the work.
- b) A list of personnel, including backup personnel, and their qualifications and experience.
- c) A traffic control plan.
- d) A drilling fluid management plan, including source of fresh water and necessary permits or approvals; type of drilling fluids and potential additives and their Material Safety Data Sheets (MSDS); method of drilling fluid containment; method of recycling drilling fluid, as applicable; method of transporting drilling fluids off site; disposal of excess drill fluids according to the Contract Documents; and method to continually monitor fluid properties and pressure throughout the course of drilling and pullback operations to anticipate drilling fluid related problems before they occur; and potential environmental impacts and emergency procedures and associated contingency plans.
- e) A health and safety plan including the company safety manual, emergency procedures, and a list of emergency personnel contact information.
- f) A drilling plan indicating the proposed type and size of directional drilling equipment; location and dimensions of staging areas; diameter of pilot hole and number and size of back reamers; guidance system; field determined elevations of the surface topography along the bore path; field determined elevations and locations of all existing Utilities within 1.5 m of the bore path; rod-by-rod profile data along the bore path; location of drill fluid control points; identification of active and passive interference along with appropriate compensation measures; method to continuously monitor and record product pipe tensile installation forces and down bore fluid pressures; pipe protection procedures; pipe gripping procedures; and temporary protection systems.
- g) A contingency plan in conformance with the Contract Documents, including identifying potential environmental impacts and emergency containment and clean-up procedures.
- h) Work permits required under the authorities having jurisdiction necessary to complete the work.

450.05 MATERIALS

450.05.01 Drilling Fluids

Drilling fluids shall be appropriately mixed for the anticipated in situ ground conditions. Only bentonite and drilling equipment manufacturer-approved polymers shall be permitted for use as drilling fluids. All additives used shall be chemically inert, biodegradable, and non-toxic. No petroleum-based or detergent additives shall be permitted.

Fluid properties shall be continually monitored throughout the course of drilling and pullback operations to ensure that the drill fluid properties remain appropriate for the in situ ground conditions.

450.05.02 Pipe Materials

Pipe and fitting type, class, and size shall be as specified in the Contract Documents.

450.05.03 Tracer Wire

Type and number of tracer wires used shall be as specified in the Contract Documents.

450.06 EQUIPMENT

450.06.01 Directional Drilling Equipment

450.06.01.01 General

The directional drilling equipment shall consist of a directional drill rig and a fluid mixing and delivery system with sufficient capacity to complete the product installation.

The drill rig and all associated equipment shall be in acceptable mechanical working order.

All drill operations and equipment shall be controlled by competent, experienced, and trained personnel.

450.06.01.02 Drilling Rig

The directional drilling rig shall:

- a) consist of a hydraulically powered boring system to rotate, push, and pull the drill rod into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill head.
- b) have drill rod that is suitable for both the drill and the product pipe installation.
- c) contain a drill head that is steerable, equipped with the necessary cutting surfaces and fluid jets, and be suitable for the anticipated ground conditions.
- d) have adequate reamers and down-bore tooling equipped with the necessary cutting surfaces and fluid jets to facilitate the product installation and be suitable for the anticipated ground conditions.
- e) support a guidance system to accurately guide boring operations.
- f) be anchored to withstand the pushing and pulling forces required to complete the product installation.
- g) contain an active strike alert system and be properly grounded during all operations.

450.06.01.03 Guidance System

The guidance system shall be setup, installed, and operated by trained and experienced personnel. The operator shall be aware of any active and passive interference that may interfere with the guidance of the system.

The type of guidance system shall be suitable for the design bore path and project specifications. The Contractor shall verify calibration of the guidance system daily prior to use.

450.06.01.04 Drill Fluid Mixing and Delivery System

The drill fluid mixing system shall be of sufficient size to thoroughly and uniformly mix the required drilling fluid.

The delivery system and reamers shall have sufficient flow and capacity to ensure that the slurry volumes are adequate for the length and diameter of the final bore and in situ ground conditions.

450.07 CONSTRUCTION

450.07.01 General

The Contract Administrator shall be notified at least 48 hours in advance of commencement of the drilling operations. Operations shall not begin until proper preparations are made.

When strike alerts are provided on a drilling rig, they shall be activated during drilling and maintained at all times.

The location of all Utilities in the work area shall be identified and located prior to the commencement of the drilling operations. If prior to commencement of drilling operations, a Utility is found to exist that would conflict with the installation of the pipe, the Contractor shall notify the Contract Administrator immediately.

450.07.02 Site Preparation

The work site shall be graded or filled to provide a level working area for the drilling rig. No alterations beyond what is required for HDD operations are to be made. All activities shall be confined to designated work areas.

450.07.03 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

Minimum horizontal and vertical clearances to existing facilities shall be maintained as specified in the Contract Documents. Clearances shall be measured from the nearest edge of the largest reamer to the nearest edge of the facility that is parallel to or crossed by the pipeline or Utility being constructed.

Existing underground facilities shall be exposed to verify their horizontal and vertical locations when the bore path comes within 1.0 m horizontally or vertically of the existing facility. Existing facilities shall be exposed by non-destructive methods. The number of exposures required to monitor work progress shall be as specified in the Contract Documents.

Should it become necessary for the Contractor to excavate or disturb existing Utilities to retrieve lost boring equipment, the Contractor shall be responsible for obtaining all relevant approvals.

450.07.04 Transporting, Unloading, Storing, and Handling Materials

Manufacturer's recommendations for transporting, unloading, storing, and handling of materials shall be followed.

450.07.05 Trenching, Backfilling, and Compacting

Trenching, backfilling, and compacting for entry and exit points or other locations along the bore shall be according to OPSS 401.

450.07.06 Support Systems

Support systems shall be according to OPSS 404.

450.07.07 Dewatering

Dewatering shall be in accordance with OPSS 517 or as specified in the Contract Documents.

450.07.08 Temporary Protection Systems

The construction of all temporary protection systems shall be according to OPSS 539. Protection shall be provided when the stability, safety, or function of an existing roadway, railway, watercourse, other works, or proposed works may be impaired. Protection may include sheathing, shoring, and piles necessary to prevent damage to works or proposed works.

450.07.09 Drilling Fluid Management

The Contractor shall employ a containment, collection, and disposal method to manage drilling fluids and to mitigate the development of inadvertent returns. The Contractor shall manage the clean-up and dispose of drilling fluids in accordance with the drilling fluid management plan.

450.07.10 Pilot Bore

The pilot bore shall be drilled along the bore path in accordance with the grade, alignment, and tolerances specified in the Contract Documents. Drill rod and product bend radius shall be taken into consideration when completing the pilot bore.

In the event the pilot bore does deviate, the Contract Administrator shall be notified. The Contract Administrator may require the Contractor to pullback and re-drill from the location along the bore path prior to the deviation. In the event that a drilling fluid fracture, inadvertent returns, or loss of circulation occurs during pilot bore drilling operations, the Contract Administrator shall be advised of the event and of the action taken.

If a drill hole beneath a road shall be abandoned, the hole shall be backfilled with grout or bentonite to prevent future subsidence.

450.07.11 Reaming

The bore shall be reamed to the appropriate size with tooling that is adequate for the in situ ground conditions and the product that is to be installed.

The final staged ream shall not exceed 1.5 times the product pipe largest outside diameter.

The drilling mud in the annular region shall not be removed after installation, but permitted to solidify and provide support for the pipe and surrounding soil.

450.07.12 Product Installation

450.07.12.01 General

The product shall be jointed and installed according to manufacturer's recommendations and shall be protected from damage in the staging area and during pullback.

The minimum allowable bending radius for the product shall not be exceeded during installation at the entry point, exit point, or any other location along the bore path.

The product shall be allowed to recover prior to the connection to a new or existing facility is made. Product recovery time shall be in accordance with the manufacturer's recommendations.

Tracer wire shall be supplied and installed along with the product, as specified in the Contract Documents.

450.07.12.02 Pullback

After completion of reaming the bore to the required diameter, the product shall be pulled into the bore path as soon as possible.

The pullback operation shall be a continuous operation, if possible, until the product pipe is installed.

The product pipe gripping method shall allow the full tensile rating of the product to be developed.

A swivel of sufficient capacity shall be used between the reamer and the product being installed. The swivel shall prevent rotational forces from the reamer being transferred to the product.

When specified in the Contract Documents, a pipe load measuring device shall be used to ensure that the manufacturer's recommended pullback force is not exceeded. (i.e., gauges, down-hole devices, weak links).

When specified in the Contract Documents, a weak link or breakaway connector shall be used to prevent excess pulling force from damaging the product.

The product shall be inspected for damage, when visible, at excavation pits and when it exits the bore.

Any damage shall be repaired to the satisfaction of the Contract Administrator.

450.07.13 Product Testing

When required, product testing shall be as specified in the Contract Documents.

450.07.14 Record Keeping

Verification record requirements of the alignment and depth of the installed product shall be as specified in the Contract Documents. A copy of the verification records shall be given to the Contract Administrator at the completion of the HDD operations.

450.07.15 Closed Circuit Television (CCTV) Inspection

When required by the Contract Documents, a CCTV inspection shall be according to OPSS 409.

450.07.16 Site Restoration

When required, site restoration shall be according to OPSS 492.

450.07.17 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

450.09 MEASUREMENT FOR PAYMENT

450.09.01 Actual Measurement

450.09.01.01 Product Installation

Measurement for a product installation shall be in metres along the centreline of the useable product between final connection points or work completed. No additional payment shall be made for end pieces to achieve the design elevation.

450.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

450.10 BASIS OF PAYMENT

450.10.01 Product Installation by HDD, "*diameter of product, product material, use of product,*" - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 450-A, November 2012 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The specification was written to encompass the majority of HDD drilling operations for small and medium sized projects with diameters generally up to 914 mm and drill lengths of less than 1,000 m. The basic design considerations should always include: minimum cover to prevent inadvertent drill fluid frac out releases; geology of the area, including future river "scour" or meander projections; site logistics; connection requirements; and site-specific issues (e.g., river crossings, wet lands, and archaeological sites).

Geotechnical and site condition information are required for a successful project design, and to ensure that the Contractor has the proper equipment and materials (i.e., drilling fluid mixtures, methods, or equipment), and pipe design.

The principal safety concern in HDD is ensuring that the drilling equipment does not contact existing underground infrastructure. The risk of contacting other Utilities can be mitigated by knowing the precise locations of all underground Utilities in close proximity to the HDD bore path. Detailed knowledge of all subsurface Utility locations is a critical component of a directional drilling project, and this information should be included in the Tender Documents.

Throughout the commentary, the designer is provided with guidance on the consideration of Quality Assurance and Quality Control (QA/QC) techniques. However, it should be noted that evolving technology and techniques for improved QA/QC are in development and the designer should refer to trade publications to identify the latest available methods. In all cases, the designer should specify the quality assurance acceptance criteria to be used for each specific project.

Subject to the scope of operations, the designer may wish to specify in the Contract Documents a more detailed work plan prior to the commencement of work, particularly for multiple pipe installations, multiple day projects, congested work areas, or environmentally sensitive sites. (450.04)

The designer should give careful consideration, in consultation with the pipe manufacturer, to ensure the installed pipe is suitable to resist all installation and long-term in-service loads, the design shall specify the minimum pipe and fitting type, class, size, maximum bend radius, and safe tensile load. (450.05.02)

The designer should specify the type and number of tracer wires. (450.05.03)

The designer should specify the following elements in the Contract Documents: the minimum horizontal and vertical clearances to existing facilities; and the number of exposures required to monitor the work progress. (450.07.03)

The designer should specify the trenching, backfilling, and compacting requirements for entry and exit points or other locations along the bore, if different than the requirements in OPSS 401. (450.07.05)

The designer may consider special provisions for backfilling and compacting, including the consideration of unshrinkable backfill to ensure proper compaction in critical locations. (450.07.05)

The designer should specify the support systems requirements, if different than the requirements in OPSS 404. (450.07.06)

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The designer should specify the dewatering requirements, if different than the requirements in OPSS 517. (450.07.07)

The designer should provide the necessary grade, alignment, and tolerances for the product installation in the Contract Documents. (450.07.10)

The designer may consider a lower reaming diameter than that specified if the ground conditions are suitable. The designer should understand that multiple passes of the reaming operation can be expected and is to be included in the unit cost for the product installation. (450.07.11)

The designer should review product-jointing specifications as provided by manufacturers. Experienced personnel with jointing accreditation may be added as a requirement of the Contract Documents depending on the type of installation. For fusible pipe products, the pipe should be completely jointed prior to the pull back operation to avoid delays during installation. All pipe jointing shall be to manufacturer specifications. (450.07.12.01)

The designer should specify the supply and installation of the tracer wire with the product. (450.07.12.01)

When required, the designer should specify the use of a pipe load measuring device to ensure that the manufacturer's recommended pullback force is not exceeded. (450.07.12.02)

For certain product installations, the designer may wish to consider the requirement of a weak link or breakaway connector or pull load measuring system to prevent excess pulling force from damaging the product. (450.07.12.02)

The designer may consider specifying physical product testing through the use of product coupons from the exit pit. In addition, in situ pressure or vacuum tests can be used to ensure the integrity of the product installation. (450.07.13)

The designer should specify the method of verifying the product installation location. The designer may consider the use of the reporting information available from the drill rig, daylighting, installation of tracer wire with the product, or the use of acoustic/magnetic locating equipment. The designer should consider specifying the required maintenance, submission of a daily drill records, drilling fluid pressures, records of any problems encountered, along with alignment and depth of bore. (450.07.14)

The tender item description for product installation by HDD shall include reference to one or more of the attributes shown (i.e., diameter of product, product material, use of product, to be complete). (450.10.01)

The designer's careful preparation of the project should greatly assist in the success of the installation. However, there may always be a risk of encountering unexpected problems that may require a fair resolution for payment. It is recommended that the designer consider a process regarding payment for failed attempts for inclusion in the Contract Documents. (450.10)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



**CONSTRUCTION SPECIFICATION FOR
PIPELINE REHABILITATION BY CURED-IN-PLACE PIPE**

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460.01 SCOPE

This specification covers the requirements for the rehabilitation of pipelines by the installation of a continuous and tight fitting cured-in-place pipe liner.

460.01.01 Specification Significance and Use

This specification has been developed for use in provincial and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

460.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

460.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 409	Closed-Circuit Television Inspection of Pipelines
OPSS 441	Watermain Installation in Open Cut
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 493	Temporary Potable Water Supply Services
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS 539	Temporary Protection Systems

CSA Standards

B64.5-07	Double Check Valve (DCVA) Backflow Preventers [Part of B64 Series-07, Backflow Preventers and Vacuum Breakers Compendium]

ASTM International

D 638-08	Standard Test Method for Tensile Properties of Plastics
D 790-07e1	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
D 2990-09	Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
F 1216-09	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
F 1743-08	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)

NSF International

61-2008	Drinking Water System Components - Health Effects

American Water Works Association (AWWA)

C510-07	Double Check Valve Backflow Prevention Assembly

460.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Cured-In-Place Pipe (CIPP) Lining means the rehabilitation of sewers and watermains by installation of a CIPP liner system within an existing pipe.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Resin means a general purpose, unsaturated, styrene-based, thermoset resin and catalyst system or an epoxy resin and hardener that is compatible with the inversion process.

460.04 DESIGN AND SUBMISSION REQUIREMENTS

460.04.01 Design Requirements

The engineering design shall be in accordance with ASTM F 1216 with the following criteria:

a) Design conditions:

- i. CIPP design shall assume fully deteriorated condition of the original pipe.
- ii. CIPP design shall assume no bonding to the original pipe wall.

b) Parameters for design:

- i. Design life of 50 years.
- ii. Safety factor of 2 on external load.
- iii. Groundwater depth is full soil depth, unless otherwise known.
- iv. Soil modulus of 4.8 MPa, unless otherwise known.
- v. Soil density of 1925 kg/m³, unless otherwise known.
- vi. Live load is Highway H20 of 110 MPa.
- vii. Ovality no greater than 5%.
- viii. Long-term flexural modulus.

Tube installation forces or pressures shall be limited so as not to stretch the tube longitudinally by more than 5% of the original length.

The flexible tube shall be fabricated to a size that neatly fits the internal circumference of the host pipe. Allowance shall be made for circumferential stretching during insertion.

460.04.02 Submission Requirements

The design for the lining shall be submitted to the Contract Administrator for approval 14 Days prior to installation. The design calculations shall show technical assumptions, identify the design formulas used, and show the wall thickness and finished inside diameter. The ovality condition used in the calculations shall be identified.

The engineering design shall graphically illustrate the installation conditions (i.e., depth of pipeline, water table, pipe invert and crown, and full details of the parameters used).

The design work shall bear the seal and signature of an Engineer.

The following information shall be submitted to the Contract Administrator 7 Days prior to commencing Work:

- a) A work plan outlining the schedule, procedures, and work site.
- b) A list of personnel, including backup personnel, with their qualifications and experience.
- c) A traffic control plan.
- d) Safety plan, including the company safety manual and emergency procedures.
- e) Product by-pass or temporary supply system plans, including methods, with a list of equipment to be used.
- f) Manufacturer's technical data containing complete information on:
 - i. Material composition, physical properties, and dimensions of the new product.
 - ii. Recommendations for transportation, handling, and storage.
 - iii. Repair of product damaged during installation.
 - iv. Installation and connection details.
 - v. Inversion pressures.
 - vi. Product curing procedures listing the curing temperature and duration, including cool down time for the product.
- g) Contingency plans for the following potential conditions:
 - i. Damage to the existing service connections.
 - ii. Improper placement of the CIPP.
 - iii. Damage to the host pipe.
 - iv. CIPP's failure to achieve structural integrity.

A sample letter to residents impacted by the work shall be submitted to the Contract Administrator for approval 7 Days prior to commencing the work.

460.05 MATERIALS

460.05.01 Liner

The CIPP liner material shall have the following minimum characteristics:

a) Initial Structural Properties of the Lining

- i. Flexural modulus 1,724 MPa according to ASTM D 790.
- ii. Flexural strength 31 MPa according to ASTM D 790.
- iii. Tensile strength, for pressure pipes only, 21 MPa according to ASTM D 638.
- iv. 50-year creep reduction of 50%+ according to ASTM D 2990.

b) Material Properties for Pipelines

The finished CIPP liner shall meet the chemical resistance requirements in accordance with ASTM F 1216 and shall be resistant to all chemicals and agents found in the water supply.

For CIPP liners installed in watermains, the liner shall be NSF/ANSI 61 compliant.

460.05.02 Tube

The CIPP tube shall consist of one or more layers of flexible needled felt or an equivalent non-woven material capable of carrying resin able to withstand installation pressures and curing temperatures and shall be compatible with the resin system used. The material shall be capable of stretching to fit irregular pipe sections and negotiate bends. The inner layer and the finished pipe surface shall have an impermeable plastic coating for enhancement of corrosion protection, flow, and abrasion properties of the liner. The tube shall be fabricated to a size that fits tightly to the internal circumference and the length of the original conduit, when installed.

The tube shall be marked at regular intervals not to exceed 1.5 m along its entire length with the manufacturer's name or identification symbol.

460.05.03 Resin

The CIPP resin shall meet the requirements of ASTM F 1216.

460.05.04 Calibration Hose

If a calibration hose is used for inflation of the CIPP liner system, it shall comply with the requirements of ASTM F 1743.

460.05.05 Lubricant

The lubricant used shall be a non-toxic oil-based product that has no detrimental effects on the tube or boiler and pump system, does not support the growth of bacteria, and does not adversely affect the fluid to be transported. Lubricant shall not be used in processes with permeable coatings.

460.05.06 Double Check Valve Backflow Preventers

Double check valve backflow preventers shall be according to CSA B64.5 or AWWA C510.

460.07 CONSTRUCTION

460.07.01 General

The Contract Administrator shall be notified at least 48 hours in advance of starting work.

The Contractor shall confirm the exact size and length of all existing pipes to be rehabilitated prior to undertaking the manufacturing of any tubes.

All required equipment shall be on-site and in satisfactory working order prior to commencing the installation of a lining section.

Work shall progress and continue as required to minimize downtime on pipelines and out-of-service periods on laterals.

At least 7 Days prior to any interruption in service, the Contractor shall advise, in writing, all residents who may be affected by the rehabilitation process about the nature, duration, and expected date of any interruption in service and the contact information of the Contractor. The Contractor shall notify all affected residents or businesses of the specific time of the disruption to their service at least 24 hours in advance and shall endeavour to minimize their inconvenience. During the course of the rehabilitation and any associated service interruption, the residents shall be kept regularly informed regarding any matters that affect them. When the interruption has ended, residents shall be advised immediately either verbally or in writing.

The Contractor shall carry out testing as specified in the Contract Documents to confirm that each service connection is live.

460.07.02 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

460.07.03 Transporting, Unloading, Storing, and Handling Materials

Manufacturer's recommendations for transporting, unloading, storing, and handling of materials shall be followed.

460.07.04 Trenching, Backfilling, and Compacting

Trenching, backfilling, and compacting for any access pits shall be according to OPSS 401.

460.07.05 Support Systems

Support systems shall be according to OPSS 404.

460.07.06 Dewatering

Dewatering shall be according to OPSS 517.

460.07.07 Temporary Protection Systems

The construction of temporary protection systems shall be according to OPSS 539.

Where the stability, safety, or function of an existing roadway, railway, watercourse, other works, or proposed works may be impaired due to the method of operation, protection shall be provided. Protection may include sheathing, shoring, and piling where necessary to prevent damage to such works or proposed works.

460.07.08 Temporary Service

460.07.08.01 Sewer Lining, By-Pass of Flow for Sewers

When specified in the Contract Documents, during the execution of the work, the sewer flow shall be by-passed around the pipeline being relined.

Pumps and by-pass lines shall be of adequate capacity and size to handle all flows.

When interruption of sewer line flows is necessary to properly conduct the inspection and rehabilitation operations, acceptable methods of flow control shall be used. The Contractor is to make all necessary arrangements with the owners, property managers, and residents of each building. The Contractor shall contact all property owners or tenants or both to coordinate the repair work to the sewer and minimize any impact to the residents and businesses.

During the inspection and rehabilitation, sewer flows shall be shut off in order to enable proper inspection of the pipe invert. After the work is completed, flows shall be restored to normal.

On all liner installation dates, the Contractor shall maintain a primary and stand-by by-pass pump and pump power supply on-site. Sufficient power supply and hoses shall be on-site in order to allow the pump to discharge into the next downstream sewer section. The stand-by by-pass pump and power supply shall be of an equal or better capability than the primary by-pass pump and power supply. No by-pass pumps or related equipment shall be disconnected or removed from the sewer or work site until after all service connections have been reinstated and the Contractor has recorded the post-installation video.

All by-pass pumping shall be in place and operational prior to the final pre-installation inspection. All by-pass pumping capacities and configurations shall be approved by the Contract Administrator prior to the actual liner installation date. When specified in the Contract Documents, all by-pass pumps and related equipment shall be silenced equipment or contained within an acceptable sound reduction structure.

460.07.08.02 Watermain Lining, Temporary Potable Water Supply Services

Temporary potable water supply services shall be according to OPSS 493.

460.07.09 Preparation of Existing Pipeline

A pre-installation inspection shall be completed in the presence of the Contract Administrator prior to the commencement of the pipeline rehabilitation.

The existing pipeline to be rehabilitated shall be prepared in accordance with the manufacturer's requirements for CIPP installation. Debris, grease, and other deposits shall be removed from the pipeline. Any obstructions remaining after flushing and cleaning shall be removed without damaging the existing pipeline walls. All roots that interfere with the lining installation shall be removed. Any calcite build-up in the existing pipeline that interferes with the CIPP shall be removed by means that do not damage the existing pipeline walls. Protrusions from deposits such as calcite shall not exceed 6 mm.

Existing service laterals that protrude more than 6 mm into the pipeline shall be removed without damage to the lateral or the pipeline wall. Flail type equipment is not permitted for the removal of protruding laterals.

The Contractor shall also install a screen in the downstream maintenance hole in order to catch any material, including cut outs from service connection openings that may migrate downstream. Such material shall be removed from the maintenance hole.

If the pre-installation inspection reveals an obstruction such as a protruding service connection, a dropped joint, or a collapse that prevents the inversion process and it cannot be removed by conventional sewer cleaning equipment, then the Contractor shall attempt a trenchless technique to remove or repair the obstruction. Any necessary excavation shall be approved in writing by the Contract Administrator prior to the commencement of the work.

When the filling of voids is necessary to ensure structural integrity of the pipeline and to prevent bridging of the liner, the Contractor shall submit a detailed procedure outlining the process and materials to be used to fill the voids to the Contract Administrator for approval.

460.07.10 Access Pits

When possible, existing valve and fitting locations or existing maintenance holes shall be used as access pit locations. Access pit locations shall be approved by the Contract Administrator prior to the beginning of construction.

When an access pit is to be located in close proximity to a closed live watermain valve, the active thrust force of the valve shall be addressed to prevent dislocation of the valve or adjacent piping and to ensure safe working conditions.

460.07.11 Replacement of Valves

For watermains, all valves along the length of pipe to be lined shall be removed and replaced with the type and size of valve specified in the Contract Documents. In all cases, a jumper wire shall be thermite welded to the existing cast or ductile iron pipe on both sides of the replaced valve.

460.07.12 Closed-Circuit Television (CCTV) Inspection

CCTV inspection shall be according to OPSS 409.

Two CCTV inspections of each pipeline section shall be completed as follows:

a) Post Preparation Video Inspection

After completion of the preparation of a pipeline section, a video inspection of the full length of the pipeline section shall be made and submitted to the Contract Administrator. Prior to the delivery of the 24-hour service interruption notice and any lining installation taking place, approval of the prepared section shall be obtained from the Contract Administrator.

b) Post-Lining Final Video Inspection of Complete Rehabilitation

After completion of all work required for the lining of the pipeline section, a video inspection of the full length of the pipeline section shall be made and submitted to the Contract Administrator for approval of the work.

The final video recording shall be submitted to the Contract Administrator for approval immediately upon completion of the work, but no more than 48 hours after the lining installation in each section.

The inside wall of the access point at each end of the pipeline section shall be clearly visible on the inspection videotape.

460.07.13 Cured-In-Place Pipe Lining Installation

The installation of the CIPP lining shall be according to the manufacturer's procedure.

Before installation begins, the Contractor shall obtain manufacturer's recommendations of the minimum pressure required to hold the tube tight against the existing pipes and the maximum allowable pressure, so as not to damage the existing pipe. Once the installation has started, pressure shall be maintained between the minimum and maximum pressures until the installation has been completed.

The existing pipes shall be dewatered for any CIPP installation that does not use an inversion method to expand the tube against the pipe wall.

460.07.14 Curing

The CIPP installation shall be according to ASTM F 1216. Qualified personnel shall monitor the curing process and maintain written records, including boiler monitor graphs, water temperatures, lining temperatures, and water head throughout the curing process. These records shall be made available to the Contract Administrator upon request.

The CIPP shall be inserted and cured in accordance with the manufacturer's parameters and procedures required for the process.

Readings shall be made and recorded at 30-minute intervals of:

- a) the boiler water, temperature in.
- b) the boiler water, temperature out.

Liner external surface temperatures at access points shall be measured using thermocouples. Thermocouples shall be placed at the invert level at the remote end of the repair to determine temperature at this location during the curing cycle.

The time required for the cure shall be determined by the temperature monitoring and shall be adjusted to suit the lengths, diameter, thickness, field conditions, and ambient temperature applicable to each pipe lining section.

Leakage testing of the CIPP shall be conducted during the cure while under hydrostatic pressure.

460.07.15 Cool-Down

The CIPP shall be cooled to a temperature below 38 °C before relieving the hydrostatic head. Cool-down may be accomplished by the introduction of cool water into the CIPP to replace water being drained from a small hole made in the down-stream end. Care should be taken in the release of the static head so that a vacuum does not develop that could damage the newly installed CIPP.

Prior to releasing the water used for curing the liner, the water shall be cooled to the ambient temperature of the sewer into which it is to drain.

460.07.16 Inflation Bladder Removal

For pulled-in-place installation techniques where the inflation bladder is designed to not bond to the CIPP, all portions of the bladder material shall be removed from the CIPP.

460.07.17 Liner Termination

The liner termination at and through sections shall be neat and free of obstructions. If the liner termination fails to make a watertight seal with the existing pipe, a seal shall be applied at this point. Sealing process shall use a material compatible with the liner pipe.

In the case where the liner is installed through an existing maintenance hole, the liner shall be trimmed neatly and parged at the spring line of the liner and at the interface between the liner and any other existing sewers or service connections entering into the maintenance hole.

460.07.18 Testing

When specified in the Contract Documents, testing shall be in accordance with the requirements of ASTM F 1216. A sample shall be taken from the cured liner obvert at an access point, sufficient in size to meet the requirements of ASTM D 790. The testing of the sample shall be done by an independent testing laboratory approved by the Contract Administrator.

a) Finished Liner

For each section of lining, the Contractor shall provide to the Contract Administrator a cylindrical sample of the lining of at least 200 mm in length. The sample shall be taken from lining that extends into an access point on the section. A suitable form shall be used to create the sample so that the conditions of making the sample are as close as possible to the installation and curing conditions for the corresponding section of pipe being lined.

CIPP samples shall be prepared and physical properties tested in accordance with ASTM F 1216.

Leakage testing of the CIPP shall be accomplished during cure while under a positive head. CIPP products in which the pipe wall is cured while not in direct contact with the pressurizing fluid, such as removable bladder, shall be tested by an alternative method approved by the Contract Administrator.

Visual inspection of the CIPP shall be in accordance with ASTM F 1216.

b) Resin

The Contractor shall supply a sample of the resin from each liner supplied, when requested by the Contract Administrator.

The layers of the cured CIPP shall be uniformly bonded. It shall be impossible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly with the probe or knife blade moving freely between the layers. If separation of the layers occurs during testing of field samples, new samples shall be cut from the work. Any reoccurrence may cause rejection of the work.

460.07.19 Flushing and Disinfecting

The CIPP liner for watermains shall be flushed and disinfected according to OPSS 441, prior to its use.

460.07.20 Service Connections and Lateral Reinstatements

Service connection and lateral reinstatement shall be made internally with appropriate remotely operated equipment. Excavation of connections or laterals shall not be allowed. Restored connection or lateral openings shall be cut neatly to full size without over-cutting. Cuts shall be smooth and without residual material left around the opening. Ragged edges or attached material shall not be allowed.

When sewer lateral flow has been interrupted, reinstatement of the lateral shall proceed urgently and with all possible speed to restore lateral flow. Laterals may be reinstated using an initial opening sufficient to restore flow, followed by completion to full reinstatement of 100% open within 24 hours.

460.07.21 Return of Watermain to Service and Removal of Temporary Potable Water Supply System

Upon receipt of satisfactory test results on water samples, the watermain shall be flushed and returned to service, permanent water service connections restored, excavations backfilled, and the temporary service lines removed without interruption of the water supply.

460.07.22 Site Restoration

Site restoration shall be according to OPSS 492.

460.07.23 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

460.09 MEASUREMENT FOR PAYMENT

460.09.01 Actual Measurement

460.09.01.01 Product Installation

Measurement for a product installation shall be by length in metres along the horizontal centreline of the product between connecting points or, if there is no connecting point, to the end of the product.

When the connecting point is a structure, measurement for a product installation shall be in metres to the centre of the structure.

460.09.01.02 Service Connection/Lateral Reinstatement

For measurement purposes, a count shall be made of the number of service connections made to the new product.

460.09.02 Plan Quantity Measurement

When payment is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

460.10 BASIS OF PAYMENT

**460.10.01 Product Installation, “*type, diameter, or use of product*” - Item
Service Connection/Lateral Reinstatement - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

No extra payment shall be made for costs associated with the control of flow for sewers.

Any extraction of reaming tools or other equipment, including extraction by excavation, shall be the responsibility of the Contractor and shall be done at no extra cost to the Owner.

Costs associated with the filling of identified voids shall be as specified in the Contract Documents. Any additional work done for the filling of additional voids identified in the video inspection shall be paid as Extra Work. Filling of voids occurring as a result of Contractor's operations shall be done at no extra cost to the Owner.

460.10.02 Closed-Circuit Television Inspection

When the Contract does not contain a separate tender item for CCTV inspection, the Contract price for product installation shall include full compensation for all labour, Equipment, and Material to do the work of CCTV Inspection.

Appendix 460-A, November 2009
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Testing for live services connection. (460.07.01)
- By-pass flow. (460.07.08.01)
- Connections to other buildings. (460.07.08.02.01)
- Type and size of replacement valves. (460.07.11)
- Cost of filling voids that have been specifically identified. (460.10.01)

The designer should determine if noise restrictions are required, if so, they should be specified in the Contract Documents. (460.07.08.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR CEMENT MORTAR LINING OF WATERMAINS

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462.01	SCOPE

This specification covers the requirements for the rehabilitation of cast or ductile iron watermain by the installation of cement mortar lining.

462.01.01 Specification Significance and Use

This specification has been developed for use in provincial and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

462.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

462.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications shall be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications shall be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 409	Closed-Circuit Television (CCTV) Inspection of Pipelines
OPSS 441	Watermain Installation in Open Cut
OPSS 442	Corrosion Protection of New and Existing Watermains
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 493	Temporary Potable Water Supply Services
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS 539	Temporary Protection Systems

American Water Works Association (AWWA)

C602-11	Cement-Mortar Lining for Water Pipelines in Place - 4 in. (100 mm) and Larger

462.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Associated Appurtenance means as defined in OPSS 441.

Fitting means as defined in OPSS 441.

462.04 DESIGN AND SUBMISSION REQUIREMENTS

462.04.01 Submission Requirements

The following information shall be submitted to the Contract Administrator 14 Days prior to the commencement of cement mortar lining operations:

- a) If applicable, pre-mixed mortar mix design.
- b) Location of access pits.
- c) Pipe cleaning procedures.
- d) Flushing, disinfection, and commissioning plan.

462.05 MATERIALS

462.05.01 Cement Mortar Lining

Materials shall be according to ANSI/AWWA C602, except as noted below or, alternatively, a pre-mixed mortar may be submitted for approval by the Contract Administrator.

Chemicals or additives of any kind shall not be permitted, unless prior written approval from the Contract Administrator has been obtained.

462.05.02 Service Boxes

Service boxes shall be as specified in the Contract Documents.

462.05.03 Valves

Valves shall be according to OPSS 441.

462.05.04 Fittings

Fittings shall be according to OPSS 441.

462.05.05 Repair Pipe

Repair pipe shall be polyvinyl chloride pipe or ductile iron pipe according to OPSS 441.

462.05.06 Sacrificial Anodes

Sacrificial anodes shall be according to OPSS 442.

462.06 EQUIPMENT

462.06.01 Cement Mortar-Lining Machine

The cement mortar-lining machine shall be provided with attachments for mechanically trowelling the mortar to produce a smooth surface so that the freshly placed and trowelled mortar is not touched until it has set. The design of the attachment shall be so as to permit operations in pipes that may be out of round, as well as to permit trowelling through bends that deflect up to and including 22.5 degrees.

462.07 CONSTRUCTION

462.07.01 General

The Contract Administrator shall be notified at least 48 hours in advance of starting work.

All fittings and appurtenances removed to facilitate the lining process shall be replaced with new fittings and appurtenances.

All fittings and appurtenances removed shall be delivered to the location specified in the Contract Documents.

462.07.02 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

462.07.03 Transporting, Unloading, Storing, and Handling Materials

Manufacturer's recommendations for transporting, unloading, storing, and handling of materials shall be followed.

462.07.04 Trenching, Backfilling, and Compacting

Trenching, backfilling, and compacting for any access pits shall be according to OPSS 401.

462.07.05 Support Systems

Support systems shall be according to OPSS 404.

462.07.06 Dewatering

Dewatering shall be according to OPSS 517.

462.07.07 Temporary Protection Systems

The construction of temporary protection systems shall be according to OPSS 539.

Where the stability, safety, or function of an existing roadway, railway, watercourse, other works, or proposed works may be impaired due to the method of operation, protection shall be provided. Protection may include sheathing, shoring, and piling where necessary to prevent damage to such works or proposed works.

462.07.08 Service Boxes

In advance of working on the street, service boxes shall be located and inspected to ensure that the curb stop is functioning and marked.

Service boxes to be adjusted to final grade and service boxes or curb stops to be replaced shall be identified to the Contract Administrator for approval. After receiving approval, the service boxes shall be adjusted or the service boxes or curb stops shall be replaced.

462.07.09 Temporary Potable Water Supply Services

Temporary potable water supply services shall be according to OPSS 493.

462.07.10 Rehabilitation of Watermains

462.07.10.01 Access Pits

When possible, existing valve and fitting locations shall be used as access pit locations. Access pit locations shall be approved by the Contract Administrator prior to the beginning of construction.

When an access pit is to be located in close proximity to a closed live watermain valve, the active thrust force of the valve shall be addressed to prevent dislocation of the valve or adjacent piping and to ensure safe working conditions.

462.07.10.02 Replacement of Valves

All valves along the length of pipe to be cement mortar lined shall be removed and replaced with the type and size of valve specified in the Contract Documents. In all cases, a jumper wire shall be thermite welded to the existing cast or ductile iron pipe on both sides of the replaced valve.

462.07.10.03 Replacement of Fittings

All fittings along the length of pipe to be cement mortar lined shall be removed and replaced with the type and size of fitting specified in the Contract Documents. In all cases, a jumper wire shall be thermite welded to the existing cast or ductile iron pipe on both sides of the replaced fitting.

462.07.10.04 Cutting of Pipe

Pipes shall be cut so that the ends are smooth and square to ensure proper reconnection.

462.07.10.05 Cleaning Existing Pipe

All rust, tubercles, deposits, loose or deteriorated remains of original coating, and other foreign material shall be removed from the inside of the pipe without damaging the structural integrity of the existing pipe. A cleaning device shall be passed through the pipe as many times as is necessary to obtain results satisfactory to the Contract Administrator. To confirm satisfactory cleaning, a closed-circuit television (CCTV) inspection of the pipe section shall be undertaken.

Solids removed during the cleaning, flushing, and pumping operations shall be captured before flowing into the drainage system and then disposed of as specified in the Contract Documents.

462.07.10.06 Bulkheads on Open Pipe Ends

All pipes shall be closed using a mechanical joint plug or cap anytime there is no work being performed on the pipe. The bulkhead shall be capable of preventing water from entering or exiting the pipe and shall be equipped with a relief valve.

462.07.10.07 Cement Mortar Lining

462.07.10.07.01 General

The lining shall consist of a one-course application of pre-mixed cement mortar, 5 mm $\pm$ 1.5 mm thick, and shall be placed by a machine projecting the mortar against the wall of the pipe and long radius bends, by centrifugal force, without injurious rebound and with sufficient velocity to cause the mortar to be densely packed and to adhere in place. The travel of the machine and the rate of discharge of mortar shall be controlled so as to produce a uniform thickness of lining around the interior and along the length of pipe.

Mortar that has attained its initial set shall not be used.

Mortar of improper consistency that does not provide a dense homogenous lining that holds itself firmly against the pipe surface and all waste materials, spatter, etc., shall be removed from the pipe. Only mortar of suitable consistency and applied with sufficient velocity to adhere firmly to the surface of the pipe shall form the lining.

If any section of the lining fails or shows evidence of failure or unusual irregularity, the faulty section of lining shall be removed to the extent indicated by the Contract Administrator and the pipe re-cleaned and the lining replaced.

462.07.10.07.02 Trowelling

The interior surface of the pipe shall be mechanically trowelled to produce a smooth surface.

462.07.10.07.03 Hand Work

Edges of linings at openings or ends of lined sections shall be neatly finished. Edges shall be rounded or beveled so as to avoid sharp angles or abrupt changes in sections. Surfaces of cement mortar lining to which additional mortar is to be placed shall be moistened just before the mortar is applied.

Hand finishing work in a section of the pipe shall be completed within 24 hours following the machine application of the mortar lining.

462.07.10.08 Closing of Pipe

Immediately upon completion of the cement mortar lining of a section of pipe, all openings in the pipe shall be closed in accordance with the Bulkheads on Open Pipe Ends clause to prevent circulation of air.

462.07.10.09 Curing

As soon as practical, without damaging the cement mortar lining, water shall be introduced into the section of pipe between bulkheads in order to maintain a moist environment.

462.07.10.10 Backflushing

When the lining has achieved sufficient set, all services shall be backflushed with water or another method approved by the Contract Administrator to remove any mortar deposited in them.

462.07.10.11 Obstruction in the Water Services

Should any water service be partially or fully obstructed, the obstruction shall be removed in a manner approved by the Contract Administrator.

462.07.10.12 Closed-Circuit Television (CCTV) Inspection

CCTV inspections shall be according to OPSS 409.

Equipment used for CCTV inspections shall have been used exclusively for the inspection of potable watermain systems in the past.

CCTV inspections shall be carried out on cleaned pipe sections and again on newly lined sections of pipe to ensure proper cleaning or cement mortar application.

All water shall be removed prior to the inspection of the watermain.

If the cleaning or cement mortar lining of any pipe section is unacceptable, the deficiency with the cleaning or mortar lining shall be corrected and the pipe section shall be reinspected.

Any valves, main stops, or other associated appurtenances that are found to have been damaged due to cleaning or lining operations shall be replaced.

462.07.10.13 Repair of Pipe

Upon application of the cement mortar lining, the openings in the pipe shall be closed as soon as possible using polyvinyl chloride pipe or ductile iron pipe and couplings approved by the Contract Administrator. Thrust restraints shall be installed according to OPSS 441. In all cases, a jumper wire shall be thermite welded to the existing cast or ductile iron pipe on both sides of the repair.

462.07.10.14 Sacrificial Anodes

Sacrificial anodes of the type and size specified in the Contract Documents shall be installed at each new valve and cast or ductile iron fitting and at each access pit according to OPSS 442 and the Contract Documents.

462.07.10.15 Hydrostatic Testing

When specified in the Contract Documents, hydrostatic testing shall be carried out according to OPSS 441.

462.07.10.16 Flushing and Disinfecting

Flushing and disinfecting of the completed watermain shall be according to OPSS 441.

462.07.10.17 Return of Watermain to Service and Removal of Temporary Potable Water Supply System

Upon receipt of satisfactory test results on water samples, the watermain shall be flushed and returned to service, permanent water service connections restored, excavations backfilled, and temporary service lines removed without interruption of the water supply.

462.07.11 Site Restoration

Site restoration shall be according to OPSS 492.

462.07.12 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

462.09 MEASUREMENT FOR PAYMENT

462.09.01 Actual Measurement

462.09.01.01 Locating, Inspecting, and Marking Service Boxes

For measurement purposes, a count shall be made of the number of service boxes located, inspected, and marked.

462.09.01.02 Adjusting Service Boxes

For measurement purposes, a count shall be made of the number of service boxes adjusted to final grade.

462.09.01.03 Replacing Service Boxes

For measurement purposes, a count shall be made of the number of service boxes excavated and replaced.

462.09.01.04 Replacing Curb Stops

For measurement purposes, a count shall be made of the number of curb stops excavated and replaced.

462.09.01.05 Access Pits

For measurement purposes, a count shall be made of the number of approved access pits excavated, backfilled, compacted, and restored.

462.09.01.06 Cement Mortar Lining

Measurement of cement mortar lining shall be by length in metres horizontally along the centreline of the pipe being lined.

462.09.01.07 Valves

For measurement purposes, a count shall be made of the number of valves installed along the cement mortar lined pipe.

462.09.01.08 Fittings

For measurement purposes, a count shall be made of the number of fittings installed along the cement mortar lined pipe.

462.09.01.09 Repair of Pipe

For measurement purposes, a count shall be made of the number of sections of pipe repaired.

462.09.01.10 Sacrificial Anodes

For measurement purposes, a count shall be made of the number of sacrificial anodes installed.

462.09.02 Plan Quantity Measurement

When payment is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

462.10 BASIS OF PAYMENT

462.10.01 Locating, Inspecting, and Marking Service Boxes - Item
Adjusting of Service Boxes - Item
Replacing of Service Boxes - Item
Replacing of Curb Stops - Item
Access Pits - Item
"type, size" Repair of Pipe - Item
"type, size" Sacrificial Anodes - Item
Flushing and Disinfecting - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

462.10.02 Rehabilitation of Watermains

462.10.02.01 Cement Mortar Lining - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Removal and replacement of valves, main stops, curb stops, service boxes, and other associated appurtenances damaged due to cleaning or lining operations shall be at no additional cost to the Owner.

Re-inspection of an unacceptably cleaned or cement lined pipe after correction of a deficiency shall be at no additional cost to the Owner.

462.10.02.02 "type, size" Valves - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work of replacing valves.

462.10.02.03 "type, size" Fittings - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work of replacing fittings.

462.10.02.04 Obstructions in Water Services

When excavation and repair of a water service is required and not caused by the negligence of the Contractor, payment shall be made as Extra Work.

When water services are partially or fully obstructed due to the ingress of loosened foreign materials from the cleaning or lining process, the obstruction shall be removed at no additional cost to the Owner.

462.10.03 Closed-Circuit Television Inspection

When the Contract does not contain a separate tender item for CCTV inspection, the Contract price for product installation shall include full compensation for all labour, Equipment, and Material to do the work of CCTV Inspection.

Appendix 462-A, November 2014 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Service box requirements. (462.05.02)
- Location for delivery of removed fittings and appurtenances. (462.07.01)
- Type and size of replacement valves. (462.07.10.02)
- Type and size of replacement fittings. (462.07.10.03)
- Disposal of solids from the cleaning, flushing, and pumping operations. (462.07.10.05)
- Type and size of sacrificial anodes to be installed. (462.07.10.14)

The designer should determine if hydrostatic testing of the watermain is required and, if so, it should be specified in the Contract Documents. (462.07.10.15)

The tender item descriptions for repair of pipe should include reference to the attributes shown (i.e., type and size of pipe to be complete). (462.10.01)

The tender item description for sacrificial anodes should include reference to the attribute shown (i.e., type and size of anode to be complete). (462.10.01)

The tender item descriptions for valves should include reference to the attributes shown (i.e., type and size of valve to be complete). (462.10.02.02)

The tender item descriptions for fittings should include reference to the attributes shown (i.e., type and size of fitting to be complete). (462.10.02.03)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 1109.010	Cathodic Protection for Metallic Watermain Systems
OPSD 1109.011	Cathodic Protection for PVC Watermain Systems



CONSTRUCTION SPECIFICATION FOR PIPELINE AND CONDUIT INSTALLATION BY PIPE BURSTING

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APPENDICES

463-A	Commentary

463.01 SCOPE

This specification covers requirements for installation of pipelines and conduits using the trenchless technology known as pipe bursting.

463.01.01 Specification Significance and Use

This specification has been developed for use in provincial and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

463.01.02

Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

463.02

REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 407	Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber Installation
OPSS 409	Closed-Circuit Television Inspection of Pipelines
OPSS 441	Watermain Installation in Open Cut
OPSS 490	Site Preparation for Pipelines, Utilities, and Associated Structures
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities and Associated Structures
OPSS 493	Temporary Potable Water Supply Services
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS 539	Temporary Protection Systems

463.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Fusion means connecting product lengths into a continuous length using elevated temperatures and pressure.

Launch Pit means an access excavation or existing access structure to an existing product for the insertion of the pipe bursting head and product.

Pipe Bursting means the application of a pipe bursting head into the interior of and along the length of an existing product to split or fracture the existing product so that the existing product and surrounding material is opened up to a sufficient size to accommodate the insertion of a product in the cavity created, without leaving any significant voids around the product. Pipe bursting methods include static, pneumatic, and hydraulic. Pipe bursting is also known internationally as pipe cracking or pipe splitting.

Product means the new pipelines or conduits.

Pull means the installation of one continuous reach of product. Generally, a pull shall commence at a launch pit and terminate at a pull pit.

Pull Pit means an access excavation or existing access structure to an existing product to receive the product or pipe bursting head or both.

Structure means a maintenance hole, valve chamber, or other such facility to access the product.

463.04

DESIGN AND SUBMISSION REQUIREMENTS

463.04.01

Submission Requirements

The following information shall be submitted to the Contract Administrator 7 Days prior to the commencement of pipe bursting operations:

- a) A work plan outlining the schedule, procedures, launch pit and pull pit locations, and Working Drawings required to execute the work on the product, service laterals, and structures.
- b) A list of personnel, including backup personnel, and their qualifications and experience.
- c) A traffic control plan.
- d) Safety plan, including the contracting company safety manual and emergency procedures.
- e) When fusion joining is used, written record of current training showing that the operator has been fully trained in the use of the fusion equipment by an authorized representative of the fusion equipment manufacturer and the product manufacturer or, when applicable, certified by the Owner or Utility for which the work is being completed.
- f) When applicable, product bypass and temporary supply system plans, including installation, operation, and testing procedures and a list of material and equipment to be used.
- g) Manufacturer's technical data containing complete information on product:
 - i. Material composition, physical properties, inside diameter, and wall thickness.
 - ii. Maximum tensile strength and corresponding maximum allowable pulling force.
 - iii. Transporting, unloading, storing and handling recommendations.

- iv. Repair.
- v. Fusion times and temperatures.
- vi. Minimum bend radius.
- vii. Recommended restraint method in structure.
- viii. Product recovery requirements.
- ix. Relaxation requirements.

h) Contingency plans for the following potential conditions:

- i. Unforeseen obstructions causing burst stoppage.
- ii. Deviation from required alignment and grade.
- iii. Extended service disruption.
- iv. Damage to the existing service connections and the replacement of product's structural integrity and methods of repair.
- v. Damage to other existing Utilities.
- vi. Soil heaving or settlement.
- vii. Contaminated soil or water.
- viii. Alignment passing through buried structures.

463.05 MATERIALS

463.05.01 Pipe Materials

Pipe type, class, pressure rating, and size shall be as specified in the Contract Documents.

463.05.02 Valves

Valve type, class, pressure rating, and size shall be as specified in the Contract Documents.

463.05.03 Fittings

Fittings shall be suitable for and compatible with the type, class, pressure rating, and size of pipe with which they are used.

463.05.04 Lubricant

Lubricant used to reduce friction, to maintain the annular space created by the pipe bursting head, and to allow the insertion of the product shall be non-toxic and biodegradable.

463.06 EQUIPMENT

463.06.01 Pipe Bursting Head

The pipe bursting head shall be according to the manufacturer's specifications for head sizes recommended for various product diameters and types, as well as parameters associated with maximum allowable upsize percentages.

463.06.02 Pipe Bursting Power Source

The pipe bursting power source shall generate sufficient force to burst and compact the existing product into the surrounding material.

463.06.03 Fusion Equipment

Fusion equipment, when used, shall be sized and rated for the product. Fusion clamps shall be sized to clamp the product properly.

463.07 CONSTRUCTION

463.07.01 General

The product shall be installed following the alignment and grade of the existing pipe and to the ovality specified in the Contract Documents.

The Contract Administrator shall be notified at least 48 hours prior to commencement of work.

463.07.02 Site Preparation

Site preparation shall be according to OPSS 490 and as specified herein.

The work site shall be graded or filled to provide a level working area for the pipe bursting equipment. No alterations beyond what is required for the pipe bursting operations shall be made. All activities shall be confined to designated work areas.

463.07.03 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

When specified in the Contract Documents, an existing facility shall be exposed to verify its horizontal and vertical location. The number of exposures required to monitor work progress shall be as specified in the Contract Documents.

463.07.04 Transporting, Unloading, Storing, and Handling Materials

Manufacturer's recommendations for transporting, unloading, storing, and handling of materials shall be followed.

463.07.05 Trenching, Backfilling, and Compacting

Trenching, backfilling, and compacting for launch pits, pull pits, and other excavation locations shall be according to OPSS 401.

Launch pits and pull pits shall be sized to allow the use of the pipe bursting equipment and to allow the product to be installed such that the product manufacturer's recommendations for product bending radius are not exceeded.

463.07.06 Support Systems

Support systems shall be according to OPSS 404.

463.07.07 Dewatering

Dewatering shall be according to OPSS 517.

463.07.08 Temporary Protection Systems

The construction of temporary protection systems shall be according to OPSS 539.

Where the stability, safety, or function of an existing roadway, railway, watercourse, other works, or proposed works may be impaired due to the method of operation, protection shall be provided. Protection may include sheathing, shoring, and piling where necessary to prevent damage to such works or proposed works.

463.07.09 Temporary Potable Water Supply Services

When specified in the Contract Documents, temporary potable water supply services shall be according to OPSS 493.

463.07.10 Product By-Pass

When specified in the Contract Documents, during the execution of the work the flow within the existing product shall be bypassed around the product being replaced and the continuity of service to each facility connected to the affected section of product shall be maintained.

The pumps and by-pass lines shall be of adequate capacity and size to handle all flows.

463.07.11 Preparation of Existing Product and Structures

All existing crosses, tees, valves, and service connections shall be located, exposed, and disconnected prior to any pipe bursting operation.

Prior to pipe bursting, the inlets, outlets, and benching of existing structures shall be enlarged sufficiently for clearance of the pipe bursting head and the product. Enlargements shall be made neatly and be no greater than that required for their purpose. Size of the enlargements shall be sufficient to allow for restoration and sealing to the product.

Existing product shall be cleared of obstructions (e.g., rocks and debris) or mechanical obstructions (e.g., repair sleeves, clamps, couplings, and intolerable deviations in grade or alignment) prior to pipe bursting.

463.07.12 Product Joining

463.07.12.01 General

The product shall be joined according to the manufacturer's recommendations.

The product shall be assembled and joined at the site to provide a leak-proof joint.

When space and the Contract Documents permit, the length of the product to be pulled shall be joined as one length prior to the commencement of the pulling operation.

When used, fusion shall be performed by technicians trained in the use of the fusion equipment.

Joints shall be capable of withstanding the loading of the installation process. All joints shall be subject to acceptance by the Contract Administrator prior to insertion.

463.07.12.02 Connection to Product or Structures

Product shall be allowed to recover from any induced stresses and strains before connection to new or existing product or structures are made. Product recovery time shall be according to the manufacturer's recommendations.

The product connection to the structure or to an existing product shall be leak-proof.

463.07.12.03 Service Connections

Service connection work shall be as specified in the Contract Documents.

Service connection work shall not commence until the product has fully recovered.

463.07.13 Product Installation

Installation procedures shall be according to the product manufacturer's guidelines.

The product shall be protected from damage during the installation process.

Suitable guides shall be used to protect the product from damage at the insertion point and at any intermediate re-entry points.

Upon commencement of the bursting process, product insertion shall be continuous from the launch pit to the pull pit, except when approved by the Contract Administrator. A pushing machine may be used to assist insertion from the rear.

When specified in the Contract Documents, a weak link, breakaway connector, or load monitor shall be used to prevent excess pulling force from damaging the product.

463.07.14 Structures and Valves

When the product enters or exits an existing structure, the structure wall shall be restored as specified in the Contract Documents. Restoration shall securely locate and anchor the product in the wall and shall produce a leak-proof seal.

The existing structure's benching shall be restored according to the requirements of the product, any other incoming product, and as specified in the Contract Documents.

When new structures or valves are specified, they shall be installed according to OPSS 407 and OPSS 441, respectively.

463.07.15 Testing

Testing of the product joining and installation shall be as specified in the Contract Documents.

When specified in the Contract Documents, closed-circuit television (CCTV) inspection shall be completed on the product after installation.

463.07.16 Record Keeping

Verification record requirements of the alignment and grade of the installed product shall be as specified in the Contract Documents. A copy of the verification records shall be given to the Contract Administrator at the completion of the pipe bursting operations.

463.07.17 Closed-Circuit Television Inspection

CCTV inspection shall be according to OPSS 409.

463.07.18 Site Restoration

Site restoration shall be according to OPSS 492.

463.07.19 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

463.08 QUALITY ASSURANCE

463.08.01 Acceptance Criteria

Acceptance criteria for the product installation shall be as specified in the Contract Documents.

463.09 MEASUREMENT FOR PAYMENT

463.09.01 Actual Measurement

463.09.01.01 Product Installation by Pipe Bursting

Measurement for a product installation by pipe bursting shall be by length in metres along the horizontal centreline of the product between connecting points or, if there is no connecting point, to the end of the product. When the connecting point is a structure, measurement for a product installation shall be by length in metres to the centre of the structure.

463.09.01.02 Service Connections

For measurement purposes, a count shall be made of the number of existing services that are disconnected from the existing product and reconnected to the product.

463.09.02 Plan Quantity Measurements

When payment is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

463.10 BASIS OF PAYMENT

**463.10.01 Product Installation by Pipe Bursting, “*type of product, diameter of product, use of product*” - Item
Product Bypass - Item
Service Connections - Item
Closed-Circuit Television Inspection - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

463.10.02 Closed-Circuit Television Inspection

When the Contract does not contain a separate tender item for CCTV inspection, the Contract price for the Product Installation by Pipe Bursting item shall include full compensation for all labour, Equipment, and Material to do the work of CCTV inspection.

Appendix 463-A, November 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

This specification was written to encompass the majority of pipe bursting operations for small and medium sized projects. However, the basic design considerations should always include properly planned entry and exit points, grade of existing host pipe, adjacent Utilities, and connection requirements.

The International Pipe Bursting Association (IPBA) normally assigns pipe bursting work to one of three classifications. These following classifications (January 2012 version) are intended for use as general guidelines when considering replacement of existing pipe by pipe bursting techniques. The classification should be determined based on the more stringent parameter in the table below.

IPBA Classification and Degree of Difficulty	Depth of Pipe m	Existing Pipe Diameter mm	New Pipe Diameter Options	Burst Length m	Original Trench Width	Soil Type
A - Minimal	< 3.65	-50 - 300	Size on Size	0 - 100	Relatively wide trench compared to expander head outside diameter.	Compressible soils outside trench (loose sand, gravel, soft clay).
B - Moderate	> 3.66 to < 5.5	—350-450	Single Upsize	-100 - 150	Trench width less than 4" wider than the expander head outside diameter.	Moderately compressible soils outside trench (medium dense to dense sand, medium to stiff clay).
C - Comprehensive	> 5.6+	-500 - 900	Double / Triple Upsize	-150 - 300	Incompressible soils outside trench.	Constricted trench geometry (width less than or equal to outside diameter of bursting head).
D - Developmental						

The designer may consider a pre-qualification process to ensure that the contractor(s) possess the required capabilities and qualifications to undertake the work required under the contract.

The designer should include the following in the Contract Documents:

Appendix 463-A

- Pipe type, class, pressure rating, and size. (463.05.01)
- Valve type, class, pressure rating, and size. (463.05.02)
- Product ovality. (463.07.01)
- Service connection work. (463.07.12.03)
- Benching restoration. (463.07.14)
- Testing of product joining and installation. (463.07.15)
- Verification record requirements. (463.07.16)
- Acceptance criteria. (463.08.01)

The designer should determine if the following are required and, if so, they should be specified in the Contract Documents:

- Exposing existing facilities. (463.07.03)
- Use of temporary potable water supply services. (463.07.09)
- Product by-pass. (463.07.10)
- Joining and pulling product as one length. (463.07.12.01)
- Use of a weak link, breakway connector, or load monitor. (463.07.13)
- Wall restoration. (463.07.14)
- Completion of a CCTV inspection. (463.07.15)

The designer should give consideration, in consultation with the pipe manufacturer, to minimum allowable product bending radii commensurate with the pipeline's strength.

The designer should give special consideration to the required grades at the entry and exit points. The designer may undertake a CCTV inspection and location analysis prior to pipe bursting to review the existing line and grade to determine if deviations are acceptable.

Product upsizing by using a pipe bursting technique may induce stresses in the surrounding soil resulting in potential damage to nearby Utilities and foundations. The degree of distortion on the zone of influence is a function of the degree of upsizing, the pipe material of a nearby Utility, the location of nearby Utilities in relation to the pipe burst pipe, and the soil conditions. The designer may consider exposure of critical services by non-destructive methods to monitor the pipe bursting progress and impacts.

The designer should consider the need for product bypass, temporary potable water supply services, or temporary flow stoppage or blockage with inflatable plugs during the pipe bursting operation. The designer may require that during the execution of the work, the flow shall be bypassed around the product being replaced and the continuity of service to each facility connected to the affected section of product be maintained. The designer should consider what should be done if there is an extended service disruption.

Appendix 463-A

For certain product installations, the designer may consider the requirement of a weak link, breakaway connector, or load monitor to prevent excess pulling force from damaging the product.

The designer should consider the type of interface and the degree of continuity between the product and the existing structure to ensure appropriate anchoring and seals in order to prevent product retraction or inadvertent leaks to the new system.

The designer may specify the completion of a CCTV inspection of the product after installation, particularly when grade thresholds are critical. In smaller diameter product installations when the designer elects to complete a CCTV survey, the designer may wish to specify a lighter interior colour of the product installation, if available.

Testing of product joining and installation may include hydrostatic, air, BACT-T, etc.

Verification record requirements may include such information as reporting information available from the pipe bursting machine, daylighting, installation of tracer wire with the product, the use of acoustic or magnetic locating equipment, etc.

Acceptance criteria requirements may include such considerations as successful bursting operation from entry to pull back location; CCTV inspection, removal of extra coupon pipe length from the pull back pit to view for stresses, grade verification, etc.

The designer may consider including a process regarding payment for failed pipe bursting attempts in the Contract Documents.

The tender item description for Product Installation by Pipe Bursting should include reference to one or more of the attributes shown (i.e., type of product, diameter of product, and use of product) to be complete.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



**CONSTRUCTION SPECIFICATION FOR
SITE PREPARATION FOR PIPELINES, UTILITIES,
AND ASSOCIATED STRUCTURES**

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490.01	SCOPE
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490.10	BASIS OF PAYMENT

APPENDICES

490-A	Commentary

490.01 SCOPE

This specification covers the requirements of site preparation for the installation of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, watermains and associated appurtenances, and other underground Utilities; maintenance holes, catch basins, ditch inlets, or valve chambers; and any other specified subsurface construction.

490.01.01 Specification Significance and Use

This specification has been developed for use in provincial and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

490.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

490.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 201	Clearing, Close Cut Clearing, Grubbing, and Removal of Surface and Piled Boulders
OPSS 206	Grading
OPSS 412	Sewage Forcemain Installation in Open Cut
OPSS 441	Watermain Installation in Open Cut
OPSS 706	Traffic Control Signing
OPSS 801	Protection of Trees
OPSS 802	Topsoil
OPSS 805	Temporary Erosion and Sediment Control Measures

490.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Associated Appurtenances means as defined in OPSS 412 for a sewer system, and OPSS 441 for a watermain.

490.07 CONSTRUCTION

490.07.01 General

Site preparatory work shall be performed prior to the installation of the pipelines, Utilities, and associated structures.

490.07.02 Removal of Existing Signing

Removal of existing signing shall be according to OPSS 706.

490.07.03 Clearing and Grubbing

Clearing and grubbing and related work shall be according to OPSS 201.

490.07.04 Shrub and Tree Relocation

Shrubs and trees to be relocated shall be protected according to OPSS 801 in their original and final locations.

Shrub and tree relocation shall be as specified in the Contract Documents.

490.07.05 Tree Protection and Pruning

Tree protection and pruning shall be according to OPSS 801.

490.07.06 Stripping and Stockpiling Topsoil

Stripping of topsoil shall be according to OPSS 206. Topsoil shall be removed carefully in the Work Areas and shall not be mixed with subsoil or other materials.

Stockpiling of topsoil shall be according to OPSS 802 and as specified in the Contract Documents. Topsoil shall not be placed in or near tree stands, along flood plains, and in areas containing natural wildlife habitats. Perimeter drainage ditches shall be constructed to intercept and divert run-off to adjacent settling ponds. Temporary erosion and sediment control measures shall be according to OPSS 805. Stockpiles shall be protected to ensure minimum environmental interference.

490.07.07 Removal of Fences and Guide Rails

Property owners or occupants shall be given at least 24 hours notice in advance of dismantling fences. Fences and guide rails shall be dismantled, where necessary. All components that are broken, bent, or damaged as a result of the operation shall be removed from the site and replaced with new components. All reusable components shall be stored and protected.

490.07.08 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

490.10**BASIS OF PAYMENT**

Payment at the Contract price for the appropriate tender items for the installation of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, watermains and associated appurtenances, and other underground Utilities; maintenance holes, catch basins, ditch inlets, or valve chambers; and any other specified subsurface construction shall be full compensation for all labour, Equipment, and Material to do the work of site preparation.

When the Contract contains separate items for work required by this specification, payment shall be at the Contract prices and according to the specifications for such work.

Appendix 490-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the shrub and tree relocation and planting requirements in the Contract Documents. (490.07.04)

The designer may choose to specify a specific location for stockpiled topsoil in the Contract Documents. (490.07.06)

If separate items are required to cover the various components of site preparation, they should be included in the Contract Documents.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



**CONSTRUCTION SPECIFICATION FOR
PRESERVATION, PROTECTION, AND
RECONSTRUCTION OF EXISTING FACILITIES**

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491.03	DEFINITIONS
491.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
491.05	MATERIALS - Not Used
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491.08	QUALITY ASSURANCE - Not Used
491.09	MEASUREMENT FOR PAYMENT - Not Used
491.10	BASIS OF PAYMENT

APPENDICES

491-A	Commentary

491.01 SCOPE

This specification covers the requirements of preservation, protection, replacement, and reconstruction of existing services and structures during the installation or removal of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, watermains and associated appurtenances, and other underground Utilities; maintenance holes, catch basins, ditch inlets, or valve chambers; and any other specified subsurface construction.

491.01.01 Specification Significance and Use

This specification has been developed for use in provincial and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

491.01.02

Appendices Significance and Use

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491.02

REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 412	Sewage Forcemain Installation in Open Cut
OPSS 441	Watermain Installation in Open Cut

491.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Associated Appurtenances means as defined in OPSS 412 and OPSS 441.

491.07 CONSTRUCTION

491.07.01 General

The requirements and regulations of road authorities, Utility companies, and railway companies shall be adhered to at all times.

491.07.02 Notification

All road authorities, Utility companies, and railway companies shall be notified in writing at least 48 hours before approaching their facilities or entering their rights-of-way.

All owners of underground services shall be requested to locate, stake, and clearly mark in the field all underground services which are located on or near the line of the proposed work. Certificates shall be obtained from all owners of underground services having facilities in the area of the proposed work certifying that their facilities have been marked to confirm the Utility location.

Necessary arrangements shall be made with railway companies for the support and protection of their tracks.

491.07.03 Existing Services and Structures

All water or gas mains, sewers or drains, conduits, cables, service pipes, sidewalks, curbs, and all other structures or property in the vicinity of the work, whether above or underground shall be sustained in place and protected from damage. All water and gas service and flow in all sewers, drains, house or inlet connections, and all watercourses encountered during the progress of the work shall be maintained.

Excavation shall be performed with care to expose buried pipes, cables, conduits, and structures whenever trenching operations approach the indicated location of buried services.

If any Utility is broken or damaged, the Utility company shall be immediately notified.

Access to fire hydrants and water and gas valves shall be maintained at all times to the satisfaction of the local authority.

491.07.04 Reconstruction of Existing Facilities

Where an existing Utility is within the limits of or crosses an excavation and cannot be sustained in place, the existing facility shall be removed, realigned, relocated, or replaced as directed in writing by the Contract Administrator. All materials comprising the Utility shall be handled with care, cleaned, salvaged, and inspected before reconstruction commences.

491.07.05 Contamination

The contents of any sewer, drain, or inlet connection shall not be allowed to flow into an excavation.

All offensive matter shall be removed from the proximity of the work.

491.07.06 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

Payment at the Contract price for the appropriate tender items for the installation of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, watermain and associated appurtenances, and other underground Utilities; maintenance holes, catch basins, ditch inlets or valve chambers; and any other specified subsurface construction, shall be full compensation for all labour, Equipment, and Material to do the work of the preservation, protection, or reconstruction of existing facilities.

When the Contract contains separate items for work required by this specification, payment shall be at the Contract prices and according to the specifications for such work.

Appendix 491-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



**CONSTRUCTION SPECIFICATION FOR
SITE RESTORATION FOLLOWING INSTALLATION OF PIPELINES,
UTILITIES, AND ASSOCIATED STRUCTURES**

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492-A	Commentary

492.01 SCOPE

This specification covers the requirements for the restoration of a site following installation of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, watermains and associated appurtenances, and other underground utilities; maintenance holes, catch basins, ditch inlets, or valve chambers; and any other specified subsurface construction.

492.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

492.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

492.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 304	Single and Double Surface Treatment
OPSS 310	Hot Mix Asphalt
OPSS 313	Hot Mix Asphalt - End Result
OPSS 314	Untreated Granular, Subbase, Base, Surface Shoulder, and Stockpiling
OPSS 350	Concrete Pavement and Concrete Base
OPSS 351	Concrete Sidewalk
OPSS 353	Concrete Curb and Gutter Systems
OPSS 412	Sewage Forcemain Installation in Open Cut
OPSS 441	Watermain Installation in Open Cut
OPSS 490	Site Preparation for Pipelines, Utilities, and Associated Structures
OPSS 721	Steel Beam Guide Rail and Cable Guide Rail
OPSS 771	Standard Highway Fence
OPSS 772	Chain-Link Fence
OPSS 802	Topsoil
OPSS 803	Sodding
OPSS 804	Seed and Cover

Ontario Provincial Standard Specification, Material

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1540	Standard Highway Fence Components
OPSS 1541	Chain-Link Fence Components
OPSS 1601	Wood - Material, Preservative Treatment, and Shop Fabrication

Canadian General Standards Board (CGSB)

138.2-96	Steel Framework for Chain Link Fence

492.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Associated Appurtenances means as defined in OPSS 412 and OPSS 441.

492.05 MATERIALS

492.05.01 Granular Materials

Granular materials shall be according to OPSS 1010.

492.05.02 Barbed Wire

Barbed wire shall be according to CAN/CGSB-138.2.

492.05.03 Electric Fence Wire

Electric fence wire shall be 2 mm diameter hot dipped galvanized wire.

492.05.04 Wood Fence

Wood fence material shall be according to OPSS 1601.

492.05.04.01 Board or Split Rail Fence

Posts and boards shall be the same size and type as used in the original fence.

Rails shall be split cedar in good condition and of adequate lengths to build either a straight or snake fence.

492.05.04.02 Wood Braces for Wire Fence

Diagonal wood braces shall be according to OPSS 1540.

492.05.05 Highway Fence

Highway fence material shall be according to OPSS 1540.

492.05.06 Steel Posts

Steel posts shall be according to OPSS 1540.

492.05.07 Chain-Link Fence

Chain-link fence material shall be according to OPSS 1541.

492.05.08 Gates

Gates shall be fabricated from material suitable to the fence on either side of the gate opening. Material for highway fence gates shall be according to OPSS 1540. Material for chain-link fence gates shall be according to OPSS 1541.

492.05.09 Guide Rail

Guide rail material shall be according to OPSS 721.

492.05.10 Concrete

Concrete for sidewalks shall be according to OPSS 351.

Concrete for curb and gutter shall be according to OPSS 353.

492.07 CONSTRUCTION

492.07.01 General

All disturbed areas shall be restored to an equivalent or better condition than existed prior to the commencement of construction.

492.07.02 Grading

Rough grading shall be performed to the levels, grades, and contours as specified in the Contract Documents allowing for the placement of surface materials. Soil shall not be disturbed within the drip line of trees and shrubs during grading.

Final grading shall be performed to the lines and elevations specified in the Contract Documents. The final grading shall be according to OPSS 206.

492.07.03 Roadway Restoration

The restoration of the roadway shall be scheduled to follow closely behind trench backfilling. The roadway shall be made and maintained safe for the passage of vehicular and pedestrian traffic after completion of backfilling and until permanent restoration takes place, as specified in the Contract Documents.

Granular subbase and base courses of the type specified in the Contract Documents shall be placed on the prepared subgrade to the dimensions specified in the Contract Documents and shall be according to OPSS 314.

The surface course of the type specified in the Contract Documents shall be placed on the prepared base course to the dimensions specified in the Contract Documents in accordance as follows:

- a) Asphalt pavement shall be according to OPSS 310 or OPSS 313 as specified in the Contract Documents.
- b) Concrete paving shall be not less than 150 mm in thickness and shall be according to OPSS 350.

- c) Gravel surface courses shall be according to OPSS 314.
- d) Surface treatment shall be according to OPSS 304.

492.07.04 Fences and Guide Rails

Fences and guide rails shall be restored with the same type of fence or guide rail that existed prior to construction along the lines and levels specified in the Contract Documents. A maximum clearance of 150 mm from ground level shall be maintained at any point along the fence line.

The erection of highway fence shall be according to OPSS 771.

The erection of chain-link fence shall be according to OPSS 772.

Posts for fences other than highway and chain-link fences shall be installed to the spacing that existed prior to construction.

Gates shall be installed at the same location and height as the gates that existed prior to construction. Gate size shall be according to the dimensions of the gate that existed prior to construction. Gates shall be secured with fittings to match the fence complete with latches, hinges, stops, and all necessary fittings.

Colour and finish material of the restored fence shall match the existing colour scheme and finish material. Where required, two coats of finish material shall be applied.

The construction of guide rails shall be according to OPSS 721.

492.07.05 Topsoil

Topsoil shall be placed after final grading operations have been completed and immediately prior to seeding or sodding operations. Topsoil shall be obtained from stockpiles prepared according to OPSS 490 or, if the required quantity is not obtainable from stockpiles, the Contractor shall import the required topsoil.

The quality of the topsoil and the construction methods for placing topsoil shall be according to OPSS 802. Stockpile sites within or adjacent to the Contract limits shall be restored to the original condition or to a condition acceptable to the Contract Administrator.

492.07.06 Shrub and Tree Replanting

Shrubs and trees shall be replanted as specified in the Contract Documents.

492.07.07 Sodding and Seeding

Lawns and grassed areas shall be sodded or seeded and covered as specified in the Contract Documents.

Sodding shall be according to OPSS 803.

Seeding and cover shall be according to OPSS 804.

492.07.08 Sidewalk and Concrete Curb and Gutter Systems

Concrete sidewalk shall be placed according to OPSS 351. Alignment and dimensions shall match existing sidewalk on either end of the restored sidewalk. Damaged sections of any sidewalk slab shall be removed and replaced to the nearest joint on either end of the damaged section.

Concrete curb and gutter systems shall be placed according to OPSS 353. Alignment and dimensions shall match the existing curb and gutter systems on either side of the restored curb and gutter. Damaged sections of curb and gutter shall be removed and replaced to the nearest joint or neat saw cut.

Placement of Granular A shall be according to OPSS 314 with a minimum depth of 100 mm as a base for the curb and gutter and sidewalk.

492.07.09 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

492.10 BASIS OF PAYMENT

Payment at the Contract price for the appropriate tender items for the installation of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, watermain and associated appurtenances, and other underground utilities; maintenance holes, catch basins, ditch inlets, or valve chambers; and any other specified subsurface construction shall be full compensation for all labour, Equipment, and Material to do the work of site restoration.

When the Contract contains separate items for work required by this specification, payment shall be at the Contract prices and according to the specifications for such work.

Appendix 492-A, November 2015 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Levels, grades, and contours for rough grading. (492.07.02)
- Lines and elevations for final grading. (492.07.02)
- Requirements for temporary roadway. (492.07.03)
- Type of granular subbase and base courses and surface course. (492.07.03)
- Dimensions of the granular subbase and base courses and surface course. (492.07.03)
- OPSS 310 or OPSS 313 for asphalt pavement. (492.07.03, a))
- Lines and levels for restoration of fences and guide rails. (492.07.04)
- Replanting of shrubs and trees. (492.07.06)
- Sodding or seeding and cover of lawns and grassed areas. (492.07.07)

Designer should determine if the Contract is to have separate items to cover the various components of site restoration or if the items for the installation of pipelines, utilities, and their associated structures will be all inclusive to cover the work. If separate items are desired, they should then be included in the Contract Documents along with the details of the work.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 912.101 to 912.532	Guide Rail System, Steel Beam
OPSD 913.101 to 913.130	Guide Rail System, Cable
OPSD 971.101 to 971.102	Fence, Highway Installation
OPSD 972.101 to 972.131	Fence, Chain-Link



CONSTRUCTION SPECIFICATION FOR TEMPORARY POTABLE WATER SUPPLY SERVICES

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493.10	BASIS OF PAYMENT

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493-A	Commentary

493.01	SCOPE

This specification covers the requirements for the installation of temporary watermain, service connections, and associated appurtenances prior to disconnecting service of an existing watermain on a temporary basis.

493.01.01 Specification Significance and Use

This specification has been developed for use in provincial and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

493.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

493.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 441	Watermain Installation in Open Cut

CSA Standards

B64.5-94	Double Check Valve (DCVA) Backflow Preventers [Part of B64 Series-07, Backflow Preventers and Vacuum Breakers Compendium]

American Water Works Association (AWWA)

C510-07	Double Check Valve Backflow Prevention Assembly

ASTM International

D 1784-11	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
D 2241-15	Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
D 3139-98 (2001)	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
F 477-14	Elastomeric Seals (Gaskets) for Joining Plastic Pipe

NSF International

61-2014a Drinking Water System Components - Health Effects

493.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Associated Appurtenance means structures, devices, and appliances, other than pipe and conduit that are used in connection with a water distribution system, such as valves, hydrants, corporation cocks, services, and thrust restraints.

Excavation, Earth and Rock means the excavation classified as earth and rock according to OPSS 206.

Temporary Hydrant means temporary fire hydrant and all associated temporary appurtenances.

Temporary Potable Water Supply Services means temporary watermains, services, hydrants, and all associated appurtenances.

Temporary Services means temporary potable water supply services installed on or just below the ground surface for the purpose of providing potable water to customers while the existing watermain is out of service.

Temporary Watermain means temporary potable water supply hose or pipe installed on or just below the ground surface for the purpose of providing potable water to temporary services and temporary fire hydrants while the existing watermain is out of service.

Watermain means an installation designed for the conveyance of water under pressure using circular pipe.

493.04

DESIGN AND SUBMISSION REQUIREMENTS

493.04.01

Submission Requirements

The following information shall be submitted to the Contract Administrator 14 Days prior to the commencement of any work requiring temporary potable water supply services:

- a) Temporary potable water supply services plans including installation, operation, testing procedures, and a list of material and equipment to be used.
- b) Temporary hydrant details.

493.05 MATERIALS

493.05.01 General

The pipe size, type, and class shall be as specified in the Contract Documents.

Fittings shall be suitable for and compatible with the pipe material and class with which they are used.

All materials in contact with potable water shall be NSF/ANSI 61 compliant and, if being reused, shall have been used exclusively for potable water services in the past.

All materials shall be capable of withstanding 860 kPa pressure and all other conditions of use.

493.05.02 Temporary Potable Water Supply Services

The pipe, hose, and all other materials used in conjunction with the temporary potable water supply services shall be as follows:

- a) Flexible hose jackets shall be abrasion resistant, either double jacket or specially coated, and be capable of being driven over by vehicles periodically without short term effects.
- b) Hose lining shall be of material that does not impart any taste or odour to the water.
- c) Hose shall come complete with aluminium couplings with threads.
- d) Rigid pipe shall be made of class 12454-B PVC material according to ASTM D 1784. Material shall have a minimum hydrostatic design stress of 14 MPa.
- e) PVC shall be formulated with impact modifiers, heat stabilizers, and ultraviolet inhibitors.
- f) Pipe extrusion shall meet or exceed all requirements of ASTM D 2241.
- g) Joints and couplings shall be according to ASTM D 3139.
- h) O-rings shall be according to ASTM F 477.
- i) Double check valve backflow preventers shall be according to CSA B64.5 and AWWA C510.

493.05.03 Valves

Valves shall be according to OPSS 441.

493.05.04 Temporary Hydrants

Temporary hydrants shall be as specified in the Contract Documents.

493.07 CONSTRUCTION

493.07.01 General

Written notices to all affected property owners are required a minimum of 48 hours prior to any disruption of water service as a result of the temporary by-pass.

Temporary water services shall be connected to the temporary watermain for each single residential unit or other building.

Connection to the private plumbing system of a residential unit shall be via a wye at an outside tap or an existing water service as specified in the Contract Documents. The connection of single residential units in series is not permitted. Each temporary water service shall have its own valved connection to the temporary watermain.

Connection to other buildings shall be as specified in the Contract Documents.

An adequate water supply shall be available at all times. If the temporary potable water supply service fails, it shall be restored within the time period specified in the Contract Documents.

Care shall be exercised during the installation of temporary potable water supply services to avoid contamination of the services.

No work shall be done during freezing weather, unless directed by the Contract Administrator. No temporary watermains or temporary water services shall be installed or operated during freezing weather. Pipes already in use shall be removed or drained and existing services restored when so directed by the Contract Administrator.

493.07.02 Temporary Watermains

The temporary watermain shall be of a size to provide adequate water supply during peak demand of connected users.

At any connection of a temporary watermain to the water supply and distribution system (e.g., at hydrants) a double check valve backflow preventer shall be installed. Source connections shall be as specified in the Contract Documents.

493.07.03 Temporary Potable Water Supply Services

Temporary potable water supply services for single residential units shall be a minimum of 19 mm inside diameter. Temporary potable water supply services for other users, including flow to maintain fire protection systems, shall be as specified in the Contract Documents.

The temporary potable water supply service connections shall be valved near the point of connection to the temporary watermain and also valved near the point of connection to a private plumbing system so that both the temporary watermain and the temporary potable water supply services may be disinfected.

493.07.04 Temporary Hydrants

When a hydrant is removed from service, a temporary hydrant and the necessary valves and fittings shall be installed and maintained according to the Contract Documents.

Before permanently shutting down the existing watermain, the temporary hydrants shall be tested to ensure that they are in proper working order.

The hydrants that are out of service during construction operations shall be bagged and clearly marked with a "HYDRANT OUT OF SERVICE" tag.

Once in use, the temporary hydrants shall be maintained until the existing or new hydrants are restored to service.

All temporary potable water supply service attachments to fire hydrants shall be easily removable for fire fighting purposes.

All temporary hydrants shall have reflective tape on the barrel for increased visibility. The temporary hydrants shall stand in an upright position at all times.

493.07.05 Valves

Valves shall be installed at each branch of a temporary watermain.

Before permanently shutting down the existing watermain, the valves shall be tested to ensure that they are in proper working order.

493.07.06 Protection

The Contractor shall provide protection of the temporary potable water supply services at locations such as road crossings, sidewalks, driveways, and walkways.

When temporary watermains cross over the roadway, the asphalt pavement shall be saw cut and removed and the temporary watermain shall be buried. Under no circumstance is a pipe road crossing to remain open and unprotected from vehicular and pedestrian traffic. If a concrete road base exists, it shall not be disturbed.

When temporary potable water supply services are used on full right-of-way reconstruction projects, the temporary potable water supply service piping shall also be buried at all sidewalks, driveways, and walkways.

When temporary potable water supply services are used on projects when the road surface is not being reconstructed, the temporary service piping shall be buried only at all road crossings. When temporary watermains or temporary potable water supply services cross a driveway or a sidewalk, asphalt or another acceptable material shall be mounded over the pipe. A polyethylene sheet shall be placed as a barrier on concrete or interlocking driveways. If the work performed or material used is not to the satisfaction of the Contract Administrator, action shall be taken to rectify the problem. Safety flashers and barricades, as may be required, shall be furnished and maintained. In general, the temporary potable water supply service pipe shall be laid where it causes the least obstruction and is least likely to be damaged.

The Contractor shall protect the temporary potable water supply services installed across all road crossings, sidewalks, driveways, and walkways during the extent of the construction schedule. This shall include earth excavation, backfill, asphalt reinstatement, and ramping material required as directed by the Contract Administrator.

The Contractor shall provide adequate signage at locations where hoses are exposed and may present a public safety hazard, such as blow off hoses at catchbasins.

493.07.07 Leakage Testing

The temporary potable water supply service shall be watertight.

Leakage testing shall be conducted in the presence of the Contract Administrator upon completion of the watermain, including services. All leaks shall be repaired prior to covering the pipe.

493.07.08 Flushing and Disinfecting Temporary Watermains and Services

Flushing and disinfecting operations shall be conducted in the presence of the Contract Administrator. The Contract Administrator shall be notified at least 2 Business Days in advance of the proposed date on which flushing and disinfecting operations are to commence. Watermains shall be flushed in a sequence approved by the Contract Administrator. All temporary watermains and services shall be flushed at a flow velocity adequate to remove any foreign debris and until the discharged water runs clear.

After flushing is completed, water from the existing distribution system shall be allowed to flow at a controlled rate into the new temporary watermain. Liquid chlorine solution shall be introduced so that the chlorine is distributed throughout the section being disinfected at chlorine concentration of 50 mg/litre minimum throughout the section. The system shall be left charged with the chlorine solution for 24 hours.

Sampling and testing for chlorine residual shall be carried out in the presence of the Contract Administrator. The chlorine residual shall be tested in the section after 24 hours. If tests indicate a chlorine residual of 25 mg/litre minimum, the section shall be flushed completely and recharged with water normal to the operation of the system. If the test does not meet the requirements, the chlorination procedure shall be repeated until satisfactory results are obtained.

Twenty-four hours after the system has been recharged and ready for operation, the Contract Administrator shall ensure that samples are taken for bacteriological tests. Samples shall be collected from every 350 m of the new watermain plus one sample from each end of each line and at least one sample from each branch. If there is indication of contamination, the disinfection procedure shall be repeated.

The temporary water supply service shall not be put into operation or the existing watermain removed from operation until approval has been given by the Contract Administrator.

Regular sampling and testing for chlorine residual shall be carried out by the Contract Administrator.

493.07.09 Removal of Temporary Potable Water Supply Services

Temporary potable water supply services may be used from approximately mid-April to mid-October. All temporary services shall be completely removed by mid-November. Any variation from this schedule shall be approved by the Contract Administrator.

493.07.10 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

All chlorinated water used for testing, flushing, or disinfecting watermains shall be directed to an acceptable outlet in a manner that meets the requirements of all applicable regulations. The method of disposal of chlorinated water is subject to the approval of the Contract Administrator.

493.10 BASIS OF PAYMENT

493.10.01 Temporary Potable Water Supply Services - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

On completion of the supply, installation, flushing, disinfecting, and testing of the temporary potable water supply services prior to putting it in operation, a progress payment to 60% of the above item shall be made. The balance shall be prorated over the remainder of the working period.

Removal or draining of the temporary potable water supply services during freezing weather and its subsequent return to service shall be at no additional cost to the Owner.

Appendix 493-A, November 2009
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer may consider including soil boring data, a geotechnical report, a subsurface report, or a soils report in the Tender Documents.

The designer should include the following in the Contract Documents:

- Pipe size, type, and class. (493.05.01)
- Temporary hydrant requirements. (493.05.04)
- Temporary potable water supply services connection requirements to buildings other than single residential units. (493.07.01)
- Time requirements for restoring the temporary potable water supply service should it fail. (493.07.01)
- Temporary potable water supply services to buildings other than single residential units, including flow to maintain fire protection systems. (493.07.03)
- Temporary hydrant and the necessary valves and fittings to be installed and maintained. (493.07.04)

Where conditions of high ground water exist, external fluids may enter via air release and air/vacuum release valves, therefore, appropriate measures shall be taken.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 1104.030 25 mm Blow Off Installation



NOTICE TO USERS OF OPSS 501

CONSTRUCTION SPECIFICATION FOR COMPACTING

OPSS 501 has been removed from this
OPS volume

The provincial version of OPSS 501 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 501

The municipal version of OPSS 501 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 501

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



**CONSTRUCTION SPECIFICATION FOR
SITE PREPARATION FOR PIPELINES,
UTILITIES, AND ASSOCIATED STRUCTURES**

References to OPSS 503 shall be deemed to mean
OPSS 490, Construction Specification for
Site Preparation for Pipelines,
Utilities, and Associated Structures

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 490:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



**CONSTRUCTION SPECIFICATION FOR
PRESERVATION, PROTECTION, AND
RECONSTRUCTION OF EXISTING FACILITIES**

References to OPSS 504 shall be deemed to mean
OPSS 491, Construction Specification for
Preservation, Protection, and
Reconstruction of Existing Facilities

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 491:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR DUST SUPPRESSANTS

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506.10	BASIS OF PAYMENT

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506-A	Commentary

506.01 SCOPE

This specification covers the requirements for dust suppressants and their application.

506.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

506.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

506.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Material

OPSS 2501	Calcium Chloride
OPSS 2503	Magnesium Chloride Solid and Magnesium Chloride Solution

Others

Environmental Protection Act, Ontario Regulation 347, General - Waste Management - R.R.O. 1990

Ministry of the Environment (MOE) - Certificate or Provisional Certificate of Approval for a Dust Suppression Waste Management System

506.04 DESIGN AND SUBMISSION REQUIREMENTS

506.04.01 Submission Requirements

Dust suppressants other than water, calcium chloride solid, calcium chloride solution, magnesium chloride solid, magnesium chloride solution, and calcium-magnesium chloride blend, or as specified in the Contract Documents shall be approved by the Contract Administrator. The following shall be submitted with a request to approve the dust suppressant within one week of execution of the Contract:

- a) The name of the material.
- b) The name of the manufacturer or supplier.
- c) The manufacturer's guidelines and recommendations for application rates that meet or exceed the performance of calcium chloride or magnesium chloride.

Dust suppressants containing waste material shall be as approved by the Contract Administrator. A copy of a Certificate or Provisional Certificate of Approval for a Dust Suppression Waste Management System shall also be included with the request to approve the dust suppressant. The certificate shall be valid for:

- a) The entire period of the Contract.
- b) The entire area within the limits of the Contract and the entire haul route.
- c) The equipment to be utilized.
- d) The point of supply.
- e) The relevant Ministry of Environment waste classification.
- f) Mixtures with any other material, with the exception of water, if mixtures are to be applied.

Prior to the application of dust suppressants containing waste material, the Contract Administrator shall be provided with a completed blue coloured copy (#5) of the Ontario Regulation 347, General - Waste Management manifest for each shipment of waste.

506.05 MATERIALS

506.05.01 Water

Water shall be free of contaminants that could adversely affect fill material or the environment.

Water shall be free of foreign material that would alter the dust suppressant solution or cause blockage in the spray equipment.

506.05.02 Calcium Chloride Solid, Calcium Chloride Solution, and Calcium-Magnesium Chloride Blend

Calcium chloride solid, calcium chloride solution, and calcium-magnesium chloride blend shall be according to OPSS 2501.

Calcium chloride solution may be substituted for calcium chloride solid.

506.05.03 Magnesium Chloride Solid and Magnesium Chloride Solution

Magnesium chloride solid and magnesium chloride solution shall be according to OPSS 2503.

Magnesium chloride solution may be substituted for magnesium chloride solid.

506.06 EQUIPMENT

506.06.01 General

Application equipment shall be capable of distributing the dust suppressant in a uniform manner at an application rate specified in the Contract Documents.

506.06.02 Pressure Distributors

Pressure distributors shall be propelled by a power unit capable of accurately maintaining any speed required for spraying and shall be provided with the following minimum equipment:

- a) A pump capable of developing in the spray manifold a constant uniform pressure to sustain the required application.
- b) A pressure gauge indicating the pressure within the spray bar graduated in increments of 15 kPa or less and visible to the operator.
- c) A rear mounted spray bar having a cab-activated positive and instant shut off that can be set at variable heights parallel to the surface and to any spraying width from 1 to 3 m to spray any portion of the roadway surface, including the shoulders. The spray bar nozzles shall be:
 - i. All of the same manufacture and size.
 - ii. Clean and in good working condition.
 - iii. Designed and set to ensure uniform fan shaped spray without atomization.

Nozzles shall be set in the spray bar at an angle permitting each spray fan to overlap adjacent spray fans in such a manner that complete coverage of the spray area is maintained should there be a malfunction of one nozzle.

- d) A strainer installed in the feed system to prevent clogging of the spray bar nozzles.
- e) A device or method that allows the operator to determine the volume remaining in the tank to an accuracy of 200 litres.
- f) Splash guards or other approved devices for shoulder spraying that shall permit spraying immediately adjacent to the pavement without over-spraying the pavement surface.
- g) A system (e.g., meter, GPS device, ground speed sensors, or calibration charts) that allows the operator to determine the rate of application with accuracy while spreading the dust suppressant.

506.07 CONSTRUCTION

506.07.01 General

Dust suppressants shall be applied according to the obligations imposed by any Certificate or Provisional Certificate of Approval for a Dust Suppression Waste Management System.

Water shall be the only dust suppressant applied within two weeks before the placement of any asphaltic concrete materials or the application of surface treatments.

Approved dust suppressants other than water, calcium chloride solid, calcium chloride solution, magnesium chloride solid, magnesium chloride solution, and calcium-magnesium chloride blend shall be applied according to the manufacturer's guidelines and application rates.

Steps shall be taken as necessary to control dust resulting from operations or by public traffic such that it does not:

- a) affect traffic,
- b) enter surface waters, or
- c) escape beyond the right-of-way to cause a nuisance to residents, businesses, or utilities.

Dust suppressants shall be applied in a manner that avoids ponding, runoff, drifting, and tracking of the material beyond the area of application.

Dust suppressant application shall not proceed during periods of rain when the surface is in a saturated condition or on areas of ponded water.

Dust suppressants other than water shall not be applied when weather forecasts indicate a high probability of rainfall in order to minimize loss of the material from the intended area of application. Areas receiving rainfall within 6 hours after application may require reapplication of the material.

Dust suppressants containing waste material shall not be stored on the Owner's property.

506.07.02 Dust Suppressant Solution

Dust suppressant solutions shall be applied by a pressure distributor. The application rate per kilometre shall be confirmed by running 250 m test sections in the presence of the Contract Administrator. Solution application rates shall be measured in t/km or in L/m².

For the maintenance of existing roadways, dust suppressant solutions shall be applied to a prepared surface. Work shall commence within 3 Working Days of receiving notice from the Contract Administrator and shall proceed continuously until completed.

506.07.03 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

506.09 MEASUREMENT FOR PAYMENT

506.09.01 Water for Dust Suppression

Measurement of water for dust suppression shall be by volume in cubic metres by one of the following methods for the quantity used in the work:

- a) The mass of the water shall be determined by weighing according to the Contract Documents and shall be the difference between the mass of the empty water tank and carrying vehicle and the mass of the full tank and carrying vehicle. The mass of the water shall be converted to cubic metres using a factor of 1,000 kg to 1 m³.
- b) The water tank shall be measured and its volume computed in cubic metres.

c) The water shall be measured through a water meter acceptable to the Contract Administrator.

506.09.02 Calcium Chloride Solid and Magnesium Chloride Solid

Measurement for calcium chloride solid and magnesium chloride solid shall be by mass in kilograms.

506.09.03 Calcium Chloride Solution

Measurement of calcium chloride solution shall be by mass in tonnes of solution, by volume in litres of solution, or by mass of equivalent solid as specified in the Contract Documents. The mass and volumetric measurement of calcium chloride solution shall be according to OPSS 2501.

506.09.04 Magnesium Chloride Solution

Measurement of magnesium chloride solution shall be by mass in tonnes of solution, by volume in litres of solution, or by mass of equivalent solid as specified in the Contract Documents. The mass and volumetric measurement of magnesium chloride solution shall be according to OPSS 2503.

506.09.05 Calcium-Magnesium Chloride Blend

Measurement of calcium-magnesium chloride blend shall be by mass in tonnes of solution or by volume in litres of solution as specified in the Contract Documents. The mass and volumetric measurement of calcium-magnesium chloride blend shall be according to OPSS 2501.

506.10 BASIS OF PAYMENT

**506.10.01 Water for Dust Suppression - Item
Calcium Chloride Solid - Item
Calcium Chloride Solution - Item
Magnesium Chloride Solid - Item
Magnesium Chloride Solution - Item
Calcium-Magnesium Chloride Blend - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

When the Contract does not contain a separate tender item for any of the above items, the Contract price for the applicable tender item for which dust suppression is required shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 506-A, November 2013
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- The dust suppressant material by type. (506.04.01)
- Method of measurement for dust suppressant solution. (506.09.03, 506.09.04, 506.09.05)
- A tender item for payment of a dust suppressant. (506.10.01)

When a dust suppressant other than water, calcium chloride solid, calcium chloride solution, magnesium chloride solid, magnesium chloride solution, or calcium-magnesium chloride blend is to be applied, the concentration and the volumetric conversion should be identified.

The proper use and application of all dust suppressants is the responsibility of the applicator and is subject to applicable Ministry of Environment requirements under legislation such as the *Environmental Protection Act* (EPA) and the *Ontario Water Resources Act*.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



**CONSTRUCTION SPECIFICATION FOR
SITE RESTORATION FOLLOWING INSTALLATION OF
PIPELINES, UTILITIES, AND ASSOCIATED STRUCTURES**

References to OPSS 507 shall be deemed to mean
OPSS 492, Construction Specification for
Site Restoration Following Installation of
Pipelines, Utilities, and Associated Structures

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 492:

- The specification was reviewed by an OPS specialty committee, and some of the technical content has changed.
- The specification designation, publication date, and references to other renumbered specifications have been changed.



NOTICE TO USERS OF OPSS 510

CONSTRUCTION SPECIFICATION FOR REMOVAL

OPSS 510 has been removed from this
OPS volume

The provincial version of OPSS 510 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 510

The municipal version of OPSS 510 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 510

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



CONSTRUCTION SPECIFICATION FOR RIP-RAP, ROCK PROTECTION, AND GRANULAR SHEETING

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511.07	CONSTRUCTION
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511.09	MEASUREMENT FOR PAYMENT
511.10	BASIS OF PAYMENT

APPENDICES

511-A	Commentary

511.01 SCOPE

This specification covers the requirements for the installation of rip-rap, rock protection, granular sheeting, and geotextile.

511.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

511.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

511.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications shall be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications shall be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1860	Geotextiles

511.05 MATERIALS

511.05.01 Rip-Rap, Rock Protection, and Granular Sheeting

Rip-rap shall be according to OPSS 1004 and as specified in the Contract Documents.

Rock protection and granular sheeting shall be according to OPSS 1004.

511.05.02 Geotextile

Geotextile shall be nonwoven, Class II according to OPSS 1860, with an FOS of 75-150 µm, unless otherwise specified in the Contract Documents.

511.07 CONSTRUCTION

511.07.01 Excavation

Prior to placing any material, the area shall be excavated or filled or both to the lines and dimensions specified in the Contract Documents and fine graded to a uniform even surface.

511.07.02 Placing Material

511.07.02.01 General

Material shall be placed to the lines and dimensions specified in the Contract Documents.

When rip-rap or rock protection is being placed on slopes, the rock shall commence at the toe of the slope and progress up the slope.

When geotextile is specified in the Contract Documents, rip-rap, rock protection, and granular sheeting shall be placed in a manner so as not to damage the geotextile.

511.07.02.02 Rip-Rap

Rip-rap shall be placed in a set and stable manner, flat on the slope with the largest dimension parallel to the slope contours. The larger pieces of rip-rap shall be placed in the bottom courses. The rip-rap shall be laid closely so that a reasonable semblance of courses is achieved. Smaller pieces of rip-rap shall be used to fill the voids.

511.07.02.03 Rock Protection

Rock protection shall be placed in a random, but stable manner.

511.07.02.04 Granular Sheeting

Granular sheeting operations shall follow earth excavation operations as closely as practical and possible.

Compaction of granular sheeting material is not required.

511.07.02.05 Geotextile

Geotextile shall be free of folds, tears, and punctures and as specified in the Contract Documents. The geotextile shall be joined so that the material overlaps a minimum of 500 mm and shall be pinned together. Alternatively, the geotextile shall be joined to conform to the seam requirements of OPSS 1860.

Geotextiles shall be fixed to prevent movement during installation. Geotextile shall be wrapped down into the ground a minimum 300 mm at termination points.

511.07.03 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

511.09 MEASUREMENT FOR PAYMENT

511.09.01 Actual Measurement

511.09.01.01 Rip-Rap

Measurement of rip-rap shall be by area in square metres following the contour of the ground.

511.09.01.02 Rock Protection

Measurement of rock protection shall be by volume in cubic metres. The volume is a product of the area of the rock protection measured following the contour of the ground by its depth.

Truck box measurement shall be used when it is not possible to take an in place measurement.

511.09.01.03 Granular Sheeting

Measurement of granular sheeting shall be by area in square metres following the contour of the ground.

511.09.01.04 Geotextile

Measurement of geotextile shall be by area in square metres following the contour of the ground, without any allowance made for overlaps.

511.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

511.10 BASIS OF PAYMENT

**511.10.01 Rip-Rap - Item
Rock Protection - Item
Granular Sheeting - Item
Geotextile - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

When there is not a separate tender item for geotextile, payment for the geotextile shall be included in the tender item for rip-rap, rock protection, or granular sheeting, as appropriate.

Appendix 511-A, November 2013
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Gradation requirements of rip-rap as per Table 8 of OPSS 1004. (511.05.01)
- Use of alternate geotextile requirements for site or project specific applications. (511.05.02)
- Lines and dimensions for excavation of rip-rap, rock protection, or granular sheeting areas. (511.07.01)
- Lines and dimension for placement of material. (511.07.02.01)
- Geotextile locations, if required. (511.07.02.01)
- Placement requirements for geotextile. (511.07.02.05)

The designer should determine if fish and fish habitat are present when placement of rip-rap, rock protection, or gravel sheeting in a watercourse is being considered. When fish and fish habitat are present, the designer should consider other options such as bioengineering techniques in consultation with relevant experts.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 810.010	General Rip-Rap Layout for Sewer and Culvert Outlets
OPSD 810.020	General Rip-Rap Layout for Ditch Inlets



NOTICE TO USERS OF OPSS 512

CONSTRUCTION SPECIFICATION FOR INSTALLATION OF GABIONS

OPSS 512 has been removed from this
OPS volume

The provincial version of OPSS 512 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 512

The municipal version of OPSS 512 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 512

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



**CONSTRUCTION SPECIFICATION FOR
TRENCHING, BACKFILLING, AND COMPACTING**

References to OPSS 514 shall be deemed to mean
OPSS 401, Construction Specification for
Trenching, Backfilling, and Compacting

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 401:

- The specification was reviewed by an OPS specialty committee, and some of the technical content has changed.
- The specification designation, publication date, and references to other renumbered specifications have been changed.



**CONSTRUCTION SPECIFICATION FOR
ROCK EXCAVATION FOR PIPELINES, UTILITIES,
AND ASSOCIATED STRUCTURES IN OPEN CUT**

References to OPSS 515 shall be deemed to mean
OPSS 403, Construction Specification for
Rock Excavation for Pipelines, Utilities,
and Associated Structures in Open Cut

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 403:

- The specification was reviewed by an OPS specialty committee, and some of the technical content has changed.
- The specification designation, publication date, and references to other renumbered specifications have been changed.



**CONSTRUCTION SPECIFICATION FOR
EXCAVATING, BACKFILLING, AND COMPACTING
FOR MAINTENANCE HOLES, CATCH BASINS,
DITCH INLETS, AND VALVE CHAMBERS**

References to OPSS 516 shall be deemed to mean
OPSS 402, Construction Specification for
Excavating, Backfilling, and Compacting
for Maintenance Holes, Catch Basins,
Ditch Inlets, and Valve Chambers

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 402:

- The specification was reviewed by an OPS specialty committee, and some of the technical content has changed.
- The specification designation, publication date, and references to other renumbered specifications have been changed.



**CONSTRUCTION SPECIFICATION FOR
DEWATERING OF PIPELINE, UTILITY, AND
ASSOCIATED STRUCTURE EXCAVATION**

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517.09	MEASUREMENT FOR PAYMENT - Not Used
517.10	BASIS OF PAYMENT

APPENDICES

517-A	Commentary

517.01 SCOPE

This specification covers the requirements for dewatering procedures to stabilize the ground and keep excavations free of water during installation of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, watermains and associated appurtenances, and other underground Utilities; maintenance holes, catch basins, ditch inlets, and valve chambers; and any other specified subsurface construction.

517.01.01 Specification Significance and Use

This specification has been developed for use in provincial and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

517.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

517.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 412	Sewage Forcemain Installation in Open Cut
OPSS 441	Watermain Installation in Open Cut
OPSS 518	Control of Water From Dewatering Operations

517.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Associated Appurtenances mean as defined in OPSS 412 and OPSS 441.

Surrounding Area means as specified by the Ministry of the Environment (MOE) or as specified in the Contract Documents.

517.04 DESIGN AND SUBMISSION REQUIREMENTS

517.04.01 Submission Requirements

The following information shall be submitted to the Contract Administrator for review at least two weeks prior to the commencement of dewatering operation:

- a) Unless provided in the Contract Documents, the permit issued by MOE for taking water from a ground water source, if required.
- b) Monitoring and contingency plans that address potential impacts to items such as, but not limited to, settlement, ground water usage and electrical and mechanical equipment failures.
- c) Stand-by power or pumping capacity or both, if required by the Contract Documents.
- d) Calibration documentation for the flow metering system.

517.07 CONSTRUCTION

517.07.01 Dewatering

A continuous dewatering operation shall be provided to keep the excavation stable and free of water. The excavation shall be monitored to ensure it remains stable and free of water.

The dewatering system shall be maintained and the surrounding area monitored for impacts to items such as, but not limited to, settlement and ground water usage. Any impacts shall be immediately reported to the Contract Administrator.

When a stand-by power or pumping system or both are required, they shall be as specified in the Contract Documents, and shall be installed on-site.

The availability, location, and use of automatic transfer switching shall be as specified in the Contract Documents.

Dewatering shall be discontinued in a manner so that disturbance of any structure or pipeline is avoided.

517.07.02 Control of Water

The control of water shall be according to OPSS 518.

517.07.03 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

517.10 BASIS OF PAYMENT

Payment at the Contract price for the appropriate tender items for the installation of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, watermain and associated appurtenances, and other underground Utilities; maintenance holes, catch basins, ditch inlets, or valve chambers; and any other specified subsurface construction shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 517-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer may consider including soil boring data, a geotechnical report, a subsurface report, or a soils report in the Tender Documents.

The designer should specify the following in the Contract Documents:

- Surrounding area. (517.03)
- Stand-by power or pumping capacity or both. (517.04.01)
- When required, stand-by power or pumping system or both. (517.07.01)
- Availability, location, and use of automatic transfer switching, based on site conditions, impacts, and risk assessment. (517.07.01)

Due to the time required, the designer should consider obtaining the dewatering permit to avoid delays. (517.04)

The need for a specific dewatering scheme should be determined. If a specific dewatering scheme is necessary, it should be specified in the Contract Documents.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR CONTROL OF WATER FROM DEWATERING OPERATIONS

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518.08	QUALITY ASSURANCE - Not Used
518.09	MEASUREMENT FOR PAYMENT - Not Used
518.10	BASIS OF PAYMENT

APPENDICES

518-A	Commentary

518.01 SCOPE

This specification covers the requirements for the control of uncontaminated water from dewatering operations to ensure that the water quality meets acceptable limits prior to discharge.

518.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

518.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

518.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 805 Temporary Erosion and Sediment Control Measures

Federal Government Publication

Fisheries Act, R.S., 1985 c. F-14

518.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Dewatering Operation means pumping, baling, temporary ditching, or vacuum removal of uncontaminated groundwater, rain water, melt water, surface run-off, water pipe leakage from excavations and trenches or within sheeted cofferdams to improve the soil stability or for other construction purposes.

Natural Attenuation Area means a dry flat-grassed meadow or open area with existing vegetation that is not subject to erosion.

Sediment means solid material, both mineral and organic, that is in suspension; is being transported; or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth surface.

Sediment Control Device means a settling pond, excavated sediment trap or basin, dewatering trap, or temporary sediment control measure according to OPSS 805.

Uncontaminated Water means any water that does not contain any deleterious substances or class of substances as defined under Section 34(1) of the Fisheries Act, and will not degrade the quality of the receiving water.

518.07 CONSTRUCTION

518.07.01 Disposal of Water

Water shall be disposed of so as not to be injurious to public health or safety, property, the environment, fisheries, or any part of the work completed or under construction. Dewatering operations shall be directed to a sediment control device or natural attenuation area prior to discharge to watercourses. If a natural attenuation area is used, a minimum 15 m setback shall be maintained from the receiving watercourse. When water is discharged to a watercourse, the water discharged shall be done in a manner that does not cause erosion or other damage to adjacent lands.

When required, a permit issued by the Ministry of the Environment (MOE) for taking water from a groundwater source shall be obtained.

518.07.02 Surface Drainage

Gutters shall be kept clear at all times for surface drainage. The flow of water shall not be directed across or over pavements or sidewalks, except through approved pipes or properly designed and constructed methods.

To protect against adverse impacts resulting from erosion and sedimentation, surface drainage from dewatering operations shall be intercepted and controlled using properly designed filtering or impoundment methods or both.

518.07.03 Settling Ponds and Sediment Traps or Basins

Settling ponds and sediment traps or basins shall be designed, constructed, and maintained according to OPSS 805 and as specified in the Contract Documents.

518.07.04 Temporary Erosion and Sediment Control Measures

The installation, maintenance, and removal of temporary erosion and sediment control measures shall be according to OPSS 805 and as specified in the Contract Documents.

518.07.05 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

518.10**BASIS OF PAYMENT**

Payment at the Contract price for the appropriate tender items associated with dewatering shall include full compensation for all labour, Equipment, and Material to do the work.

When the Contract contains separate items for work required by this specification, payment shall be at the Contract prices and according to the specifications for such work.

Appendix 518-A, November 2011 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should be aware that this specification is only for uncontaminated water sources.

The designer should specify the following in the Contract Documents:

- Construction requirements for settling ponds and sediment basins. (518.07.03)
- Types of erosion and sediment control measures. (518.07.04)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 219.100	Light-Duty Straw Bale Barrier
OPSD 219.110	Light-Duty Silt Fence Barrier
OPSD 219.130	Heavy-Duty Silt Fence Barrier
OPSD 219.150	Sandbag Barrier
OPSD 219.180	Straw Bale Flow Check Dam
OPSD 219.190	Silt Fence Flow Check Dam
OPSD 219.200	Sandbag Flow Check Dam
OPSD 219.210	Rock Flow Check Dam, V-Ditch
OPSD 219.211	Rock Flow Check Dam, Flat Bottom Ditch
OPSD 219.220	Excavated Sediment Trap in Ditch
OPSD 219.230	Chute for Excavated Sediment Trap
OPSD 219.231	Berm Barrier
OPSD 219.240	Dewatering Trap
OPSD 219.260	Turbidity Curtain
OPSD 219.261	Turbidity Curtain, Seam Detail



CONSTRUCTION SPECIFICATION FOR PAVEMENT MARKING

References to OPSS 532 shall be deemed to mean
OPSS 710, Construction Specification for
Pavement Marking

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 710:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR SUPPORT SYSTEMS

References to OPSS 538 shall be deemed to mean
OPSS 404, Construction Specification for
Support Systems

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 404:

- The specification was reviewed by an OPS specialty committee, and some of the technical content has changed.
- The specification designation, publication date, and references to other renumbered specifications have been changed.



NOTICE TO USERS OF OPSS 539

CONSTRUCTION SPECIFICATION FOR TEMPORARY PROTECTION SYSTEMS

OPSS 539 has been removed from this
OPS volume

The provincial version of OPSS 539 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 539

The municipal version of OPSS 539 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 539

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



CONSTRUCTION SPECIFICATION FOR STANDARD HIGHWAY FENCE

References to OPSS 540 shall be deemed to mean
OPSS 771, Construction Specification for
Standard Highway Fence

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 771:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR CHAIN-LINK FENCE

References to OPSS 541 shall be deemed to mean
OPSS 772, Construction Specification for
Chain-Link Fence

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 772:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR EXPANDED METAL ANTI-GLARE SCREEN

References to OPSS 542 shall be deemed to mean
OPSS 791, Construction Specification for
Expanded Metal Anti-Glare Screen

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 791:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR TRAFFIC CONTROL SIGNING

References to OPSS 543 shall be deemed to mean
OPSS 706, Construction Specification for
Traffic Control Signing

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 706:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR STEEL BEAM GUIDE RAIL AND CABLE GUIDE RAIL

References to OPSS 552 shall be deemed to mean
OPSS 721, Construction Specification for
Steel Beam Guide Rail and Cable Guide Rail

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 721:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR CONCRETE BARRIERS

References to OPSS 553 shall be deemed to mean
OPSS 740, Construction Specification for
Concrete Barriers

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 740:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



**CONSTRUCTION SPECIFICATION FOR
GUIDE RAIL END TREATMENT -
ECCENTRIC LOADER TERMINAL SYSTEM**

References to OPSS 555 shall be deemed to mean
OPSS 730, Construction Specification for
Guide Rail End Treatment -
Eccentric Loader Terminal System

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 730:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR CONNECTICUT IMPACT ATTENUATION SYSTEM

References to OPSS 556 shall be deemed to mean
OPSS 753, Construction Specification for
Connecticut Impact Attenuation System

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 753:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



**CONSTRUCTION SPECIFICATION FOR
GUIDE RAIL END TREATMENT -
CRASH-CUSHION ATTENUATING TERMINAL SYSTEM**

References to OPSS 558 shall be deemed to mean
OPSS 731, Construction Specification for
Guide Rail End Treatment -
Crash-Cushion Attenuating Terminal System

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 731:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



**CONSTRUCTION SPECIFICATION FOR
GUIDE RAIL END TREATMENT -
STEEL BEAM ENERGY ATTENUATING TERMINAL SYSTEMS**

References to OPSS 559 shall be deemed to mean
OPSS 732, Construction Specification for
Guide Rail End Treatment -
Steel Beam Energy Attenuating Terminal Systems

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 732:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR THE PROTECTION OF TREES

References to OPSS 565 shall be deemed to mean
OPSS 801, Construction Specification for
the Protection of Trees

The renumbered specification has been relocated to Division 8 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 801:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR TOPSOIL

References to OPSS 570 shall be deemed to mean
OPSS 802, Construction Specification for
Topsoil

The renumbered specification has been relocated to Division 8 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 802:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR SODDING

References to OPSS 571 shall be deemed to mean
OPSS 803, Construction Specification for
Sodding

The renumbered specification has been relocated to Division 8 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 803:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR SEED AND COVER

References to OPSS 572 shall be deemed to mean
OPSS 804, Construction Specification for
Seed and Cover

The renumbered specification has been relocated to Division 8 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 804:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES

References to OPSS 577 shall be deemed to mean
OPSS 805, Construction Specification for
Temporary Erosion and Sediment Control Measures

The renumbered specification has been relocated to Division 8 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 805:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR INSTALLATION OF ELECTRICAL CHAMBERS

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602-A	Commentary

602.01 SCOPE

This specification covers the requirements for the installation, adjustment, and rebuilding of electrical chambers.

602.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

602.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

602.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 401	Trenching, Backfilling, and Compacting
OPSS 402	Excavating, Backfilling, and Compacting for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 403	Rock Excavation for Pipelines, Utilities, and Associated Structures in Open Cut
OPSS 404	Support Systems
OPSS 407	Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber Installation
OPSS 408	Adjusting or Rebuilding Maintenance Holes Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 490	Site Preparation for Pipelines, Utilities, and Associated Structures
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS 609	Grounding
OPSS 610	Removal of Electrical Equipment and Materials
OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1103	Emulsified Asphalt
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production
OPSS 1351	Precast Reinforced Concrete Components for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1801	Corrugated Steel Pipe (CSP) Products
OPSS 1850	Frames, Grates, Covers, and Gratings
OPSS 2401	Electrical Handholes

CSA Standards

C22.2 No. 42-10	General Use Receptacles, Attachment Plugs and Similar Wiring Devices
C83-96 (R2011)	Communication and Power Line Hardware
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles

ASTM International

A 48/A 48M-03 (2008)	Grey Iron Castings

Bureau de Normalisation du Quebec (BNQ)

3624-115-2007-05-04	Polyethylene (PE) Pipe and Fittings - Flexible Pipes for Drainage - Characteristics and Test Methods

602.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Electrical Chamber means a structure or chamber for placing and maintaining conductors, cables, ducts, or electrical equipment. Electrical chamber is a general name for electrical maintenance holes and handholes.

Rock means as defined in OPSS 206.

602.05 MATERIALS

602.05.01 Concrete

Concrete for cast-in-place electrical maintenance holes shall be according to OPSS 1350 with a nominal 28-Day compressive strength of 30 MPa.

602.05.02 Steel Reinforcement

Steel reinforcement shall be according to OPSS 1440.

602.05.03 Sand Bedding

Sand bedding shall consist of sand conforming to the gradation requirements of mortar sand according to OPSS 1004.

602.05.04 Precast Concrete Electrical Maintenance Holes

Precast concrete electrical maintenance holes shall be according to OPSS 1351 and the Contract Documents. The requirement for a Prequalification Certificate issued under the Plant Prequalification Program stated in OPSS 1351 does not apply to precast concrete electrical maintenance holes.

602.05.05 Electrical Handholes

Electrical handholes shall be according to OPSS 2401 and the Contract Documents.

602.05.06 Steps

Steps for electrical maintenance holes shall be according to OPSS 1351.

602.05.07 Adjustment Units

Precast adjustment units shall be according to OPSS 1351 and as specified in the Contract Documents.

602.05.08 Frames with Covers

Maintenance hole frames with covers shall be according to OPSS 1850 and the Contract Documents.

Frames with covers for handholes shall be cast ferrous alloy according to ASTM A 48, Class No. 30 C, and the Contract Document.

602.05.09 Pulling Irons

Pulling irons for cast-in-place maintenance holes shall be galvanized wrought steel according to CSA C83, Item C83.48.

Pulling irons for precast concrete maintenance holes shall be 20 mm diameter, 200 mm long galvanized steel straight thimble eye bolts with heavy square nuts, and 100 x 100 x 10 mm square washers according to CSA C83, Items C83.65 and C83.30, No. 3.

602.05.10 Drain Pipe and Fittings

Drain pipe and fittings shall be 100 mm diameter non-perforated, corrugated high density polyethylene, according to BNQ 3624-115.

Plugs shall be polyethylene according to C22.2 No. 42.

Corrugated steel end sections and fittings shall be according to OPSS 1801.

Rodent gates shall be galvanized according to CSA G164.

602.05.11 Mortar

Mortar shall consist of a mixture of one part Portland cement according to OPSS 1301 and two parts mortar sand according to OPSS 1004, wetted with sufficient water to make the mixture plastic. Water shall be according to OPSS 1302. Air entrainment shall be 12%.

602.05.12 Waterproofing

Waterproofing material shall be emulsified asphalt, anionic slow-setting type according to OPSS 1103.

602.05.13 Grounding Materials

Grounding materials shall be according to OPSS 609.

602.05.14 Granular Material

Granular material for bedding and backfill shall be according to OPSS 1010.

602.05.15 Flexible Utility Marker

Flexible utility marker shall be according to the Contract Documents.

602.07 CONSTRUCTION

602.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

Electrical chambers of the type specified in the Contract Documents shall be installed on firm foundations at the locations and to the elevations specified in the Contract Documents and shall be constructed plumb and true to alignment.

The top of structures shall be installed below the final grade to allow for the placing of adjustment units to facilitate the placing of the top of the frame with grate or cover to the final grade.

Flexible utility markers for electrical chambers shall be installed at locations specified in the Contract Documents.

602.07.02 Removals

Removals shall be according to OPSS 610.

602.07.03 Site Preparation

Site preparation shall be according to OPSS 490.

602.07.04 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

602.07.05 Cold Weather Work

All work shall be protected from freezing. Structures shall not be installed on frozen ground.

602.07.06 Transporting, Unloading, Storing, and Handling Materials

Manufacturer's recommendations for transporting, unloading, storing, and handling of materials shall be followed.

Materials that are unsound or damaged shall be rejected.

602.07.07 Excavating, Backfilling, and Compacting

Excavating, backfilling, and compacting for the installation of electrical chambers shall be according to OPSS 402.

Earth shall be excavated to accommodate at least 300 mm of granular backfill around the outer walls of the unit. When specified in the Contract Documents, a drainage pocket or drainage facilities lower than the electrical chamber floor shall be excavated and backfilled with 19 mm clear crushed rock.

Earth shall be excavated for separate drainage pockets and drain pipes as specified in the Contract Documents.

Backfill around the walls of units shall be according to OPSS 402, except that acceptable native material may be used when any part of the electrical chamber is 1.5 m or more beyond the outside edge of the shoulder.

Backfill for electrical chambers installed in grassed areas shall be native backfill.

Granular backfill or unshrinkable backfill, or material approved by the Contract Administrator shall be used for electrical chambers within 1.5 m of the outside edge of the shoulder.

602.07.08 Support Systems

Support systems shall be according to OPSS 404.

602.07.09 Dewatering

Dewatering shall be according to OPSS 517.

602.07.10 Electrical Chamber Drains

Drainage facilities shall be as specified in the Contract Documents.

The drain pipe shall be installed as specified in the Contract Documents and according to OPSS 401. Holes in electrical chamber drains shall be formed by core drilling or other approved methods.

Ends of cut steel bars shall be coated with epoxy paste and the drain pipe shall be mortared in place so that it does not protrude into the structure cavity.

The drain pipe shall have a formed trap in all cases when drainage is connected to a storm sewer system.

The drain pipe shall be provided with a 150 mm diameter corrugated steel end section and rodent gate in all cases when drainage is connected to an embankment slope or ditch is specified. The drain pipe shall be inserted at least 300 mm into the end section.

Drain pipes shall be laid in a trench between 300 and 400 mm wide, with a minimum grade of 400H 1V. Sand bedding and backfill of 150 mm each shall be placed when the drain pipe is installed in rock.

602.07.11 Installation

602.07.11.01 Electrical Maintenance Holes

Maintenance holes shall be oriented so that ducts and duct bank entries have an angle of 90° between the maintenance hole wall and the axis of the ducts and duct bank. If this is not possible, the angle shall not be less than 45°.

Maintenance holes shall be oriented so that maintenance hole steps are placed on the maintenance hole wall nearest to the travelled edge of pavement.

All inside wall protuberances shall be ground smooth prior to installation of wiring baffles and mechanical supports for cables.

All liquid and debris shall be cleaned from the electrical chambers upon completion and prior to the acceptance of work by the Contract Administrator.

When the Contract Documents specify that a maintenance hole is to be constructed on existing runs of rigid duct, either direct buried, in steel liner, or concrete encased; the ducts, concrete encasement, reinforcing steel, and steel liners shall be cut back and removed to suit the maintenance hole dimensions. The Contractor may,

- a) construct a cast-in-place electrical maintenance hole around the duct structure and modify the duct after placing the maintenance hole, or
- b) cut the duct structure back to a minimum of 300 mm beyond the outer maintenance hole walls, install a precast unit, and reinstate ducts into the maintenance hole.

Pulling irons shall be mounted on all maintenance hole walls opposite to the rigid duct entry and, when specified in the Contract Documents, in the floor of the units, and centred under the cover opening. Pulling irons shall be installed as specified in the Contract Documents and before waterproofing the unit. When pulling irons are installed after concrete has been poured, a 22 mm diameter hole shall be drilled in the wall and an eyebolt installed with a square washer and nut on each side of the wall.

602.07.11.01.01 Precast Electrical Maintenance Holes

Precast maintenance holes shall be supplied to the depth specified in the Contract Documents or to the depths necessary to accommodate the depths of ducts, duct banks, or cable required to enter the precast unit. When the vertical location of ducts are adjusted for Utility clearance or drainage and a deeper maintenance hole is required, the additional depth may be obtained by additional courses of brick or precast adjustment units up to 255 mm depth.

Precast maintenance holes shall be installed on a level surface and then backfilled and compacted to maintain the specified unit plumb and true to the required alignment and grades.

Precast or mono bases shall be placed level. Subsequent sections, complete with joint seal systems, shall be installed according to the manufacturer's recommendations.

During installation, all duct openings and drainage facilities shall be fitted to the required orientation and location and all segmental sections, gaskets, and PVC waterstops shall be firmly seated.

Adjustment of the structure shall be carried out by lifting the affected sections free of the excavation, re-levelling the base, if necessary, and re-installing the sections. Damaged sections and gaskets shall be replaced.

Lift holes shall be plugged with mortar.

602.07.11.01.02 Cast-In-Place Electrical Maintenance Holes

Cast-in-place maintenance holes shall be cast plumb and true to the alignment and grades specified in the Contract Documents.

Concrete shall be placed, cured, protected, and finished according to OPSS 904. Steel reinforcement shall be placed according to OPSS 905.

Formwork for duct openings shall be accurately located to the dimensions specified in the Contract Document and shall consist of either non-metallic or removable forms. Ducts, duct banks, duct end bells, and liners shall be set in the framework prior to pouring concrete and shall be installed to provide an opening for later installation of these items.

602.07.11.02 Electrical Handholes

Electrical handholes shall be cast-in-place concrete handholes, precast concrete handholes, or prefabricated handholes made of semi-concrete or non-concrete materials.

Electrical handholes shall be installed plumb, true to alignment and grade, and firmly bedded on the drainage pocket backfill.

During installation, the duct entry holes shall be oriented in the required direction. The enlarging of duct entry holes is prohibited.

602.07.11.02.01 Cast-In-Place Concrete Electrical Handholes

Formwork for cast-in-place electrical handholes shall be secured to form a concrete envelope of uniform wall thickness and shall be set plumb and firmly bedded on the drainage pocket backfill. The cast iron frame and all ducts shall be installed in the formwork prior to pouring concrete.

Concrete shall be poured, cured, protected, and finished according to OPSS 904.

Outside formwork shall be removed to at least 150 mm below finished grade.

602.07.12 Duct Entry Holes

Duct entry holes shall be provided in the walls of electrical chambers in the orientation and number specified in the Contract Documents.

Any unused duct entry holes shall be firmly plugged from the inside with plastic plugs or, when waterproofing is specified, with mortar to the full thickness of the concrete walls.

When concrete encased duct banks are installed in maintenance hole units, the steel reinforcement of the duct bank shall be inserted 75 mm into the maintenance hole wall. The duct bank encasement shall be completely surrounded and bonded to the concrete wall. When direct buried rigid ducts, rigid ducts by subsurface installation or steel liners are installed in maintenance hole units, they shall be completely surrounded with concrete or grouted in place with mortar to the full thickness of the maintenance hole wall.

602.07.13 Grounding

Grounding shall be according to OPSS 609.

Metal cable racks and maintenance hole frames shall be connected to the system ground wire. When a ground rod is required at a maintenance hole, the system ground wire shall exit and re-enter the maintenance hole to enable ground rod connection as specified in the Contract Documents.

Both the handhole frames and covers shall be connected to the system ground wire when low-voltage cables are in the handhole. When frames are not present, 1.5 m of #6 AWG ground wire shall be connected between the system ground wire and the metallic cover.

602.07.14 Waterproofing

When specified in the Contract Documents, waterproofing material shall be applied to the outside walls, top, and adjustment units of concrete electrical chambers. For precast electrical chambers, the underside of the

floor slab shall have a similar application. For cast-in-place electrical chambers, 300 µm polyethylene sheeting shall be installed between the underside of the floor and the bedding prior to pouring concrete. All holes not used shall be grouted with mortar.

Waterproofing material shall be applied at the rate of 0.8 L/m² of surface.

602.07.15 Installation of Adjustment Units

The installation of precast adjustment units shall be according to OPSS 407 and as specified in the Contract Documents.

602.07.16 Installation of Frames and Covers

Frames with covers shall be installed according to OPSS 407 and as specified in the Contract Documents.

Maintenance hole covers and gaskets shall be secured as specified in the Contract Documents.

Cast iron frames for handhole covers shall be adjusted to the required elevation and crossfall. Mortar shall be used to smooth out any edges protruding above the concrete envelope.

Cast iron covers for handholes shall be secured as specified in the Contract Documents.

Covers for prefabricated handholes shall be firmly seated according to the manufacturer's instructions.

602.07.17 Adjusting and Rebuilding Electrical Chambers

The adjusting and rebuilding of existing electrical chambers shall be according to OPSS 408 and as specified in the Contract Documents.

602.07.18 Quality Control

602.07.18.01 Pre-Installation Testing and Inspection

Electrical chambers and chamber drain components shall be inspected prior to installation to ensure that they are according to the Contract Documents.

The Contractor shall submit to the Contract Administrator certification from the manufacturer that the product is according to the Contract Documents.

602.07.18.02 Pre-Installation Strength Testing of Semi-Concrete and Non-Concrete Handholes

Ten percent of the handholes shall be selected for strength testing. For each handhole selected, the handhole shall be placed on a flat surface with only the bottom of the handhole in contact with the ground. No external support shall be provided for the sides of the handhole. A weight of 2,000 kg shall be placed on top of the handhole for ten minutes. At the end of each test, the handhole shall be inspected. The handhole shall not exhibit any signs of cracking or deformation. If the handhole is deformed, cracked, or damaged in any way, it shall be considered failed and shall be replaced. If one or more handholes fail, then another 10% of the handholes shall be selected and tested. If one or more of those handholes fail, then all of the handholes shall be tested.

The Contractor shall submit the results of the strength testing to the Contract Administrator.

602.07.18.03 Electrical Chamber Installations

The Contractor shall ensure that the following are according to the requirements specified in the Contract Documents:

- a) Properly seated and aligned to a plumb position.
- b) Type of backfill.
- c) Compaction of backfill.
- d) All unused holes and spaces are filled.
- e) Waterproofing has been correctly applied.
- f) All frames and covers are secured and adjusted to grade.

602.07.19 Temporary Electrical Work

The work for temporary electrical installations shall be the same as for permanent installations of the same type of work, except that the work shall include the removal of the installations when they are no longer required.

602.07.20 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

602.09 MEASUREMENT FOR PAYMENT

602.09.01 Actual Measurement

602.09.01.01 Electrical Maintenance Holes Electrical Handholes

For measurement purposes, a count shall be made of the number of complete electrical chambers installed.

602.09.01.02 Adjusting and Rebuilding Electrical Chambers

For measurement purposes, a count shall be made of the number of electrical chambers adjusted or rebuilt.

602.09.01.03 Electrical Chamber Drains

Measurement of electrical chamber drains shall be by length in metres along the horizontal centreline of the drain pipe from the centre of the electrical chamber to the centre of the drainage pocket, storm sewer structure, storm sewer pipe, or concrete culvert or outlet end of the drain terminating at an embankment slope or ditch.

602.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

602.10 BASIS OF PAYMENT

**602.10.01 Electrical Maintenance Holes - Item
Electrical Handholes - Item
Adjusting and Rebuilding Electrical Chambers - Item
Electrical Chamber Drains - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

**602.10.02 Electrical Maintenance Holes, Temporary - Item
Electrical Handholes, Temporary - Item
Electrical Chamber Drains, Temporary - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Progress payment for temporary installation of above tender items shall be based on the following percentages of the Contract price:

80% for supply and installation

20% for removal

602.10.03 Rock Excavation for Trenches and Associated Structures

Payment for rock excavation for trenches and associated structures shall be according to OPSS 403.

Appendix 602-A, November 2012 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

Designer should specify the following in the Contract Documents:

- Type, location, and elevations of electrical chambers. (602.07.01)
- Flexible utility marker locations. (602.07.01)
- Precast electrical maintenance hole depths. (602.07.11.01.01)
- Alignment and grade of cast-in-place electrical maintenance holes. (602.07.11.01.02)
- Duct opening locations and dimensions in cast-in-place electrical maintenance holes. (602.07.11.01.02)
- Orientation and number of duct entry holes in electrical chambers. (602.07.12)

The designer should determine if the following are required and, if so, specify them in the Contract Documents:

- Drainage pockets and drain pipes. (602.07.07)
- Pull irons in the floor of maintenance holes. (602.07.11.01)
- Waterproofing of concrete electrical chambers. (602.07.14)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 704.010	Precast Concrete Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers
OPSD 2110.010	Electrical Maintenance Hole, Cast-in-Place, 1200 mm x 1200 mm
OPSD 2110.050	Electrical Maintenance Hole, Cast-in-Place, 600 mm x 1450 mm
OPSD 2110.060	Electrical Maintenance Hole, Cast-in-Place, 1800 mm x 2440 mm
OPSD 2110.070	Electrical Maintenance Hole, Cast-in-Place, 1200 mm x 1650 mm
OPSD 2111.020	Electrical Maintenance Hole, Precast Concrete, 600 mm x 1450 mm
OPSD 2111.030	Electrical Maintenance Hole, Precast Concrete, 1200 mm Dia.
OPSD 2111.040	Electrical Maintenance Hole, Precast Concrete, 1200 mm x 1650 mm
OPSD 2111.050	Electrical Maintenance Hole, Precast Concrete, 1800 mm x 2400 mm
OPSD 2112.01	Electrical Handhole, Precast Concrete with Cover, 300 mm Dia.
OPSD 2112.02	Electrical Handhole, Precast Concrete with Cover, 460 mm Dia.
OPSD 2112.030	Electrical Handhole, Precast Concrete - 675 mm Diameter
OPSD 2112.040	Electrical Handhole, Precast Concrete - 600 x 600 mm
OPSD 2112.05	Electrical Handhole, Precast Concrete with Cover, 300 x 500 mm
OPSD 2113.010	Electrical Handhold, Non and Semi-Concrete, General Requirements

Appendix 602-A

OPSD 2116.01	Drainage Facilities for Electrical Maintenance Holes
OPSD 2116.02	Electrical Maintenance Hole, Drains to Drainage Pockets, Embankment Outlets, and Ditches
OPSD 2116.03	Electrical Maintenance Hole, Drains to Storm Sewer Systems
OPSD 2117.01	Electrical Maintenance Holes, General Installation Requirements
OPSD 2117.02	Electrical Handholds, General Installation Requirements
OPSD 2118.010	Electrical Chamber, Installation in Median
OPSD 2118.020	Electrical Chamber, Installation in Slope
OPSD 2123.01	Electrical Maintenance Holes, Entry of Direct Buried Ducts
OPSD 2123.02	Electrical Maintenance Holes, Entry of Encased Ducts
OPSD 2123.03	Electrical Handholds, Entry of Direct Buried and Encased Ducts



CONSTRUCTION SPECIFICATION FOR INSTALLATION OF DUCTS

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603.01 SCOPE

This specification covers the requirements for the installation of flexible ducts, rigid ducts concrete encased, rigid ducts direct buried, rigid ducts by subsurface installation, rigid ducts steel encased by subsurface installation, and surface mounted duct systems. This specification also covers the requirements for rock excavation for all electrical work.

603.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

603.01.02

Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

603.02

REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 401	Trenching, Backfilling, and Compacting
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 501	Compacting
OPSS 610	Removal of Electrical Equipment and Materials
OPSS 905	Steel Reinforcement for Concrete

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production
OPSS 1359	Unshrinkable Backfill
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1802	Smooth Walled Steel Pipe

CSA Standards

B137.1-13 Polyethylene (PE) Pipe, Tubing, and Fittings for Cold-Water Pressure Services
C22.2 No. 45.1-07 (R2012) Electrical Rigid Metal Conduit - Steel
C22.2 No. 211.1-06 (R2011) Rigid Types EB1 and DB2/ES2 PVC Conduit
C22.2 No. 211.2-06 (R2011) Rigid PVC (Unplasticized) Conduit
C22.2 No. 227.1-06 (R2011) Electrical Nonmetallic Tubing
C22.2 No. 2515-09 (R2014) Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

ASTM International

F 2160-10 Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)

Underwriters Laboratories (UL)

UL 651A - 10/26/2011 Type EB and Rigid PVC Conduit and HDPE Conduit

National Electrical Manufacturers Association (NEMA)

TC 7-2013 Smooth Wall Coilable Electrical Polyethylene Conduit

Electrical Safety Authority (ESA)

Ontario Electrical Safety Code - 2012

603.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Electrical Junction Boxes means surface mounted or embedded boxes for use with electrical wirings or devices.

Horizontal Directional Drilling (HDD) means directional boring or guided horizontal boring.

Rock means as defined in OPSS 206.

603.05 MATERIALS

603.05.01 Concrete

Concrete shall be according to OPSS 1350 with a nominal 28-Day compressive strength of 20 MPa.

603.05.02 Steel Reinforcement

Steel reinforcement shall be according to OPSS 1440.

603.05.03 Sand Bedding

Sand bedding shall consist of sand conforming to the gradation requirements of mortar sand according to OPSS 1004.

603.05.04 Fish Line and Trace Wire

Fish line shall be nylon or polypropylene material with a minimum test strength of 400 N. Trace wire shall be minimum #12 AWG copper wire, green insulation.

603.05.05 Steel Liner

Steel liner shall be according to OPSS 1802.

603.05.06 Mortar

Mortar shall consist of a mixture of one part Portland cement according to OPSS 1301 and two parts mortar sand according to OPSS 1004, wetted with sufficient water to make the mixture plastic. Water shall be according to OPSS 1302. Air entrainment shall be 12%.

603.05.07 Unshrinkable Backfill

Unshrinkable backfill shall be according to OPSS 1359.

603.05.08 Ducts and Fittings

Ducts and fittings shall be according to the applicable standards shown in Table 1.

For surface mounted duct systems when runs of ducts exceed 50 m, rigid ducts and fittings shall be of regular wall thickness with watertight reinforced thermosetting resin conduit (RTRC) duct. Hanger support systems shall consist of galvanized steel supports and fibreglass tubular spacers with galvanized steel hardware. Support systems shall allow for multiple sizes of duct in each horizontal layer.

For surface mounted duct systems when runs of ducts are 50 m and under, they shall be rigid polyvinyl chloride (PVC) conduit or rigid galvanized steel conduit.

Ducts for HDD shall be solvent-free, mechanical spline connected with hydraulic seal, and rigid PVC ducts certified to CSA C22.2 No. 211.2.

603.05.09 Marker Tape

Marker tape shall be 75 mm wide polyethylene (PE) or copolymer material, colour red, with repeating black lettering "Caution - Buried Electric Line" or a similar message.

603.05.10 Concrete Anchors

Concrete anchors for surface mounted duct systems shall be of the epoxy resin system type when runs of ducts exceed 50 m. When runs are 50 m or less, the anchors shall be either of the epoxy resin type or metal expansion anchors. Each anchor shall have a minimum pullout strength of 60 kN for an embedment depth of 200 mm or less.

603.07 CONSTRUCTION

603.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

Ducts shall be installed as specified in the Contract Documents.

Ducts for communication cables shall be installed in trenches with varying depth so that drainage is provided. A minimum depth of cover of 450 mm may be used in flat terrain in order to ensure that the ducts slope towards a maintenance hole. When the terrain allows natural drainage due to its slope, the depth of cover shall be 550 mm.

Non-metallic ducts installed and used when exposed to direct rays of the sun shall be specifically approved for the purpose and be marked (e.g., "SR," "Outdoor," "RTRC Type AG") according to the Ontario Electrical Safety Code.

Wobble joint fittings with expanded polystyrene bedding shall be installed when direct buried rigid ducts terminate at concrete structures such as electrical maintenance holes, footings, bridge structures, retaining walls, and duct banks.

603.07.02 Protection During Construction

When ducts are installed prior to placing roadbed granular materials, the ducts shall be protected with a minimum cover of 300 mm of compacted backfill material.

603.07.03 Removals

Removals shall be according to OPSS 610.

603.07.04 Locating Existing Ducts

The Contractor shall locate all existing ducts requiring modification or usage.

603.07.05 Excavation

603.07.05.01 General

Trenches shall be excavated to the widths, depths, and alignment as specified in the Contract Documents. Such dimensions may be adjusted to obtain proper clearances with Utilities or other works.

The trench bottom shall be free of sharp rock fragments or debris and uniformly graded to support the ducts.

603.07.05.02 Earth Excavation

When unsuitable earth material is encountered in the trench bottom, it shall be removed and replaced with suitable material, as directed by the Contract Administrator.

The trench bottom shall be undisturbed earth or suitable imported material compacted according to OPSS 501.

When trenches are to be constructed prior to the completion of final grades, the Contractor may excavate trenches to give a minimum temporary cover of 300 mm for the ducts.

603.07.05.03 Rock Excavation for Electrical Installations

Rock excavation for the installation of ducts shall be according to OPSS 206.

603.07.06 Flexible Ducts

Flexible ducts shall be laid loosely in the trench to allow for expansion and contraction. Ducts shall be installed free of kinks or flattening and without sharp objects in the trench.

Couplings used for flexible ducts made of PE shall be PVC serrated couplings or shall consist of a 450 mm piece of the duct, one size larger than the flexible duct, slotted, and centred over the butted joint and securely fastened using stainless steel strapping. When PE pipe is used, pulling points for cable shall be similarly constructed.

For the PE flexible ducts for communication fibre-optic cable, installation of runs between maintenance holes up to 120 m in length shall be done with a single run of non-spliced duct. For runs up to 240 m in length, one splice is allowed. For runs exceeding 240 m, one splice per 120 m maximum is allowed. Such duct splices shall be fully waterproofed using silicon sealant and plasticized waterproofing sealant and shall be inspected by the Contract Administrator prior to backfilling.

Couplings used for flexible ducts made of electrical non-metallic tubing (ENT) shall be according to manufacturer's drawings or instructions. When ENTs are used, pulling points for cable shall be at the electrical chambers.

High density polyethylene (HDPE) couplings shall be used for HDPE duct and shall be according to manufacturer's drawings or instructions. When HDPE ducts are used, pulling points for cable shall be at the electrical chambers.

Flexible ducts shall be installed so that stacking or crossovers within the trench are not required, except for the purpose of entering concrete encased rigid ducts or electrical chamber sleeves.

Flexible ducts shall be installed within all underpavement crossings not having an electrical chamber on each end.

At direct buried poles, flexible ducts shall be inserted into the wiring aperture and turned up to within 450 mm of the pole handhole.

At concrete footings for base mounted poles, flexible ducts shall be inserted through the sleeves to at least 750 mm above the foundation.

At entries to pad mounted substations and to pad mounted traffic signal controllers, flexible ducts shall be installed within the sleeves and cut off flush with the top of the sleeves. The void between the duct and the sleeve shall be sealed with an electrical sealant for pad mounted controllers.

When it is required to join flexible ducts with rigid ducts, serrated adapter couplings shall be installed.

When flexible ducts are brought into electrical chambers, the ducts shall remain free in the entry holes of handholes and grouted into entry holes of maintenance holes.

When flexible ducts are specified in the Contract Documents, the Contractor shall have the option of using rigid ducts of the same inside diameter.

603.07.07 Rigid Ducts, Concrete Encased

Plastic spacers, suitable to the size and type of ducts and the duct separation specified in the Contract Documents, shall be installed along the trench bottom at 1.5 m maximum intervals. When transitions in grade are required, the trench bottom shall be adjusted to allow the spacers to seat firmly and hold any required duct bends.

Steel reinforcement shall be installed according to OPSS 905. Rods shall overlap by at least 60 mm and shall be tied to the plastic spacers. Lengths of duct shall be connected using couplings suitable to the size and type of duct. Couplings shall be staggered to obtain a minimum of 50 mm clearance between ducts or couplings. Ducts shall be tied to the spacers. The assembly shall be anchored securely to prevent shifting during placing of concrete.

Concrete may be poured directly into the trench or form work installed along the sides of the duct bank. The method of transporting, placing, and consolidating the concrete shall be such as to prevent segregation. Concrete placing and transporting devices shall not be supported by the steel reinforcement. Concrete shall be deposited within 1.5 m of its final position. Chutes shall have sufficient slope to deliver concrete of the approved consistency and shall have a maximum length of 15 m. When concrete is to be dropped more than 1.5 m, fully enclosed vertical drop chutes extending to the point of deposit shall be used. Concrete shall be placed at a steady rate such that a monolithic concrete is obtained without the formation of cold joints. The finish shall be raked or trimmed to produce a flat surface.

Rigid ducts shall be installed with a minimum slope of 400H:1V. Where deviations in vertical grade are required to avoid Utilities or other works, ducts shall be installed so that water cannot accumulate in the ducts.

Except where connections to electrical maintenance holes are required, rigid ducts and casing crossing paved areas shall extend 1.0 m beyond the back face of the curb or to the back edge of the shoulder.

When it is required to install transition sections between different types of rigid duct installations, the Contractor shall use deflection couplings or bend the ducts as required over a maximum of two standard duct lengths to obtain the required configuration.

603.07.08 Rigid Ducts, Direct Buried

The trench bottom shall be shaped and uniformly graded to support the entire duct. Lengths of duct shall be connected using couplings suitable to the size and type of duct supplied.

603.07.09 Flexible and Rigid Ducts by Subsurface Installation

Pits required for subsurface installation operations shall be set back a minimum distance from the edge of pavement or back of curb so that excavation is not done within a 1H:1V slope from the edge of pavement or back of curb to the bottom of the pit.

Bore holes shall only be 50 mm larger in diameter than the rigid duct being installed. When rigid ducts are being installed using the push-pull method, the steel rod shall be accurately aligned and pushed through the target pit. The push cap shall be replaced by a suitably sized expander unit and pulled back to the operating pit.

Lengths of duct shall be connected using couplings suitable to the size and type of duct supplied.

All temporary piling or supports used for boring or jacking equipment shall be removed or cut off to a minimum of 1.0 m below finished grade. All excavations or holes shall be backfilled and all temporary fill shall be removed.

When steel encasements are being installed using the boring and jacking method, the steel encasement shall be advanced so that the bore hole wall is supported by the steel encasement to within 300 mm of the head of the auger.

For HDD method, no drilling pit is required. Installation shall be according to the HDD machinery and duct manufacturers' guidelines and recommendations.

603.07.10 Surface Mounted Duct Systems

The Contractor shall not drill through bridge reinforcing steel. The Contractor shall locate reinforcing steel with a cover meter and position anchors accordingly.

For surface mounted duct systems, when the runs exceed 50 m horizontally:

- a) The installation of the support systems and ducts shall be carried out according to the duct manufacturer's installation procedures.
- b) Rigid ducts shall be installed parallel to the structural surfaces, either horizontally or vertically, using offset bends or fittings where changes in alignment are necessary.

For surface mounted duct systems, when runs are 50 m or less horizontally:

- a) Conduit fittings and junction boxes shall be installed in neat straight lines in the locations specified in the Contract Documents
- b) Rigid conduits shall be installed parallel to the structural surfaces, either horizontally or vertically, using offset bends or fittings where changes in alignment are necessary.

Appropriate fittings and deflection couplings shall be used for the installation. PVC boxes shall be mounted to provide the least interference with at least two stainless steel bolts and expansion anchors. Duct connection shall be cemented to the PVC box adapters.

Conduits shall be secured at intervals using conduit straps according to the Ontario Electrical Safety Code.

Conduit straps and junction boxes shall be fastened to concrete surfaces by drilling and inserting concrete anchors and securing the equipment with stainless steel bolts.

Conduit straps and junction boxes shall be fastened to steel structural members using stainless steel hardware.

603.07.11 Utility Clearance

When Utilities interfere with the specified elevation of any ducts, the Contractor shall notify the Contract Administrator to arrange inspection of the crossing point. The Contractor shall adjust the location of the ducts to obtain the clearance required and shall construct any concrete saddle or alternative protection approved by the Utility company.

603.07.12 Breaking Into Concrete Structures

When specified in the Contract Documents, the Contractor shall break into existing electrical chambers and existing substation or controller pads for installing ducts.

The space between the duct and the opening shall be filled with mortar.

603.07.13 Extension of Existing Duct Bank

Extension of existing duct banks shall be as specified in the Contract Documents.

603.07.14 Cable and Duct Protection and Marking

The Contractor shall install cable bricks or concrete protection at locations specified in the Contract Documents. Marker tape shall be installed along the centreline of the trench approximately 250 mm below finished grade or asphalt or concrete surfaces.

Cable brick shall be seated on uniformly graded and compacted material and butted end to end. Multiple rows of bricks shall be installed in trenches with direct buried high-voltage cables and when the width of the trench exceeds 300 mm.

Concrete protection shall be poured on uniformly graded and compacted material occupying the full width of the excavated trench to a minimum depth of 50 mm.

603.07.15 Termination

All ducts shall be temporarily plugged or sealed until wiring is installed. All ducts with wiring installed that terminate in traffic signal control cabinets, Advanced Traffic Management Systems (ATMS) control cabinets, or distribution assemblies shall be sealed.

When ducts are specified in the Contract Documents as spare or intended for future use, the duct ends shall be plugged with plastic plugs.

603.07.16 Backfilling

Except when unshrinkable backfill is used, backfilling shall be according to OPSS 401. Backfill material containing rock fragments and stone larger than 50 mm in diameter shall not be placed within 300 mm of the duct.

Sand bedding shall be placed in trenches for flexible duct when the trench bottom contains sharp rock fragments and when crossover of flexible ducts is required.

Backfill for concrete encased rigid ducts shall be placed at least 24 hours after pouring concrete.

Unshrinkable or granular backfill in trench for rigid ducts crossing paved areas shall extend to the wall of maintenance hole when maintenance holes are required; otherwise, 1.0 m beyond the back face of curb or, when there is no curb, to the back edge of shoulder.

603.07.17 End Marking

The location of the ends of all ducts not terminating in electrical chambers or pole foundations shall be marked by a concrete marker that is flush with the finished grade and located 300 mm beyond the shoulder edge or by a 50 x 50 mm cut cross on curbs, sidewalks, or barriers. The marker shall have an impressed arrow indicating the position of the ducts.

Concrete 400 x 300 x 50 mm markers shall be installed over runs of ducts for communication cables deviating from a straight line. A marker shall be installed wherever a tangent section meets a circular section. When the circular section is more than 20 m in length, an intermediate marker shall be installed.

Concrete markers shall be installed within 72 hours of backfilling of the trench.

603.07.18 Fish Line and Trace Wire

Fish line and trace wire shall be installed in all ducts specified in the Contract Documents as being spare or intended for future use. A 1.5 m length of fish line and trace wire shall extend out of each end of the duct beside the plastic plug, remain coiled, and tied in an accessible location.

603.07.19 Quality Control

603.07.19.01 Pre-Installation Testing and Inspection

All ducts shall be inspected to ensure that they are as specified in the Contract Documents.

All ducts shall be inspected to ensure they are stamped with the appropriate CSA designation, strength, and type. During installation, all ducts shall be inspected to ensure they are properly bedded, have sufficient depth of cover, and are coupled or connected to electrical chambers, poles, or other devices as specified in the Contract Documents.

603.07.19.02 Proof of Performance Testing and Inspection

All ducts shall be inspected and tested to ensure that they are as specified in the Contract Documents. All ducts shall be tested to ensure that they are free of debris, water, breakage, or distortion.

603.07.20 Temporary Electrical Work

The work for temporary electrical installations shall be the same as for permanent installations of the same type of work, except that the work shall include the removal of the installations when they are no longer required.

603.07.21 Site Restoration

Site restoration shall be according to OPSS 492.

603.07.22 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

603.08 QUALITY ASSURANCE

The Owner may perform field tests required for concrete according to OPSS 1350.

The Owner may perform tests for compaction according to OPSS 501.

603.09 MEASUREMENT FOR PAYMENT

603.09.01 Actual Measurement

603.09.01.01 Flexible Ducts Rigid Ducts, Concrete Encased Rigid Ducts, Direct Buried Rigid Ducts by Subsurface Installation Rigid Ducts, Steel Encased by Subsurface Installation Flexible Ducts by Subsurface Installation

Measurement of ducts shall be by length in metres horizontally along the longitudinal axis of the duct or trench; from centre to centre of poles, pole footings, electrical chambers, junction boxes, sign footings, and traffic signal controller cabinet pads; and to the face of bridge structures, retaining walls, and substation pads.

603.09.01.02 Rock Excavation for Electrical Installations

Measurement of rock excavation shall be by volume in cubic metres based on the quantity of rock below the upper limit and within the theoretical lines specified in the Contract Documents. The upper limit is the existing rock surface as measured after removal of overburden, but prior to rock excavation or the lowest elevation of all other excavation specified in the Contract Document, whichever is lower.

The volume of boulders in an excavation shall be based on 3 maximum rectilinear dimensions. When boulders classified as rock are measured for payment, only the amount removed shall be considered for payment. The total volume of rock considered for payment shall not exceed the volume of excavation within the theoretical lines.

603.09.01.03 Surface Mounted Duct Systems

Measurement of surface mounted duct systems shall be by length in metres horizontally along the duct, without deductions for junction boxes, from one point of attachment to other points of attachment.

603.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurements.

603.10 BASIS OF PAYMENT

- 603.10.01 Flexible Ducts - Item**
Rigid Ducts, Concrete Encased - Item
Rigid Ducts, Direct Buried - Item
Rigid Ducts by Subsurface Installation - Item
Rigid Ducts, Steel Encased by Subsurface Installation - Item
Rock Excavation for Electrical Installation - Item
Surface Mounted Duct Systems - Item
Flexible Ducts by Subsurface Installation - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

If the Contractor chooses to substitute flexible ducts with rigid ducts, payment for those rigid ducts shall be at the unit price bid for the tender item Flexible Ducts.

When drilling and blasting are required as a part of the work, progress payment shall be made according to OPSS 206.

The work of providing clearance for required Utility crossing shall be administered as Change in the Work.

- 603.10.02 Flexible Ducts, Temporary - Item**
Rigid Ducts, Concrete Encased, Temporary - Item
Rigid Ducts, Direct Buried, Temporary - Item
Rigid Ducts by Subsurface Installation, Temporary - Item
Rigid Ducts, Steel Encased by Subsurface Installation, Temporary - Item
Surface Mounted Duct Systems, Temporary - Item
Flexible Ducts by Subsurface Installation, Temporary - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Materials to do the work.

Progress payment for temporary installation of the above tender items shall be based on the following percentages of the Contract price:

80% for supply and installation

20% for removal

TABLE 1
Ducts and Fittings

Duct and Fitting Description	Type	Direct Buried	Concrete Encased	Subsurface Installation		Embedded Work	Surface Mounted	Standard
				In Ground	In Liner			
PE	Flexible	X	-	-	-	-	-	CSA B137.1 Series 75
ENT	Flexible	X	X	X	X	X	-	CAN/CSA C22.2 No. 227.1
HDPE	Flexible	X	-	X (Note 1)	-	-	-	UL 651A; ASTM F 2160, Schedule 40; and NEMA TC 7 for type EPEC
PVC	Rigid	X	X	X	X	X	X	CSA C22.2 No. 211.2
Polymeric PVC	Rigid	-	X Type DB2	-	-	X Type DB2	-	CSA C22.2 No. 211.1
RTRC	Rigid	X standard or heavy wall (Note 2)	X standard or heavy wall	X standard or heavy wall (Note 2)	X standard or heavy wall	X standard or heavy wall	X standard or heavy wall	CSA C22.2 No. 2515
Galvanized Steel	Rigid	X	-	X	X	-	X	CSA C22.2 No. 45.1
Notes: 1. HDPE duct may be used for subsurface installation for extra low-voltage cables only when ducts are 50 mm diameter or smaller. 2. Heavy wall shall be used when ducts are 100 mm diameter or greater.								

Appendix 603-A, November 2015 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following the Contract Documents:

- Duct locations and other installation requirements. (603.07.01)
- Trench widths, depths, and alignment. (603.07.05.01)
- Conduit fitting and junction box locations. (603.07.10)
- Duct break-in locations. (603.07.12)
- Existing duct bank locations requiring extension. (603.07.13)
- Cable brick or concrete protection locations. (603.07.14)
- Ducts as spare or future use. (603.07.15)

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- Need to break into existing electrical chambers and substation or controller pads. (603.07.12)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 2100.050	Cable and Duct Protection and Marking
OPSD 2100.06	Rigid Ducts Encased in Concrete
OPSD 2101.01	Duct Installation in Trenches
OPSD 2101.020	Extension of Existing Rigid Ducts Encased in Concrete
OPSD 2102.01	Underground Rigid Duct Connection at Concrete Structure
OPSD 2103.01	Rigid Duct Termination for High Voltage Cables at Utility Poles
OPSD 2103.02	Duct Installation Profiles
OPSD 2103.030	Duct Installation in Existing Paved Area, Unshrinkable Backfill Method
OPSD 2103.04	Rigid Duct Installation in Existing Paved Area, Granular Backfill Method
OPSD 2103.05	Duct Installation at Utility Crossings
OPSD 2103.06	Augering Pits for Subsurface Installation of Ducts and Encasements
OPSD 2104.01	RE Ducts Surface Mounted on Structures
OPSD 2123.01	Electrical Maintenance Holes, Entry of Direct Buried Ducts
OPSD 2123.02	Electrical Maintenance Holes, Entry of Encased Ducts
OPSD 2123.03	Electrical Handholes, Entry of Direct Buried and Encased Ducts
OPSD 2126.010	Distribution Assembly, Concrete Pad and Ducts, Plan and Section A-A
OPSD 2126.020	Distribution Assembly, Concrete Pad and Ducts, Section B-B



**CONSTRUCTION SPECIFICATION FOR
INSTALLATION OF CABLE**

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604-A	Commentary

604.01 SCOPE

This specification covers the requirements for the installation of high-voltage, low-voltage, and extra low-voltage cables, including cable splicing and terminations.

604.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

604.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

604.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 603	Installation of Ducts
OPSS 609	Grounding
OPSS 610	Removal of Electrical Equipment and Material

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 2409	Traffic Signal Cable
OPSS 2410	Extra Low Voltage Cable

CSA Standards

C22.2 No. 38-10	Thermoset-Insulated Wires and Cables
C22.2 No. 65-13	Wire Connectors
C22.2 No. 129-10	Neutral-Supported Cable
C22.2 No. 197-M1983 (R2008)	PVC Insulating Tape
C22.2 No. 239-09	Control and Instrumentation Cables
C22.3 No. 1-10	Overhead Systems
C57-98 (R2011)	Electric Power Connectors for Use in Overhead Line Conductors
C83-96 (R2011)	Communication and Power Line Hardware
G12-92 (R2012)	Zinc-Coated Steel Wire Strand

Insulated Cable Engineers Association (ICEA)

S-81-570-2005	600 Volt Rated Cables of Ruggedized Design for Direct Burial Installations as Single Conductors or Assemblies of Single Conductors
S-93-639-2000/NEMA WC 74-2006	5 - 46 kV Shielded Power Cables for Use in the Transmission and Distribution of Electrical Energy
S-94-649-2004	Concentric Neutral Cables Rated 5 - 46 kV
S-95-658-2000/NEMA WC70-2009	Power Cables Rated 2000 V or Less for the Distribution of Electrical Energy
S-96-659-2000/NEMA WC71-1999	Non Shielded Power Cables Rated 2001 - 5000 V
S-97-682-2007	Utility Shielded Power Cables Rated 5 - 46 kV
S-105-692-2011	600 Volt Single Layer Thermoset Insulated Utility Underground Distribution Cables

International Municipal Signal Association (IMSA)

19-2-1997	Paired Polyethylene-Insulated Polyvinyl Chloride-Jacketed Communication Cable with Electrical Shield

Electrical Safety Authority (ESA)

Ontario Electrical Safety Code

Others

Electrical and Utilities Safety Association of Ontario Rule Book

604.05 MATERIALS

604.05.01 General

All cables exposed to direct rays of the sun shall be approved for exposure to direct rays of the sun and shall be marked as such according to the Ontario Electrical Safety Code (e.g., SR and Sunlight Resistant).

604.05.02 High-Voltage Cables

604.05.02.01 General

High-voltage cables shall be as specified in the Contract Documents.

604.05.03 Low-Voltage Cables

604.05.03.01 General

Low-voltage multiconductor cables shall be according to CAN/CSA C22.2 No. 239.

Low-voltage single conductor cables shall be type RWU90 according to CSA C22.2 No. 38.

Low-voltage neutral supported cables with one, two, or three insulated aluminum conductors and ACSR neutral shall be 600 V type NS-90 and shall be according to CSA C22.2 No. 129.

Low-voltage multiconductor traffic signal cable shall be according to OPSS 2409.

604.05.03.02 Conductors

Conductors shall be insulated stranded copper and be according to CAN/CSA C22.2 No. 239.

604.05.04 Extra Low-Voltage Cables

Extra low-voltage cables for use with traffic signal interconnection systems shall be according to IMSA No. 19-2.

Extra low-voltage cables for use with traffic signal actuation devices shall be according to OPSS 2410.

604.05.05 Messenger Cables

Messenger cables shall be stranded galvanized steel according to CAN/CSA G12.

604.05.06 Hardware and Fittings

Hardware and fittings for aerial cable installations shall be according to CAN/CSA C83.

604.05.07 Connectors

Cable connectors shall be according to CSA C22.2 No. 65 and CSA C57.

604.05.08 Electrical Insulating Tape

Electrical insulating tape shall be according to CSA C22.2 No. 197 and rated for 600 V and -10 to 90 °C working temperatures.

604.05.09 High-Voltage Splices and Terminations

High-voltage splices, stress relief termination kits, potheads, and cable terminations shall be suitable for indoor or outdoor application as required; shall suit the size, type, and rating of cable used; and shall be according to the requirements of the power supply authority.

604.05.10 Low-Voltage Splices

Low-voltage splices shall be of the type specified in the Contract Documents.

604.05.11 Sand Bedding

Sand bedding shall consist of sand conforming to the gradation requirements of mortar sand according to OPSS 1004.

604.05.12 Fish Line

Fish line shall be nylon or polypropylene material with minimum test strength of 400 N.

604.05.13 Cable Marking

Minimum markings shall consist of manufacturer's name, size of conductor, voltage rating, temperature rating, and type of insulation.

Coloured coded SR rated cables shall be solid coloured or tri-stripe coloured cable and shall be approved according to the Ontario Electrical Safety Code.

604.07 CONSTRUCTION

604.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

604.07.02 Removals

Removal shall be according to OPSS 610.

604.07.03 Excavation, Sand Bedding, Backfill, and Compaction

Earth and rock excavation, sand bedding, backfill, and compaction for the installation of direct buried cables shall be according to OPSS 603.

604.07.04 Cable Protection Bricks

Cable protection bricks for direct buried cables shall be installed according to OPSS 603.

604.07.05 Fish Line

A fish line shall be installed in all ducts or conduits when traffic signal cables are installed. A 1.5 m length of fish line shall remain coiled, tied, and accessible in each pole handhole, electrical maintenance hole, junction box, and controller.

604.07.06 Coils and Slack Cable

When specified in the Contract Documents, coils of cable and slack cable shall remain for future extension by others. Coils shall be neatly taped and remain in a readily accessible location. Cable ends shall be sealed with heat shrink tubing boots.

A minimum 300 mm length of lighting and power cables shall remain at all accessible pulling points, splicing points, or cable termination points. A coil length of low-voltage, traffic signal, and extra low-voltage cables shall remain at all electrical maintenance holes and underground junction boxes so that a minimum of 1.0 m total length of cable may be pulled out above finished grade.

604.07.07 Mechanical Support

High-voltage cables passing through electrical maintenance holes shall be wall-mounted on porcelain saddles with galvanized steel cable racks and installed in locations specified in the Contract Documents.

Low-voltage and extra low-voltage cables passing through electrical maintenance holes shall be wall-mounted on galvanized steel cable racks where unsupported lengths of cable exceed 1.2 m. Bend radii shall be kept greater than the minimum recommended by the cable manufacturer and fastened with mechanical supports, where required. All cable and duct expansion joints shall be accurately formed and mechanically supported as specified in the Contract Documents.

Cable splices shall be supported in a similar manner with racks positioned approximately 150 mm on each side of the splice and mounted between 400 and 600 mm below finished grade.

All cables shall be trained to the maintenance hole walls and supported on cable racks. Sufficient rack arms shall be provided to adequately support the cables. All cables shall be bundled neatly with black outdoor nylon cable ties and each circuit identified with vinyl marking bands.

Nylon or stainless steel mesh cable grips shall be installed to support vertical cable runs when the unsupported cable mass exceeds 25 kg.

604.07.08 Barriers

When specified in the Contract Documents, barriers shall be installed between high-voltage and low-voltage cables, between communication and power cables, and between cables with different disconnecting means. Barriers shall be according to the Ontario Electrical Safety Code.

604.07.09 Low Temperature Handling

Cables shall be warmed to at least 0 °C at point of installation prior to installation. Cable shall not be installed when the ambient temperature is below -25 °C.

604.07.10 Cables in Ducts

Cable shall be pulled through ducts using compatible cable lubricant, mechanical aids, and pulling cables or ropes as required. The pulling tension and sidewall bearing pressure (SWBP) shall not exceed the safe tension recommended by the cable manufacturer.

When intermediate pulling points are required for the installation of cables in flexible duct, the flexible duct shall be cut and spliced according to OPSS 603.

604.07.11 Cables, Direct Buried

Cables shall be installed in sand bedding using the cable spacing and depth specified in the Contract Documents. When it is necessary for cables to cross over other cables, a minimum depth of 100 mm of sand bedding material shall be placed between the cables at the point of crossing. When it is necessary for cables to cross Utilities, a minimum separation of 300 mm shall be maintained, above or below the Utility. Such separation shall be backfilled with sand bedding material and a minimum of three cable protection bricks shall be installed over the cables according to OPSS 603.

Marker tape shall be installed along the centreline of all trenches.

604.07.12 Cables, Aerial

Cables shall be tensioned to obtain the sag, clearance, and tension values specified in the Contract Documents for the particular installation temperature.

When specified in the Contract Documents, cables shall be installed on messenger cables. When lashing of cable to a messenger strand is required, a mechanical lashing machine shall be used to install single wound 1.14 mm diameter stainless steel lashing wires. In lieu of lashing wires, and when specified in the Contract Documents, black outdoor nylon cable ties may be used.

Drip loops and expansion loops shall be formed at each pole or conduit entry and held free of the pole or other cables and connections.

Cables shall be re-tensioned, as necessary, to maintain the required cable clearances.

All work shall be according to CAN/CSA C22.3 No. 1, the Ontario Electrical Safety Code, and the Electrical and Utilities Safety Association of Ontario Rule Book.

604.07.13 Splices and Terminations

Cable splices and terminations shall be made at locations specified in the Contract Documents.

Ends of all insulated cables shall be sealed or capped to prevent the ingress of moisture prior to splicing or termination.

High-voltage cable splices and terminations shall be according to the manufacturer's recommendations for the rating and type of cable used.

Low-voltage cable splices for single-stranded conductors installed underground shall be made with compression connectors insulated with electrical insulating tape and protected with waterproof splices. Waterproof splices shall be installed according to the manufacturer's recommendations.

Low-voltage cable splices for solid conductors installed underground shall be made by twisting the conductors together with a minimum 12 mm length overlap, soldered, and insulated with electrical insulating tape and protected with waterproof splices. Waterproof splices shall be installed according to the manufacturer's recommendations.

Low-voltage cable splices for cable installed aerially or above ground shall be made with compression connectors protected with insulating covers.

Extra low-voltage cable splices shall be made by twisting the conductors together with a minimum 12 mm length overlap and then soldered or connected by the installation of threaded seized-conductor connector sets as specified in the Contract Documents. Above ground soldered splices shall be insulated with insulated tubing or insulated boots. Underground soldered splices shall be insulated with waterproof heat shrink tubing or heat shrink boots as specified in the Contract Documents. Seized-conductor connectors shall be protected with heat shrink tubing.

Stranded conductors shall be connected to the terminal board using the insulated fork tongue compression connectors. Solid conductors shall be connected directly to the terminal board.

All conductors, insulation, and jackets shall be carefully cleaned prior to installing connections, splices, or terminations. All ground shields, braids, or tapes shall be securely connected to a ground wire according to OPSS 609.

Low-voltage and extra low-voltage splices shall be made only in accessible locations such as electrical maintenance holes, junction boxes, and pole handholes. Underground splices additional to those specified in the Contract Documents shall only be allowed when staging of the work requires partial completion and the future extension of the cables is part of the Contract.

604.07.14 Cable Systems

The work of cable systems shall be as described in the Cables in Ducts; Cables, Direct Buried; Cables, Aerial; and Splices and Terminations subsections.

604.07.15 Quality Control

604.07.15.01 General

The Contract Administrator shall be given 24 hours notice of when tests are to be performed. The Contract Administrator may witness all tests and all splice installations.

Tests shall be performed at 500 V for cable insulation rated at less than 600 V and at 1,000 V for cable installation rated 600 V or greater.

604.07.15.02 Pre-Installation Testing and Inspection

Cables, splicing, and connection components shall be inspected prior to installation to ensure that they meet the requirements of the Contract Documents.

604.07.15.03 Proof of Performance Testing and Inspection

The Contractor shall ensure that all cables are installed, tested, and spliced as specified in the Contract Documents and that all cables are energized and in working order.

The test results shall be submitted to the Contract Administrator.

604.07.15.04 High-Voltage Systems

All high-voltage cable systems shall be checked upon completion of the installation of cables, splices, and terminations and prior to connection to switch gear or the source of energy. High potential tests shall be performed on all cables according to Table 1.

604.07.15.05 Low-Voltage Systems

Tests shall be limited to approximately 10% of the total cable system and shall be completed at random locations selected by the Contract Administrator. In the event of failure of any test, the Contract Administrator may choose another 10% of the system for further testing.

The following tests shall be performed prior to energizing the system:

- a) The continuity of selected cables shall be checked by means of an ohmmeter test.

Accumulated resistance shall not exceed the nominal resistance of the cable length, as specified by the cable manufacturer, plus an allowable resistance of 20% per splice or connection.

- b) Resistance to ground tests.

Leakage to ground of selected cables shall be checked by means of a megger test. Resistance to ground shall be 10 megohm or greater.

604.07.15.06 Extra Low-Voltage Systems

Continuity of all cables and connections shall be checked by means of an ohmmeter test prior to energizing the system. This test shall be completed with temporary jumpers installed to by-pass any active system elements or any passive DC blocking devices.

Cables shall be tested for leakage to ground by means of a megger test. Resistance to ground shall be 10 megohm or greater.

604.07.16 Temporary Electrical Work

The work for temporary electrical installations shall be the same as for permanent installations of the same type of work, except that the work shall include the removal of the installations when they are no longer required.

604.07.17 Site Restoration

Site restoration shall be according to OPSS 492.

604.07.18 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

604.09 MEASUREMENT FOR PAYMENT

604.09.01 Actual Measurement

604.09.01.01 Cable

Measurement for cable shall be by length in metres horizontally along the longitudinal axis of the duct, trench, or aerial cable; from centre to centre of poles, pole footings, electrical chambers, junction boxes, sign footings, and traffic signal controller cabinet pads; and to the face of bridge structures, retaining walls, and substation pads.

604.09.01.02 High-Voltage Terminations and Splices

For measurement purposes, a count shall be made of the number of high-voltage splices and terminations completed, regardless of the type, size, or rating.

604.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

604.10 BASIS OF PAYMENT

604.10.01 High-Voltage Cables, Direct Buried - Item
Low-Voltage Cables, Direct Buried - Item
Extra Low-Voltage Cables, Direct Buried - Item
Traffic Signal Cables, Direct Buried - Item
Co-Axial Cables, Direct Buried - Item
High-Voltage Cables, in Ducts - Item
Low-Voltage Cables, in Ducts - Item
Extra Low-Voltage Cables, in Ducts - Item
Traffic Signal Cables, in Ducts - Item
Co-Axial Cables, in Ducts - Item
Communication Cables, in Ducts - Item
Low-Voltage Cables, Aerial - Item
Low-Voltage Cables, Aerial with ACSR Neutral - Item
Low-Voltage Cables, Aerial on Messenger Cable - Item
Extra Low-Voltage Cables, Aerial - Item
Extra Low-Voltage Cables, Aerial on Messenger Cable - Item
Traffic Signal Cables, Aerial - Item
Traffic Signal Cables, Aerial on Messenger Cable - Item

Co-Axial Cables, Aerial - Item
 Co-Axial Cables, Aerial on Messenger Cable - Item
 Communication Cables, Aerial - Item
 Steel Messenger Cables, Aerial - Item
 ACSR Cables, Aerial - Item
 Cable Systems - Item
 High-Voltage Terminations and Splices - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

604.10.02 **High-Voltage Cables, Direct Buried (Temporary) - Item**
Low-Voltage Cables, Direct Buried (Temporary) - Item
Extra Low-Voltage Cables, Direct Buried (Temporary) - Item
Traffic Signal Cables, Direct Buried (Temporary) - Item
Co-Axial Cables, Direct Buried (Temporary) - Item
High-Voltage Cables, in Ducts (Temporary) - Item
Low-Voltage Cables, in Ducts (Temporary) - Item
Extra Low-Voltage Cables, in Ducts (Temporary) - Item
Traffic Signal Cables, in Ducts (Temporary) - Item
Co-Axial Cables, in Ducts (Temporary) - Item
Communication Cables, in Ducts (Temporary) - Item
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Low-Voltage Cables, Aerial on Messenger Cable (Temporary) - Item
Extra Low-Voltage Cables, Aerial (Temporary) - Item
Extra Low-Voltage Cables, Aerial on Messenger Cable (Temporary) - Item
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Co-Axial Cables, Aerial (Temporary) - Item
Co-Axial Cables, Aerial on Messenger Cable (Temporary) - Item
Communication Cables, Aerial (Temporary) - Item
Steel Messenger Cables, Aerial (Temporary) - Item
ACSR Cables, Aerial (Temporary) - Item
High-Voltage Terminations and Splices (Temporary) - Item
Cable Systems (Temporary) - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Progress payment for temporary installation of the above tender items shall be based on the following percentages of the Contract price:

80% for supply and installation

20% for removal

604.10.03 Rock Excavation

Payment for rock excavation shall be according to OPSS 603.

TABLE 1
High-Voltage System Testing Requirements

Voltage Rating V	Cable Type	Test Specification
0 - 2,000	Nonshielded	ICEA S-95-658/NEMA WC70
2,001 - 5,000	Nonshielded	ICEA S-96-659/NEMA WC71
5,000 - 46,000	Shielded	ICEA S-93-639/NEMA WC74
5,000 - 46,000	Concentric Neutral	ICEA S-94-649
5,000 - 46,000	Utility Shielded	ICEA S-97-682
600	Single Layer Thermoset Insulated Utility Underground Distribution	ICEA S-105-692
600	Ruggedized Insulated Direct Burial	ICEA S-81-570
Notes: A. The AC high-voltage test shall be according to ICEA publications, except that the applied test voltage and duration of the test shall be as specified by the power supply authority. B. The DC high-voltage test shall be according to ICEA publications, except that the applied test voltage and duration of the test shall be as specified by the power supply authority and the cumulative testing time shall not exceed the time limit specified by the power supply authority. If re-testing is required, approval and re-test voltage value shall be obtained from the power supply authority.		

Appendix 604-A, November 2013
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- High-voltage cable material requirements. (604.05.02.01)
- Type of low-voltage splices. (604.05.10)
- Location of porcelain saddles and galvanized steel cable racks. (604.07.07)
- Cable and duct expansion joints formed and mechanically supported. (604.07.07)
- Cable spacing and depth. (604.07.11)
- Cable sag, clearance, and tension values. (604.07.12)
- Cable splice and termination locations. (604.07.13)
- Solder or threaded seized-conductor connector. (604.07.13)
- Above ground soldered splices: insulated tubing or insulated boots. (604.07.13)
- Underground soldered splices insulation: waterproof heat shrink tubing or heat shrink boots. (604.07.13)

The designer should determine if the following are required and, if so, they should be specified in the Contract Documents:

- Coils of cable and slack cable. (604.07.06)
- Barriers. (604.07.08)
- Messenger cables. (604.07.12)
- Option of using black outdoor nylon cable ties. (604.07.12)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Appendix 604-A

Related Ontario Provincial Standard Drawings

OPSD 2100.010	Cable Installation in Trenches
OPSD 2100.050	Cable and Duct Protection and Marking
OPSD 2242.01	Wooden Pole with Neutral Supported Cable
OPSD 2242.02	Wooden Pole with Aerial Signal Cable Lashed on Messenger
OPSD 2245.01	Installation of Aerial Cable Systems
OPSD 2245.020	Minimum Vertical Clearances for Aerial Cable Systems
OPSD 2530.01	Splices for Traffic Signal Cable and Extra Low Voltage Cable
OPSD 2545.01	PVC Junction Box for Signal Cable Splicing



CONSTRUCTION SPECIFICATION FOR GROUNDING

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609.10	BASIS OF PAYMENT

APPENDICES

609-A	Commentary

609.01 SCOPE

This specification covers the requirements for the installation of electrical grounding equipment and grounding systems.

609.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

609.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

609.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 501	Compacting
OPSS 603	Installation of Ducts
OPSS 610	Removal of Electrical Equipment and Materials

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous

CSA Standards

C22.2 No. 38-10	Thermoset-Insulated Wires and Cables
C22.2 No. 41-07	Grounding and Bonding Equipment
G40.20/G40.21-04 (R2009)	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles

ASTM International

B 3-01 (2007) Soft or Annealed Copper Wire

Electrical Safety Authority (ESA)

Ontario Electrical Safety Code

Underwriters Laboratories (UL)

UL 467-Sept 2007 Grounding and Bonding Equipment

Others

IEEE 837-2002 Standard for Qualifying Permanent Connections Used in Substation Grounding

609.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

609.05 MATERIALS

609.05.01 Ground Rods

Ground rods shall be solid steel, 19 mm diameter, 3 m long, copper clad for the full length and shall be according to CSA C22.2 No 41.

609.05.02 Ground Plates

Ground plates shall be hot dip galvanized solid steel, 600 x 600 x 10 mm minimum dimensions. Steel shall be according to CAN/CSA G40.20/G40.21, Grade 260W, and shall be galvanized according to CAN/CSA G164.

609.05.03 Bare Ground Wire

Bare ground wire shall be soft drawn stranded copper and shall be according to ASTM B 3.

609.05.04 Insulated Ground Wire

Insulated ground wire shall be stranded copper, insulation colour green and shall be according to CSA C22.2 No. 38, type RWU 90 - cross-link.

609.05.05 Ground Connectors

Moulded connectors shall consist of metallic alloys and fusible powder mixtures held in place by suitable moulds and connected using an exothermic type welding process. Physical requirements of the connection shall be according to CSA C22.2 No. 41.

Mechanical connectors shall be according to CSA C22.2 No. 41 or UL 467.

High pressure irreversible compression connectors shall be:

- a) Made of pure wrought copper extrusion.
- b) Made of the same material as the conductors.
- c) According to CSA 22.2 No. 41, UL 467, and IEEE 837.
- d) Connected according to the manufacturer's recommendations.
- e) Connected using a minimum compressive force of 100 kN and a minimum compressive pressure of 70 MPa.

High pressure irreversible compression connectors shall have crimp verification for the inspection and verification of CSA and UL compliance markings.

609.05.06 Solder

Solder shall be 60/40, tin/lead mix, resin core type.

609.05.07 Sand Bedding

Sand bedding shall consist of sand conforming to the gradation requirements of mortar sand according to OPSS 1004.

609.05.08 Ducts and Fittings

Ducts and fittings shall be CSA approved and as specified in the Contract Documents.

609.07 CONSTRUCTION

609.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

All metallic components shall be connected to system ground.

All compaction shall be according to OPSS 501.

609.07.02 Removals

Removals shall be according to OPSS 610.

609.07.03 Excavation and Backfill

Earth and rock excavation and backfill shall be according to OPSS 603.

609.07.04 Ground Wire in Ducts

Ground wire shall be pulled through ducts using cable lubricant, mechanical aids, and pulling cables or ropes as required. The pulling tension shall be according to the cable manufacturer's specifications.

609.07.05 Ground Wire, Direct Buried

When ground wire crosses over direct buried cables, a minimum depth of 100 mm of sand bedding material shall be placed between the ground wire and the buried cables at the point of crossing.

When ground wire does not share a common trench with ducts or direct buried cable, the ground wire shall be installed at a minimum depth of 600 mm below finished grade.

609.07.06 Ground Wire on Poles or Open Surfaces

Ground wire installed on concrete or metal poles shall be run in rigid duct. Ground wire installed on wooden poles shall be run in protective moulding or in rigid duct. In both cases, the conduit or moulding shall be aligned in straight runs complementing the taper of the pole.

Conduit shall be mechanically fastened to wooden poles using PVC conduit clamps and galvanized lag screws. Moulding shall be mechanically fastened to wooden poles using galvanized steel staples. Stainless steel strapping shall be installed to secure conduit on concrete or metal poles.

When ground wire is to be installed on a concrete surface, the concrete shall be drilled to accommodate expandable metal anchors for nylon cable clamps held in place with stainless steel bolts. For installation on wooden surfaces, galvanized steel staples shall be installed. For installation on metal surfaces, nylon cable clamps and stainless steel screws or bolts, nuts, and washers shall be installed. The ground wire shall be installed in straight, neat lines and shall be supported at maximum intervals of 450 mm.

609.07.07 Ground Wire in Electrical Chambers or Enclosures

Ground wires in electrical chambers and enclosures shall be trained towards the structure walls with bend radii greater than the minimum recommended by the cable manufacturer. Ground wires shall be fastened with mechanical supports when required.

Ground wire in electrical chambers shall be connected to ground lugs attached to the frame. For electrical chambers with metallic covers and non-metallic frames, the ground wire shall be connected to the ground lugs attached to the cover. Ground wire in electrical enclosures shall be connected to the ground lug provided.

609.07.08 Ground Wire Connections

Ground connectors shall be used on all ground wire connections. All surfaces shall be cleaned to bare metal prior to making ground connections.

Moulded connectors or high pressure irreversible compression connectors shall be used at pad mounted electrical-electronic equipment, power supply locations, and all locations where the ground connectors are direct buried or inaccessible.

Messenger cables shall be grounded using compression connectors.

609.07.09 Coils of Ground Wire

Coiled ground wire shall be left at the locations shown in the Contract Documents. Coils shall be neatly taped and left in a safe readily accessible location.

609.07.10 Ground Electrodes

609.07.10.01 General

The installation of ground electrodes shall be according to the Ontario Electrical Safety Code.

The work for ground electrodes shall include the work to install ground rods, ground plates, and the associated work described in this specification.

When bedrock, rock fill, or similar materials unsuitable for driving ground rods are encountered at depths of 450 mm to 2.0 m below finished grade, the ground rod shall be replaced with a ground plate.

When bedrock, rock fill, or similar materials are encountered at less than 450 mm below finished grade, the ground electrode shall be installed at a different location when driving of a ground rod or installation of a ground plate is possible.

609.07.10.02 Ground Rods

Ground rods shall be driven in a vertical position when soil conditions allow. When rocks, stones, or similar materials are encountered, ground rods may be driven at a maximum angle of 45° to the vertical.

609.07.10.03 Ground Plates

Ground plates shall be installed on a minimum 150 mm thick compacted bed of suitable native earth material over rock.

609.07.11 Bonding Jumpers

The work for bonding jumpers shall include the work described for ground wire on poles or open surfaces, and ground wire connections.

609.07.12 Grounding Systems

The work included shall be as described for ground wires, ground electrodes, and bonding jumpers.

609.07.13 Testing Requirements

At pad and pole mounted power supply locations, the resistance to ground of the grounding grid shall be tested and measured. In soils of low conductivity, additional ground rods, ground plates, and ground wires shall be added as required by the Contract Administrator or the Electrical Safety Authority. The Contract Administrator shall be notified 48 hours prior to resistance to ground measurements are taken. These measurements shall be undertaken with the Contract Administrator present under dry soil conditions, and when frost penetration has not exceeded 150 mm. Readings shall not exceed 25 ohms. The test results shall be documented by the Contractor and a copy of the test results shall be given to the Contract Administrator.

609.07.14 Quality Control

609.07.14.01 Pre-Installation Testing and Inspection

Grounding cables, bonding jumpers, ground electrodes, and connection components are to be inspected prior to and during installation to ensure that they meet the requirements of the Contract Documents.

609.07.14.02 Proof of Performance Testing and Inspection

All system and components grounding shall be inspected and tested to ensure that they meet the requirements of the Contract Documents. All electrical grounding connections and splices shall be inspected to ensure they have been properly installed.

At pad and pole mounted power supply locations, the resistance to ground of the grounding grid shall be tested and measured. These measurements shall be undertaken when frost penetration does not exceed 150 mm. Readings shall not exceed 25 ohms. In soils of low conductivity, additional ground rods, ground plates, and ground wires shall be added, as required. Copies of all test documentation shall be submitted to the Contract Administrator.

A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Quality Verification Engineer shall affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:

- a) Work
- b) Material and installations
- c) Inspection, testing, and test results

609.07.15 Temporary Electrical Work

The work for temporary electrical installations shall be the same as for permanent installations of the same type of work, except the work shall include the removal of the installations when they are no longer required.

609.07.16 Restoration

Site restoration shall be according to OPSS 492.

609.07.17 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

609.09 MEASUREMENT FOR PAYMENT

609.09.01 Actual Measurement

609.09.01.01 Ground Wires

Measurement for ground wire shall be by length in metres horizontally along the longitudinal axis of the duct or trench, or open surface, from centre to centre of poles, pole footings, electrical chambers, or enclosures; sign footings; controller cabinet pads, and ground electrodes; or the face of bridge structures, retaining walls, and substation pads.

609.09.01.02 Ground Electrodes

For measurement purposes, a count shall be made of the number of ground electrodes installed.

609.09.01.03 Bonding Jumpers

For measurement purposes, a count shall be made of the number of bonding jumpers installed.

609.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

609.10 BASIS OF PAYMENT

**609.10.01 Ground Wires - Item
Ground Electrodes - Item
Bonding Jumpers - Item
Grounding Systems - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

When the Contract contains separate items for the work required by this specification, payment shall be at the Contract prices and according to the specifications for such work.

**609.10.02 Ground Wires (Temporary) - Item
Ground Electrodes (Temporary) - Item
Bonding Jumpers (Temporary) - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Progress payment for temporary installation of the above tender items shall be based on the following percentages of the Contract price:

80% for supply and installation
20% for removal

609.10.03 Rock Excavation for Electrical Installation

Payment for rock excavation for electrical installation shall be according to OPSS 603.

Appendix 609-A, November 2012 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Duct and fitting requirements. (609.05.08)
- Coiled ground wire locations. (609.07.09)

Grounding should be shown symbolically on the contract drawings.

Quantity sheets should include such information as location by station to station or structure to structure, quantities for each location, size of wire, whether bare or insulated wire is used, number of electrodes and bonding jumpers.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 2117.01	Electrical Maintenance Holes, General Installation Requirements
OPSD 2117.02	Electrical Handholes, General Installation Requirements
OPSD 2126.010	Distribution Assembly, Concrete Pad and Ducts, Plan and Section A-A
OPSD 2126.020	Distribution Assembly, Concrete Pad and Ducts, Section B-B
OPSD 2130.01	Supply Control Cabinet Installation, Overhead and Underground Services
OPSD 2240.01	Wood Pole with Elliptical Bracket, Overhead and Underground Circuits
OPSD 2255.010	Pole Wiring Diagram, 120V System
OPSD 2255.020	Pole Wiring Diagram, 120/240V System
OPSD 2255.030	Pole Wiring Diagram, 347/600V System
OPSD 2255.040	Pole Wiring Diagram, Lighting Pole on Bridge Structure
OPSD 2265.01	Grounding for Steel Beam Guide Rail
OPSD 2265.02	Grounding for Box Beam Median Barrier
OPSD 2400.030	Distribution Assembly, Wiring Schematic
OPSD 2440.010	Supply Control Cabinet Assembly Type 1, 120/240V, 100A, 1-Phase, 3-Wire
OPSD 2440.020	Supply Control Cabinet Assembly Type 2, 120/208V, 100A, 3-Phase, 4-Wire
OPSD 2441.000	Supply Control Cabinet Assembly Type 3, 120/240V, 100A, 1-Phase, 3-Wire
OPSD 2453.170	High Mast Lighting Pole, Internal Drive Raising and Lowering Equipment, 374/600V, 3-Phase, Wiring Diagram
OPSD 2453.180	High Mast Lighting Pole, Internal Drive Raising and Lowering Equipment, 120/240V, 1-Phase, Wiring Diagram
OPSD 2453.210	High Mast Lighting Pole, External Drive Raising and Lowering Equipment, 374/600V, 3-Phase, Wiring Diagram
OPSD 2453.220	High Mast Lighting Pole, External Drive Raising and Lowering Equipment, 120/240V, 1-Phase, Wiring Diagram
OPSD 2528.01	Traffic Signal Equipment, Pole Wiring Diagram
OPSD 2532.01	Flasher Beacon and Downlight for Roadway Sign and Wiring Diagram
OPSD 2534.010	Sign Light Assembly for Keep Right Sign and Wiring Diagram

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OPSD 2536.010	Flasher Beacons for Roadway Sign and Downlight and Wiring Diagram
OPSD 2540.01	Aerial Traffic Signal Installation
OPSD 2540.02	Aerial Flasher Beacon Installation
OPSD 2547.01	Controller Cabinet Grounding System
OPSD 2550.01	Installation for Aerial Interconnection Cables at Terminal Board
OPSD 2552.01	Traffic Signal System Equipment on Wooden or Concrete Poles, Overhead Wiring Installation
OPSD 2554.010	Traffic Signal System Equipment on Wooden or Concrete Poles, Underground Wiring Installation



CONSTRUCTION SPECIFICATION FOR REMOVAL OF ELECTRICAL EQUIPMENT AND MATERIALS

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610.01	SCOPE
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610.10	BASIS OF PAYMENT

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610-A	Commentary

610.01 SCOPE

This specification covers the requirements for demolition, salvage, and removal, either completely or partially, of electrical equipment and materials.

610.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

610.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

610.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 492	Site Restoration Following Installation of Pipes, Utilities, and Associated Structures
OPSS 510	Removal

610.04 DESIGN AND SUBMISSION REQUIREMENTS

610.04.01 Submission Requirements

610.04.01.01 Operations Plans

An operations plan shall be submitted to the Contract Administrator a minimum of 3 weeks prior to the commencement of polychlorinated biphenyl (PCB) related activities. The plan shall describe the overall approach to the work and include the following:

- a) Operational methodologies.

- b) Work area delineation and security details.
- c) Environmental impact management, such as spill prevention and containment and emergency response plan.
- d) Contamination control.
- e) Equipment and area decontamination procedures.
- f) Ontario Ministry of the Environment (MOE) Certificate of Approval numbers as applicable for transportation and transfer facilities.

PCB wastes and PCB related wastes to be moved to a transfer facility shall be included in the operations plan with details regarding their eventual transport to a disposal facility for destruction.

610.07 CONSTRUCTION

610.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

Demolition, salvage, and removal of electrical equipment and materials shall be as specified in the Contract Documents.

The Contractor shall acquire all permits, approvals, releases, and agreements necessary to do the work.

610.07.02 Timing of Work

Existing electrical systems required to continue in-service shall remain functional during construction operations until new or modified systems are operational.

610.07.03 Removal

Removal of non-electrical material and objects required for the removal of electrical equipment and material shall be according to OPSS 510.

Where partial removal of pavement, sidewalk, curb and gutter, or other structures is required for removal of electrical equipment, the broken edges of the object to remain in place shall be squared up and trimmed along straight lines at a minimum distance of 300 mm from any area disturbed by removal operations.

Steel reinforcement, conduits, ducts, wires, and debris associated with the removed portions of such structures shall be removed for disposal.

610.07.04 Demolition

Demolition of concrete, brick, timber, and masonry structures, including pole footings, equipment pads, concrete poles, and substation buildings shall be carried out in such a manner and with such equipment as not to disturb adjacent pavement, Utilities, other works, or electrical equipment and material to remain in place and with such care as to leave material designated to be salvaged in an undamaged condition.

610.07.05 Luminaires

Prior to removing luminaires, all lamps and glass shall be removed.

610.07.06 Cables and Conduits

Underground cables shall be completely removed and conduit systems shall be cut back to a depth of 600 mm below finished grade and abandoned in place.

610.07.07 Transformers

Transformers containing PCBs, including all internal components, and all PCB related wastes shall be removed and managed as subject waste as specified in the Contract Documents.

Transformers not containing PCBs shall be removed, salvaged, and transported to storage sites specified in the Contract Documents.

610.07.08 Temporary Installations

Equipment and materials supplied by the Contractor for use with temporary installations shall be removed. Equipment and materials supplied by the Owner for use with temporary installations shall be removed and salvaged as specified in the Contract Documents.

610.07.09 Salvage of Equipment

610.07.09.01 Damages

Due care shall be exercised when removing electrical equipment and materials for salvage. Equipment and materials damaged through improper handling or through loss after removal shall be repaired or replaced.

Prior to removal operations, the Contract Administrator shall be notified of any equipment that is broken or deteriorated to the point where salvage is not practical.

610.07.09.02 Packaging of Electrical Equipment and Materials

Electrical equipment and materials that has been removed shall be packed for protection against damage.

All equipment or material in excess of 100 kg shall be securely mounted on wooden pallets suitable for handling by forklift trucks.

610.07.09.03 Shipping of Salvaged Electrical Equipment and Materials

All salvaged equipment and materials shall be loaded, transported, and unloaded at the sites specified in the Contract Documents.

Delivery to any Owner unloading sites shall be made between 09:00 and 15:30, local time. The Contract Administrator shall be notified 3 Business Days in advance of delivery to the Owner's unloading sites.

610.07.10 Quality Control

610.07.10.01 Pre-Removal Testing and Inspection

Components specified for removal shall be inspected prior to removal. If the components are to be salvaged for reuse within the Contract limits or for storage at the Owner's premises, the Contractor shall make a list of any imperfections of those components and shall submit the list to the Contract Administrator 3 Business Days prior to the commencement of removal.

610.07.10.02 Proof of Performance Testing and Inspection

The removal work shall be inspected to ensure that all electrical removals have been carried out and that all components requiring disposal at approved sites have been completed so that no such materials remain on the Owner's lands.

610.07.11 Site Restoration

Site restoration shall be according to OPSS 492.

610.07.12 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

610.10 BASIS OF PAYMENT

610.10.01 Removal of Electrical Equipment - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Materials to do the work.

Work required to salvage and transport liquid type transformers shall be paid as Extra Work.

Appendix 610-A, November 2008
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The design should specify the following in the Contract Documents:

- Electrical equipment and materials for demolition, salvage, and removal. (610.07.01)
- Subject waste management requirements. (610.07.07)
- Storage sites for transformers without PCBs. (610.07.07)
- Salvage requirements for equipment and material removed from temporary installations. (610.07.08)
- Salvaged equipment and material unloading sites. (610.07.09.03)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR INSTALLATION OF UNDERPASS LUMINAIRES

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611-A	Commentary
611-B	Supplemental Requirements for Using OPSS 611 in Municipal Contracts

611.01 SCOPE

This specification covers the requirements for the installation, replacement, and relamping of underpass luminaires.

611.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

611.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

611.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, and publications:

Ontario Provincial Standard Specifications, Construction

OPSS 603	Installation of Ducts
OPSS 604	Cable Installation
OPSS 609	Grounding
OPSS 610	Removal of Electrical Equipment and Materials

Ontario Provincial Standard Specifications, Material

OPSS 2434	Underpass Luminaires

CSA Standards

C22.2 No. 49-10	Flexible Cords and Cables
C22.2 No. 248.8-11	Low-Voltage Fuses - Part 8: Class J Fuses
C22.2 No. 65-13	Wire Connectors
C22.2 No. 197-M1983 (R2008)	PVC Insulating Tape
C22.2 No. 227.2.1-04 (R2009)	Liquid-Tight Flexible Nonmetallic Conduit

G40.20-04/G40.21-04 (R2009)	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
W59-03 (R2008)	Welded Steel Construction (Metal Arc Welding)
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles

American National Standards Institute (ANSI)

C78.380-2007 Electric Lamps - High Intensity Discharge Lamps, Method of Designation

Illuminating Engineering Society of North America (IESNA)

LM-63-02	Standard File Format for Electronic Transfer of Photometric Data and Related Information
LM-79-08	Electrical and Photometric Measurements of Solid-State Lighting Products

611.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

611.04 DESIGN AND SUBMISSION REQUIREMENTS

611.04.01 Submission Requirements

A photometric test report shall be submitted for each photometric curve used in the luminaires to be installed under the Contract. The testing and test reports for high intensity discharge (HID) luminaires (e.g., high pressure sodium) shall be according to IESNA LM-63. The testing and test reports for LED luminaires shall be according to IESNA LM-79. The testing and test reports shall be completed by an independent laboratory or a National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory, which is accredited for testing the type of luminaire to be installed under the Contract (i.e., accredited for IESNA LM-63 for HID luminaires or IESNA LM-79 for LED luminaires). Each test report shall be dated and signed. The test reports shall be submitted to the Contract Administrator prior to the commencement of fabrication.

611.05 MATERIALS

611.05.01 Luminaires

Underpass luminaires shall be according to OPSS 2434.

611.05.02 Lamps

Lamps shall be clear or coated as specified in the Contract Documents and shall meet the requirements of ANSI C78.380.

611.05.03 Low-Voltage Cables

Single conductor low-voltage cables for use in conduit systems shall be according to OPSS 604.

Low-voltage cable for entry to luminaires shall be single conductor stranded copper and shall be according to CSA C22.2 No. 49, Type GTF.

611.05.04 Wire Connectors

Wire connectors shall be of the insulated spring or compression type and shall be according to CAN/CSA C22.2 No. 65.

611.05.05 Ground Wire

Ground wire shall be Type GTF.

611.05.06 Fuses

Fuses shall be according to CSA C22.2 No. 248.8, 600V, 10 amps rating.

611.05.07 Ducts and Fittings

Non-metallic flexible liquid-tight ducts and connectors shall be according to CAN/CSA C22.2 No. 227.2.1.

611.05.08 Tape

Electrical insulating tape shall be according to CSA C22.2 No. 197 rated for 600 V and -10 to 90 °C working temperature.

611.05.09 Luminaire Mounting Brackets

Luminaire brackets shall be steel according to CSA G40.20/G40.21, Grade 260W, and shall be hot dip galvanized according to CSA G164.

Welding of members shall be carried out according to CSA W59.

611.05.10 Protective Guard

The luminaires shall be supplied with the luminaire manufacturer's protective guard as specified in the Contract Documents.

611.07 CONSTRUCTION

611.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

The work for the installation, replacement, or relamping of the luminaires shall include all required hardware and fixtures to ensure operation of the unit.

611.07.01.01 Ordering Luminaires

Immediately following the award of the Contract, the Contractor shall order the luminaires as required for this Contract.

The Contractor shall obtain verification of the delivery dates of the luminaires from the supplier and notify the Contract Administrator of the delivery dates within 72 hours after the award of the Contract.

The Contractor shall ensure timely and accurate communication with both the Owner and the supplier regarding the delivery, schedules, and requirements for the luminaires.

Delivery and off-loading of the luminaires shall be completed in a timely and efficient manner.

611.07.02 Removals

Removals shall be according to OPSS 610.

611.07.03 Surface-Mounted Ducts

Non-metallic, flexible, liquid-tight ducts and connectors shall be used for connecting the underpass luminaires to the closest junction boxes as specified in the Contract Documents.

Surface-mounted ducts shall be installed according to OPSS 603.

611.07.04 Luminaire Mounting Brackets

When specified in the Contract Documents, the luminaries shall be installed on mounting brackets.

Luminaire mounting brackets shall be fastened to concrete surfaces by drilling and inserting metal expansion anchors and securing the bracket with 10 mm diameter stainless steel machine bolts and lock washers.

Luminaire mounting brackets shall be fastened to steel structural members as specified in the Contract Documents, using stainless steel hardware.

The luminaire mounting bracket shall be fastened to the surfaces to allow the level installation of the luminaire.

611.07.05 Wiring

Wiring shall be installed according to OPSS 604. Each luminaire shall be individually protected with a fuse. The fuse shall be located either in the junction box or in the luminaire. All connectors shall be insulated and secured with tape.

Each luminaire shall be wired with Type GTF conductors connected to the ballast leads with insulated spring connectors secured with tape. GTF conductors shall be connected to the underpass lighting circuits in the junction box with insulated spring connectors secured with tape.

611.07.06 Grounding

Underpass luminaires shall be connected to the system ground according to OPSS 609.

611.07.07 Installation of Luminaires

Luminaires shall be protected from conditions where moisture or dirt could damage the ballasts or reflecting surfaces of the optical system.

Luminaires shall be mounted on concrete surfaces specified in the Contract Documents by drilling and inserting metal expansion anchors and securing the luminaires with 10 mm diameter stainless steel machine bolts, lock washers, and PVC spacers.

Luminaires shall be mounted on the steel structural members specified in the Contract Documents, using stainless steel hardware.

All underpass luminaires are to be installed level using stainless steel hardware.

The luminaire reflector and refractor shall be thoroughly cleaned prior to installing lamps.

The wire guard and housing hardware shall be securely fastened in place.

611.07.08 Replacing Luminaires

When specified in the Contract Documents, existing luminaires, associated flexible conduit, and wiring shall be removed and new luminaires, associated flexible conduit, fittings, and wiring shall be installed.

When new luminaires are of a different style than the existing luminaires, new concrete anchors or mounting hardware shall be installed.

611.07.09 Relamping

Existing lamps shall be removed, the luminaires thoroughly cleaned, and new lamps installed.

611.07.10 Quality Control

611.07.10.01 Pre-Installation Testing and Inspection

Luminaires, brackets, socket setting, refractor type, and ballast type shall be inspected to ensure they meet the requirements of the Contract Documents.

611.07.10.02 Proof of Performance Testing and Inspection

Luminaires shall be inspected and tested to ensure that they meet the requirements of the Contract Documents. The Contractor shall ensure that all lamps installed in luminaires have undergone a minimum burning-in period of 100 consecutive nighttime hours prior to acceptance of the work by the Contract Administrator. For daytime tunnel illumination systems, the burn-in time is not required to be continuous and shall be achieved during normal daytime hours.

Low-voltage system tests required on the wiring system shall be performed according to OPSS 604.

A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Quality Verification Engineer shall affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:

- a) Work
- b) Material and installations
- c) Inspection, testing, and test results

611.07.11 Temporary Electrical Work

The work for temporary electrical installations shall be the same as for permanent installations of the same type of work, except the work shall include the removal of the installations when they are no longer required.

611.07.12 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

611.09 MEASUREMENT FOR PAYMENT

611.09.01 Actual Measurement

611.09.01.01 Underpass Luminaires

For measurement purposes, a count shall be made of the number of underpass luminaires installed.

611.09.01.02 Replace Underpass Luminaires

For measurement purposes, a count shall be made of the number of underpass luminaires replaced.

611.09.01.03 Relamp Underpass Luminaires

For measurement purposes, a count shall be made of the number of underpass luminaires relamped.

611.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

611.10 BASIS OF PAYMENT

**611.10.01 Underpass Luminaires - Item
Replace Underpass Luminaires - Item
Relamp Underpass Luminaires - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

When the Contract contains separate items for the work required by this specification, payment shall be at the Contract prices and according to the specifications for such work.

611.10.02 Underpass Luminaires, Temporary - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Progress payments for temporary installation of the above tender item shall be based on the following percentages of the Contract price:

80% for supply and installation
20% for removal

Appendix 611-A, November 2013
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Clear or coated lamps. (611.05.02)
- Junction box locations. (611.07.03)
- Location of luminaire installations. (611.07.07)

The designer should determine if the following are required and, if so, specify them in the Contract Documents:

- Luminaires mounted on brackets. (611.07.04)
- Luminaire replacement. (611.07.08)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 2305.020	Underpass Luminaires, Wall Mounted Installation
OPSD 2310.010	Underpass Luminaire, Ceiling Mounted Installation with Tee Bracket
OPSD 2310.020	Tee Bracket for Ceiling Mounted Underpass Luminaire
OPSD 2310.030	Wedge Mounting Bracket for Underpass Luminaire
OPSD 2310.040	Support Bracket for Column Mounted Underpass Luminaire
OPSD 2315.010.	Underpass Luminaire Wiring Detail

Appendix 611-B, November 2013

FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

Supplemental Requirements for Using OPSS 611 in Municipal Contracts

OPSS 611 Installation of Underpass Luminaires, is amended as follows:

611.03 Definitions

Section 611.03 is amended by the deletion of the definition for Quality Verification Engineer and replaced by the following:

Quality Verification Engineer (QVE) means a representative of the Owner qualified to provide the services specified in the Contract Documents.



CONSTRUCTION SPECIFICATION FOR INSTALLATION OF POWER SUPPLY EQUIPMENT

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614-A	Commentary

614.01 SCOPE

This specification covers the requirements for the installation of distribution assemblies and supply control cabinet assemblies.

614.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

614.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

614.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 603	Installation of Ducts
OPSS 604	Installation of Cable
OPSS 609	Grounding
OPSS 616	Footings and Pads for Electrical Equipment

Ontario Provincial Standard Specifications, Material

OPSS 2414	Power Supply Equipment
OPSS 2485	Photoelectric Controllers

Electrical Safety Authority (ESA)

Ontario Electrical Safety Code

614.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Service Box means an approved assembly consisting of an enclosure designed and constructed so that it can be effectually locked or sealed, contain either service fuses and a service switch or a circuit breaker, and allow the switch or circuit breaker to be manually operated.

614.04 DESIGN AND SUBMISSION REQUIREMENTS

614.04.01 Submission Requirements

The following information shall be submitted to the Contract Administrator:

- a) Actual breakdown cost of Utility work, such as hook up, transformation, etc.
- b) Utility company contact person's name, title, address, and telephone and mobile phone numbers.

Working drawings shall be submitted according to OPSS 2414.

614.05 MATERIALS

614.05.01 Distribution Assemblies

Distribution assemblies shall be according to OPSS 2414 and the Contract Documents.

614.05.02 Supply Control Cabinet Assemblies

Supply control cabinet assemblies shall be according to OPSS 2414 and the Contract Documents.

614.05.03 Service Boxes

Non-metallic enclosures for service boxes shall be certified or approved and marked Suitable for Use as Service Equipment.

614.05.04 Photoelectric Controllers

Photoelectric controllers shall be according to OPSS 2485.

614.05.05 Cables and Cable Connectors

Cables and cable connectors shall be according to OPSS 604.

614.05.06 Grounding Materials

Grounding materials shall be according to OPSS 609.

614.05.07 Conduit and Fittings

Rigid ducts and fittings shall be according to OPSS 603.

614.07 CONSTRUCTION

614.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

Concrete pads shall be according to OPSS 616 and as specified in the Contract Documents.

614.07.02 Distribution Assemblies

Equipment enclosures shall be installed squarely and symmetrically on concrete pads.

A neoprene gasket shall be attached squarely and symmetrically on the bottom base H-beam of the enclosure prior to installation. Base H-beam anchor bolts shall be secured in place at locations specified in the Contract Documents.

614.07.03 Supply Control Cabinet Assemblies

Supply control cabinet assemblies shall be mounted securely on poles using stainless steel strapping.

Rigid ducts and fittings shall be installed on wooden poles using two-hole galvanized pipe straps one trade size larger with galvanized lag screws and on metal or concrete poles using stainless steel strapping, at intervals specified in the Ontario Electrical Safety Code. The conduit system shall be installed in straight lengths to follow the taper of the pole. Offset bends, meter hubs, terminal adapters, and fittings shall be used when required to avoid pole attachments and be kept free of kinks or scorch marks.

When specified in the Contract Documents, a meter socket, acceptable to the power supply authority, shall be installed.

614.07.04 Cables and Fuses

Cables, terminations, and connections shall be installed according to OPSS 604. Service cables from the point of service connection to the main disconnecting means shall be installed according to the Ontario Electrical Safety Code and the requirements of the power supply authority.

Only high-voltage fuses that have a current rating approved by the power supply authority shall be installed.

614.07.05 Grounding

All grounding work shall be according to OPSS 609.

All concrete pad mounted equipment shall be bonded by means of bonding jumpers connected between the equipment ground bus and the exterior ground grid. Lightning arrestors shall have the ground cable connected securely to the equipment ground bus. The neutral bus of the main disconnecting means or the secondary neutral terminal of the transformer shall be grounded.

The system ground wire and the service ground wire shall be connected to the neutral bus in supply control cabinet assemblies.

614.07.06 Photoelectric Controllers

614.07.06.01 General

Photo-conductive cell windows shall be set to face in a northerly direction and away from any nearby light sources.

614.07.06.02 Distribution Assemblies

Photoelectric controllers shall be installed according to the Contract Documents.

614.07.06.03 Supply Control Cabinet Assemblies

Photoelectric controllers shall be installed on poles with twist lock mounting sockets and brackets. Brackets shall be mounted on metal or concrete poles with stainless steel strapping or on wooden poles with galvanized lag screws.

614.07.07 Quality Control

614.07.07.01 Pre-Installation Testing and Inspection

Power supply equipment shall be inspected prior to installation to ensure that it meets the requirements of the Contract Documents. A visual inspection of all the power supply equipment shall be performed prior to its delivery. The following components shall be inspected to ensure that they meet the requirements of the Contract Documents:

a) Barriers and raceways	k) Grounding connections
b) Breakers	l) Insulation
c) Cabinet materials	m) Labels
d) Conduits and tubings	n) Lightning arrestors
e) Contactors	o) Panelboards
f) Disconnect switches	p) Photoelectric controllers
g) Doors and latching mechanisms	q) Switches
h) Enclosure materials	r) Transformers
i) Cabinet general appearance	s) Wires and connectors
j) Grounding and bonding materials	

614.07.07.02 Proof of Performance Testing and Inspection

The installed power supply equipment shall be inspected and tested. All components listed under the Pre-Installation Testing and Inspection clause shall be inspected. Low voltage system tests shall be performed on wiring of the equipment according to OPSS 604. Grounding of equipment shall be tested according to OPSS 609.

A Certification of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Quality Verification Engineer shall affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:

- a) Work
- b) Material and installations
- c) Inspection, testing, and test results

614.07.08 As Constructed Drawings

In the event changes to the accepted Working Drawings are necessary, as constructed drawings bearing the stamp and signature of an Engineer shall be submitted to the Contract Administrator.

614.07.09 Temporary Electrical Work

The work for temporary electrical installations shall be the same as for permanent installations of the same type of work, except the work shall include the removal of the installations when they are no longer required.

614.07.10 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

614.09 MEASUREMENT FOR PAYMENT

614.09.01 Actual Measurement

**614.09.01.01 Distribution Assemblies
Supply Control Cabinet Assemblies**

For measurement purposes, a count shall be made of the number of assemblies installed.

614.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

614.10 BASIS OF PAYMENT

**614.10.01 Distribution Assemblies - Item
Supply Control Cabinet Assemblies - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

614.10.02**Distribution Assemblies, Temporary - Item
Supply Control Cabinet Assemblies, Temporary - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, Material to do the work.

Progress payment for temporary installation of the above tender items shall be based on the following percentages of the Contract price:

80% for supply and installation
20% for removal

Additional payment shall not be made for the electrical energy and service required to do the work.

Appendix 614-A, November 2012
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Distribution assembly material requirements as follows: (614.05.01)

Distribution assembly, pad mounted, ____ kVA
600 V, 3-phase, complete with:
____ amp Main fused disconnect ____ volt
____ amp Main unfused disconnect
____ amp Main lighting breaker
____ amp Main auxiliary system fused disconnect
____ - ____ amp ____ volt Auxiliary system fused disconnect
____ - ____ amp Branch breakers (for lighting panelboard)
____ - ____ amp Branch breakers (for ____ volt panelboard)
____ amp Meter socket (as per local power supply authority standards)
Meter socket catalogue No. _____

Supply control cabinet assembly material requirements as follows: (614.05.02)

Supply control cabinet assembly, type ____, ____ volt
____ amp ____ -phase, complete with:
____ amp Main circuit breaker
____ amp Traffic signal circuit breaker
____ amp Circuit breakers
____ amp Meter socket (as per local power supply authority standards)
Meter socket catalogue No. _____

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- Meter sockets. (614.07.02)

The designer should coordinate with the power supply authority the payment for electrical energy and service.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

Power Supply Equipment Drawings:

OPSD 2126.010 to OPSD 2130.01
OPSD 2400.000 to OPSD 2400.030
OPSD 2440.010 to OPSD 2441.020



CONSTRUCTION SPECIFICATION FOR ERECTION OF POLES

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615.10	BASIS OF PAYMENT

APPENDICES

615-A	Commentary

615.01 SCOPE

This specification covers the requirements for the erection of poles used for the mounting of lighting equipment, traffic signals and control equipment, low-voltage aerial cables, and extra low-voltage aerial cables.

615.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

615.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

615.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 501	Compacting
OPSS 603	Installation of Ducts
OPSS 609	Grounding
OPSS 610	Removal of Electrical Equipment and Materials
OPSS 904	Concrete Structures

Ontario Provincial Standard Specifications, Material

OPSS 1350	Concrete - Material and Production
OPSS 1442	Epoxy Coated Steel Reinforcement for Concrete
OPSS 2420	Wood Poles
OPSS 2421	Spun Concrete Poles Class D
OPSS 2422	Heavy Class Steel and Sectional Steel Poles
OPSS 2423	Steel Poles, Base Mounting
OPSS 2452	Aluminum Poles, Base Mounting
OPSS 2453	Sectional Steel Poles

CSA Standards

C83-96 (R2005) Communication and Power Line Hardware
G12-92 (R2007) Zinc Coated Steel Wire Strand

Others

Ontario Electrical Safety Code

615.05 MATERIALS

615.05.01 Concrete

Concrete shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 30 MPa.

615.05.02 Steel Reinforcement

Steel reinforcement shall be fusion-bonded epoxy coated according to OPSS 1442.

615.05.03 Poles

Concrete poles shall be according to OPSS 2421.

Steel poles for base mounting shall be according to OPSS 2423.

Aluminum poles for base mounting shall be according to OPSS 2452.

Sectional steel poles for direct burial or base mounting shall be according to OPSS 2453.

Wooden poles shall be according to OPSS 2420.

Heavy class steel poles and heavy class sectional steel poles shall be according to OPSS 2422. This class is required for poles with mast arms longer than 5.5 m.

615.05.04 Frangible Bases

Frangible bases shall be as specified in the Contract Documents.

615.05.05 Pole Hardware and Accessories

Pole line hardware shall be according to CSA C83.

Steel guy cable shall be according to CAN/CSA G12.

Guy anchors shall be of the helical power driven or direct buried expandable type with a minimum diameter of 250 mm and a minimum anchor rod ultimate strength of 50 kN.

615.07 CONSTRUCTION

615.07.01 General

The general requirements for electrical work shall be as specified in the Contract Documents.

Concrete, wooden, and metal poles shall be installed at locations specified in the Contract Documents.

All compaction shall be according to OPSS 501.

Grounding of poles shall be according to OPSS 609 and the Contract Documents.

615.07.01.01 Pole Orientation

Concrete and metal poles shall be installed with the handhole location on the pole as specified in the Contract Documents and such that the top wiring aperture is at right angles to the centreline of the road being served.

615.07.01.02 Pole Handling

Poles shall be handled using suitable non-abrasive slings at the pole pick up points as specified by the pole manufacturer.

615.07.01.03 Removals

Removals shall be according to OPSS 610.

615.07.02 Sectional Steel Poles

615.07.02.01 Assembly

Sectional steel poles shall be assembled in order of section number, taper, and diameter. Sections with wiring apertures shall be set with consideration given to the handhole location.

All sections shall be assembled by compression according to the manufacturer's instructions such that each section meets the normal overlap limits marked on the pole or refusal. Seam welds shall be slightly offset during assembly. The finished length of the pole shall be less than or equal to the nominal pole length.

Pole lengths of 5.64 m or more shall be assembled using three self-tapping screws or impact inserted pins. Screws and pins shall be installed in the overlap of all sections below the signal bracket so that they are spaced equally around the pole.

615.07.03 Direct Buried Poles

615.07.03.01 Installation in Earth

Excavation shall be by auger or by other suitable means to obtain a hole large enough to accommodate concrete encasement and backfill. Where the excavation extends beyond the neat limits specified in the Contract Documents, and, where concrete encasement is specified in the Contract Documents, concrete may be placed to the undisturbed earth or the encasement may be formed with the remainder of the backfill made up of native material.

615.07.03.02 Installation in Rock

Where rock is encountered, the method of installation shall be chosen from those specified in the Contract Documents and be based on the depth of rock below finished grade. Each method of installation in rock shall be approved by the Contract Administrator prior to construction.

Rock anchors, bolts for rock mounts, and steel dowel bars shall be installed in drilled holes and grouted in place with non-shrink grout. Poles shall be cut off at the top end to provide the correct top of pole elevation. Wooden poles that have been cut off shall have the ends treated with preservative according to the pole manufacturer's specifications.

Concrete levelling pads, concrete backfill up to the top of the rock grade, and formed concrete encasement shall be placed according to OPSS 904.

Native or imported earth material shall be used as backfill above or around the concrete encasement and compacted.

Rock excavation shall be according to OPSS 603.

615.07.03.03 Pole Alignment

Direct buried poles shall be held plumb by using a suitable temporary support assembly during concrete setting time and during backfilling operations.

615.07.04 Base Mounted Poles

615.07.04.01 Preparation

Anchorage templates shall be removed prior to installation of poles and frangible bases.

All studs, bolts, and nuts shall be cleaned and coated with white lithium-based grease.

615.07.04.02 Installation of Frangible Bases

When frangible bases are specified in the Contract Documents, they shall be installed according to manufacturer's specifications.

615.07.04.03 Pole Erection

When specified in the Contract Documents, poles shall be installed on frangible bases.

Poles shall be set plumb.

615.07.05 Apertures

Drilled apertures shall be accurately aligned to suit pole attachments or equipment. Wiring apertures in metal poles shall be provided with rubber grommets. Apertures in metal poles shall be deburred, and in galvanized steel poles, be coated with grey zinc-rich paint and allowed to dry before placing rubber grommets in them.

Unused pole apertures shall be plugged with rubber, neoprene, or plastic plugs.

615.07.06 Guy Anchors

Guy anchors and associated hardware shall be installed as specified in the Contract Documents and the Ontario Electrical Safety Code. Anchorage plates shall be installed at the specified guy lead distance and adjusted to remain clear of any existing guy anchors by a minimum distance of 600 mm and then backfilled with native material and compacted.

Guy anchors shall be installed with single or double guy cable sets as specified in the Contract Documents.

All guy cables shall be installed to a snug condition prior to aerial cable stringing and readjusted upon completion to maintain poles in a plumb position.

Guy cables shall be tightened to maintain pole alignment and aerial cable clearances.

615.07.07 Quality Control

615.07.07.01 Pre-Installation Testing and Inspection

Poles shall be inspected for any obvious flaws, prior to erection.

The Contractor shall certify that heavy class steel and sectional steel poles are according to the supplier's design and drawings as specified in OPSS 2422. The Contractor's certification shall reference the supplier's drawing numbers.

615.07.07.02 Proof of Performance Testing and Inspection

The work of pole erection shall be inspected to ensure that it is according to the Contract Documents. The inspection shall ensure that:

- a) poles and appurtenances have been properly installed
- b) poles are plumb
- c) anchorage assemblies and frangible bases are installed correctly

615.07.08 Temporary Electrical Work

The work for temporary electrical installations shall be the same as for permanent installations of the same type of work, except the work shall include the removal of the installations when they are no longer required.

615.07.09 Site Restoration

Site restoration shall be according to OPSS 492.

615.07.10 Management of Excess Materials

Management of excess material shall be as specified in the Contract Documents.

615.09 MEASUREMENT FOR PAYMENT

615.09.01 Actual Measurement

615.09.01.01 Poles

For measurement purposes, a count shall be made of the number of poles installed regardless of the type and size of the poles, and shall include any frangible bases and guy anchors installed with the poles.

615.09.01.02 Sectional Steel Poles, Direct Buried in Earth

For measurement purposes, a count shall be made of the number of sectional steel poles direct buried in earth.

615.09.01.03 Concrete Poles, Direct Buried in Earth

For measurement purposes, a count shall be made of the number of concrete poles direct buried in earth.

615.09.01.04 Wooden Poles, Direct Buried in Earth

For measurement purposes, a count shall be made of the number of wooden poles direct buried in earth.

615.09.01.05 Sectional Steel Poles, Direct Buried in Rock

For measurement purposes, a count shall be made of the number of sectional steel poles direct buried in rock.

615.09.01.06 Concrete Steel Poles, Direct Buried in Rock

For measurement purposes, a count shall be made of the number of concrete poles direct buried in rock

615.09.01.07 Wooden Poles, Direct Buried in Rock

For measurement purposes, a count shall be made of the number of wooden poles direct buried in rock.

615.09.01.08 Sectional Steel Poles, Base Mounted

For measurement purposes, a count shall be made of the number of base mounted sectional steel poles installed.

615.09.01.09 Heavy Class Sectional Steel Poles, Base Mounted

For measurement purposes, a count shall be made of the number of base mounted heavy class sectional steel poles installed.

615.09.01.10 Steel Poles, Base Mounted

For measurement purposes, a count shall be made of the number of base mounted steel poles installed.

615.09.01.11 Heavy Class Steel Poles, Base Mounted

For measurement purposes, a count shall be made of the number of base mounted heavy class steel poles installed.

615.09.01.12 Aluminum Poles, Base Mounted

For measurement purposes, a count shall be made of the number of base mounted aluminum poles installed.

615.09.01.13 Frangible Bases

For measurement purposes, a count shall be made of the number of frangible bases installed.

615.09.01.14 Guy Anchors

For measurement purposes, a count shall be made of the number of guy anchors installed, regardless of the size and type.

615.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

615.10 BASIS OF PAYMENT

615.10.01 Poles - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Materials to do the work.

When the Contract contains separate items for the work required by this specification, payment shall be at the Contract price for such work.

615.10.02
Sectional Steel Poles, Direct Buried in Earth - Item
Concrete Poles, Direct Buried in Earth - Item
Wooden Poles, Direct Buried in Earth - Item
Sectional Steel Poles, Direct Buried in Rock - Item
Concrete Poles, Direct Buried in Rock - Item
Wooden Poles, Direct Buried in Rock - Item
Sectional Steel Poles, Base Mounted - Item
Heavy Class Sectional Steel Poles, Base Mounted - Item
Steel Poles, Base Mounted - Item
Heavy Class Steel Poles, Base Mounted - Item
Aluminum Poles, Base Mounted - Item
Frangible Bases - Item
Guy Anchors - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

615.10.03 **Sectional Steel Poles, Direct Buried in Earth (Temporary) - Item**
Concrete Poles, Direct Buried in Earth (Temporary) - Item
Wooden Poles, Direct Buried in Earth (Temporary) - Item
Sectional Steel Poles, Direct Buried in Rock (Temporary) - Item
Concrete Poles, Direct Buried in Rock (Temporary) - Item
Wooden Poles, Direct Buried in Rock (Temporary) - Item
Sectional Steel Poles, Base Mounted (Temporary) - Item
Steel Poles, Base Mounted (Temporary) - Item
Aluminum Poles, Base Mounted (Temporary) - Item
Frangible Bases (Temporary) - Item
Guy Anchors (Temporary) - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Materials to do the work.

Progress payment for the above tender items shall be based on the following percentages of the Contract price:

80% for supply and installation

20% for removal

615.10.04 Rock Excavation

Payment for rock excavation shall be according to OPSS 603.

Rock excavation shall not include holes drilled in rock for the placement of steel dowel bars.

Appendix 615-A, November 2008 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Type and location of poles. (615.07.01)
- Excavation beyond the neat limit. (615.07.03.01)
- Concrete encasement for direct buried poles. (615.07.03.01)
- Single or double guy cable sets. (615.07.08)

The design should determine if the following is required and, if so, it should be specified in the Contract Documents:

- Poles installed on frangible base locations (615.07.04.02)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

2200 Series	Electrical Drawings OPSD 2200.01 to OPSD 2260.01
OPSD 2410.01	Spun Concrete Pole - Class "D"
OPSD 2410.02	18.3 m Spun Concrete Pole - Class "D" for TV Camera Mounting
OPSD 2415.010	Steel Pole - Base Mounting
OPSD 2416.010	Steel Pole - Concrete Barrier Mounting
OPSD 2420.01	1.8 m or 2.4 m Aluminum Tapered Elliptical Bracket
OPSD 2421.010	Lamp Wattage Label for Luminaire
OPSD 2428.01	Frangible Bases
OPSD 2432.010	Aluminum Pole - Base Mounting



CONSTRUCTION SPECIFICATION FOR FOOTINGS AND PADS FOR ELECTRICAL EQUIPMENT

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616-A	Commentary

616.01 SCOPE

This specification covers the requirements for the installation of footings and pads required for mounting electrical equipment.

616.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

616.01.02

Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

616.02

REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 501	Compacting
OPSS 603	Installation of Ducts
OPSS 610	Removal of Electrical Equipment and Materials
OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1308	Joint Filler in Concrete
OPSS.1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete

CSA Standards

G40.20/G40.21-04 (R2009) General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
G164-M92 (R2003) Hot Dip Galvanizing of Irregularly Shaped Articles
W59-03 (R2008) Welded Steel Construction (Metal Arc Welding)

ASTM International

A 53/A 53M-10 Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded, and Seamless
A 193/A 193M-11a Alloy Steel and Stainless Steel Bolting for High Temperature or High Pressure Services and Other Special Purpose Applications
A 563M-07a Carbon and Alloy Steel Nuts

American National Standards Institute (ANSI)

B18.22.1-1965 (R2003) Plain Washers

Society of Automobile Engineers (SAE)

J403 - Dec 2009 Chemical Composition of SAE Carbon Steels

616.05 MATERIALS

616.05.01 Concrete

Concrete shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 30 MPa.

616.05.02 Steel Reinforcement

Steel reinforcement shall be according to OPSS 1440.

616.05.03 Granular Material

Granular materials shall be Granular A or B according to OPSS 1010.

616.05.04 Ducts and Fittings

Ducts and fittings shall be according to OPSS 603.

616.05.05 Anchorage Assemblies and Hardware

All steel components shall be hot dipped galvanized according to CAN/CSA G164.

616.05.05.01 Anchor Assembly Struts

Anchor assembly struts shall be grade SAE 1030 steel according to SAE J403.

616.05.05.02 Studs, Nuts, and Washers

Studs shall be grade SAE C1541 steel according to SAE J403, high tensile stress proof with a yield strength of 690 MPa, and a tensile strength of 860 MPa.

Hex nuts shall be steel grade B steel according to ASTM A 563.

Washers shall be according to ANSI B18.22.1.

616.05.05.03 Ferrules

Steel ferrules shall be grade AISI C12L14 rotoprobed bar according to SAE J403.

616.05.06 Steel Footings and Hardware

Steel footings and hardware shall be grade SAE 1020 steel according to SAE J403.

Steel top plates and steel equipment base plate shall be according to CSA G40.20/G40.21, Grade 260WT minimum.

Steel for footing shafts smaller than 150 mm in diameter shall be according to ASTM A 53.

Steel for footing shafts 150 mm and larger in diameter shall be hollow structural sections according to CSA G40.20/G40.21, Grade 350 W minimum.

Welding of the top plate shall be according to CSA W59 minimum.

Steel footings, steel equipment base plate, and mounting hardware shall be hot dip galvanized according to CSA G164.

Stainless steel bolts, nuts, and flat washers shall be according to ASTM A 193.

616.05.07 H-Section Assemblies and Hardware

H-section assemblies and hardware shall be grade SAE 1020 steel according to SAE J403.

Steel plate for H-section and the H-section shall be according to CSA G40.20/G40.21, Grade 260WT minimum.

H-section shall be HP200x54.

All welding shall be according to CSA W59 minimum.

H-section anchorage assemblies and mounting hardware shall be hot dip galvanized according to CAN/CSA G164.

616.05.08 Joint Filler

Expansion joint filler shall be type A or B according to OPSS 1308.

616.05.09 Grout

Grout shall consist of a mixture of one part Portland cement according to OPSS 1301 and two parts mortar sand according to OPSS 1004, wetted with sufficient water to make the mixture plastic. Water shall be according to OPSS 1302.

616.05.10 Wooden Pads

Wooden pads for controller cabinet shall be as specified in the Contract Documents.

616.06 EQUIPMENT

Equipment for the installation of steel footings shall be according to the following minimum requirements:

- a) Boom truck complete with hydraulic take-off.
- b) Hydraulically operated torque head with a minimum torque rating of 16,000 N·m complete with Kelly bar drive.
- c) Kelly bar adapter and universal driving plate.
- d) Torque indicator.

616.07 CONSTRUCTION

616.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

616.07.02 Removal

Removals shall be according to OPSS 610.

616.07.03 Concrete Footings and Pads

616.07.03.01 General

616.07.03.01.01 Excavation

Earth excavation for footings shall be carried out by the use of an auger, when practical. When additional excavation is required beyond the neat limits, such excavation shall be a minimum of 300 mm width beyond the neat dimensions of the footing to accommodate granular backfill.

When unsuitable material is encountered in the excavation, it shall be removed and replaced with material approved by the Contract Administrator.

Rock excavation shall be according OPSS 206.

616.07.03.01.02 Steel Reinforcement

Steel reinforcement shall be according to OPSS 905.

616.07.03.01.03 Concrete

Concrete shall be placed, finished, cured, and protected according to OPSS 904. Concrete shall be sampled and tested according to OPSS 1350.

Concrete in earth shall be placed directly against the undisturbed walls of the excavation or may be formed in place, provided that a minimum of 300 mm width is available for placing granular backfill. The upper portion of the footing shall be formed to a minimum of 75 mm below grade level.

When concrete is placed immediately adjacent to other concrete structures or pavement, expansion joint filler shall be installed around the abutting edge of the footing.

Concrete finish for footings installed in concrete barrier wall shall match the barrier wall finish.

616.07.03.01.04 Grading

The Contractor shall excavate and place fill material to the finished grade elevation according to OPSS 206.

616.07.03.02 Concrete Footings

616.07.03.02.01 Sleeves and Ducts

Sleeves for footings shall be accurately located to suit incoming ducts or cable systems and shall be securely tied to the steel reinforcement prior to placing concrete.

All sleeves or ducts shall be cut off cleanly above the footing at the height specified in the Contract Documents.

Sleeves or ducts shall be temporarily plugged or sealed until wiring is installed. Where ducts or sleeves are specified as spare or intended for future use, the ducts or sleeves shall be plugged with plastic plugs.

Location of sleeves or ducts shall be marked on the top of the concrete footing with a 50 x 50 mm cut or formed cross.

616.07.03.02.02 Anchorage Assemblies

Anchorage assemblies shall be installed using studs as specified in the Contract Documents.

Anchorage assemblies of the size and type specified in the Contract Documents shall be accurately positioned in the pole and sign footings. The alignment of the studs shall be parallel to the edge of the driving lane. Anchorage assemblies shall be securely tied to the steel reinforcement.

Studs shall be factory inserted in the ferrules and held in place with a pre-applied thread locking compound. A wooden template shall be provided. Nuts and washers shall be installed hand tight by the fabricator. Studs shall have the exposed threads above the ferrule coated with factory applied white lithium grease. The integrity of the compound shall be maintained throughout the installation and no attempt shall be made to remove or adjust the studs.

The anchorage assembly shall be installed and adjusted level in all directions on the wooden template using a carpenter's level. Upon initial concrete set, the wooden template shall be removed and the drainage channels and other surface features shall be completed.

When the removal of the studs for repair or replacement purposes is required, the ferrules and the studs shall be cleaned to remove the old thread locking compound. New thread locking compound shall be applied to the insertion length of the studs prior to tightening to full depth.

616.07.03.02.03 H-Section Assemblies

H-section for barrier walls shall be accurately positioned in the concrete footings under the concrete barrier. The alignment of the studs shall be parallel to the edge of the driving lane. The plumb position of the anchorage assemblies shall be maintained during the placing of concrete.

616.07.03.02.04 Concrete

Concrete pole footings shall be placed so that the top of the footing is within ± 25 mm of the elevation specified in the Contract Documents.

616.07.03.02.05 Granular Backfill

When granular backfill is specified in the Contract Documents or, when granular backfill is placed around footings, it shall be compacted according to OPSS 501.

616.07.03.02.06 Concrete Footings in Earth

Concrete footings in earth shall be placed at locations specified in the Contract Documents.

616.07.03.02.07 Concrete Footings in Rock

The work for concrete footings in rock shall include placing dowels and concrete. Concrete footings in rock shall to be placed at locations specified in the Contract Documents.

616.07.03.02.07.01 Dowels in Rock

When specified in the Contract Documents, steel dowel bars shall be installed. Dowel bars shall be grouted in holes drilled into rock using non-shrink grout.

616.07.03.03 Concrete Pads

Concrete pads shall be placed at locations specified in the Contract Documents.

616.07.03.03.01 Granular Bases

Granular material shall be placed as foundation for concrete pads. Granular material shall be placed in conjunction with the installation of ducts under the concrete pads. The granular base shall be compacted according to OPSS 501.

616.07.03.03.02 Sleeves and Ducts

Sleeves and ducts shall be located within the concrete pads as specified in the Contract Documents so that cables may be installed vertically to the cable terminations in the pad mounted equipment.

Ducts shall be installed below pads according to OPSS 603 and shall be suitably aligned for connection to exterior duct or cable systems.

616.07.04 Steel Footings

616.07.04.01 Installation

The Contractor shall install steel footings larger than 150 mm diameter using the equipment as outlined in the Equipment section. Alternate methods of applying torque are permitted for 150 mm diameter or smaller steel footings.

During installation, the steel footing shall be maintained in a plumb position by use of a carpenter's level or a survey instrument. In all cases, the steel footing shall be installed so that the final location of the top plate rests on or is slightly below final grade. Steel footings to be used for poles shall be oriented such that the top plate is either perpendicular to or parallel to the edge of pavement, as required by duct orientation. Steel footings for other equipment mounting shall be oriented to suit the equipment to be mounted.

Steel footings shall be installed by turning the units into the earth at locations specified in the Contract Documents. Torque on footings larger than 150 mm in diameter shall be monitored and recorded during the turning operation and shall show a consistent and gradually increasing torque as the footing advances in depth.

When difficulties are encountered installing the steel footing due to the presence of boulders or rock fragments; or where the torque required to install the footing exceeds 20,000 N·m; or where the torque is less than 5,000 N·m when the shaft is fully driven into the ground, the footing shall be withdrawn and relocated 1.0 m minimum away from the original position, as approved by the Contract Administrator. If turning of the footing proves impractical, a pilot hole of 150 mm diameter may be predrilled and the footings then turned into the pilot hole. If this method proves impractical, a hole of 300 mm maximum diameter may be augured and the footing then installed into the hole. Compacted limestone screenings or expandable foam backfill shall be placed around the shaft to the bottom of the wiring aperture. Backfill of native material shall be placed above this level and compacted according to OPSS 501.

If the steel footings cannot be installed due to local conditions, a concrete footing shall be installed.

616.07.04.02 Mounting Hardware and Steel Equipment Base Plate

The mounting hardware and steel equipment base plate shall be installed as specified in the Contract Documents.

616.07.05 Wooden Pads

616.07.05.01 Installation

Wooden pads for controller cabinets shall be fabricated and placed at locations specified in the Contract Documents.

616.07.05.02 Granular Bases

A granular base shall be installed as a foundation for wooden pads. Granular material shall be placed in conjunction with the installation of ducts under the wooden pads. The granular base shall be compacted according to OPSS 501.

616.07.05.03 Sleeves and Ducts

Sleeves in wooden pads shall be located so that cables may be installed vertically to the cable terminations in the pad mounted equipment. Ducts shall be installed below the pads according to OPSS 603 and shall be suitably aligned for connection to exterior duct or cable systems.

616.07.06 Quality Control

616.07.06.01 Pre-Installation Testing and Inspection

Anchorage assemblies, studs or bolts, and connection components shall be inspected prior to installation to ensure that they are according to the Contract Documents.

616.07.06.02 Proof of Performance Testing and Inspection

The work shall be inspected to ensure that it is according to the Contract Documents. The work shall be inspected to ensure that all components are installed and that all footings and pads, including anchorage assemblies, are properly oriented and in working order.

616.07.07 Temporary Electrical Work

The work for temporary electrical installations shall be the same as for permanent installations of the same type of work, except that the work shall include the removal of the installations when they are no longer required.

616.07.08 Site Restoration

Site restoration shall be according to OPSS 492.

616.07.09 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

616.08 QUALITY ASSURANCE

The Owner may perform tests for concrete according to OPSS 1350.

The Owner may perform tests for compaction according to OPSS 501.

The Owner may inspect each pole footing as specified in the Contract Documents.

616.09 MEASUREMENT FOR PAYMENT

616.09.01 Actual Measurement

616.09.01.01 Concrete Footings in Earth

For measurement purposes, a count shall be made of the number of concrete footings installed in earth.

616.09.01.02 Concrete Footings in Rock

For measurement purposes, a count shall be made of the number of concrete footings installed in rock.

616.09.01.03 Concrete Pads

For measurement purposes, a count shall be made of the number of concrete pads installed.

616.09.01.04 Steel Footings

For measurement purposes, a count shall be made of the number of steel footings installed.

616.09.01.05 Wooden Pads

For measurement purposes, a count shall be made of the number of wooden pads installed.

616.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

D 616.10 BASIS OF PAYMENT

**D 616.10.01 Concrete Footings in Earth - Item
Concrete Footings in Rock - Item
Concrete Pads - Item
Steel Footings - Item
Wooden Pads - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

When a specified steel footing cannot be placed due to local conditions and a concrete footing is installed in its place, such work shall be paid as Extra Work.

616.10.02

Concrete Footings in Earth, Temporary - Item
Concrete Footings in Rock, Temporary - Item
Concrete Pads, Temporary - Item
Steel Footings, Temporary - Item
Wooden Pads, Temporary - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Progress payment for the above tender items shall be based on the following percentages of the Contract price:

80% for supply and installation

20% for removal

Appendix 616-A, November 2012 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Wooden pad requirements. (616.05.10)
- Cut-off grade for sleeves and ducts. (616.07.03.02.01)
- Size and type of anchorage assemblies. (616.07.03.02.02)
- Top of concrete pole footing elevation. (616.07.03.02.04)
- Concrete footing in rock locations. (616.07.03.02.07)
- Concrete pad locations. (616.07.03.03)
- Steel footing locations. (616.07.04.01)
- Wooden pad locations. (616.07.05.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 2200.01	Concrete Footing for Base Mounted Lighting and Signal Poles
OPSD 2200.02	Concrete Foundation for Direct Buried Lighting Poles Where Rock is Encountered
OPSD 2200.03	Concrete Foundation for Base Mounted Lighting Poles Where Rock is Encountered
OPSD 2200.04	Concrete Footing and Anchorage Assembly for 3.3 m Base Mounted Metal Pole
OPSD 2200.070	Pole Footing in Earth for Cast-in-Place Concrete Barrier
OPSD 2200.080	Pole Footing in Rock for Cast-in-Place Concrete Barrier
OPSD 2203.03	Steel Equipment Base Plate for Controller Cabinet
OPSD 2210.01	Local Grading at Pole Foundations
OPSD 2210.020	Installation of Direct Buried Poles in Slopes
OPSD 2215.02	Anchorage Assembly
OPSD 2215.03	Pole Mounting Details for Base Mounted Metal Pole
OPSD 2216.010	Anchorage Assembly for Pole Footing in Concrete Barrier
OPSD 2514.02	Concrete Pad for Controller Cabinet



CONSTRUCTION SPECIFICATION FOR INSTALLATION OF ROADWAY LUMINAIRES

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617-B	Supplemental Requirements for Using OPSS 617 in Municipal Contracts

617.01 SCOPE

This specification covers the requirements for the installation of luminaires and brackets on poles complete with associated wiring and connections.

617.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

617.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

617.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 604	Installation of Cable
OPSS 609	Grounding
OPSS 610	Removal of Electrical Equipment and Materials

Ontario Provincial Standard Specifications, Material

OPSS 2432	High Pressure Sodium Luminaires for Highway Lighting

CSA Standards

C22.2 No. 9.0-96 (R2011)	General Requirements for Luminaires
C22.2 No. 65-13	Wire Connectors
C22.2 No. 211.2-06 (R2011)	Rigid PVC (Unplasticized) Conduit
C22.2 No. 248.8-11	Low-Voltage Fuses - Part 8: Class J Fuses
C83-96 (R2011)	Communication and Power Line Hardware

American National Standards Institute (ANSI)

C78.380-2007 High-Intensity Discharge Lamps, Method of Designation

Illuminating Engineering Society of North America (IESNA)

LM-63-02 Standard File Format for Electronic Transfer of Photometric Data and Related Information
LM-79-08 Electrical and Photometric Measurements of Solid-State Lighting Products

617.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

617.04 DESIGN AND SUBMISSION REQUIREMENTS

617.04.01 Submission Requirements

A photometric test report shall be submitted for each photometric curve used in the luminaires to be installed under the Contract. The testing and test reports for high intensity discharge (HID) luminaires (e.g., high pressure sodium) shall be according to IESNA LM-63. The testing and test reports for LED luminaires shall be according to IESNA LM-79. The testing and test reports shall be completed by an independent laboratory or a National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory, which is accredited for testing the type of luminaire to be installed under the Contract (i.e., accredited for IESNA LM-63 for HID luminaires or IESNA LM-79 for LED luminaires). Each test report shall be dated and signed. The test reports shall be submitted to the Contract Administrator prior to the commencement of fabrication.

617.05 MATERIALS

617.05.01 Luminaires

617.05.01.01 Roadway Lighting Type

Roadway lighting luminaires shall be according to OPSS 2432 and the Contract Documents.

617.05.01.02 High Mast Lighting Type

High mast lighting luminaires shall be according to OPSS 2432 and the Contract Documents.

617.05.01.03 Floodlighting Type

Floodlighting luminaires shall be according to CSA C22.2 No. 9.0 and the Contract Documents.

617.05.02 Lamps

Lamps shall be high pressure sodium according to ANSI C78.380 with ANSI lamp designations shown in Table 1. Lamp wattages shall be permanently marked using a label affixed to the underside of the luminaires as specified in the Contract Documents.

617.05.03 Low-Voltage Cables

Single conductor low-voltage cables shall be according to OPSS 604.

617.05.04 Wire Connectors

Wire connectors shall be of the compression type and shall be according to CAN/CSA C22.2 No. 65.

617.05.05 Insulating Covers

Insulating covers for connectors shall be of the vinyl snap lock type or heat shrink tubing type and rated at 600 V.

617.05.06 Brackets

Brackets shall be as specified in the Contract Documents.

617.05.07 Conduit and Fittings

Conduit and fittings required for wooden pole mounting shall be of the rigid PVC type according to CSA C22.2 No. 211.2.

617.05.08 Hardware

Hardware for wooden pole mounting shall be according to CSA C83.

617.05.09 Grounding Materials

Ground wire and connectors shall be according to OPSS 609.

617.05.10 Fuse Holders and Fuses

Fuse holders shall be of the in-line type suitable for use with #12 AWG conductors, rated 600 V, and shall be complete with protective boots. Fuses shall be according to CSA C22.2 No. 248.8, 600 V with a current rating as specified in the Contract Documents.

617.07 CONSTRUCTION

617.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

617.07.01.01 Ordering Luminaires

Immediately following the award of the Contract, the Contractor shall order the luminaires as required for this Contract.

The Contractor shall obtain verification of the delivery dates of the luminaires from the supplier and notify the Contract Administrator of the delivery dates within 72 hours after the award of the Contract.

The Contractor shall ensure there is timely and accurate communication with both the Owner and the supplier regarding the delivery, schedules, and requirements for the luminaires.

Delivery and off-loading of the luminaires shall be completed in a timely and efficient manner.

617.07.02 Removals

Removals shall be according to OPSS 610.

617.07.03 Lamp Installation

Lamps shall be installed after poles have been erected and the brackets and luminaires mounted and levelled.

617.07.04 Brackets

617.07.04.01 Roadway Lighting Type

Brackets shall be installed at right angles to the centreline of the roadway being served. Bracket clamping assemblies shall be securely tightened. Brackets shall be mounted on wooden poles using 16 mm diameter galvanized steel square head through bolts, nuts, and 50 x 50 mm washers.

617.07.04.02 Floodlighting Type

Bracket assemblies shall be oriented to give the floodlight aiming specified in the Contract Documents. Bracket clamping assemblies shall be securely tightened.

617.07.05 Luminaires

617.07.05.01 General

Luminaires shall be stored in conditions free of moisture, dirt, and other factors that could damage the ballasts or reflecting surfaces of the optical system.

Luminaires shall be mounted on brackets and shall be installed level along both the longitudinal and transverse axis.

Luminaire clamping assemblies shall be securely tightened upon completion of levelling.

Luminaires shall be orientated and aimed using the horizontal and vertical angles specified in the Contract Documents. When instructed by the Contract Administrator, each luminaire or luminaire component shall be readjusted once under nighttime operating conditions.

Glass refractors shall be installed complete with gaskets. Mounting hardware shall be securely tightened. The luminaire reflector and refractor shall be thoroughly cleaned prior to installing lamps. Lamps shall be installed with the installation date marked on the lamp base.

If required, the refractor and the lamp holder shall be reset or replaced according to manufacturer's instructions to give the proper type of light distribution specified in the Contract Documents.

When specified in the Contract Documents, the luminaires shall be equipped with shields. The shields shall be mounted in such a manner so as to prevent loosening, turning, or falling when subject to vibration or wind loading in the installed position and to permit relamping without removing or distorting the alignment of the shields.

The shield shall be installed according to the manufacturer's instructions. The orientation of each shield shall be as specified in the Contract Documents. After the shield is attached to the luminaire-retaining ring, it shall be rotated such that its centre (the deepest point) is aligned with the specified angle. The angle specified is based on geometric rotation with the true north as its reference (0 degrees). Once the shield is aligned to the specified angle, it shall be secured in place by tightening the holding ring.

The luminaire assembly when closed and in the operating position shall not be subject to damage by vibration.

617.07.05.02 High Mast Lighting Type

A maximum of one luminaire shall be installed on each arm of the luminaire ring.

Each luminaire shall be bolted and secured onto its respective luminaire arm.

617.07.06 Wiring and Connections

Riser wires in metal and concrete poles shall be terminated at the luminaire terminal block and installed through the bracket and pole to the pole handhole.

Riser wires on wooden poles shall enter the bracket with a drip loop and shall be installed in conduit when the distance from the bracket to the low voltage bus exceeds 450 mm.

Connections or riser wires to the assigned feeder conductors shall be made with compression connectors insulated with insulating covers.

In-line fuse holders and fuses shall be installed in the pole handhole and placed in an accessible location. For wooden poles, in-line fuse holder and fuses shall be installed at the point of connection.

617.07.07 Grounding

Grounding shall be according to OPSS 609.

For metal or concrete pole mounting, a #12 AWG insulated (green) stranded copper ground wire shall be installed between the luminaire housing ground terminal and the ground stud in the pole handhole.

For wooden pole mounting, a #12 AWG insulated (green) stranded copper ground wire shall be installed between the luminaire housing ground terminal and the system ground.

617.07.08 Replacing Luminaires

Existing luminaires shall be removed and new luminaires shall be installed according to the Contract Documents. Existing riser wires and luminaire ground wire shall be salvaged and connected to the new luminaires.

617.07.09 Relamping

When required, existing lamps shall be removed. The existing luminaires shall be thoroughly cleaned and new lamps shall be installed according to the Contract Documents.

617.07.10 Quality Control

617.07.10.01 Pre-Installation Testing and Inspection

Luminaires, brackets, socket setting, refractor type and ballast type shall be tested and inspected to ensure that they are according to the Contract Documents.

617.07.10.02 Proof of Performance Testing and Inspection

Luminaires shall be tested and inspected to ensure that they are levelled correctly and according to the Contract Documents. All lamps installed in luminaires shall have a minimum burning-in period of 100 nighttime hours prior to acceptance of the work by the Contract Administrator. All luminaire shielding shall be installed prior to the start of the burn-in period.

All tests required on the wiring system shall be according to OPSS 604.

A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Quality Verification Engineer shall affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:

- a) Work
- b) Material and installations
- c) Inspection, testing, and test results

617.07.11 Temporary Electrical Work

The work for temporary electrical installations shall be the same as for permanent installations of the same type of work, except the work shall include the removal of the installations when they are no longer required.

617.07.12 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

617.09 MEASUREMENT FOR PAYMENT

617.09.01 Actual Measurement

617.09.01.01 Roadway Lighting Luminaires and Bracket Assemblies

For measurement purposes, a count shall be made of the number of roadway lighting luminaires and bracket assemblies installed.

617.09.01.02 High Mast Lighting Luminaires

For measurement purposes, a count shall be made of the number of high mast lighting luminaires installed.

617.09.01.03 Floodlighting Luminaires and Bracket Assemblies

For measurement purposes, a count shall be made of the number of floodlighting luminaires and bracket assemblies installed.

617.09.01.04 Replace Roadway Lighting Luminaires

For measurement purposes, a count shall be made of the number of roadway lighting luminaires replaced.

617.09.01.05 Replace High Mast Lighting Luminaires

For measurement purposes, a count shall be made of the number of high mast lighting luminaires replaced.

617.09.01.06 Replace Floodlighting Luminaires

For measurement purposes, a count shall be made of the number of floodlighting luminaires replaced.

617.09.01.07 Relamp Roadway Lighting Luminaires

For measurement purposes, a count shall be made of the number of new lamps installed in existing roadway lighting luminaires.

617.09.01.08 Relamp High Mast Lighting Luminaires

For measurement purposes, a count shall be made of the number of new lamps installed in existing high mast lighting luminaires.

617.09.01.09 Relamp Floodlighting Luminaires

For measurement purposes, a count shall be made of the number of new lamps installed in existing floodlighting luminaires.

617.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

617.10 BASIS OF PAYMENT

617.10.01 Roadway Lighting Luminaires and Bracket Assemblies - Item
High Mast Lighting Luminaires - Item
Floodlighting Luminaires and Bracket Assemblies - Item
Replace Roadway Lighting Luminaires - Item
Replace High Mast Lighting Luminaires - Item
Replace Floodlighting Luminaires - Item
Relamp Roadway Lighting Luminaires - Item
Relamp High Mast Lighting Luminaires - Item
Relamp Floodlighting Luminaires - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

617.10.02 Roadway Lighting Luminaires and Bracket Assemblies (Temporary) - Item
Floodlighting Luminaires and Bracket Assemblies (Temporary) - Item
High Mast Lighting Luminaires (Temporary) - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Progress payments for the above tender items shall be based on the following percentages of the Contract price:

80% for supply and installation
20% for removal

TABLE 1
Lamps for Roadway Lighting

Lamp Type	Lamp Wattage	Lamp Nominal Operating Voltage	Lamp Finish	ANSI Lamp Designation
High Pressure Sodium (HPS)	100	55	Clear	S54-100
	150	55	Clear	S55-150
	200	100	Clear	S66-200
	200	100	Coated	S66/D-22
	250	100	Clear	S50-250
	310	100	Clear	S67-310
	400	100	Clear	S51-400
	600	105	Clear	S106-600
	750	120	Clear	S111-750
	1000	250	Clear	S52-1000

Appendix 617-A, November 2013 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Roadway lighting luminaire requirements. (617.05.01.01)
- High mast lighting luminaire requirements. (617.05.01.02)
- Floodlighting luminaire requirements. (617.05.01.03)
- Bracket type. (617.05.06)
- Fuse current rating. (617.05.10)
- Floodlight bracket orientation. (617.07.04.02)
- Light distribution requirements. (617.07.05.01)
- High mast lighting horizontal and vertical orientation angles. (617.07.05.01)

The designer should determine if the following are required and, if they are, specify them in the Contract Documents:

- Luminaire shields. (617.07.05.01)
- Luminaire shield orientation. (617.07.05.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 2418.010	1.8 m and 2.7 m Steel Truss Bracket for Steel Poles
OPSD 2420.01	1.8 m and 2.4 m Aluminum Tapered Elliptical Bracket
OPSD 2421.010	Lamp Wattage Label for Luminaire
OPSD 2453.000	High Mast Lighting Pole, Luminaire and Handhole Orientation
OPSD 2453.060	High Mast Lighting Pole, Flood Light Luminaire Mounting Details
OPSD 2453.070	High Mast Lighting Pole, Luminaire Support Ring
OPSD 2453.090	High Mast Lighting Pole, Luminaire Shroud
OPSD 2453.091	High Mast Lighting Pole, Luminaire Shroud Details

Appendix 617-B, November 2013

FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

Supplemental Requirements for Using OPSS 617 in Municipal Contracts

OPSS 617 Installation of Roadway Luminaires, is amended as follows:

617.03 Definitions

Section 617.03 is amended by the deletion of the definition for Quality Verification Engineer and replaced by the following:

Quality Verification Engineer (QVE) means a representative of the Owner qualified to provide the services specified in the Contract Documents.



**CONSTRUCTION SPECIFICATION FOR
TRAFFIC SIGNAL EQUIPMENT AND
ELECTRICAL TRAFFIC CONTROL DEVICES**

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620-A	Commentary

620.01	SCOPE

This specification covers the requirements for the installation of traffic signal equipment and electrical traffic control devices.

620.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

620.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

620.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 603	Installation of Ducts
OPSS 604	Installation of Cable
OPSS 609	Grounding
OPSS 610	Removal of Electrical Equipment and Materials
OPSS 624	Traffic Signal Interconnection Equipment

Ontario Provincial Standard Specifications, Material

OPSS 2409	Traffic Signal Cable
OPSS 2410	Extra Low-Voltage Cable
OPSS 2460	Traffic Signal Arms, Brackets, Hangers, Fittings, and Hardware
OPSS 2461	Signal Heads

Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 12 - Traffic Signals

CSA Standards

C22.2 No. 41-13	Grounding and Bonding Equipment
C22.2 No. 45.2-08 (R2013)	Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel
C22.2 No. 65-13	Wire Connectors
C22.2 No. 85-14	Rigid PVC Boxes and Fittings
C22.2 No. 197-M1983 (R2013)	PVC Insulating Tape
C22.2 No. 211.2-06 (R2011)	Rigid PVC (Unplasticized) Conduit
C57-98 (R2011)	Electric Power Connectors for Use in Overhead Line Conductors

Electrical Safety Authority (ESA)

Ontario Electrical Safety Code

Others

Ontario Highway Traffic Act, R.S.O. 1990, Chapter H.8
Transport Canada Guideline for Inspecting and Testing Pre-emption of Interconnected Traffic Control Signals and Railroad Crossing Warning Systems

620.03 DEFINITIONS

For the purpose of this specification, the definitions in the OTM Book 12 and the following definitions apply:

Auxiliary Signal Head means a traffic signal head installed as supplementary to the primary and secondary signal heads and that may be necessary due to local conditions.

Beaconing Actuation means the actuation of the audible signal when a pedestrian push button is pressed and held for a predefined period, typically 3 seconds.

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Detection means the operation of a detector sensor unit in registering the presence or passage of a vehicle or pedestrian.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

General Conformance means that in the opinion of an Engineer, the standard of construction work fulfills the essential requirements of the Contract Documents and has been done in accordance with normally accepted industry standards and shall perform its intended function.

Highway Signal Head means a traffic signal head with a 300 mm diameter red lens and with 200 mm diameter amber and green lenses.

Interconnection means the system of cables and devices that operate traffic signal controllers at consecutive intersections in a fixed or pre-programmed timing sequence.

Pedestrian Signal Head means a traffic signal head comprising of a walk and don't walk symbol mounted at a crosswalk.

Primary Signal Head means a traffic signal head mounted on the far right side of an intersection approach.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Secondary Signal Head means a traffic signal head mounted on the far left side or in the median of an intersection approach.

Signal Head means an assembly containing one or more signal displays.

Special Signal Head means a traffic signal head comprised of a combination of sections with red, amber, and green displays or sections with green and amber displays.

Standard Signal Head means a traffic signal head with 200 mm diameter red, amber, and green lenses.

Uninterruptible Power Supply means a backup power supply that supplies temporary power without an interruption in system operation in the event of a short-term loss of power from the local supply authority.

Vehicle Extension means the time, in seconds, added to the green interval to permit additional green time upon actuation by a vehicle approaching the intersection.

620.04 DESIGN AND SUBMISSION REQUIREMENTS

620.04.01 Submissions Requirements

620.04.01.01 Working Drawings and Service Manuals

Working Drawings and service manuals shall be submitted as specified in the Contract Documents.

620.05 MATERIALS

620.05.01 Traffic Signal Heads and Flasher Beacons

Traffic signal heads shall be according to OPSS 2461, OTM Book 12, and the Ontario Highway Traffic Act.

Flasher beacons shall be according to OPSS 2461.

620.05.02 Mast Arms, Brackets, and Signal Hangers

Mast arms, brackets, and signal hangers shall be according to OPSS 2460 and the Contract Documents.

620.05.03 Traffic Signal Cables

Traffic signal cables shall be according to OPSS 2409.

620.05.04 Electrical Insulating Tape

Electrical insulating tape shall be according to CSA C22.2 No. 197 and rated for 600 V and -10 to 90 °C working temperature.

620.05.05 Light Sources

620.05.05.01 Incandescent Lamps

Incandescent lamps shall be according to OPSS 2461.

620.05.05.02 LED Modules

LED modules shall be according to OPSS 2461.

620.05.06 Ducts and Fittings

Rigid PVC ducts and fittings shall be according to CSA C22.2 No. 211.2. Rigid aluminum ducts and fittings shall be according to CSA C22.2 No. 45.2.

620.05.07 Electrical Connectors

Wire connectors shall be of the insulated wing nut, vibration proof spring type, and shall be according to CSA C22.2 No. 65.

Cable connectors shall be according to CSA C22.2 No. 65 and CSA C57.

Mechanical connectors shall be according to CSA C22.2 No. 41.

620.05.08 Junction Boxes and Fittings

PVC junction boxes and fittings shall be according to CSA C22.2 No. 85.

620.05.09 Strapping

Stainless steel strapping and buckles shall have a minimum ultimate strength of 4.5 kN.

620.05.10 Traffic Signal Mounting Equipment

Fittings, accessories, and hardware shall be as specified in the Contract Documents.

620.05.11 Grommets

Grommets shall be rubber or neoprene sized to suit the aperture, metal thickness, and cable diameter.

620.05.12 Grounding Materials

Grounding materials shall be according to OPSS 609.

620.05.13 Controllers

Controllers shall be as specified in the Contract Documents.

620.05.14 Loop Detectors

Extra low-voltage cables for loop detectors shall be according to OPSS 2410.

620.05.15 Pedestrian Push Buttons

Pedestrian push buttons shall be as specified in the Contract Documents.

620.05.16 Accessible Pedestrian Signals

Accessible pedestrian signals shall be as specified in the Contract Documents.

620.05.17 Sealing Compound

Sealing compound shall be of the cold pumped type or hot poured type as specified in the Contract Documents.

620.05.18 Aerial Mounting Equipment

Fittings, accessories, and hardware shall be as specified in the Contract Documents.

620.05.19 Microloop Detectors

Microloop detectors shall be according to the manufacturer's specifications and as specified in the Contract Documents.

620.05.20 Microwave Detectors

Microwave detectors shall be according to the manufacturer's specifications and as specified in the Contract Documents.

620.05.21 Video Detectors

Video detectors shall be according to the manufacturer's specifications and as specified in the Contract Documents.

620.05.22 Variable Message Signs

Variable message signs shall be according to the manufacturer's specifications and as specified in the Contract Documents.

620.05.23 Advance Warning Signs

Advance warning signs shall be according to the manufacturer's specifications and as specified in the Contract Documents.

620.05.24 Traffic Signal Pre-Emption Equipment

Traffic signal pre-emption equipment shall be according to the manufacturer's specifications, as specified in the Contract Documents, and the specific requirements of the authority that is authorized to activate and use the pre-emption function.

620.05.25 Uninterruptible Power Supply Systems

Uninterruptible power supply systems shall be according to the manufacturer's specifications and as specified in the Contract Documents.

620.07 CONSTRUCTION

620.07.01 General

General electrical work requirements shall be as specified in the Contract Documents.

The work shall include the supply, installation, modification, and testing of all materials and systems required to provide traffic signal systems, traffic control devices, and other devices that are fully functional and perform their intended function as specified in the Contract Documents.

620.07.02 Traffic Signals

620.07.02.01 Mast Arms

The attachment point of the mast arm on the pole shall be set to obtain the required clearance from finished grade to the bottom of the signal head. When two or more mast arms are mounted on the same pole, the clearance height of the primary head shall be set to obtain the required clearance height specified in the Contract Documents. Other mast arms with secondary or auxiliary signal heads shall be adjusted on the pole so that a minimum separation of one pole diameter is obtained between fittings or bolts touching the pole.

Holes for wooden pole mounting shall be drilled to accommodate the through bolts. Nuts shall be tightened to obtain a minimum wood compression of 3 mm under the washers.

Mast arm attachment to steel poles using U bolts or pole plates shall be tightened to a point when the pole just begins to deform.

Mast arms shall be installed perpendicular to the through lanes of traffic being served.

620.07.02.02 Traffic Signal Head Supports

Silicon based sealer shall be applied to the assembly as specified in the Contract Documents.

Traffic signal heads shall be supported as specified in the Contract Documents.

Traffic signal head supports shall be fastened onto the tenon of the mast arm or onto the traffic signal pole itself. Traffic signal head supports shall be adjusted and secured.

620.07.02.03 Double Arm Brackets

Double arm brackets shall be assembled on signal heads prior to pole mounting. The arm shall be installed in parallel alignment and all locknuts securely tightened.

Pole plates shall be mounted on the side of the pole so that the signal heads meet the required clearance height from finished grade. Pole plates shall be secured with stainless steel strapping that shall not overlap or secure any other equipment on the pole.

620.07.02.04 Signal Heads

Signal heads shall be installed facing the direction of approaching traffic. LED modules or incandescent lamps of the size and type specified in the Contract Documents shall be installed. Incandescent lamps shall be installed with positive electrical contact in the signal head lamp holders. Lamp holders for incandescent lamps shall be turned so that the gap in the lamp filament is facing upwards.

Signal heads shall be covered with opaque covers and remain securely in place until all tests have been completed and the signal heads are put into operation. Pedestrian heads shall be turned to face the pole prior to operation.

Signal heads shall be adjusted for maximum visibility and focusing prior to final tightening or sealing of hardware. Unused top and bottom hubs in signal heads shall be plugged with bird stops and the top hub shall have a gasket.

620.07.02.05 Wiring Apertures

Wiring apertures shall be drilled as required in metal poles. Apertures shall be located clear of the vertical seam and overlapping sections of sectional steel poles. Apertures shall be de-burred and painted with grey zinc rich paint. Grommets shall be installed after the paint is dry.

620.07.02.06 Pole Mounted Conduit Systems

Pole mounted conduit systems including rigid PVC junction boxes and all necessary fittings and hardware shall be installed when traffic signal equipment is to be installed on concrete or wooden poles. Conduit shall be installed in straight lengths to follow the taper of the pole using stainless steel strapping or galvanized steel two-hole clips secured by galvanized lag screws at 1.5 m maximum spacing. Offset bends shall be used when required to avoid pole attachments and other equipment. Conduits shall be kept free of kinks or scorch marks.

620.07.02.07 Wiring

Traffic signal cable shall be installed between the signal head and the pole handhole or the pole mounted PVC junction box. Wiring shall be run through the mast arms, signal hangers, and the upper arm of double arm brackets. A minimum length of 600 mm of riser cable shall be left in pole handholes.

Aerial cable from the PVC junction box to the signal head shall be installed according to OPSS 604.

Riser cables shall be connected to LED modules or incandescent lamp holder leads via terminal blocks or with insulated wing nut vibration proof spring connectors. Termination of spare conductors and handhole or junction box connections shall be made with insulated spring connectors. All insulated wire connectors shall be held in place with three half laps of electrical vinyl tape. Upon completion of connections, all conductors shall be neatly bundled together and secured with four laps of electrical vinyl tape.

Signal heads shall be bonded according to OPSS 609 and the Ontario Electrical Safety Code using the designated bonding conductor in the cable, and connected securely to the signal head and the pole ground stud or the system ground wire in PVC junction boxes.

Cables shall be identified at all access points and labelled as specified in the Contract Documents. Cables shall be identified using tags with permanent waterproof markings.

620.07.02.08 Optically Directed Signal Heads

Optically directed signal heads shall be installed according to the manufacturer's instructions. Signal heads shall be adjusted to focus along the designated roadways or traffic lanes.

620.07.02.09 Aerial Mounted Equipment

Aerial mounted equipment shall be installed using all fittings, hardware, PVC junction boxes, and accessories necessary for the mounting of equipment on aerial messenger cable systems. All compression nuts, lock nuts, and fitting hardware shall be securely tightened to prevent shifting of equipment by wind.

620.07.02.10 Equipment Modifications

Removal of existing equipment shall be according to OPSS 610 and as specified in the Contract Documents. Installation of new, refurbished, or modified equipment shall be done according to the requirements for installation of the particular items of equipment as described herein.

620.07.03 Traffic Control Devices

620.07.03.01 Flasher Beacons

Flasher beacons for post top mounting shall be aligned facing the direction of approaching traffic.

Flasher beacons for pole front or side mounting shall be aligned facing the direction of approaching traffic and mounted on double arm brackets or mast arms and signal hangers as specified in the Contract Documents.

Single or multiple cluster of flasher beacons for aerial mounting shall be arranged on the overhead support cable to provide the required visibility and clearances for each direction of approaching traffic to be controlled. Mounting hardware shall be securely tightened.

620.07.03.02 Flasher Mechanisms

Flasher mechanisms shall be mounted in enclosures with the accompanying conduit, conduit fittings, and wiring systems.

620.07.03.03 Sign Light Assemblies

Sign light assemblies shall be installed with rigid aluminum conduit and fittings, lamp holders, and lamps and shall be installed facing the direction of approaching traffic. Lengths of conduit shall be secured against fittings with lock nuts.

620.07.03.04 Internally Illuminated Signs

Internally illuminated signs shall be installed on double arm brackets, mast arms and signal hangers, or aerial support cables as specified in the Contract Documents.

620.07.03.05 Grounding

Traffic control devices shall be grounded according to OPSS 609.

620.07.03.06 Removals

Removals shall be according to OPSS 610.

620.07.04 Controllers

620.07.04.01 Controller Cabinets

620.07.04.01.01 Pole Mounted Controller Cabinets

Pole mounted controller cabinets shall be installed complete with mounting brackets, hardware, stainless steel strapping, and pole mounted conduits and fittings and shall be located and oriented as specified in the Contract Documents.

620.07.04.01.02 Pad Mounted Controller Cabinets

Pad mounted controller cabinets shall be installed complete with hardware and accessories and shall be located and oriented as specified in the Contract Documents.

A gasket shall be attached squarely and symmetrically on the bottom channel of the cabinet prior to installation with holes for mounting bolts drilled, when necessary.

A gasket with adhesive on one side shall be provided to install between the concrete pad and the bottom of the cabinet or base extension unit.

The cabinet enclosure shall include a main cabinet and a base extension unit. The top of the base extension unit shall match the bottom of the main cabinet. A gasket shall be installed between the main cabinet and the base extension unit. All stainless steel hardware to bolt the main cabinet together with the base extension unit shall be provided.

620.07.04.01.03 Pedestal Mounted Controller Cabinets

Pedestal mounted controller cabinets shall be installed complete with hardware and accessories and shall be located and oriented as specified in the Contract Documents.

620.07.04.01.04 Equipment Bonding

Equipment bonding shall be according to OPSS 609 and the Ontario Electrical Safety Code.

620.07.04.02 Controller Equipment

620.07.04.02.01 Shelf-Mounted and Rack-Mounted Equipment

Shelf-mounted and rack-mounted controller equipment shall be neatly and suitably arranged on the shelves or racks so that all preformed wiring harnesses are of adequate length to allow connections and may be trained to out-of-the-way locations. Similar items of equipment shall be grouped together. All equipment shall be installed with the front facing outward so that the main operational controls and switches are readily accessible.

620.07.04.02.02 Cabinet-Wall Mounted Equipment

Cabinet-wall mounted equipment shall be installed level and clear of nearby components. The equipment shall be bolted in place with minimum 5 mm diameter stainless steel machine bolts, nuts, and lock washers.

620.07.04.02.03 Identification of Equipment

All equipment shall be identified with permanent markings.

620.07.04.02.04 Security

Controller cabinets shall be kept locked at all times, except when work is being performed on the controller cabinet equipment. Upon completion of the work, all keys to the controller cabinet shall be given to the Contract Administrator.

620.07.04.02.05 Traffic Signal Control Programming and Timing

All controller and conflict monitor programming shall be installed and all timing controls, switches, and programming controls shall be set.

The Contract Administrator shall provide the traffic signal interval timing to the Contractor. The Contractor shall install the traffic signal timing into the traffic signal controller. The Contractor shall verify that the traffic signal timing is consistent and complete prior to installing it.

620.07.05 Activation Devices

620.07.05.01 Detector Loops

620.07.05.01.01 Loop Layout

Detector loops shall be accurately laid out on the pavement to the dimensions specified in the Contract Documents. Slot cutting lines shall be marked with non-permanent materials.

When the layout of a loop crosses a major pavement crack, butt or expansion joint, or irregularity, the treatment for the crossing shall be as specified in the Contract Documents.

620.07.05.01.02 Saw Cutting

The Contractor shall ensure that the temperature is within allowable limits prior to saw cutting and ensure that any dampness or precipitation can be successfully blown out of saw cut slots prior to and during installation.

Saw cutting of loop slots in pavement shall be in straight lines with slot depths and widths according to the dimensions specified in the Contract Documents. Corner cutting for slots shall be extended only far enough past each corner point to obtain the full depth of the slot. Slot crossing of pavement irregularities shall be constructed using additional widths and depths of slots as specified in the Contract Documents.

When specified in the Contract Documents, saw-cut marks shall be made on the curbs to indicate location of the loop.

620.07.05.01.03 Slot Preparation

Upon completion of saw cutting, the slot shall be cleaned with compressed air and dried by applying heat.

Corner of slot shall be rounded using hand tools. All slots and corners shall be examined for protrusions of sharp stone aggregates or debris that may damage the cable. Any such protrusions or debris shall be removed. Final slot preparation shall be done immediately prior to installation of the cable.

620.07.05.01.04 Flexible Duct Installation

A hole shall be drilled through the pavement to accommodate a flexible duct at the location specified in the Contract Documents.

All work for flexible duct installation, including earth excavation, backfill, removal, and restoration shall be according to OPSS 603.

620.07.05.01.05 Loop Cable

The loop shall be installed with the size, winding direction, configurations, number of turns, and type of cables as specified in the Contract Documents.

The loop cable end that progresses clockwise shall be marked at the splice point with two bands of colour contrasting electrical vinyl tape.

Each loop cable and extra low-voltage cable shall be identified with a vinyl sleeve wire marker in the splice point as specified in the Contract Documents.

Cable in slots shall be firmly and carefully tamped in place using a blunt instrument on each successive turn of cable. Cables shall be held in place to prevent floating using 25 mm lengths of foam backer rod at 600 mm intervals.

When cables are installed in slots crossing pavement irregularities, all cables shall be installed through split neoprene tubing.

Loop cables between the loop and the splice point, including those in the slot, shall be twisted together to form a consistent lay of 10 turns per metre. The entire loop and lead cable system shall be installed as a continuous and unspliced length of cable.

620.07.05.01.06 Sealing Compound

Sealing compound shall be installed in slots as specified in the Contract Documents.

Sealing compounds shall be installed in slots as protection for loop cables. Sealing compound shall be allowed to set according to the manufacturer's instructions prior to allowing vehicles to cross over the loop. Loop sealant shall be applied directly into the loop slot with no spillage. Spilled loop sealant or other excess loop sealant on the road surface that is not within the loop slot shall be removed from the road surface. Sealing compound shall be of the following types:

a) Cold Pumped Type

Cold pumped compounds shall be installed using a pressure pump or cartridge gun according to the manufacturer's instructions.

b) Hot Poured Type

Hot poured sealant shall be applied according to the manufacturer's recommendation. Hot poured sealant shall not be used when loops are to be installed in the binder course pavement prior to placement of the top course of pavement over the loops.

620.07.05.01.07 Splicing

Splices of cables shall be made only at the designated splice points. Cables shall be stripped of insulation by approximately 12 mm, butt spliced, soldered together, and covered with a resin or silicone material to produce a sealed connection.

620.07.05.02 Microloop Detectors

Microloop detectors shall be installed in underground ducts at the depths and locations specified in the Contract Documents. Microloops shall be connected to lead-in cable as specified in the Contract Documents.

Ducts for microloops and lead-in cables shall be installed by subsurface installation according to OPSS 603. Lead-in cables for microloops shall be installed according to OPSS 604.

620.07.05.03 Microwave Detectors

Microwave detectors shall be installed at locations and mounting heights specified in the Contract Documents. Microwave detectors shall be orientated and configured for operation according to the manufacturer's specifications and as specified in the Contract Documents.

All cabling and equipment required to transmit, receive, and process microwave detection signals shall be installed according to the manufacturer's specifications and as specified in the Contract Documents.

620.07.05.04 Video Detectors

Video detectors shall be installed at locations and mounting heights specified in the Contract Documents. Video detectors shall be orientated and configured for operation according to the manufacturer's specifications and as specified in the Contract Documents.

All cabling and equipment required to transmit, receive, and process video and video detection signals shall be installed according to the manufacturer's specifications and as specified in the Contract Documents.

620.07.05.05 Variable Message Signs

Variable message signs shall be installed at locations specified in the Contract Documents. Variable message signs shall be orientated and configured for operation according to the manufacturer's specifications and as specified in the Contract Documents.

All cabling and equipment required to transmit messages to the variable message signs shall be installed according to the manufacturer's specifications and as specified in the Contract Documents.

620.07.05.06 Advance Warning Signs

Advance warning signs shall be installed at locations specified in the Contract Documents. Advance warning signs shall be orientated and configured for operation according to the manufacturer's specifications and as specified in the Contract Documents.

All cabling and equipment required to transmit messages to the advance warning signs shall be installed according to the manufacturer's specifications and as specified in the Contract Documents.

620.07.05.07 Pedestrian Push Buttons

Pedestrian push buttons shall be installed at locations specified in the Contract Documents and include the installation of pedestrian push buttons and push button signs as specified in the Contract Documents.

Pedestrian push buttons and push button signs shall be mounted on the side of the pole so that the pedestrian signal push button sign arrow indicates the proper direction for which roadway crossing is required.

Pedestrian push buttons shall be installed with stainless steel self-tapping screws or stainless steel strappings. A wiring aperture shall be drilled in metal poles and fitted with a rubber grommet or a rigid conduit shall be installed on poles for wiring access.

Push buttons for metal poles shall be installed as specified in the Contract Documents with an integral sign frame or separately mounted with stainless steel strappings or screws.

620.07.05.08 Accessible Pedestrian Signals

Accessible pedestrian signals shall be installed according to all applicable laws and regulations.

620.07.06 Traffic Signal Pre-Emption Equipment

Traffic signal pre-emption equipment shall be installed according to the manufacturer's instructions and as specified in the Contract Documents. Pre-emption equipment shall be set up to operate according to the manufacturer's specifications, as specified in the Contract Documents, and the specific requirements of the authority that is authorized to activate and use the pre-emption function.

620.07.07 Traffic Signal Interconnection Equipment

Traffic signal interconnection equipment shall be installed according to OPSS 624 and as specified in the Contract Documents.

620.07.08 Traffic Signal Control Equipment Supplied by Owner

When the Owner supplies the traffic signal control equipment, the equipment shall be loaded and transported from the Owner's premises specified in the Contract Documents. The Contractor shall ensure that all components are safely connected, secured, and packaged prior to transporting the equipment.

620.07.09 Uninterruptible Power Supply Systems

Uninterruptible power supply equipment shall be installed and adjusted according to the manufacturer's instructions and as specified in the Contract Documents.

620.07.10 Quality Control

620.07.10.01 General

The Contract Administrator shall be notified of the time and location of all inspection and testing 3 Business Days prior to the start of the work and confirm that the work shall be performed as scheduled 24 hours prior to the start of the work.

The work shall be inspected and tested 3 Days prior to the actual turn on of the signals to ensure that it is according to the requirements as specified in the Contract Documents.

A minimum of 72 hours prior to the scheduled activation of each traffic signal, the Contractor shall coordinate and attend an on-site quality control meeting with the Contract Administrator.

Upon completion of installations and testing, a visual check shall be made of the controller cabinet to ensure proper operation of the equipment.

All test results shall be submitted to the Contract Administrator.

620.07.10.02 Test Plans

A test plan shall be submitted to the Contract Administrator documenting how the traffic signals and electrical traffic control devices will be tested. The test plan shall be submitted to the Contract Administrator prior to any installation work and a minimum of 30 Business Days prior to the start of any testing.

The Contractor shall make additions or modifications to the test plan as specified by the Contract Administrator. Testing shall not commence until the test plan has been accepted by the Contract Administrator. Once accepted, the traffic signals and traffic control devices shall be tested according to the accepted test plan and as specified in the Contract Documents.

As a minimum, the test plan shall include a pre-installation test plan and a proof of performance test plan.

Once accepted by the Contract Administrator, the accepted test plan shall form part of the Contract Documents.

620.07.10.03 Pre-Installation Testing and Inspection

Actuation devices and connection components shall be inspected prior to installation to ensure that they meet the requirements as specified in the Contract Documents.

Traffic signal controllers and components shall be inspected prior to installation to ensure that they meet the requirements as specified in the Contract Documents.

The Contractor shall be responsible for ensuring that all controller and conflict monitor programming are installed and that all timing controls, switches, and programming controls are properly set.

Signal heads, mast arms, traffic signal head supports, double arm brackets, and connection components shall be inspected prior to installation to ensure that they meet the requirements as specified in the Contract Documents.

620.07.10.03.01 Traffic Signal Control Equipment

Traffic signal control cabinets complete with traffic signal control equipment shall be tested and inspected. The functionality and performance of each component shall be tested and confirmed to operate according to the manufacturer's specifications and as specified in the Contract Documents.

The entire traffic signal control equipment shall be tested with the traffic signal control equipment installed within the cabinet and all programming, timing, switches, and controls installed and set. The functionality and performance of the traffic signal control equipment as a complete system shall be tested and confirmed to operate according to the traffic signal timing plan, the manufacturer's specifications, and as specified in the Contract Documents.

If the traffic signal control equipment or any part thereof fails to operate correctly, the deficiency shall be corrected and the testing and inspection repeated in full.

620.07.10.03.02 Traffic Signal Equipment

The functionality and performance of each piece of traffic signal equipment shall be tested and inspected and confirmed to operate according to the manufacturer's specifications and as specified in the Contract Documents.

If the traffic signal equipment or any part thereof fails to operate correctly, the deficiency shall be corrected and the testing and inspection repeated in full.

620.07.10.03.03 Electrical Traffic Control Devices

The functionality and performance of each electrical traffic control device shall be tested and inspected and confirmed to operate according to the manufacturer's specifications and as specified in the Contract Documents.

If the electrical traffic control device or any part thereof fails to operate correctly, the deficiency shall be corrected and the testing and inspection repeated in full.

620.07.10.03.04 Controllers

Pre-shipping shop tests are required prior to transporting the controller to the Working Area. When the Owner supplies the controller, the tests shall be carried out by the Owner.

The following pre-installation tests are required:

a) Cabinet Assembly and Components

A visual check shall be made to ensure that all components necessary to the complete controller are present and that all pre-assembled equipment is securely mounted and connected.

b) Circuit Output

The output terminal board voltage shall be tested for 108 V minimum output from load switches and for proper terminal assignment according to the manufacturer's wiring diagram.

c) Programming

With the actual phase timing for the intended intersection in operation, the controller programming shall be tested to ensure that the intended operation is accomplished. This test shall include all required combinations of actuation and recall settings together with any special features such as advance green, phase skip, pre-emption, or coordination.

d) Interval Sequence

With the proper programming for the intended intersection in operation, but with modified timing values suitable to test conditions, the controller unit shall be cycled through all phases for a minimum of 24 hours. Controller output shall be tested using a test board with indicator lights to ensure that the proper phases and phase intervals appear in the correct sequence. The testing shall be conducted using either a 120 V test board wired to the output side of the load switches or by a 24 V test board wired to the input side of the load switches. Test results shall be confirmed a minimum of 6 times.

e) Actuation

With an appropriate test board, the effect of detection devices and pedestrian push buttons in entering a call to the controller unit shall be tested. All modes of detector sensor unit program and vehicle extension calls shall be tested. Tests shall confirm that all calls are registered, activated, and are associated with the correct traffic phase.

f) Conflict Monitors

Conflict monitors shall be tested according to the manufacturer's recommendations. All flash and reset functions shall be tested.

g) Flashers

The output of flasher units and flash transfer relays shall be tested for proper functioning over a two hour period.

h) Recall

Recall switch functions for each phase shall be tested to ensure that the controller recalls to the phase selected and remains on hold in the absence of a call on an opposing phase.

i) Manual Override Controls

Manual override controls shall be tested for proper operation under all possible switching combinations.

j) Environmental Controls

The heater element and circuitry shall be tested for continuity and proper resistance. The ventilation fan shall be checked for proper operation in conjunction with the thermostat control system. If the average temperature during the installation period is below 5 °C, the cover plate shall be installed over the louvers and the heater circuit shall be prepared for operation.

620.07.10.04**Proof of Performance Testing and Inspection**

The work shall be inspected and tested a minimum of 3 Business Days prior to the actual turn on of the signals to ensure that it is according to the requirements as specified in the Contract Documents. In particular, and without limiting the foregoing, ensure all components are installed, tested, and proven to perform as specified in the Contract Documents and that all cables are energized and in working order and that the signal timing is consistent and complete, without activating the traffic signals for public display.

All proof of performance testing and inspection shall be performed on site with all signal heads covered with an opaque covering and all pedestrian signal heads turned to face the pole to which they are attached.

All traffic signal cable circuits shall be tested according to OPSS 604.

Each signal display shall be inspected and tested for correct phase connection and operation as specified in the Contract Documents.

Detection and actuation devices shall be tested and inspected for correct operation according to the manufacturer's specifications and as specified in the Contract Documents. This testing shall include observation of all calls generated to verify that they are registered and activated.

Traffic signal timing shall be verified to be consistent and complete. With the proper programming and signal timing in operation and with all system components and circuits connected, the traffic signal system shall be cycled through all of its phases and operations.

620.07.10.04.01**Detector Loops**

Loop wiring shall be tested for continuity, for leakage to ground, and for inductance at the controller cabinet. Resistance to ground shall be 10 mega ohm or greater. Inductance shall be within 25% of the value specified in the Contract Documents using a 100 kHz signal at 5 V.

Any detector loop required to be replaced shall be removed from the original slot and a new detector loop shall be installed in the original slot or installed in a re-cut slot. The new detector loop shall be installed with new wiring and sealing compound and retested.

All test results shall be submitted to the Contract Administrator.

620.07.10.04.02**Microloop Detection Systems**

Microloop detection systems shall be tested to confirm that the microloop detection equipment is accurately detecting vehicles and transmitting calls to the controller. Microloop detection systems shall be tested according to the manufacturer's specifications and as specified in the Contract Documents.

620.07.10.04.03**Microwave Detection Systems**

Microwave detection systems shall be tested to confirm that the microwave detection equipment is accurately detecting vehicles and transmitting calls to the controller. Microwave detection systems shall be tested according to the manufacturer's specifications and as specified in the Contract Documents.

620.07.10.04.04**Video Detection Systems**

Video detection systems shall be tested to confirm that the video detection equipment is accurately detecting vehicles and transmitting calls to the controller. Video detection systems shall be tested according to the manufacturer's specifications and as specified in the Contract Documents.

620.07.10.04.05 Variable Message Sign Systems

Variable message sign systems shall be tested to confirm that messages are accurately transmitted to the variable message signs and that the messages are displayed correctly. Variable message sign systems shall be tested according to the manufacturer's specifications and as specified in the Contract Documents.

620.07.10.04.06 Advance Warning Sign Systems

Advance warning sign systems shall be tested to confirm that the signs activate and deactivate at the correct points in the cycle of traffic control signal indications and that the advance warning signs activate and display correctly. Advance warning sign systems shall be tested according to the manufacturer's specifications and as specified in the Contract Documents.

620.07.10.04.07 Pedestrian Push Buttons

Upon completion of the installation of the pedestrian push buttons, the system shall be tested at the controller cabinet.

620.07.10.04.08 Accessible Pedestrian Signals

Upon completion of the installation of the accessible pedestrian signals, the system shall be tested for proper actuation and operation.

620.07.10.04.09 Traffic Signal Pre-Emption Equipment

Traffic signal pre-emption equipment shall be tested to confirm that each pre-emption system (i.e., railway, emergency vehicles, and transit) works correctly and performs its intended function. Pre-emption equipment shall be tested to confirm that pre-emption requests are served in the following order of priority:

- a) Railway
- b) Emergency Vehicles
- c) Transit

620.07.10.04.09.01 Railroad

Upon completion of the railroad pre-emption installation, the pre-emption system shall be tested according to Transport Canada Guideline for Inspecting and Testing Pre-emption of Interconnected Traffic Control Signals and Railroad Crossing Warning Systems.

620.07.10.04.09.02 Emergency Vehicles

Testing of pre-emption equipment for emergency vehicles shall be coordinated with the emergency services that will use this pre-emption function. Emergency services (e.g., fire and ambulance) shall be present for the testing of this pre-emption equipment.

620.07.10.04.09.03 Transit

Upon completion of the transit signal pre-emption installation, the pre-emption system shall be tested with the assistance of the transit authority to confirm the correct operation of the transit signal pre-emption devices and algorithm.

620.07.10.04.10 Controllers

620.07.10.04.10.01 General

Field tests are required upon completion of the installation of the controller. The controller shall be allowed to operate functionally only after all testing has been completed and all components are operational.

620.07.10.04.10.02 Signal Cable

All traffic signal cable circuits shall be tested according to OPSS 604.

620.07.10.04.10.03 Interval Sequence

With the proper programming and timing functions in operation, the controller shall be cycled through all phases with all signal circuits connected and with signal heads covered.

620.07.10.04.10.04 Actuation

All calls shall be observed to be registered and activated. Actuation equipment shall be tested.

620.07.10.04.11 Uninterruptible Power Supply Systems

Uninterruptible power supply systems shall be tested to confirm that the system operation continues without interruption when there is an interruption of power from the local supply authority. The duration of operation on the uninterruptible power supply system shall be confirmed to be according to the manufacturer's specifications and as specified in the Contract Documents.

620.07.10.04.12 System Proof of Performance Testing and Inspection

The work shall be inspected and tested to ensure that the work is according to the requirements as specified in the Contract Documents. In particular, and without limiting to the foregoing, all components are installed, tested, and proven as specified in the Contract Documents and that all cables are energized and in working order without activating the traffic signals for public display.

The complete traffic signal system, including the traffic signal control system, shall be inspected and tested to verify that the complete integrated system operates correctly, safely, and as specified in the Contract Documents.

The inspection, testing, and test results shall be certified by a Quality Verification Engineer. The Quality Verification Engineer shall issue a Certificate of Conformance that the work has been inspected and tested and that the material and installation are in general conformance with the requirements as specified in the Contract Documents.

620.07.11 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

620.08 QUALITY ASSURANCE

Equipment and Materials, as supplied by the Contractor, are subject to inspection by the Contract Administrator prior to installation.

Equipment requiring the submission of Working Drawings and service manuals as specified in the Contract Documents may be inspected by the Contract Administrator prior to shipping from the manufacturer's factory or at the supplier's place of business. The Contractor shall inform the Contract Administrator when the equipment fabrication is complete and shall make suitable arrangements for any required inspection.

All electrical installation work is subject to random inspection by the Contract Administrator. The Contract Administrator may witness any testing performed by the Contractor during installation.

620.09 MEASUREMENT FOR PAYMENT

620.09.01 Actual Measurement

620.09.01.01

- Loop Detectors**
- Microloop Detectors**
- Microwave Detectors**
- Video Detectors**
- Pedestrian Push Buttons**
- Traffic Actuation Equipment**
- Traffic Signal Controllers**
- Pedestal Mounted Traffic Signal Controllers**
- Traffic Signal Head Supports**
- Single Member Arms and Signal Hangers**
- Double Arm Brackets**
- Highway Type Signal Heads**
- Special Type Signal Heads**
- Standard Type Signal Heads**
- Pedestrian Type Signal Heads**
- Single Signal Head Sections**
- Optically Directed Signal Heads**
- Flasher Beacons**
- Flasher Mechanisms**
- Sign Light Assemblies**
- Internally Illuminated Signs**
- Variable Message Signs**
- Advance Warning Signs**
- Accessible Pedestrian Signals**

For measurement purposes, a count shall be made of the number of each of the above types of traffic signal equipment or traffic control device installed.

620.09.01.02

- Traffic Signal Controller Modifications (Intersection Locations)**
- Traffic Signal Equipment Modifications (Intersection Locations)**

For measurement purposes, a count shall be made of the number of each of the above types of traffic signal equipment modified.

620.09.01.03 Uninterruptible Power Supply Systems

For measurement purposes, a count shall be made of the number of uninterruptible power supply systems installed.

620.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

620.10 BASIS OF PAYMENT

620.10.01 **Loop Detectors - Item**
Microloop Detectors - Item
Microwave Detectors - Item
Video Detectors - Item
Pedestrian Pushbuttons - Item
Traffic Actuation Equipment - Item
Traffic Signal Controllers - Item
Pedestal Mounted Traffic Signal Controllers - Item
Traffic Signal Controller Modifications (Intersection Locations) - Item
Traffic Signal Equipment Modifications (Intersection Locations) - Item
Traffic Signal Head Supports - Item
Single Member Arms and Signal Hangers - Item
Double Arm Brackets - Item
Highway Type Signal Heads - Item
Special Type Signal Heads - Item
Standard Type Signal Heads - Item
Pedestrian Type Signal Heads - Item
Single Signal Head Sections - Item
Optically Directed Signal Heads - Item
Flasher Beacons - Item
Flasher Mechanisms - Item
Sign Light Assemblies - Item
Internally Illuminated Signs - Item
Variable Message Signs - Item
Advance Warning Signs - Item
Accessible Pedestrian Signals - Item
Uninterruptible Power Supply Systems - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

620.10.02 Traffic Signal Equipment - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work of installing all traffic signal equipment.

620.10.03 Traffic Control Devices - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work of installing all traffic control devices.

620.10.04 Rock Excavation

Payment for rock excavation shall be according to OPSS 603.

Appendix 620-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Traffic signal mounting equipment fittings, accessories, and hardware specifications. (620.05.10)
- Controller specifications. (620.05.13)
- Pedestrian push button specifications. (620.05.15)
- Aerial mounting equipment fittings, accessories, and hardware specifications. (620.05.18)
- Microloop detector specifications. (620.05.19)
- Microwave detector specifications. (620.05.20)
- Video detector specifications. (620.05.21)
- Variable message sign specifications. (620.05.22)
- Advance warning sign specifications. (620.05.23)
- Traffic signal pre-emption equipment specifications. (620.05.24)
- Uninterruptible power supply system specifications. (620.05.25)
- Primary traffic signal head clearance height. (620.07.02.01)
- Sealer requirement for traffic signal head assemblies. (620.07.02.02)
- Size and type of LED modules or incandescent lamps to be installed in the signal heads. (620.07.02.04)
- Labelling requirement for cables. (620.07.02.07)
- Existing equipment to be removed for existing equipment modification. (620.07.02.10)
- Internally illuminated sign installation specifications. (620.07.03.04)
- Location and orientation of pole mounted controller cabinets. (620.07.04.01.01)
- Location and orientation of pad mounted controller cabinets. (620.07.04.01.02)
- Location and orientation of pedestal mounted controller cabinets. (620.07.04.01.03)
- Location and size of detector loops. (620.07.05.01.01)

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- Treatment for loops crossing major cracks, butt or expansion joints, or irregularities. (620.07.05.01.01)
- Loop saw cut depths, width, and length dimensions. (620.07.05.01.02)
- Location of flexible ducts for detector loops. (620.07.05.01.04)
- Size, winding direction, configurations, number of turns, and type of cable for detector loops. (620.07.05.01.05)
- Identification markings for loop and extra low-voltage cables. (620.07.05.01.05)
- Location of sealing compound to be installed for loop cable slots. (620.07.05.01.06)
- Depth and location of microloop detectors. (620.07.05.02)
- Installation specifications for microloop detectors and type of lead-in cable. (620.07.05.02)
- Location and mounting height of microwave detectors. (620.07.05.03)
- Orientation, configuration, and installation specifications for microwave detectors. (620.07.05.03)
- Location and mounting height of video detectors. (620.07.05.04)
- Orientation, configuration, and installation specifications for video detectors. (620.07.05.04)
- Location of variable message signs. (620.07.05.05)
- Orientation, configuration, and installation specifications for variable message signs. (620.07.05.05)
- Location of advance warning signs. (620.07.05.06)
- Orientation, configuration, and installation specifications for advance warning signs. (620.07.05.06)
- Location of pedestrian push buttons and pedestrian push button sign specifications. (620.07.05.07)
- Installation specifications for push buttons on metal poles. (620.07.05.07)
- Installation and set up specifications for traffic signal pre-emption equipment. (620.07.06)
- Installation specifications for traffic signal interconnection equipment. (620.07.07)
- Installation and adjustment specifications for uninterruptible power supply systems. (620.07.09)
- Traffic signal control equipment operation details. (620.07.10.03.01)
- Traffic signal equipment operation details. (620.07.10.03.02)
- Electrical traffic control device operation details. (620.07.10.03.03)
- Signal display performance details. (620.07.10.04)
- Detection and actuation device testing requirements. (620.07.10.04)
- Inductance value for detector loop testing. (620.07.10.04.01)

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- Microloop detection system operation details. (620.07.10.04.02)
- Microwave detection system operation details. (620.07.10.04.03)
- Video detection system operation details. (620.07.10.04.04)
- Variable message sign system operation details. (620.07.10.04.05)
- Advance warning sign system operation details. (620.07.10.04.06)
- Uninterruptible power supply system operation details. (620.07.10.04.11)

The designer should determine if the following are required and, if so, specify them in the Contract Documents:

- Beaconing actuation for accessible pedestrian signals. (620.05.16)
- Additional orientation guides for accessible pedestrian signals. (620.05.16)
- Additional accessible pedestrian signal features. (620.05.16)
- Saw-cut marks on curb to indicate loop location. (620.07.05.01.02)
- Supply of traffic signal control equipment by owner and location of control for pickup. (620.07.08)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 2011.701	General Symbols, Traffic Actuation Devices
OPSD 2200.041	Concrete Footing for 1.5m Base Mounted Pedestrian Pushbutton Pole
OPSD 2232.010	Sectional Steel Pole with Brackets, Luminaire, and Traffic Signal Head
OPSD 2235.01	Pole Guying Details
OPSD 2236.010	Wooden Pole and Anchorage Settings in Solid Rock 1
OPSD 2236.020	Wooden Pole and Anchorage Settings in Solid Rock 2
OPSD 2238.01	Wooden Pole in Earth
OPSD 2240.01	Wood Pole with Elliptical Bracket, Overhead and Underground Circuits
OPSD 2242.01	Wood Pole with Neutral Supported Cable
OPSD 2242.02	Wood Poles with Aerial Signal Cables Lashed on Messenger
OPSD 2245.01	Installation of Aerial Cable Systems
OPSD 2245.020	Minimum Vertical Clearances for Aerial Cable Systems
OPSD 2250.01	Aluminum Tapered Elliptical Brackets on Metal and Concrete Poles, Mounting Details
2500 Series Electrical Drawings	



CONSTRUCTION SPECIFICATION FOR TRAFFIC SIGNAL INTERCONNECTION EQUIPMENT

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APPENDICES

624-A	Commentary

624.01	SCOPE

This specification covers the requirements for the installation of traffic signal interconnection equipment.

624.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

624.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

624.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 604	Cable Installation
OPSS 609	Grounding
OPSS 620	Traffic Signal Equipment and Electrical Traffic Control Devices

Ministry of Transportation Publications

Traffic Signal Control Equipment Specifications

Canadian Standards Association

C22.2 No. 59-1972	Fuses (Bot Plug and Cartridge enclosed Types)
C22.2 No. 65-03	Wire Connectors (Tri-National standard, with UL 486A-486B and NMX-J-543-ANCE-03)

624.05 MATERIALS

624.05.01 Interconnection Cable

Interconnection cable shall be as specified in the Contract Documents.

624.05.02 Protective Devices

Fuse blocks shall be of the spring clip type with isolating barriers, 30 A, 600 V rating, machine screw terminals, and moulded phenolic base.

Fuses shall be 5 A, 125 V, dual element slow blowing glass tube type MDX, and according to CSA C22.2 No. 59.

Metal oxide varistors shall be rated 150 V AC, 200 V DC, 30 joules, and 4 kA peak current.

624.05.03 Connectors

Wire terminal connectors shall be of the insulated fork tongue compression type for stranded conductors and according to CAN/CSA C22.2 No. 65.

Wiring harness connectors shall be of the MS bayonet type to suit equipment requirements.

624.05.04 Data Modems

Data modems for use with System 170 traffic signal controllers on tone control or telephone line systems shall be Model 400 units meeting the requirements of the MTO Traffic Signal Control Equipment Specifications.

624.05.05 AC/DC Isolator Units

AC/DC isolator units for use with System 170 traffic signal controllers on 120 V interconnection systems shall be special devices meeting the requirements of the Contract.

624.05.06 Coordinating Units

Coordinating units shall be either electromechanical or solid state types as specified in the Contract Documents, complete with self contained housing for shelf mounting and MS connectors and wiring harness.

624.05.07 Master System 170 Controller Units

Master System 170 controller units shall meet the requirements of the MTO Traffic Signal Control Equipment Specifications with software suitable for master operation and complete with wiring harness and type C1 and C5 connectors.

624.05.08 Auxiliary Output Files

Auxiliary output files for use with the master System 170 controller units shall be Model 420 meeting the requirements of the MTO Traffic Signal Control Equipment Specifications.

624.07 CONSTRUCTION

624.07.01 General

Requirements of OPSS 620 shall apply insofar as interconnection equipment forms part of the traffic signal controller.

624.07.02 Interconnection Cable

Aerial and underground interconnection cable shall be installed between controllers according to OPSS 604.

624.07.03 Protective Devices

Fuse blocks, fuses, and metal oxide varistors shall be installed on the incoming interconnection cable. The fuse block shall be mounted on the wall of the controller cabinet as close to the cabinet ground bus as practical. A metal oxide varistor shall be securely connected between the load side terminal of the fuse block and the ground bus for each side terminal of the fuse block and the ground bus for each incoming conductor of the interconnection cable. Ground connections shall be according to OPSS 609.

624.07.04 Coordinating Units

Coordinating units shall be shelf mounted and connected to the controller using MS connectors and wiring harness. Output wiring harness shall be connected to the corresponding circuits on the load side of the fuse block.

624.07.05 Master System 170 Controller Units and Auxiliary Output File

The power supply unit shall be relocated to the rear rack at the top. The master System 170 controller unit shall be installed in the front rack at the top. The auxiliary output file shall be installed in the front rack below any existing equipment. Wiring harness shall be installed with the C1 and C5 connectors to connect the master unit to the auxiliary output file and to connect the local input file to the auxiliary output file as specified in the Contract Documents.

624.07.06 Data Modems

Data modems shall be installed in the input file locations specified in the Contract Documents. Wiring harness connections shall be made between the modem terminals and the appropriate load side terminals of the fuse block.

624.07.07 AC/DC Isolator Units

AC/DC isolator units shall be installed in the input file locations specified in the Contract Documents. Jumper cables shall be installed between input file locations specified in the Contract Documents. Wiring harness connections shall be made between the isolator unit terminals and the appropriate terminals on the load side of the fuse block. All wires will be marked 120 V with permanent markers.

624.07.08 Work to be Coordinated with Others

The Contractor shall coordinate the Work with the following work that is done by others:

- a) Programming of the master controller unit PROM.
- b) Setting of all timing controls, switches, and programming controls.

- c) Set up and adjustment of all offset, dial transfer, hold, force-off, and pre-emption functions.
- d) Energization of the system.

624.09 MEASUREMENT FOR PAYMENT

624.09.01 Actual Measurement

624.09.01.01 Master System 170 Controller Units and Auxiliary Output Files

For measurement purposes, a count shall be made of the master System 170 controller units and auxiliary output files installed.

624.09.01.02 Data Modems, Model 400

For measurement purposes, a count shall be made of the data modems, Model 400 installed.

624.09.01.03 AC/DC Isolators, Model 252

For measurement purposes, a count shall be made of the AC/DC isolators, Model 252 installed.

624.09.01.04 Master Coordinating Units, Solid State

For measurement purposes, a count shall be made of the solid state master coordinating units installed.

624.09.01.05 Master Coordinating Units, Electromechanical

For measurement purposes, a count shall be made of the electromechanical master coordinating units installed.

624.09.01.06 Local Coordinating Units, Solid State

For measurement purposes, a count shall be made of the solid state local coordinating units installed.

624.09.01.07 Local Coordinating Units, Electromechanical

For measurement purposes, a count shall be made of the electromechanical local coordinating units installed.

624.09.01.08 Coordinating Units, Wireless

For measurement purposes, a count shall be made of the wireless coordinating units installed.

624.09.01.09 Controller Interconnection Protective Devices

For measurement purposes, a count shall be made of the controller interconnection protective devices installed.

624.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

624.10**BASIS OF PAYMENT****624.10.01**

Master System 170 Controller Units and Auxiliary Output Files - Item
Data Modems, Model 400 - Item
AC/DC Isolators, Model 252 - Item
Master Coordinating Units, Solid State - Item
Master Coordinating Units, Electromechanical - Item
Local Coordinating Units, Solid State - Item
Local Coordinating Units, Electromechanical - Item
Coordinating Units, Wireless - Item
Controller Interconnection Protective Devices - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Materials to do the work.

624.10.02**Traffic Signal Interconnection Equipment**

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Materials to do the work.

Appendix 624-A, November 2007
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Material requirements for interconnection cables. (624.05.01)
- Coordinating units to be either electromechanical or solid state type. (624.05.06)
- Connection requirements for the master unit. (624.07.05)
- Input file locations for the installation of data modems. (624.07.06)
- Input file locations for the installation of AC/DC isolator units. (624.07.07)
- Input file locations for the installation of jumper cables. (624.07.07)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

None



**CONSTRUCTION SPECIFICATION FOR
INSTALLATION OF SECTIONAL STEEL
HIGH MAST LIGHTING POLES**

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630.09	MEASUREMENT FOR PAYMENT
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APPENDICES

630-A	Commentary

630.01 SCOPE

This specification covers the requirements for the installation of sectional steel high mast lighting poles complete with raising and lowering equipment, including mechanical and electrical components.

630.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

630.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

630.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Material

OPSS 2471	Sectional Steel High Mast Lighting Poles
OPSS 2476	Raising and Lowering Equipment for High Mast Lighting Poles

CSA Standards

S6-06	Canadian Highway Bridge Design Code

630.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

630.04 DESIGN AND SUBMISSION REQUIREMENTS

630.04.01 Submission Requirements

630.04.01.01 Assembly of Sectional Steel High Mast Lighting Poles

The Contractor shall submit installation drawings, calculations, and procedures to the Contract Administrator at least 14 Days prior to the commencement of scheduled start of pole assembly for approval. An Engineer shall affix his or her seal and signature on the installation drawings, calculations, and procedures verifying that they are consistent with the Contract Documents and sound engineering practices.

These installation drawings, calculations, and procedures shall include all details of equipment to be used in jacking the sections together and lifting the assembled pole, including placing and securing it on the anchorage assembly.

630.04.01.02 Training Certificate

A certificate of training from the manufacturer of the high mast lighting raising and lowering equipment for each person who will be doing the installation work shall be provided to the Contract Administrator. The certificates shall be submitted 14 Days prior to the commencement of the installation work, and the work shall not proceed until the certificates are accepted by the Contract Administrator. Training certificates that are 5 years old or more shall not be accepted.

The training certificate shall state that the manufacturer certifies that the individual has successfully completed an in-depth training course in the following areas:

- a) Assembly of the pole sections.
- b) Assembly of the raising and lowering equipment.
- c) Operation of the raising and lowering equipment.
- d) Installation of high mast poles and lighting equipment.
- e) Levelling of the luminaire ring assembly.
- f) Inspection of high mast poles and lighting equipment.
- g) Maintenance and repair techniques for sectional steel high mast lighting equipment.
- h) Safety procedures.

The training certificate shall be dated and signed by officers of the manufacturer and shall indicate the dates that the training was given.

630.05 MATERIALS

630.05.01 Sectional Steel High Mast Lighting Poles

Sectional steel high mast lighting poles shall be according to OPSS 2471.

630.05.02 Raising and Lowering Equipment

Raising and lowering equipment shall be according to OPSS 2476.

630.07 CONSTRUCTION

630.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

630.07.01.01 Ordering Sectional Steel High Mast Lighting Poles and Raising and Lowering Equipment

Immediately following the award of the Contract, the Contractor shall order the high mast lighting poles and the raising and lowering equipment, as required for this Contract.

The Contractor shall obtain verification of the delivery dates of the high mast lighting poles and the raising and lowering equipment from the suppliers and notify the Contract Administrator of the delivery dates within 72 hours after the award of the Contract.

The Contractor shall ensure timely and accurate communication with both the Owner and the suppliers regarding the delivery, schedules, and requirements for the high mast lighting poles and the raising and lowering equipment.

The Contractor shall coordinate with the suppliers of the sectional steel high mast lighting poles and the raising and lowering equipment to ensure compatibility between the poles and the raising and lowering equipment. All necessary measures shall be taken to make all high mast equipment 100% compatible and fully functional.

Delivery and off-loading of the sectional steel high mast lighting poles and the raising and lowering equipment shall be completed in a timely and efficient manner.

630.07.02 Sectional Steel High Mast Lighting Poles and Equipment

630.07.02.01 Assembly of Sectional Steel High Mast Lighting Poles

The lifting equipment used in contact with the pole sections shall be non-abrasive in nature.

Sectional steel high mast lighting poles shall be assembled so that all sections for individual poles are matched as fabricated. The completed sectional steel high mast lighting pole shall be according to the overall tolerances specified in the Contract Documents.

630.07.02.02 Raising and Lowering Equipment

The raising and lowering equipment and the mechanical and electrical components shall be installed according to the manufacturer's specifications and recommendations.

The raising and lowering equipment manufacturer shall be present during the equipment installation to ensure proper assembly procedures and commissioning.

630.07.02.03 Pole Installation

At least 14 Days prior to the start of pole installation, the Contract Administrator shall be informed, in writing, of the pending operation.

The anchorage setting templates shall be removed prior to installation of lighting poles.

The pole shall be installed plumb, with the base plate positioned and the door orientated as specified in the Contract Documents. The pole shall have adequate support during installation. The pole shall not be considered self-supporting until all fasteners in the base are tightened by the turn-of-nut method according to CSA S6.

A 12 mm square, welded, 19 AWG galvanized steel metal mesh shall be placed around the outside circumference of the anchor bolt circle, between the pole base plate and the footing after pole installation is completed.

The orientation of the high mast lighting pole shall be as specified in the Contract Documents.

630.07.02.04 High Mast Lighting Equipment

High mast lighting equipment shall be installed as specified in the Contract Documents.

630.07.03 Quality Control

630.07.03.01 Pre-Installation Testing and Inspection

The pre-installation testing and inspection of the high mast lighting pole complete with raising and lowering equipment, including mechanical and electrical components, shall be according to manufacturer's specification and the Contract Documents.

A letter of compliance from the manufacturer of the sectional steel high mast lighting pole equipment, certifying that the sectional steel high mast lighting pole equipment is according to the Contract Documents shall be provided to the Contract Administrator by the Contractor.

Testing on the torque limiter shall be conducted on the internal drive raising and lowering equipment and on the portable power drill for the external drive raising and lowering equipment unit. The Contractor shall ensure that the torque limiter is set and functions according to the manufacturer's recommendations. The cord connecting the control to each raising and lowering motor or portable power drill shall be a minimum length of 13 m.

630.07.03.02 Proof of Performance Testing and Inspection

The ring assembly, including luminaires, and the raising and lowering equipment shall be fully raised, latched, unlatched, and fully lowered a minimum of five times for each installed sectional steel high mast lighting pole. After each raising and lowering sequence, every piece of the raising and lowering equipment shall be inspected to ensure that all components are functioning properly and are not damaged. The cables inside the pole shall be inspected. Twisted cables shall be untwisted prior to each subsequent raising and lowering sequence.

The following shall be inspected:

- a) Winch gear and housing
- b) Winch cable
- c) Supporting cables
- d) Power cable

- e) Ring assembly
- f) Latching system

If problems or deficiencies occur during the testing, the test shall be stopped and the problem or deficiency corrected. Once the problem or deficiency has been corrected, the testing process of the pole and associated material shall be repeated in full.

Each ring assembly and supporting cable shall be inspected and adjusted to ensure that the ring is level.

630.07.03.02.01 Certificate of Conformance

A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Quality Verification Engineer shall affix his or her seal and signature to the completed Certificate of Conformance confirming that the following:

- a) All of the high mast equipment at each high mast pole was tested and inspected.
- b) The high mast lighting raising and lowering equipment is in general conformance with the requirements of the Contract Documents.
- c) Each sectional steel high mast lighting pole has been installed plumb with the base plate positioned as specified in the Contract Documents.
- d) Each sectional steel high mast lighting pole and raising and lowering equipment passed the proof of performance testing and inspection.
- e) The torque limiter has been fully tested and verified to be fully functional according to the manufacturer's recommendations and the Contract Documents.
- f) The sectional steel high mast lighting pole jacking and installation procedures have been carried out according to the installation drawings, calculations, and procedures.
- g) At the end of the testing at each sectional steel high mast lighting pole, the ring assembly has been levelled, raised to the top of the pole, and fully and properly docked and latched to the head frame assembly at the top of the pole.

630.07.04 Document Submission

The service manual for the high mast lighting equipment shall document in detail the installation and operation of the high mast lighting equipment and components. It shall include clear and detailed illustrations indicating layouts of controls, displays, schematic and wiring diagrams, and other information required to correctly operate a fully assembled and operational high mast lighting unit, as well as the maintenance and service aspects of individual components.

The service manual for the high mast lighting equipment shall include part numbers and settings and options of installation and operation. The manual shall provide sections that completely describe the theory of operation using block diagrams, wiring and schematic diagrams, diagnostic and repair procedures, assembly instructions and drawings, component layout drawings, and acceptable manufacturers and suppliers of miscellaneous component parts.

Each manual for the high mast lighting equipment shall detail all major assembling, adjusting, and aligning procedures and identify all acceptable tolerances or variances. Manuals shall also include:

- a) Detailed specifications of major components.
- b) Copies of the Working Drawing specified in OPSS 2471 and OPSS 2476 reduced to 8½ x 11" paper format.

- c) Component warranty certificates.
- d) Operating instructions.
- e) All other relevant documents or drawings.

630.07.05 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

630.08 QUALITY ASSURANCE

The Owner may make random inspections of individual high mast lighting poles, visually check for proper assembly with related equipment, and witness the raising and lowering of the ring assembly.

630.09 MEASUREMENT FOR PAYMENT

630.09.01 Actual Measurement

**630.09.01.01 25 m Sectional Steel High Mast Lighting Poles and Equipment
 30 m Sectional Steel High Mast Lighting Poles and Equipment
 35 m Sectional Steel High Mast Lighting Poles and Equipment
 40 m Sectional Steel High Mast Lighting Poles and Equipment
 45 m Sectional Steel High Mast Lighting Poles and Equipment**

For measurement purposes, a count shall be made of the number of each size of sectional steel high mast lighting poles and equipment installed.

630.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

630.10 BASIS OF PAYMENT

**630.10.01 25 m Sectional Steel High Mast Lighting Poles and Equipment - Item
 30 m Sectional Steel High Mast Lighting Poles and Equipment - Item
 35 m Sectional Steel High Mast Lighting Poles and Equipment - Item
 40 m Sectional Steel High Mast Lighting Poles and Equipment - Item
 45 m Sectional Steel High Mast Lighting Poles and Equipment - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Progress payments shall be based on the following percentages of the Contract price for milestones accepted by the Contract Administrator:

- 35% for delivery of all high mast lighting poles and equipment
- 5% for certificate of training
- 20% for installation of all high mast lighting poles and equipment
- 40% for completed and signed Certificate of Conformance for all High Mast Lighting Poles and Equipment

Appendix 630-A, November 2012 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Tolerances for the assembled sectional steel high mast pole. (630.07.02.01)
- Base plate positioning, door orientation, and pole orientation. (630.07.02.03)
- High mast lighting equipment installation requirements. (630.07.02.04)
- Pre-installation testing and inspection requirements. (630.07.03.01)
- Raising and lowering equipment requirements. (630.07.03.02.01)
- Torque limiter requirements. (630.07.03.02.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 2450.010	High Mast Lighting, 25, 30, and 35 m Octagonal Pole with Double Base Plate
OPSD 2450.011	High Mast Lighting Pole, 25, 30, and 35 m 8-Sided Pole
OPSD 2450.020	High Mast Lighting, 40 and 45 m Octagonal Pole with Double Base Plate
OPSD 2450.021	High Mast Lighting Pole, 40 and 45 m 12-Sided Pole
OPSD 2452.010	High Mast Lighting, 25, 30, and 35 m Round Pole with Double Base Plate
OPSD 2452.020	High Mast Lighting, 40 and 45 m Round Pole with Double Base Plate
OPSD 2453.000	High Mast Lighting Pole, Luminaire and Handhole Orientation
OPSD 2453.010	High Mast Lighting Pole, Cable Holder and Storage Hook Details
OPSD 2453.020	High Mast Lighting Pole, Handhole Cover Hinges, Latches, and Padlock
OPSD 2453.050	High Mast Lighting Pole, Nameplate Details
OPSD 2453.060	High Mast Lighting Pole, Flood Light Luminaire Mounting Details
OPSD 2453.070	High Mast Lighting Pole, Luminaire Support Ring
OPSD 2453.080	High Mast Lighting Pole, Head Frame and Ring Assembly
OPSD 2453.090	High Mast Lighting Pole, Luminaire Shroud
OPSD 2453.091	High Mast Lighting Pole, Luminaire Shroud Details
OPSD 2453.140	High Mast Lighting Pole, Internal Drive Raising and Lowering Equipment - List of Components
OPSD 2453.150	High Mast Lighting Pole, Internal Drive Raising and Lowering Equipment - Layout
OPSD 2453.160	High Mast Lighting Pole, Internal Motor and Winch Details
OPSD 2453.170	High Mast Lighting Pole, Internal Drive Raising and Lower Equipment, 347/600V, 3-Phase, Wiring Diagram
OPSD 2453.180	High Mast Lighting Pole, Internal Drive Raising and Lower Equipment, 120/240V, 1-Phase Wiring Diagram
OPSD 2453.190	High Mast Lighting Pole, External Drive Raising and Lowering Equipment - List of Components
OPSD 2453.200	High Mast Lighting Pole, External Drive Raising and Lowering Equipment - Layout

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OPSD 2453.210	High Mast Lighting Pole, External Drive Raising and Lower Equipment, 347/600V, 3-Phase, Wiring Diagram
OPSD 2453.220	High Mast Lighting Pole, External Drive Raising and Lower Equipment, 120/240V, 1-Phase, Wiring Diagram
OPSD 2454.010	High Mast Lighting Pole, Double Base Plate Details



**CONSTRUCTION SPECIFICATION FOR
CONCRETE FOOTINGS AND MAINTENANCE PLATFORMS
FOR HIGH MAST LIGHTING POLES**

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631.08	QUALITY ASSURANCE - Not Used
631.09	MEASUREMENT FOR PAYMENT
631.10	BASIS OF PAYMENT

APPENDICES

631-A	Commentary

631.01 SCOPE

This specification covers the requirements for the installation of concrete footings and maintenance platforms for high mast lighting poles.

631.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

631.02

REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 501	Compacting
OPSS 603	Installation of Ducts
OPSS 609	Grounding
OPSS 903	Deep Foundations
OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete
OPSS 906	Structural Steel for Bridges

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1202	Bearings - Elastomeric Plain and Steel Laminated
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1801	Corrugated Steel Pipe (CSP) Products
OPSS 2474	Anchorage Assembly - High Mast Lighting Pole

631.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Earth means as defined in OPSS 206.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

631.05 MATERIALS

631.05.01 Concrete

Concrete shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 30 MPa.

631.05.02 Steel Reinforcement

Steel reinforcement shall be according to OPSS 1440.

631.05.03 Structural Steel

Structural steel shall be according to OPSS 906.

631.05.04 Corrugated Steel Pipe

Corrugated steel pipe shall be according to OPSS 1801 and as specified in the Contract Documents.

631.05.05 Neoprene Pad

Neoprene pad shall be according to the plain bearing requirements specified OPSS 1202.

631.05.06 Granular A

Granular A shall be according to OPSS 1010.

631.05.07 Sleeves and Ducts

Sleeves and ducts shall be according to OPSS 603.

631.05.08 Anchorage Assemblies

Anchorage assemblies shall be according to OPSS 2474.

631.07 CONSTRUCTION

631.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

Concrete footings and maintenance platforms for high mast lighting poles shall be as specified in the Contract Documents.

631.07.02 Concrete Footings for High Mast Lighting Poles

631.07.02.01 Earth Excavation

Excavation of the pole base shall be to the neat lines and grades specified in the Contract Documents. When additional excavation beyond the neat limits is required, such excavation shall be a minimum of 300 mm beyond the neat dimensions of the footing to accommodate backfill.

The Contractor is responsible for constructing excavations without disturbing the sides or bases of the excavation.

When rock is encountered, the earth excavation shall be widened to the dimensions suitable for rock excavation or rock drilling operations. Rock excavation shall be according to OPSS 603.

631.07.02.02 Caisson Pile

Caisson piles shall be as specified in the Contract Documents and placed according to OPSS 903.

The base of the caisson or shallow foundation shall be cleaned of loosened or softened materials or both and inspected prior to pouring concrete. Complete documentation of the inspection and installation of each caisson shall be maintained and submitted to the Contract Administrator.

631.07.02.03 Steel Reinforcement

Steel reinforcement shall be placed according to OPSS 905.

631.07.02.04 Anchorage Assemblies

Anchorage assemblies of the size, diameter, length, and type specified in the Contract Documents shall be positioned in footings to obtain the proper position and handhole orientation.

Anchorage assemblies shall be securely tied to the steel reinforcement and provided with supports to maintain the position of the anchorage assembly during the placing of concrete. The anchorage assembly shall not be welded to the steel reinforcement.

The anchorage setting templates shall remain in place until immediately prior to the installation of the poles.

631.07.02.05 Sleeves and Ducts

Sleeves and ducts for footings shall be located to suit incoming duct or cable systems and shall be securely tied to the steel reinforcement and supported prior to the placing of concrete.

The number of sleeves shall be as specified in the Contract Documents.

Sleeves shall be cut off cleanly above the footing to a minimum of 150 mm above the pole base plate.

Sleeves shall be temporarily plugged or sealed until wiring is installed.

631.07.02.06 Concrete

Concrete shall be placed according to OPSS 904, except as noted herein.

In earth, concrete may be placed directly against the undisturbed earth or may be formed in place such that a minimum of 300 mm all around the footing is available for the placing of granular backfill. The upper portion of the footing shall be formed to a minimum of 150 mm below grade level. Formwork shall be removed to a minimum depth of 150 mm below finished grade prior to placing granular backfill.

In rock, concrete shall be placed directly against the excavated rock surfaces. Portions of footings in earth above the top of the rock surface shall be formed as noted in the previous paragraph.

Prior to the installation of the pole, the concrete shall have reached the minimum strength specified in the Contract Documents.

Concrete for the high mast lighting pole footings shall be cured according to OPSS 904, except as noted herein.

- a) Wet burlap shall be applied to the top surface of the footing immediately after completion of the finishing operation without damaging or marring the surface of the concrete and shall be kept wet during the curing period.
- b) When white pigmented membrane is used as a curing compound on adjacent concrete barrier wall, a minimum of one coat of the curing compound shall be applied to the concrete footing immediately after completion of the curing cycle for the footing. Additional curing compound shall be applied as necessary to ensure colour uniformity with the adjacent concrete barrier wall.
- c) The curing compound shall only be used on the exposed final surfaces of the footing. Curing compound shall not be applied to construction joints.

631.07.02.07 Granular Backfill

Granular A backfill shall be placed around footings in earth and compacted according to OPSS 501.

631.07.02.08 Granular Apron

A granular apron consisting of Granular A shall be placed around each high mast lighting pole footing as specified in the Contract Documents.

631.07.02.09 Grading

Earth grading around the high mast lighting pole footings shall be as specified in the Contract Documents and OPSS 206.

631.07.03 Maintenance Platforms for High Mast Lighting Poles

631.07.03.01 Neoprene Pad

The size of the neoprene pad shall be as specified in the Contract Documents.

631.07.03.02 Fabrication, Delivery, and Installation

Fabrication, delivery, and installation of the platform and railing shall be according to OPSS 906 and the Contract Documents.

631.07.03.03 Grounding

Grounding shall be according to OPSS 609.

631.07.03.04 Mechanical Concrete Anchors

Mechanical concrete anchors shall be installed in accordance with the manufacturer's recommendations.

631.07.04 Quality Control

631.07.04.01 Submission of Certificate of Conformance

A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Quality Verification Engineer shall affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:

- a) Work
- b) Material and installations
- c) Inspection, testing, and test results

The Certificate of Conformance shall include that:

- a) The excavation was carried out without causing instability to the base and walls of the excavation.
- b) The base of the caisson or shallow concrete foundation was cleaned of loosened or softened material or both prior to placing concrete.
- c) The anchorage assemblies, sleeves, and ducts were properly placed in the centre of the concrete footings within a 15 mm tolerance.
- d) The placement of concrete was completed according to OPSS 904.

631.07.05 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

631.09 MEASUREMENT FOR PAYMENT

631.09.01 Actual Measurement

631.09.01.01 Concrete Footings for High Mast Lighting Poles

For payment purposes, a count shall be made of the number of concrete footings for high mast lighting poles installed.

631.09.01.02 Maintenance Platform for High Mast Lighting Poles

For payment purposes, a count shall be made of the number of maintenance platforms for high mast lighting poles installed.

631.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

631.10 BASIS OF PAYMENT

**631.10.01 Concrete Footings for High Mast Lighting Poles - Item
Maintenance Platform for High Mast Lighting Poles - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

631.10.02 Rock Excavation for Electrical Installation

Payment for rock excavation for electrical installation shall be according to OPSS 603.

Appendix 631-A, November 2015 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Pole base excavation lines and grades. (631.07.02.01)
- Caisson pile requirements. (631.07.02.02)
- Anchorage assembly size, diameter, length, and type. (631.07.02.04)
- Number of sleeves into the pole bases. (631.07.02.05)
- Minimum concrete strength for pole installation. (631.07.02.06)
- Grading around pole footing requirements. (631.07.02.09)
- Maintenance platform requirements. (631.07.03)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 2210.030	High Mast Lighting Pole, Apron
OPSD 2218.010	High Mast Lighting Pole Anchorage Assembly Placement
OPSD 2456.010	High Mast Lighting Pole Anchorage Assembly Details for Double Base Plate
OPSD 2456.011	High Mast Lighting Pole Anchorage Assembly Details



CONSTRUCTION SPECIFICATION FOR WATERMAIN INSTALLATION IN OPEN CUT

References to OPSS 701 shall be deemed to mean
OPSS 441, Construction Specification for
Watermain Installation in Open Cut

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 441:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



**CONSTRUCTION SPECIFICATION FOR
CATHODIC PROTECTION OF NEW AND
EXISTING WATERMAINS**

References to OPSS 702 shall be deemed to mean
OPSS 442, Construction Specification for
Corrosion Protection of New and
Existing Watermains

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 442:

- The specification was reviewed by an OPS specialty committee, and some of the technical content has changed.
- The specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR PERMANENT SMALL SIGNS AND SUPPORT SYSTEMS

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703.09	MEASUREMENT FOR PAYMENT
703.10	BASIS OF PAYMENT

APPENDICES

703-A	Commentary

703.01	SCOPE

This specification covers the requirements for the installation and removal of permanent small signs and support systems, and the relocation of small signs.

703.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

703.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

703.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 501 Compacting

Ontario Provincial Standard Specifications, Material

OPSS 2001 Signs

Ontario Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 1B - Sign Design Principles

CSA Standards

O80 Series-08 (R2012)	Wood Preservation
O141-05 (R2014)	Softwood Lumber

ASTM International

A 123/A 123M-13	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 153/A153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 780/A 780M-09	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

Others

National Lumber Grade Authority (NLGA)
Canadian Wood Preservers Bureau (CWPB)

703.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Relocation means to move an existing permanent sign to a new chainage or offset or both.

Removal means to remove and dispose of an existing permanent sign or support system or both.

Sign and Sign Board means a traffic control device mounted on a fixed support that conveys a specific message by means of symbols and or words, and is officially erected for the purpose of regulating, warning, informing, and guiding traffic.

Sign Support System means a wooden or steel post of specified dimensions, hardware, and material embedded vertically into the ground for mounting signs at a specified height above the roadway and ground. The system may consist of a single, double, or triple post configuration.

Sign Hardware means metal hardware including, but not limited to, nuts, bolts, washers, spacers, and lock washers for attaching signs to sign support systems.

Small Sign Assembly means one or more signs mounted on a sign support system with specified sign hardware having a total sign or sign board area not greater than 3.6 m².

703.05 MATERIALS

703.05.01 General

The Contractor shall select a sign support system for each small sign assembly installation as specified in the Contract Documents.

All supplied components shall be according to the manufacturer's specifications and as specified in the Contract Documents. All sign hardware shall be hot dip galvanized according to ASTM A 153. New sign boards shall be supplied as specified in the Contract Documents.

703.05.02 Wooden Posts

703.05.02.01 General

All wooden posts shall be in dressed sizes and pressure treated with wood preservative.

The tolerance on the cross-sectional dimensions of all wooden posts shall be ± 2 mm.

703.05.02.02 Wood Preservative

Wood preservative shall be according to CAN/CSA O80 Series, Use Category UC 4.1.

703.05.02.03 Marking of Wood for Identification of Grade and Species

All wooden posts shall be stamped for species and grading according to CSA O141 by an approved agency authorized by the National Lumber Grade Authority (NLGA). The stamp shall be visible after installation and located at least 1.8 m from the bottom of the post.

703.05.02.04 Marking of Wood for Identification of Preservative Treatment

All wooden posts shall be stamped for wood preservative treatment using a certification mark authorized by the Canadian Wood Preservers Bureau (CWPB). The wood preservative stamp shall be visible after installation and located at least 1.8 m from the bottom of the post.

703.05.03 Metal Posts

703.05.03.01 General

All supplied metal posts, bolts, washers, and nuts shall be according to the manufacturer's specifications and the Contract Documents.

All metal posts shall be hot dip galvanized after fabrication according to ASTM A 123.

All sign hardware shall be hot dip galvanized according to ASTM A 153.

703.05.04 Signs

Signs shall be according to OPSS 2001.

703.07 CONSTRUCTION

703.07.01 General

All breakaway and non-breakaway sign support systems shall be installed according to the manufacturer's specifications and as specified in the Contract Documents at locations specified in the Contract Documents.

All sign boards shall be installed according to OTM Book 1B and as specified in the Contract Documents.

All signs shall be installed, relocated, or removed at locations specified in the Contract Documents. Signs shall be installed so that they do not obstruct and are not obstructed by existing permanent signs or other objects. The Contract Administrator shall be notified prior to installation of sign supports if it is not possible to install a new or relocated sign as specified in the Contract Documents due to this requirement.

Signs shall be covered temporarily for traffic operational reasons when directed by the Contract Administrator. Signs shall be covered so they are not visible to approaching motorists. The cover shall remain securely in place until the signs are appropriate for display as directed by the Contract Administrator. The covering material shall not damage or make any marks on the signs.

Acceptable material from post hole excavation shall be used as backfill around posts and compacted according to OPSS 501.

Posts shall be plumbed within a tolerance of ± 20 mm. The sign shall be levelled on a multiple post system within a tolerance of ± 10 mm.

Back-to-back signs may be installed on single or multiple posts. The sign support system shall be selected based on the largest sign area on one side of the post.

Cut ends and field drilled holes shall receive two applications of 2% copper naphthenate wood preservative. Field applied wood preservative that comes in contact with any metal components shall be removed immediately.

Damaged and cut areas of hot dip galvanized coatings on any galvanized components shall be repaired according to ASTM A 780.

703.07.02 Sign Supply

Signs shall be supplied by the Owner or by the Contractor as specified in the Contract Documents.

703.07.02.01 Owner Supplied Signs

703.07.02.01.01 Sign Ordering

The Contractor shall submit a list of signs required for this Contract to the Contract Administrator. The list of signs shall contain the quantity and details of the signs and the date for pick up by the Contractor. The list of signs shall be submitted a minimum of 12 weeks prior to the pickup date.

703.07.02.01.02 Sign Pickup

The Contractor shall pickup all the ordered signs on the list of required signs at a location provided in the Contract Documents to be supplied by the Owner within 10 Business Days of receiving notice from the Contract Administrator that the signs are ready for pickup. The Contractor shall ensure that all signs are safely secured and packaged prior to transporting the signs.

703.07.02.01.03 Sign Confirmation and Inspection

The Contractor shall within 5 Business Days confirm in writing with the Contract Administrator that all the ordered signs were received in accordance with the list of required signs. The Owner shall be notified of any incorrect signs identified by the Contractor. The Contractor shall be responsible for the cost of replacing all damaged, missing, and incorrect signs subsequent to the Contractor's order confirmation.

703.07.02.02 Contractor Supplied Signs

The Contractor shall supply all signs as specified in the Contract Documents.

703.07.03 New Signs

New sign boards shall be attached to new sign support systems with sign hardware as specified in the Contract Documents.

703.07.04 Relocation of Signs

Relocated sign boards shall be attached to new support systems with sign hardware as specified in the Contract Documents. No portion of the existing sign, support system, and sign hardware shall be left at the original sign location and any excess material including support system and sign hardware shall be managed as specified in the Contract Documents or as directed by the Contract Administrator.

703.07.05 Removal of Signs

No portion of the removed sign, support system, and sign hardware shall be left at the original sign location and any excess materials shall be managed as specified in the Contract Documents.

703.07.06 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

703.09 MEASUREMENT FOR PAYMENT

703.09.01 Actual Measurement

703.09.01.01 Small Signs, Ground Mounted, New

For measurement purposes, a count shall be made of the number of new small sign assemblies installed.

703.09.01.02 Small Signs, Relocation

For measurement purposes, a count shall be made of the number of small sign assemblies relocated.

703.09.01.03 Small Signs, Removal

For measurement purposes, a count shall be made of the number of small sign assemblies removed.

703.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

703.10 BASIS OF PAYMENT

703.10.01 Small Signs, Ground Mounted, New - Item Small Signs, Relocation - Item Small Signs, Removal - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Costs associated with any required repairs or removals and replacements of defective materials shall be the Contractor's responsibility at no additional cost to the Owner.

Appendix 703-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- New sign board material requirements. (703.05.01)
- Locations of breakaway and non-breakaway sign support systems. (703.07.01)
- Locations of signs to be installed, relocated, or removed. (703.07.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 985.110 to 990.110 Small Sign Support Systems



CONSTRUCTION SPECIFICATION FOR POST MOUNTED DELINEATORS

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704.10	BASIS OF PAYMENT

APPENDICES

704-A	Commentary

704.01 SCOPE

This specification covers the requirements for the installation of post mounted delineators.

704.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

704.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

704.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Material

OPSS 2001 Signs

Ontario Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 11 - Pavement, Hazard and Delineation Markings

ASTM International

A 36/A 36M-12	Carbon Structural Steel
A 123/A 123M-13	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 153/A 153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
D 4956-13	Retroreflective Sheeting for Traffic Control

704.05 MATERIALS

704.05.01 Delineator Posts

Delineator post dimensions shall be as specified in the Contract Documents.

Delineator posts shall be fabricated from steel according to ASTM A 36M and hot dip galvanized after fabrication according to ASTM A 123M.

704.05.02 Hardware

Hardware shall be as specified in the Contract Documents. All hardware shall be hot dip galvanized according to ASTM A 153M.

704.05.03 Delineators

Delineators shall be outfitted with high intensity retroreflective sheeting according to ASTM D 4956, Type III or IV; and the colour according to OTM Book 11. Dimensions shall be as specified in the Contract Documents. Sign blanks shall be metal and according to OPSS 2001 with dimensions as specified in the Contract Documents.

704.07 CONSTRUCTION

704.07.01 General

Post mounted delineators shall be installed plumb and set according to alignment and grade according to and at the locations and spacing specified in the Contract Documents.

704.07.02 Delineators

Delineators shall be mounted on the posts as specified in the Contract Documents. Delineators shall be centred vertically and horizontally over the post holes. The type shall be as specified in the Contract Documents.

704.07.03 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

704.09 MEASUREMENT FOR PAYMENT

704.09.01 Actual Measurement

704.09.01.01 Post Mounted Delineators

For measurement purposes, a count shall be made of the number of complete post mounted delineators installed.

704.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

704.10**BASIS OF PAYMENT****704.10.01****Post Mounted Delineators - Item**

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Costs associated with any required removals and replacement or repairs of defective work and materials shall be the Contractor's responsibility at no additional cost to the Owner.

Appendix 704-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Post mounted delineator locations and spacing. (704.07.01)
- Type A or Type B post mounted delineators. (704.07.02)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 984.101 Post Mounted Delineator, Installation



CONSTRUCTION SPECIFICATION FOR FLEXIBLE DELINEATOR POSTS

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705.08	QUALITY ASSURANCE - Not Used
705.09	MEASUREMENT FOR PAYMENT
705.10	BASIS OF PAYMENT

APPENDICES

705-A	Commentary

705.01 SCOPE

This specification covers the requirements for the installation of permanent and temporary flexible delineator posts and relocation of temporary flexible delineator posts.

705.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

705.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

705.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standards Specifications, Material

OPSS 1212 Hot Poured Rubberized Asphalt Joint Sealing Compound

Ontario Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 7 - Temporary Conditions
Book 11 - Pavement, Hazard and Delineation Markings

ASTM International

D 4956-13 Retroreflective Sheeting for Traffic Control

705.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Flexible Delineator Post means a tubular plastic marker installed vertically for the purpose of channelizing traffic or delineating roadside features in temporary or permanent applications. The tubular post is securely fixed to the ground surface by hinged (flexible) connection to a solid base. When impacted by a vehicle, the post has the ability to bend 90° from vertical and self-restore following impacts.

705.04 DESIGN AND SUBMISSION REQUIREMENTS

705.04.01 Submission Requirements

One copy of the manufacturer's installation instructions shall be submitted to the Contract Administrator.

Installation of the flexible delineator posts shall not commence until the Contract Administrator has received the copy of the instructions.

705.05 MATERIALS

705.05.01 Flexible Delineator Posts

A list of approved manufacturers shall be as specified in the Contract Documents.

All supplied system components shall be according to the manufacturer's specifications.

The height of the post shall be as specified in the Contract Documents.

The post colour shall match the colour of the reflective sheeting.

To maintain a visually consistent installation, only one product shall be used on the Contract.

705.05.02 Anchor and Support Hardware

Anchor and support hardware used to fix the flexible delineator post to the ground surface shall be supplied by the manufacturer.

705.05.03 Reflective Sheeting

Flexible delineator posts shall be outfitted with high intensity retroreflective sheeting according to ASTM D 4956, Type III or IV. For permanent conditions, the colour shall be according to OTM Book 11. For temporary conditions, the colour shall be according to OTM Book 7. Dimensions, spacing, and quantity shall be as specified in the Contract Documents.

705.05.04 Temporary Flexible Delineator Posts

Temporary flexible delineator posts may be reused provided each post meets each of the following criteria:

- a) The ability to bend 90° from vertical and self-restore to a vertical position after impacts.
- b) The base is intact and permits anchorage to the ground surface that is equivalent to a new post.
- c) The post is intact without any cracks or fissures.

- d) The retroreflective sheeting is fully intact with only minor tears or scratches that do not affect the reflectivity of the sheeting.

705.07 CONSTRUCTION

705.07.01 General

Permanent and temporary flexible delineator posts shall be installed and securely fixed to the ground surface according to the manufacturer's instructions at locations specified in the Contract Documents.

705.07.02 Relocation of Temporary Flexible Delineator Posts

Flexible delineator posts shall be relocated as specified in the Contract Documents, including the removal of existing and installation of new anchorage hardware and adhesives.

All holes resulting from the relocation of the delineator post assemblies shall be filled with a hot poured rubberized asphalt joint sealing compound according to OPSS 1212 when they are located in areas not to be resurfaced as part of the Work. At the time of filling, the holes shall be dry and free of dust and debris.

705.07.03 Maintenance of Temporary Flexible Delineator Posts

Flexible delineator posts shall be maintained for the duration of the construction period for which they are required.

Flexible delineator posts shall be monitored on a daily basis. Missing or broken flexible delineator posts shall be replaced within 48 hours.

Posts that do not have a uniform or satisfactory appearance to the satisfaction of the Contract Administrator shall be replaced or corrected within 48 hours of notification.

D 704.07.04 Removal of Temporary Flexible Delineator Posts

Flexible delineator posts and associated hardware and adhesives shall be removed at the completion of the construction period for which they were required.

All holes resulting from the removal of the delineator post assemblies shall be filled with a hot poured rubberized asphalt joint sealing compound according to OPSS 1212 when they are located in areas not to be resurfaced as part of the Work. At the time of filling, the holes shall be dry and free of dust and debris.

705.07.05 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

705.09 MEASUREMENT FOR PAYMENT

705.09.01 Actual Measurement

705.09.01.01 Flexible Delineator Post - Permanent

For measurement purposes, a count shall be made of the number of complete flexible delineator posts installed.

705.09.01.02 Flexible Delineator Post - Temporary

For measurement purposes, a count shall be made of the number of complete flexible delineator posts installed and removed, up to the maximum number of flexible delineator posts required to be in place at any one time during the Contract.

705.09.01.03 Flexible Delineator Post - Relocation

For measurement purposes, a count shall be made of the number of complete flexible delineator posts relocated. Flexible delineator posts that are temporarily surplus and are required for future stages shall be paid for as one relocation for the combined moves into and out of storage, including any off-site storage required due to on-site restrictions.

705.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

705.10 BASIS OF PAYMENT

**705.10.01 Flexible Delineator Post - Permanent - Item
Flexible Delineator Post - Temporary - Item
Flexible Delineator Post - Relocation - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

When the Contract contains separate items for the work required by this specification, payment shall be at the Contract price and according to the specification for such work.

Costs associated with any required removals and replacement or repairs of defective work and materials shall be the Contractor's responsibility at no additional cost to the Owner.

Appendix 705-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- A list of approved manufacturers. (705.05.01)
- Post height. (705.05.01)
- Dimensions, spacing, and quantity of retroreflective sheeting. (705.05.03)
- Flexible delineator post locations. (705.07.01)
- Relocation of flexible delineator posts. (705.07.02)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR TRAFFIC CONTROL SIGNING

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706.02	REFERENCES
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706.09	MEASUREMENT FOR PAYMENT - Not Used
706.10	BASIS OF PAYMENT

APPENDICES

706-A	Commentary

706.01	SCOPE

This specification covers the requirements for traffic control signing during construction.

706.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

706.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

706.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications or publications:

Canadian General Standards Board (CGSB)

CGSB 62-GP-11M, May 1978 - Marking Material, Retroreflective Enclosed Lens, Adhesive Backing

Authority Publications - Ministry of Transportation of Ontario:

Traffic Control Manual for Roadway Work Operations - Field Edition

Manual of Uniform Traffic Control Devices, M.U.T.C.D.

706.03 DEFINITIONS

Construction Signs means all traffic control signs and associated devices identified in Part A, Division 5, Temporary Conditions, M.U.T.C.D. Manual, including vehicles and sign trailers, required to support signs and equipment to supply sign lighting, excluding the contract identification sign and highway number markers.

Manual means the "Traffic Control Manual for Roadway Work Operations", Field Edition and the Manual of Uniform Traffic Control Devices, M.U.T.C.D.

706.05 MATERIALS

706.05.01 Reflective Surfaces

Reflective materials and surfaces shall conform to M.U.T.C.D.

706.05.02 Signs

All details with respect to materials, dimensions and other requirements except reflectivity, shall conform to the M.U.T.C.D.

706.07 CONSTRUCTION

706.07.01 Traffic Control Signing

Traffic control signing shall include the work of supplying, locating, relocating, erecting, operating and maintaining construction signs, and shall conform to the Manual unless otherwise specified. The contract identification signs will be supplied, erected, and maintained by the Authority.

Signs shall be in place before work affecting traffic begins, shall be well maintained to be effective at all times, shall remain operational throughout the duration of the operation requiring signs, including the shutdown period, and shall be removed upon completion of the operation.

Ramps or roadways identified in the contract for complete closure shall be signed conforming to the M.U.T.C.D.

706.07.02 Existing Signing

Any existing signs removed by the Contractor to accommodate construction shall be kept operational by placement on a temporary support and shall be reinstalled conforming to the M.U.T.C.D after the work operation is complete. Temporarily relocated existing signs shall be kept at the same height, offset and basic location from traffic as before removal.

706.07.03 Seasonal Shutdown

During seasonal shutdown, the Authority will take responsibility for the maintenance, including replacement, of construction signs unless otherwise specified.

Responsibility for the maintenance of construction signs during seasonal shutdown will not be assumed by the Authority until the signing has been inspected, sign installation deviations from the Manual corrected and signing approved in writing by the Authority.

Construction signs placed, replaced or repaired by the Authority during seasonal shutdown will become the property of the Contractor.

Upon resumption of operations, the Contractor shall review and provide written acceptance of the signing; deviations from the Manual shall be noted and these will be corrected by the Authority. Once deviations are repaired, the Contractor shall resume responsibility as specified herein.

706.10**BASIS OF PAYMENT****706.10.01****Traffic Control Signing - Lump Sum Item**

Payment at the contract price for the above item shall be full compensation for all labour, equipment and material required to do the work.

For progress payment, fifty percent of the contract price will be paid upon the supply and installation of the complete initial traffic control signing plan. The balance will be prorated over the balance of the working period.

Appendix 706-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR MODIFIED OVERHEAD SIGNBOARDS

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707.01	SCOPE
707.02	REFERENCES
707.03	DEFINITIONS – Not Used
707.04	DESIGN AND SUBMISSION REQUIREMENTS – Not Used
707.05	MATERIALS – Not Used
707.06	EQUIPMENT – Not Used
707.07	CONSTRUCTION
707.08	QUALITY ASSURANCE – Not Used
707.09	MEASUREMENT FOR PAYMENT
707.10	BASIS OF PAYMENT

APPENDICES

707-A	Commentary

707.01 SCOPE

This specification covers the requirements for the installation of new overlay signboards on existing overhead extruded signboards.

707.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

707.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

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The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

707.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Ministry of Transportation Publications

Ontario Traffic Manual (OTM)
Sign Support Manual

707.07 CONSTRUCTION

707.07.01 General

All existing overlay signboard panels shall be removed by drilling out all pop rivets used to fasten it to the extruded sign.

New overlay signboard panels shall be installed according to the sign details.

Aluminum pop rivets, 1/8" X 7/16", shall be used to install the overlay panel directly on top of the existing extruded sign. The rivets shall be spaced around the perimeter of each overlay panel 25 mm (1") from the edge of the panel at 150 mm (6") centre to centre spacing.

Inside each 1220 mm (4') panel, 6 aluminum pop rivets shall be inserted equally spaced 610 mm (24") from the edge of the panel. Inside each 914 mm (3') panel, 6 aluminum pop rivets shall be inserted equally spaced 450 mm (18") from the edge of the panel. If the panel is over 1830 mm (6') in height, 6 pop rivets shall be installed equally spaced 450 mm (18") from the edge of the panel.

To ensure panels do not peel, ¼ " stainless steel self-tapping screws shall be attached to the corners of all overlay panels, regardless of size.

707.07.02 Sign Ordering

The following shall be submitted to the Contract Administrator a minimum of 12 weeks prior to the installation date:

- a) List of all required overlay signboards,
- b) Sign details for the overlay signboards, and
- c) Date for pick-up.

707.07.03 Sign Pick up

All ordered signboards shall be picked up at the location specified in the "Schedule of Materials to be Supplied by the Owner" within 10 Business Days of receiving notice from the Contract Administrator that the signs are ready for pick up.

707.07.04 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

707.09 MEASUREMENT FOR PAYMENT

707.09.01 Actual Measurement

707.09.01.01 Modified Overhead Signboards

For measurement purposes, a count shall be made of each modified signboard installed.

707.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

707.10 BASIS OF PAYMENT

707.10.01 Modified Overhead Signboards - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 707, November 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS 710
NOVEMBER 2010**
(Formerly OPSS 532, June 1991)

**CONSTRUCTION SPECIFICATION FOR
PAVEMENT MARKING**

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710.10	BASIS OF PAYMENT

APPENDICES

710-A	Commentary

710.01	SCOPE

This specification covers the requirements for the application of pavement markings onto bituminous or concrete pavement.

710.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

710.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

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710.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Material

OPSS 1712	Organic Solvent Based Traffic Paint
OPSS 1713	Thermoplastic Pavement Marking Materials
OPSS 1714	Field Reacted, Polymeric Pavement Marking Materials
OPSS 1715	Preformed Plastic Pavement Marking Tap
OPSS 1716	Water-Borne Traffic Paint
OPSS 1750	Traffic Paint ReflectORIZING Glass Beads

Ontario Ministry of Transportation Publications

Manual of Uniform Traffic Control Devices for Ontario, MUTCD

For the purpose of this specification, the following definitions shall apply:

Durable Pavement Markings: refer to pavement markings produced by either thermoplastics, field reacted polymer or a preformed plastic tape of durable type.

Field Reacted Polymeric Pavement Marking Material: refers to a pavement marking material consisting of two separate components; a polymerizable component and a curing agent or a polymerization catalyst. These two components are designed to be mixed at the site at recommended proportions and applied during the pot life of the mixture.

Hot Applied Thermoplastic Pavement Marking Material: refers to a thermoplastic material that is specifically formulated for hot spray or screed application.

Organic Solvent Based Traffic Paint: refers to a traffic paint whose components are carried in an organic solvent system and will form a solid paint film on evaporation of the solvent after application.

Pavement Markings: refer to markings on pavements, used to delineate vehicle operating limits on highways and streets, conforming to the size and shape, as specified in the MUTCD.

Permanent Pavement Markings: refer to pavement markings placed other than Temporary Pavement Markings or short term pavement markings.

Preformed Plastic Pavement Marking Tape: refers to plastic material specifically designed and preformed into pliable rolls or ribbons of various lengths and widths or into symbols.

Premarking: refers to the indicating marks, required to identify the position of pavement markings.

Reflectorization: refers to a material, treatment or process to enable incident light to be returned in high proportions in the general direction of the light source.

Short Term Pavement Markings: refer to the markings placed prior to the placement of permanent pavement markings, on any milled, levelling, binder or top course pavements where existing lane widths, arrangements and alignments are maintained.

Temporary Pavement Markings: refer to pavement markings placed on temporary roadway surfaces or alignments during construction.

Temporary Pavement Marking Material: refers to pavement marking materials designed to maintain a service life of a minimum of three months.

Temporary Pavement Markings - Removable: refer to pavement markings using materials designed to be removed after use.

Temporary Raised Pavement Markers: refer to raised reflective devices.

Traffic Paint: refers to a paint specifically formulated for use as a pavement marking.

Water-Borne Traffic Paint: refers to a traffic paint whose components are carried in water either as an emulsion or a dispersion and will form a solid paint film on deposition and evaporation of water and volatiles after application.

710.04 DESIGN AND SUBMISSION REQUIREMENTS

710.04.01 General

One-litre samples of solvent based and/or water- borne paint; 500 g samples of thermoplastics; 500 g sample of field reacted polymeric materials, with an adequate amount of catalyst or curing agent; one metre section of preformed pavement marking tape and a 200 g sample of reflectorizing glass beads to be used on the contract shall be supplied to the Authority one month prior to use, prepaid, by the Contractor.

If any sample fails to conform to the specification requirements, none of the batch from which the sample was taken shall be used. New batches shall be obtained at no additional cost to the Authority and the new batches shall be tested until an acceptable batch is obtained.

710.05 MATERIALS

710.05.01 Classification

Pavement markings are classified into the following types based on performance requirements:

- a. Traffic Paint
- b. Pavement Marking - Durable
- c. Pavement Marking - Temporary
- d. Pavement Marking - Temporary - Removable

710.05.02 Organic Solvent Based Traffic

Organic solvent based traffic paint shall conform to OPSS 1712.

710.05.03 Thermoplastic Pavement Marking Materials

Thermoplastic pavement marking materials shall conform to OPSS 1713.

710.05.04 Field Reacted Polymeric Pavement Marking Materials

Field reacted polymeric pavement marking materials shall conform to OPSS 1714.

710.05.05 Preformed Plastic Pavement Marking Tape

Preformed plastic pavement marking tape shall conform to OPSS 1715.

710.05.06 Water-Borne Traffic Paint

Water-borne traffic paint shall conform to OPSS 1716.

710.05.07 Special Considerations

Materials not conforming to the no-tracking time requirements of the applicable specification, may be used when approved by the Authority.

710.06 EQUIPMENT

710.06.01 General

The equipment to be used for application or installation of pavement markings shall be as recommended by the manufacturer of the respective pavement marking material.

710.06.02 Spray Equipment

710.06.02.01 General

Spray equipment shall be used for application of solvent based traffic paint, water-borne traffic paint, thermoplastics and field reacted polymeric material recommended for spray application.

Spray equipment shall be fabricated from materials that will not contaminate the traffic paint and other pavement marking materials.

The spray equipment shall provide a uniform stripe to the required width and thickness, with sharp edges without excessive splatter or overspray. The equipment shall have the capability to provide pavement markings conforming to the MUTCD. The equipment shall be provided with glass bead dispenser to apply overlay glass beads at the recommended rate.

710.06.02.02 Thermoplastic Pavement Markings

Equipment to be used for the application of thermoplastic material shall be capable mixing, maintaining and applying the material at the recommended temperature.

710.06.03 Other Methods of Application

Field reacted polymeric materials and thermoplastics shall be applied using a screed applicator.

Preformed plastic tape shall be installed conforming to the manufacturer's recommendations.

710.07 CONSTRUCTION

710.07.01 General

As part of the work, the Contractor shall supply pavement marking and symbols conforming to the applicable shapes and sizes as outlined in the MUTCD.

The Contractor shall apply the pavement marking and symbols conforming to the contract drawings, when provided, MUTCD and the manufacturer's recommendations.

The work of pavement marking includes: providing samples of materials for testing for conformity to the appropriate material specification, surface preparation, pavement marking obliterating, premarking, application of temporary, short term and permanent pavement markings.

Where the pavement marking scheme is not shown in the contract drawings, it shall conform to the MUTCD or be provided by the Authority.

710.07.02 Surface Preparation

The pavement surface must be clean and dry. Contaminants such as dirt, loose asphalt particles and oily residue shall be removed prior to application of pavement marking.

710.07.03 Pavement Marking Obliterating

Durable markings and traffic paint shall be obliterated or removed using the method indicated in the contract at the location(s) specified.

710.07.04 Premarking

The Contractor shall provide the necessary measurements required to establish the position of all pavement markings.

710.07.05 Temporary Pavement Marking

Temporary markings shall include surface preparation, premarking and placement of temporary markings.

Temporary pavement marking shall be placed on temporary road surfaces prior to the opening to the general public, conforming to MUTCD or as specified in the contract.

710.07.06 Short Term Pavement Marking

Short term pavement marking is required when a paved roadway is to be opened to the general public prior to the application of permanent pavement markings.

As part of the work of pavement marking, the Contractor shall apply short term pavement markings for the centreline and lane lines.

Short term pavement markings shall be applied conforming to MUTCD and as amended by Table 1.

Short term pavement markings shall not conflict with permanent pavement markings.

Short term pavement markings placed on final surface course shall be of the removable type.

A temporary raised pavement marker may be used in place of one 0.3 m line.

710.07.07 Permanent Pavement Marking

Permanent pavement marking includes surface preparation, premarking, short term pavement marking, removal of short term pavement markings and placement of permanent pavement markings.

When permanent pavement markings cannot be placed prior to the opening to traffic, Freeways, Major and Minor Roadways must have short term pavement markings conforming to Division C of the MUTCD and as amended by Table 1.

Permanent pavement markings must be in place and maintained prior to any winter shut down.

TABLE 1
Short Term Pavement Markings

TYPE OF MARKING NOTE 1	TYPE OF ROADWAY	LENGTH OF LINES MIN.	LENGTH OF GAPS MAX.	LENGTH OF TIME BEFORE PERMANENT MARKINGS ARE PLACED MAX.
A	Freeway - six Lanes or Greater, Three Lanes per Direction	3 m Note 2	9 m Note 2	15 Working Days
B	Freeway - Four Lanes, Two Lanes per Direction	0.3 m	15 m	15 Working Days
C	Major Roadways- Six Lanes or Greater, Three Lanes per Direction	3 m Note 2	6 m Note 2	15 Working Days
D	Major Roadways - Four Lanes, or Less	0.3 m	15 m	15 Working Days
E	Minor Roadways	0.3 m	15 m	20 Working Days

Notes: 1. Type of marking as specified elsewhere in the contract.
2. Same as MUTCD.

710.07.08 Selection of Materials

When the item Pavement Marking, or Pavement Marking Symbols, is called for, the Contractor is restricted to traffic paint.

When the item Pavement Marking, Durable or Pavement Marking Symbols, Durable is called for, the Contractor's choice of material is restricted to:

- durable preformed plastic tape
- field reacted polymeric pavement marking material
- thermoplastic pavement marking material

When the item Pavement Marking, Temporary, or Pavement Marking Symbols, Temporary, is called for the Contractor may choose from all marking materials.

When the item Pavement Marking, Temporary Removable, or Pavement Marking Symbols, Temporary - Removable is called for, the Contractor's choice of material is restricted to temporary preformed, removable pavement marking tape.

Selection of pavement marking material for use on a particular type of pavement surface shall conform to the manufacturer's recommendations.

710.07.09 Application

710.07.09.01 General

All pavement markings shall be accurately spaced and present a clean-cut, uniform appearance during either the day or night.

The application of pavement marking materials shall conform to the following requirements and the manufacturer's recommendations.

710.07.09.02 Organic Solvent Based Traffic Paint

Paint shall be applied when the pavement surface temperature is 5°C and above, unless otherwise approved in writing by the Authority.

Paint shall be applied at a rate which results in a uniform thickness of 230 ± 25 microns dry film. Reflectorizing glass beads, conforming to OPSS 1750, shall be applied uniformly at a rate as shown below, immediately after paint application, to ensure embedment of the glass beads.

Overlay glass beads shall not be applied on to black paint which is used for obliterating previous markings.

Rate of Application for Overlay Glass Beads per litre of Traffic Paint	
% Volume Solids of Traffic Paint	Glass Beads Required in kg
40-56	0.7
57-70	0.8

The paint temperature shall be between 40°C and 70°C when applied to the pavement.

710.07.09.03 Water-Borne Traffic Paint

Paint shall be applied as specified in clause 710.07.09.02 except that the pavement surface temperature shall be 10°C and above.

710.07.09.04 Thermoplastic Pavement Marking Material

The material shall be applied when the pavement surface temperature is 5°C and above. The maximum relative humidity shall be 70%. At pavement surface temperatures below 5°C, the pavement shall be preheated immediately prior to material application.

Thermoplastics shall be applied at a rate which results in a uniform thickness of $1.90 \text{ mm} \pm 0.40 \text{ mm}$, measured dry. Markings shall not be applied over pavement joints.

Reflectorizing glass beads conforming to OPSS 1750 with the exception of the requirements for silicone coating shall be applied uniformly at a rate of $1.5 \text{ kg} \pm 0.10 \text{ kg}$ per 10 m^2 of marking immediately after marking material applications and before the material hardens.

710.07.09.05 Field Reacted Polymeric Pavement Marking Materials

Field reacted polymeric pavement marking materials which are recommended for screed application shall be applied at a rate which results in a uniform thickness of $1.90 \text{ mm} \pm .40 \text{ mm}$, measured dry. Markings shall not be applied over pavement joints.

The materials shall be applied when the pavement surface temperature is 5°C and above. The maximum surface temperature shall be 35°C. The maximum relative humidity shall be 70%.

Reflectorizing glass beads conforming to OPSS 1750 with the exception of the requirement for silicone coating, shall be applied uniformly at a rate of $1.5 \text{ kg} \pm 0.10 \text{ kg}$ per 10 m^2 of marking, immediately before the material hardens.

Field reacted polymeric pavement marking materials recommended for spray application shall be applied at a uniform thickness of $.30 \text{ mm} \pm .15 \text{ mm}$, unless otherwise approved in writing by the Authority.

710.07.09.06 Preformed Plastic Tape

The tape shall be applied when the pavement surface temperature is 21°C and above. The maximum relative humidity shall be 70%.

Joints of marking tape shall be butt joints without overlaps. Preformed markings shall not be applied over pavement joints.

710.07.09.07 Pavement Marking, Temporary Removable

Temporary removable pavement markings shall be applied conforming to the manufacturer's recommendation and shall be removed as indicated. Removed material shall be disposed of outside the right-of-way.

710.07.09.08 Raised Pavement Markers, Temporary

The Contractor shall supply and install temporary raised pavement markers conforming to the Authority's requirements and the manufacturer's recommendations. Markers used shall be capable of remaining in place for a period of one to six months as specified in the contract. Temporary raised pavement markers shall be removed as specified in the contract. Removed material shall be disposed of outside the right-of-way.

710.08 QUALITY ASSURANCE

710.08.01 General

Random sampling may be carried out by the Authority during material application to assess line quality.

710.08.02 Line Quality

Line width, thickness, the nature of the edges and uniformity in appearance will be assessed by the Authority. The dry film thickness will be measured by a paint inspection gauge or a coating thickness gauge.

Glass bead distribution will be inspected for evenness in distribution, degree of embedment and retroreflectance.

710.08.03 Measurement of Temperature and Humidity

The testing of ambient and surface temperature will be by thermometer, and surface thermometer, respectively. Humidity will be measured using recording hygrometer.

710.09 MEASUREMENT FOR PAYMENT

710.09.01 Actual Measurement

710.09.01.01 Pavement Marking Pavement Marking, Durable Pavement Marking, Temporary Pavement Marking, Temporary - Removable Pavement Marking Obliterating

Measurement for pavement marking is by the horizontal length in metres of 10 cm wide line excluding gaps. Wider lines are measured in 10 cm equivalents.

Each symbol to be obliterated will be approximately equated in area to a 10 cm wide line.

710.09.01.02 Pavement Marking Symbols
Pavement Marking Symbols, Durable
Pavement Marking Symbols, Temporary
Pavement Marking Symbols, Temporary - Removable
Raised Pavement Markers, Temporary

The unit of measurement is each.

710.09.02 Plan Quantity Measurement

710.09.02.01 Pavement Marking
Pavement Marking, Durable
Pavement Marking, Temporary
Pavement Marking, Temporary - Removable
Pavement Marking Obliterating

Measurement for Pavement Markings is by Plan Quantity, as may be revised by Adjusted Plan Quantity, of the horizontal length in metres of 10 cm wide line, excluding gaps. Wider lines are measured in 10 cm equivalents.

Each symbol to be obliterated will be approximately equated in area to a 10 cm wide line.

710.09.02.02 Pavement Marking Symbols
Pavement Marking Symbols, Durable
Pavement Marking Symbols, Temporary
Pavement Marking Symbols, Temporary - Removable
Raised Pavement Markers, Temporary

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity. The unit is each.

710.10 BASIS OF PAYMENT

710.10.01 Pavement Marking - Item
Pavement Marking Symbols - Item
Pavement Marking, Durable - Item
Pavement Marking Symbols, Durable - Item
Pavement Marking, Temporary - Item
Pavement Marking Symbols, Temporary - Item
Pavement Marking, Temporary Removable - Item
Pavement Marking Symbols, Temporary - Removable - Item
Raised Pavement Markers, Temporary - Item
Pavement Marking Obliterating - Item

Payment at the contract price for the above item(s) shall be full compensation for all labour, equipment and material required to do the work.

Appendix 710-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Method and locations of markings and paint obliteration and removal. (710.07.03)
- Temporary pavement marking requirements. (710.07.05)
- Type of markings. (710.07.07)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



NOTICE TO USERS OF OPSS 721

CONSTRUCTION SPECIFICATION FOR STEEL BEAM GUIDE RAIL AND CABLE GUIDE RAIL

OPSS 721 has been removed from this
OPS volume

The provincial version of OPSS 721 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 721

The municipal version of OPSS 721 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 721

USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS



NOTICE TO USERS OF OPSS 723

CONSTRUCTION SPECIFICATION FOR ENERGY ATTENUATORS

OPSS 723 has been removed from this
OPS volume

The provincial version of OPSS 723 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 723

The municipal version of OPSS 723 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 723

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



**CONSTRUCTION SPECIFICATION FOR
GUIDE RAIL END TREATMENT -
ECCENTRIC LOADER TERMINAL SYSTEM**

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730-A	Commentary

730.01 SCOPE

This specification covers the requirements for the installation of eccentric loader terminal systems.

730.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

730.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

730.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 721 Steel Beam Guide Rail and Cable Guide Rail

Ontario Provincial Standard Specifications, Material

OPSS 1504 Steel Beam Guide Rail
OPSS 1601 Wood, Preservative Treatment, and Shop Fabrication
OPSS 1801 Corrugated Steel Pipe (CSP) Products

Ontario Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 6 - Warning Signs

CSA Standards

G4-09	Steel Wire Rope for General Purpose and for Mine Hoisting and Mine Haulage
G40.20-13/G40.21-13	General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel
W59-13	Welded Steel Construction (Metal Arc Welding)

ASTM International

A 123/A 123M-13	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 153/A 153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 449-10	Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
A 576-90b (2012)	Steel Bars, Carbon, Hot-Wrought, Special Quality
A 741-11e1	Metallic-Coated Steel Wire Rope and Fittings for Highway Guardrail
A 780/A 780M-09	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

American National Standards Institute (ANSI)

B18.6.4-1998 (R2005) Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws

730.05 MATERIALS

730.05.01 Cable Assembly

Swaged fittings shall be machined from hot rolled carbon steel according to ASTM A 576, Grade 1035, and shall be annealed suitable for cold swaging. Swaged fittings shall be galvanized prior to swaging according to ASTM A 153.

Studs shall be according to ASTM A 449 and galvanized according to ASTM A 153. Threads shall have a Class 2A fit prior to galvanizing.

Cables shall be zinc coated steel wire rope according to ASTM A 741. The cable shall be preformed, 6 x 19 wire strand core or independent wire rope core, Type II construction, Class A galvanized, right regular lay, and manufactured with improved plough steel. Steel shall be according to CSA G4, Grade 110/120, and have a minimum breaking strength of 190 kN.

Strength of the assembled swaged fitting, stud, and nuts shall match the breaking strength of the wire rope.

730.05.02 Wooden Posts and Blocks

Wooden posts and blocks shall be according to OPSS 1601.

730.05.03 Object Marker Posts

Object marker posts shall be 2.44 m long perforated steel U channel with 11 mm diameter holes at 50 mm c/c, minimum weight of 4.46 kg/m, and hot dip galvanized according to ASTM A 123.

730.05.04 Miscellaneous Steel Components

Miscellaneous steel components such as post anchor tubes; struts; cable attachments; shelf angles; bearing plates; soil plates; plate washers; and eccentric loader assembly, not including the corrugated steel pipe, shall be medium structural steel according to CSA G40.21, minimum Grade 260W, and hot dip galvanized after fabrication according to ASTM A 123.

Bolt holes in miscellaneous components shall be flush to the surface and shall not deviate by more than 1.0 mm in any direction from the location specified in the Contract Documents. Cut edges shall not deviate from their specified location by more than 0.5 mm and length by more than 25 mm.

All welding shall be according to CSA W59.

730.05.05 Riveted Corrugated Steel Pipes

Riveted corrugated steel pipes shall be according to OPSS 1801 and the Contract Documents, and shall be hot dip galvanized according to ASTM A 123.

730.05.06 Steel Beam Guide Rails, Nuts, Bolts, Washers, and Fasteners

Steel beam guide rails, nuts, bolts, and washers shall be according to OPSS 1504.

Fasteners shall be galvanized, self drilling, self-tapping, and according to ANSI/ASME B18.6.4.

730.07 CONSTRUCTION

730.07.01 General

Eccentric loader terminal systems shall be installed according to and at locations specified in the Contract Documents.

730.07.02 Posts and Post Anchors

Wooden posts and post anchors shall be set to the depth and alignment at the locations specified in the Contract Documents, regardless of the material encountered. Permissible tolerance for plumb shall be 20 mm maximum over the post length above ground.

Wooden post tops shall be cut to the height and to the chamfer specified in the Contract Documents.

All holes below grade shall be drilled in the wooden posts prior to installation.

All holes and the cut tops of the wooden posts shall be treated with two coats of an approved wood preservative according to OPSS 1601.

730.07.03 Steel Beam Guide Rails

Steel beam guide rails shall be installed according to OPSS 721.

Eccentric loader terminal systems shall be connected to new or existing steel beam guide rail as specified in the Contract Documents.

Eccentric loader terminal system mounting heights shall be measured vertically from the top of the steel beam guide rail. Eccentric loader terminal system mounting heights shall be within the following ranges:

- a) 685 to 760 mm during construction.
- b) 685 to 735 mm upon completion of the Work.

Where curb with gutter is required, steel beam guide rail mounting heights shall be measured:

- a) Vertically at face of steel beam guide rail, when face of steel beam guide rail is more than 300 mm beyond the gutter line.
- b) Vertically at the gutter line, when face of steel beam guide rail is 300 mm or less beyond the gutter line.

730.07.04 Damage to Galvanizing

Precautions shall be taken to protect galvanizing against damage. Minor abrasions shall be repaired according to ASTM A 780.

The method of repair for any damage shall be approved by the Contract Administrator prior to the commencement of such work.

730.07.05 Object Markers and Oversize Snow Plow Markers

A Wa-33 object marker according to OTM Book 6, a Wz-2 oversize snow plow marker, and galvanized mounting hardware shall be installed at each energy attenuator.

The Wa-33 object marker and Wz-2 oversize snow plow marker shall be securely fastened to a U channel post and the post shall be direct buried to a minimum embedment depth of 900 mm.

Posts shall be installed at locations specified in the Contract Documents.

730.07.06 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

730.08 QUALITY ASSURANCE

730.08.01 Miscellaneous Steel Components

The Contract Administrator may request documentation and obtain and test components to ensure compliance with this specification. Material not in compliance shall be removed from the Working Area and replaced.

730.09 MEASUREMENT FOR PAYMENT

730.09.01 Actual Measurement

730.09.01.01 Eccentric Loader Terminal System

For measurement purposes, a count shall be made of the number of complete eccentric loader terminal system installed.

730.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

730.10 BASIS OF PAYMENT

730.10.01 Eccentric Loader Terminal System - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Costs associated with any required removals and replacements or repairs of defective work and materials shall be the Contractor's responsibility at no additional cost to the Owner.

Appendix 730-A, November 2014 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Eccentric loader terminal system locations. (730.07.01)

The designer should not specify eccentric loader terminal systems with new installations of steel beam guide rail on roads with posted speed limits equal to or greater than 70 km/h. However, this restriction does not apply to roads with centreline radius of less than 190 m (e.g., interchange loop ramps) or to the steel beam with eccentric loader to 3-cable transition treatment (i.e., OPSD 912.382).

Wherever possible, the designer should eliminate the use of curb with gutter, in advance of and along the length of end treatments and crash cushions. See MTO Roadside Safety Manual for additional information.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 202.030	Roadway Widening for Guide Rail End Treatments and Transitions
OPSD 912.140	Guide Rail System, Steel Beam, Wooden Post Assembly, Installation - Single Rail
OPSD 922.401	Energy Attenuator, End Treatment, Eccentric Loader Terminal System, Component - Loader Assembly
OPSD 922.402	Energy Attenuator, End Treatment, Eccentric Loader Terminal System, Component - Rail and Cable Attachment
OPSD 922.410	Energy Attenuator, End Treatment, Eccentric Loader Terminal System, Assembly - Loader Detail
OPSD 922.430	Energy Attenuator, End Treatment, Eccentric Loader Terminal System, Installation - Layout and Post
OPSD 984.201	Energy Attenuator, End Treatment, Delineation, Installation - Approach End
OPSD 984.202	Energy Attenuator, End Treatment, Delineation, Installation - Leaving End



**CONSTRUCTION SPECIFICATION FOR
GUIDE RAIL END TREATMENT
CRASH-CUSHION ATTENUATING TERMINAL (CAT-350) SYSTEM**

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731-A	Commentary

731.01 SCOPE

This specification covers the requirements for the installation of Crash-Cushion Attenuating Terminal (CAT-350) systems on double guide rail.

731.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

731.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

731.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Material

OPSS 1601 Wood, Preservative Treatment, and Shop Fabrication

Ontario Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 6 - Warning Signs

ASTM International

A 123/A 123M-09 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 780/A 780M-09 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

731.04 DESIGN AND SUBMISSION REQUIREMENTS

731.04.01 Submission Requirements

One copy of the manufacturer's installation instructions and Working Drawings shall be submitted to the Contract Administrator.

Installation of the CAT-350 system shall not commence until the Contract Administrator has received the copy of the installation instructions and Working Drawings.

731.05 MATERIALS

731.05.01 General

All supplied system components shall be according to the manufacturer's specifications.

731.05.02 U Channel Posts

Posts shall be 2.44 m long perforated steel U channel with 11 mm diameter holes spaced on 50 mm centres, minimum weight of 4.46 kg/m, and hot dip galvanized according to ASTM A 123.

731.07 CONSTRUCTION

731.07.01 General

CAT-350 systems shall be installed according to manufacturer's instructions at locations specified in the Contract Documents.

The CAT-350 system shall be installed in a straight line.

731.07.02 Wooden Posts and Steel Foundation Tubes

Wooden posts and steel foundation tubes shall be set to the depth and alignment at the locations specified in the Contract Documents, regardless of the material encountered.

Wooden post tops shall be cut to the height and to the chamfer specified in the Contract Documents.

All holes below grade shall be drilled in the wooden posts prior to installation.

All holes and cut tops of the wooden posts shall be treated with two coats of an approved wood preservative according to OPSS 1601.

All steel foundation tubes and soil plates shall be installed such that no more than 100 mm is exposed above finished grade at any location.

731.07.03 Steel Beam Guide Rails

CAT-350 systems shall be connected to new or existing steel beam guide rail, structures, or concrete transition walls by installing the appropriate steel beam guide rail in these transition areas as specified in the Contract Documents.

CAT-350 system mounting heights shall be measured vertically from the top of the steel beam guide rail. CAT-350 system mounting heights shall be 685 to 735 mm during construction and upon completion of the work.

Where curb with gutter is required, steel beam guide rail mounting heights shall be measured:

- a) Vertically at face of steel beam guide rail, when face of steel beam guide rail is more than 300 mm beyond the gutter line.
- b) Vertically at the gutter line, when face of steel beam guide rail is 300 mm or less beyond the gutter line.

731.07.04 Damage to Galvanizing

Precautions shall be taken to protect galvanizing against damage. Minor abrasions shall be repaired according to ASTM A 780. Components with major abrasions shall be replaced.

The method of repair for any damage shall be approved by the Contract Administrator prior to the commencement of such work.

731.07.05 Object Markers and Oversize Snow Plow Markers

A Wa-33 object marker according to OTM Book 6, a Wz-2 oversize snow plow marker, and galvanized mounting hardware shall be installed at each energy attenuator.

When installed on a paved surface, the object marker and oversize snow plow marker shall be integrally attached to a surface mounted flexible post. The signs and post shall be supplied by the manufacturer as a complete unit. The post shall have the ability to bend 90° from vertical and self-restore after impacts. The minimum outside diameter of the post shall be 60 mm. The post shall be anchored to the pavement according to manufacturer's recommendations.

When installed on a granular surface, the Wa-33 object marker and Wz-2 oversize snow plow marker shall be securely fastened to a U channel post and the post shall be direct buried to a minimum embedment depth of 900 mm.

Posts shall be installed at locations specified in the Contract Documents.

731.07.06 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

731.09 MEASUREMENT FOR PAYMENT

731.09.01 Actual Measurement

731.09.01.01 Crash-Cushion Attenuating Terminal System

For measurement purposes, a count shall be made of the number of complete Crash-Cushion Attenuating Terminal system installed.

731.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

731.10 BASIS OF PAYMENT

731.10.01 Crash-Cushion Attenuating Terminal System - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Costs associated with any required removals and replacement or repairs of defective work and materials shall be the Contractor's responsibility at no additional cost to the Owner.

Appendix 731-A, November 2013 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Crash-Cushion Attenuating Terminal system locations. (731.07.01)

Wherever possible, the designer should eliminate the use of curb with gutter, in advance of and along the length of end treatments and crash cushions. See MTO Roadside Safety Manual for additional information.

The CAT-350 system is intended to be used to terminate double rail steel beam guide rail located in medians where impacts are anticipated from both sides of the system in unidirectional or bidirectional applications.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 912.141	Guide Rail System, Steel Beam, Wooden Post Assembly, Installation - Double Rail
OPSD 922.330	Energy Attenuator, End Treatment, Crash-Cushion Attenuating Terminal (CAT-350) System, Assembly



NOTICE TO USERS OF OPSS 732

CONSTRUCTION SPECIFICATION FOR GUIDE RAIL END TREATMENT - STEEL BEAM ENERGY ATTENUATING TERMINAL SYSTEMS

OPSS 732 has been removed from this
OPS volume

The provincial version of OPSS 732 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 732

The municipal version of OPSS 732 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 732

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS 740
NOVEMBER 2010**
(Formerly OPSS 553, February 1991)

**CONSTRUCTION SPECIFICATION FOR
CONCRETE BARRIERS**

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740.01 SCOPE

This specification covers the requirements for the construction of permanent concrete barriers and temporary concrete barriers.

740.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

740.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

740.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 301	Restoring Unpaved Roadway Surfaces
OPSS 310	Asphaltic Concrete, Hot Mix, Hot Laid and Hot Mix Patching
OPSS 314	Untreated Granular Subbase, Base, Surface, Shoulder and Stockpiling
OPSS 501	Compacting
OPSS 904	Concrete Structures
OPSS 919	Formwork and Falsework

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Granular A, B, M, and Select Subgrade Material
OPSS 1150	Asphaltic Concrete, Hot Mix and Hot Laid
OPSS 1305	Moisture Vapour Barriers
OPSS 1306	Burlap
OPSS 1308	Joint Filler (Concrete)
OPSS 1315	White Pigmented Membrane Curing Compounds for Concrete
OPSS 1350	Concrete (Materials and Production)

OPSS 1352 Precast Concrete Barriers
OPSS 1440 Steel Reinforcement for Concrete
OPSS 1442 Epoxy Coated Steel Reinforcement for Concrete

Ontario Ministry of Transportation Publications

Manual of Uniform Traffic Control Devices of Ontario, M.U.T.C.D.

CSA Standards

CAN/CSA-G40.21-M87 - Structural Quality Steels
CSA-G164-M1981 - Hot Dip Galvanizing of Irregularly Shaped Articles

740.03 DEFINITIONS

Asymmetric: refers to the barrier placed where the pavement elevations on each side of the barrier differ.

740.04 DESIGN AND SUBMISSION REQUIREMENTS

740.04.01 General

Where the Contractor wishes to use a concrete barrier design other than as called for in the contract, he shall request permission from the Authority, at least four weeks prior to starting any work affected by his proposed change.

740.05 MATERIALS

740.05.01 Concrete - General

The concrete mix design for all concrete barriers shall be the responsibility of the Contractor.

740.05.02 Concrete for Cast-in-place Barrier

The concrete for cast-in-place concrete barrier shall be a minimum strength of 30 MPa, except that the Tall Wall Concrete Barrier, shall be a minimum strength of 35 MPa, and shall conform to OPSS 1350 using a nominal maximum size aggregate of 19.0 mm. All coarse aggregate used for slip formed Tall Wall concrete barrier shall have all faces crushed.

740.05.03 Precast Concrete Barrier

Precast concrete barrier shall conform to OPSS 1352.

740.05.04 Concrete Pad for Precast Concrete Barrier

The concrete pad under the precast concrete barrier shall be a minimum strength of 30 MPa and shall conform to OPSS 1350.

740.05.05 Curing

Membrane curing compound shall conform to OPSS 1315. Burlap shall conform to OPSS 1306 moisture vapour barrier shall conform to OPSS 1305.

740.05.06 Joint Filler

Joint filler for permanent concrete barrier shall conform to OPSS 1308.

740.05.07 Formwork

Formwork for permanent concrete barrier shall conform to OPSS 919.

740.05.08 Reinforcing Steel

All reinforcing steel in permanent precast concrete barriers shall be epoxy coated conforming to OPSS 1442.

Epoxy patching compound shall be applied to all welds of epoxy coated reinforcing steel.

Reinforcing steel in temporary concrete barriers shall conform to OPSS 1440.

740.05.09 Asphaltic Concrete

Asphaltic concrete shall conform to OPSS 1150.

740.05.10 Granular

Granular foundation material shall conform to OPSS 1010.

740.05.11 Interlocking Components

Hollow structural steel and wide flange steel sections used in permanent precast concrete barrier shall be 350W grade conforming to CAN/CSA G40.21 and shall be hot dip galvanized after fabrication conforming to CSA G164.

740.07 CONSTRUCTION

740.07.01 Concrete Barrier

The work shall include foundation preparation, placement of the concrete barrier or precast concrete barrier units, expansion joints, construction joints, curing of the concrete, surface finish and treatment at bridge piers.

Construction of permanent concrete barrier shall be by use of the following methods:

1. conventional wooden or steel formwork;
2. slip-form;
3. precast concrete barrier units.

Permanent concrete barrier constructed by methods 1. and 2. above shall conform to OPSS 904 and 919 except as otherwise stated in this specification.

Precast concrete barrier containing the I-Lock connection, may be used in permanent installations. The precast concrete barrier shall be secured in place with 50 mm of asphalt placed on both sides of the barrier as shown on the contract drawings.

740.07.01.01 Foundation Preparation

Preparation of the granular foundation shall conform to OPSS 314 and 301, as appropriate. Immediately ahead of placing concrete, the Contractor shall wet down the subgrade by means of a uniform spray of water sufficient to wet the subgrade thoroughly without leaving standing water.

Placement of asphaltic concrete pavement beneath and adjacent to the precast concrete barrier shall conform to OPSS 310.

The concrete pad for the precast barrier shall conform to OPSS 904 and shall be placed in such a manner and to such width and thickness as to ensure that there are no voids between the concrete pad and the barrier and that the barrier is set to the correct line and grade.

740.07.01.02 Tolerances

The dimensions of the completed barrier shall not deviate by more than 10 mm from the dimensions specified.

The horizontal alignment shall not deviate more than 10 mm from the required lines indicated in the contract.

When a 3 m long, straight edge is placed on the top and faces of the cast-in-place concrete barrier surface, the surface of the concrete shall not vary more than 6 mm from the edge of the straight edge.

When the slipformed concrete barrier does not conform to the tolerances, the Contractor may correct to the required tolerances, using a magnesium float, while the concrete is still plastic, providing the surface and/or the barrier is not damaged during such adjustments.

740.07.01.03 Surface Finish

The surface of the concrete barrier placed with conventional forms shall be given a basic treatment and Class "B" finish conforming to OPSS 904.

The slip-formed barrier surface shall not be brushed. Offsets and fins shall be removed immediately by light trowelling. Surface blemishes 10 mm or less in diameter shall be left untouched. If surface blemishes larger than 10 mm diameter occur, adjustments in the operation shall be made to correct the condition. If the adjustments do not correct the condition within 10 m, the operation shall be halted until the condition is corrected either by adjustments to the operation or to the concrete mix.

The use of water on the completed barrier to correct imperfections shall not be permitted.

740.07.01.04 Curing

Curing for unformed surfaces of cast-in-place slip form concrete barrier shall conform to OPSS 904 for unformed surfaces.

Curing for formed surfaces shall conform to OPSS 904 for formed surfaces.

When joints are made after the application of curing compound the exposed face of the barrier in the vicinity of the joint shall be retreated with curing compound.

When white pigmented membrane is used as curing compound on slip formed barrier, it shall also be used on adjacent preformed barrier sections for colour uniformity.

740.07.01.05 Cold Weather Concreting

Concrete shall not be placed by slip-forming when the air temperature is below 0°C.

Placing concrete by slip-forming shall not be carried out when the air temperature is below 5°C unless the concrete at the time of placing is between 15°C and 30°C. Concrete placed by slip-forming when the air temperature is below 5°C or concrete subject to temperatures below 5°C during the first 7 days shall conform to OPSS 904.

740.07.01.06 Expansion Joints

Expansion joints 12 mm min. in width shall be installed where concrete barrier abuts a structure, adjacent to piers, over existing deck expansion joints and at the locations indicated in the contract. The expansion joint shall be filled with Type 'A' expansion joint filler.

If forming the joint is performed before the concrete has hardened, the adjacent portions of the barrier shall be supported firmly to ensure the design shape of the barrier wall is constructed as specified.

740.07.01.07 Construction Joints

Construction joints located at the end of a days placement shall be squared.

Continuity between adjacent sections of the construction joint shall be achieved by installing three horizontal epoxy coated reinforcing bars, size 25 mm x 1 m long, placed 500 mm on each side of the joint. The three bars shall be located on the barrier centreline placed 150 mm from the top and equally spaced at 150 mm.

Tall Wall concrete barrier, Type E design, shall contain five horizontal epoxy coated reinforcing bars, spaced as above, at each construction joint.

740.07.01.08 Treatment at Bridge Piers

Granular A material with asphalt surface shall be used to fill the area between concrete barriers where separation occurs at bridge piers or at other locations where separation of the barriers is required. Compaction of granular shall conform to OPSS 501. The asphalt surface shall conform to OPSS 310.

740.07.02 Temporary Concrete Barrier

The work shall include foundation preparation, placement of the precast concrete barrier units, placement of construction markers and removal of the barrier and barrier debris from the contract site upon completion of the contract.

Construction of temporary concrete barrier shall be by use of precast concrete barrier units.

The precast units shall be installed with interlocking devices properly engaged. Each run of precast concrete barrier shall consist of units having the same type of connecting device including the end treatments.

Repaired precast concrete barrier units may be used providing the structural integrity of the unit conforms to OPSS 1352.

740.07.02.01 Restrictions on Use of Connections

For contracts awarded on or before December 31, 1992, Contractors may use precast concrete barrier units with one of the following connections:

I-Lock
Concrete Key
Hook & Eye

For contracts awarded after December 31, 1992, Contractors shall use only precast concrete barrier units with I-Lock connection on:

- a. divided roadways with two or more lanes in each direction, and
- b. on other roadways with posted speeds of 80 km/h or greater.

For contracts awarded on or before December 31, 1995, Contractors may continue to use one of the three above connections on:

- c. roadways with posted speeds of less than 80 km/h.

For contracts awarded after December 31, 1995, only the I-Lock connection shall be permitted on all roadways.

740.07.02.02 Foundation Preparation

Temporary concrete barrier shall be installed on a solid foundation having a slope of up to 6% maximum measured perpendicular to the installation. Two days shall be allowed between the placement of final asphalt surface and placement of temporary concrete barrier. Temporary concrete barrier shall be in place prior to the opening of traffic operations.

Drainage shall be maintained under the temporary concrete barrier.

740.07.02.03 Tolerances

The horizontal and vertical alignment at the junction of each barrier section shall be within 15 mm. The maximum radius on which the barrier may be placed shall be as specified for each interlocking design.

740.07.02.04 Construction Markers

Construction markers shall be placed in advance of the temporary precast concrete barrier installation to assist in directing the traffic away from the flared approach end treatment. "Lane Closure Taper Length" and "Maximum Distance Between Markers" shall conform to the M.U.T.C.D.

740.07.02.05 On Site Storage

Temporary concrete barrier being stored on site for re-use on the same contract shall be stored:

- a. with protection by means of a standard temporary concrete barrier installation placed at a minimum of 1.0 m from the edge of the driving lane.

- b. without protection, storage shall be offset from the edge of the driving lane conforming to the following:

Posted Speed kph	Offset m
100	10.0
90	9.0
80	7.0
70	6.0
60	5.0
50	3.0

740.07.03 Temporary Concrete Barrier, Relocation

The work shall include the relocation of temporary concrete barrier and shall conform to subsection 740.07.02. Removal of the barrier units from the Contract site upon completion of the Contract is included with the item "Temporary Concrete Barrier".

740.07.04 Reflectors

Reflectors placed on temporary and permanent concrete barrier shall conform to the M.U.T.C.D.

740.07.05 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

740.08 QUALITY ASSURANCE

740.08.01 Acceptance Criteria for Precast Concrete Barrier

Final inspection of the precast units will not be made until they have been installed.

Precast units damaged in transit or during placement shall be replaced by the Contractor at his own expense.

All temporary concrete barrier units shall meet each of the following criteria.

- a. The elements of each connecting device shall be intact and shall provide an effective connection equivalent in strength to that of a newly manufactured connection.
- b. Concrete within 200 mm of each connecting device shall be structurally sound, free of cracks, spalling and breakage, to ensure safe and satisfactory performance of the connection.
- c. Concrete breakouts in areas, other than as addressed in (b), shall not exceed 150 mm in diameter in either vertical or longitudinal directions.
- d. Individual areas of surface damage including concrete spalls shall not measure more than 150 mm in any direction and shall not exceed a 25 mm depth. (Max. 150 x 150 x 25 mm). The accumulated total surface damage on the traffic side of the unit shall not exceed 10% of the total surface area of the respective side.
- e. Other than as addressed by (d) there shall be no exposed coarse aggregate, such as honeycombing. The top and bottom surface of the precast unit are excluded from this condition.
- f. Cracks shall not extend through the precast unit.

740.09 MEASUREMENT FOR PAYMENT

740.09.01 Actual Measurement

**740.09.01.01 Concrete Barrier
Tall Wall Barrier
Asymmetric Concrete Barrier
Asymmetric Tall Wall Barrier**

Measurement will be made in metres along the centreline of the barrier, from end to end of installation, and shall include the length required for lighting pole footings and over-head sign structure footings.

Where two concrete barriers are constructed back to back, Type B or E1, they will be treated as a single installation and the length will be measured only once for payment purposes.

740.09.01.02 Granular

Measurement will conform to OPSS 314.

740.09.01.03 Asphaltic Concrete

Measurement will conform to OPSS 310.

740.09.01.04 Temporary Concrete Barrier

Measurement will be made along the centreline of the barrier in metres from end to end of the installation, including temporary end sections for the supply, installation and removal of the maximum length of barrier required to be in place at any one time during the life of the contract.

740.09.01.05 Temporary Concrete Barrier, Relocation

Measurement will be made along the centreline of the barrier, in metres from end to end including end sections for each relocation.

Barrier that is temporarily surplus for intermediate stages, but will be required for later stages, will be paid as one relocation for the combined moves into and out of on site storage, including any off site storage required due to space restrictions.

740.09.02 Plan Quantity Measurement

**740.09.02.01 Concrete Barrier
Tall Wall Barrier
Asymmetric Concrete Barrier
Asymmetric Tall Wall Barrier**

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity of the length in metres along the centreline of the barrier, from end to end of the installation, and shall include the length for lighting pole footings and overhead sign structure footings. Where two concrete barriers are constructed back to back, Type B or E1, they will be treated as a single installation for measurement and payment purposes.

740.09.02.02 Temporary Concrete Barrier

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity, of the length in metres along the centreline of the barrier from end to end of the installation, for the supply, installation and removal of the maximum length of barrier required to be in place at any one time during the life of the contract.

740.09.02.03 Temporary Concrete Barrier, Relocation

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity, of the length in metres along the centreline of the barrier from end to end of the installation for each relocation.

Barrier that is temporarily surplus for intermediate stages, but will be required for later stages, will be paid as one relocation for the combined moves into and out of on site storage, including any off site storage required due to space restrictions.

740.10 BASIS OF PAYMENT

**740.10.01 Concrete Barrier -Item
Tall Wall Barrier - Item
Asymmetric Concrete Barrier - Item
Asymmetric Tall Wall Barrier - Item**

Payment at the contract price for the above item(s) shall be full compensation for all labour, equipment and material required to construct the barriers, including any concrete backfill between Type B or E1 concrete barriers at the location of bridge piers or transitions.

When the Contractor installs precast units as a permanent concrete barrier, the contract price shall include full compensation for placing the concrete pad.

740.10.02 Granular

Granular material used as backfill between concrete barriers shall be paid for at the contract price for the appropriate granular items.

740.10.03 Asphaltic Concrete

Asphaltic concrete laid as a foundation or used as asphalt surface at bridge piers shall be paid for at the contract price for the appropriate hot mix item.

**740.10.04 Temporary Concrete Barrier - Item
Temporary Concrete Barrier, Relocation - Item**

Payment at the contract price for the above item(s) shall be full compensation for all labour, equipment and material required to do the work.

Appendix 740-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Horizontal alignment. (740.07.01.02)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR TEMPORARY CONCRETE BARRIERS

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741-A	Commentary

741.01 SCOPE

This specification covers the requirements for the construction of temporary concrete barriers.

This specification also covers the requirements for installation of restraint systems for temporary concrete barrier, Type M connection only, by the following three methods: pinning to asphalt pavement, strapping to concrete, or bolting through concrete.

741.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

741.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

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The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

741.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Material

OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1504	Steel Beam Guide Rail
OPSS 1601	Wood, Preservative Treatment, and Shop Fabrication

Ontario Ministry of Transportation Publications

Ontario Traffic Manual (OTM):

Book 7 - Temporary Conditions

Book 11 - Pavement, Hazard and Delineation Markings

MTO Form:

PH-CC-876 Certification of Temporary Precast Concrete Barrier Installations

CSA Standards

G40.20-13/G40.21-13 W59-13	Rolled or Welded Structural Quality Steel/Structural Quality Steel Welded Steel Construction (Metal Arc Welding)

ASTM International

A 123/A 123M-13 D 4956-13	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products Retroreflective Sheeting for Traffic Control

741.05 MATERIALS

741.05.01 Concrete

Concrete shall be according to OPSS 1350, except that the restrictions on volume batching shall not apply. The Contractor shall assume the responsibility for the mix design. The following specific requirements shall apply:

- a) Class of concrete: Nominal minimum 28-Day compressive strength of 35 MPa
- b) Coarse aggregate: 19.0 mm nominal maximum size

741.05.02 Reinforcing Steel Bars

Reinforcing steel bars shall be according to OPSS 1440 and the Contract Documents.

741.05.03 Connection Assembly Components

Connection assembly components including steel shapes and hollow sections for the I-Lock connection shall be Grade 350W according to CSA G40.20/G40.21 and the Contract Documents. Connection assembly components for other non-proprietary temporary concrete barrier systems shall be according to the Contract Documents.

Connection assembly components for proprietary temporary concrete barrier systems shall be according to manufacturer's specifications and the Contract Documents.

741.05.04 Restraint Systems, Type M Connection Only

All materials required for the restraint systems shall be according to the Contract Documents.

741.05.05 Thrie Beam Guide Rails, Bolts, and Nuts

Thrie beam guide rails shall be fabricated according to OPSS 1504 and the Contract Documents. Bolts and nuts shall be according to OPSS 1504.

741.05.06 Steel Plates, Bolts, and Nuts

Steel plates shall be fabricated according to CSA G40.20/G40.21 and the Contract Documents. Steel plates shall have minimum yield strength of 345 MPa. All steel plates shall be hot dip galvanized after fabrication according to ASTM A 123. Bolts and nuts shall be according to OPSS 1504.

741.05.07 Wooden Block

Wooden blocks shall be according to OPSS 1601.

741.05.08 Delineators

Delineators shall be two-sided and each side shall have a minimum reflective surface of 100 x 100 mm; high intensity retroreflective sheeting according to ASTM D 4956, Type VIII; orange colour; and flexibility to bend 90° from vertical and self restore.

741.05.09 Marking

All temporary concrete barrier units manufactured before March 1, 2008 shall be permanently and legibly marked by the manufacturer on the top or sides of each temporary concrete barrier as follows:

- a) Name or trademark of the manufacturer.
- b) Identification of plant if manufacturer has more than one plant.
- c) The date of manufacture identifying at minimum the year of manufacture with two digits.
- d) Markings shall be stencilled in indelible ink, stencilled in paint, or embossed.

All temporary concrete barrier units manufactured on or after March 1, 2008 shall be permanently and legibly marked by the manufacturer on each temporary concrete barrier as follows:

- a) Name or trademark of manufacturer on file with Owner including identification of plant if manufacturer has more than one plant and year of manufacture embossed on top of each temporary concrete barrier at one end.
- b) Owner approved three digit code of manufacturer and plant identification, and six digit code for date of manufacture (Year Month Day, example January 15, 2008 is 080115) stencilled in minimum 50 mm high digits with indelible ink or paint on top of each temporary concrete barrier at opposite end of embossed markings.
- c) Duplicate three digit code of manufacturer and plant identification, and six digit code for date of manufacture, stencilled in minimum 50 mm high digits with indelible ink or paint on the vertical face of one end elevation of each temporary concrete barrier.
- d) Markings are not permitted on traffic faces of temporary concrete barrier.

741.07 CONSTRUCTION

741.07.01 Temporary Concrete Barrier

Temporary concrete barrier shall be installed at locations specified in the Contract Documents.

Construction of temporary concrete barrier shall be by use of precast concrete barrier units.

Temporary concrete barrier shall be installed with connections properly engaged.

It is acceptable to transition from one type of temporary concrete barrier to another type of temporary concrete barrier using the temporary concrete barrier transition detail according to the Contract Documents. The proportion of each type of approved temporary concrete barrier used for the Work shall be at the Contractor's discretion. However, a minimum continuous length of 100 m of any one type of temporary concrete barrier is required prior to transitioning to another type.

741.07.01.01 Restrictions on Use of Connections

Contractors shall use temporary concrete barriers with one of the following types of connections:

- a) Type J
- b) Type M
- c) Type T

Contractors shall be permitted to use temporary concrete barriers with I-Lock connections on roadways with posted speeds less than 70 km/h.

At locations where restrained temporary concrete barriers are specified in the Contract Documents, temporary concrete barriers with Type M connections shall be used.

741.07.01.02 Foundation Preparation

Temporary concrete barrier shall be installed on a solid foundation having a slope of up to 6% maximum measured perpendicular to the installation. Two Days shall be allowed between the placement of final asphalt surface and placement of temporary concrete barrier. Temporary concrete barrier shall be in place prior to the opening of traffic operations.

Drainage shall be maintained under the temporary concrete barrier.

741.07.01.03 Tolerances

The horizontal and vertical alignment at the junction of each barrier section shall be within 15 mm. The minimum radius on which the barrier may be placed shall be as specified for each type of connection.

741.07.01.04 Construction Markers

Construction markers shall be placed in advance of the temporary precast concrete barrier installation to assist in directing the traffic away from the flared approach end treatment. Taper length for full lane closures and the maximum distance between markers shall be according to OTM Book 7.

741.07.01.05 Quality Control

The Contractor is responsible to supply and install the temporary precast units and certify that they meet the acceptance criteria listed under the Acceptance Criteria for Temporary Precast Concrete Barrier clause. The Contractor shall do an initial inspection of the units prior to installation and a further inspection of the units after each installation. When the installed or relocated units do not meet the acceptance criteria, the Contractor shall remove such units and replace them with units that meet the acceptance criteria. Each installation and relocation of units shall be certified by submitting to the Contract Administrator a completed MTO Form PH-CC-876 Certification of Temporary Precast Concrete Barrier Installations within 24 hours of installation or relocation of the units. Certification shall be done by an authorized representative of the Contractor.

While in-service on the Contract and when units have been damaged or alignment discontinuity is beyond that allowable by the acceptance criteria, the affected units shall be reinstalled or replaced as necessary. The Contractor shall perform the repair within a 48 hour period, starting at the occurrence or first awareness.

Repaired precast concrete barrier units may be used provided that the structural integrity of the unit is maintained. An Engineer's seal and signature shall be affixed to documentation certifying that the repair method used shall not impact the structural integrity of the unit.

741.07.01.05.01 Acceptance Criteria for Temporary Precast Concrete Barrier

For all applications, any unit that fails one or more of the following acceptance criteria shall be rejected:

- a) Dimensions of each unit shall not deviate from those specified by more than the following tolerance:
 - i. Specified dimensions up to 300 mm $\pm$ 5 mm
 - ii. Specified dimensions greater than 300 mm $\pm$ 10 mm
- b) Steel elements of each connecting device shall be free of visible fracture, distortion, and perforation.
- c) Concrete within 200 mm of a connecting device shall be free of visible cracks that exceed 0.3 mm in width, measured at the widest point of the crack.
- d) All cracks wider than 0.3 mm, other than addressed in c), shall neither extend through the precast unit nor be longer than 300 mm.
- e) The unit shall be free of honeycombing.
- f) The end of any unit shall not be located further than 50 mm from the horizontal alignment of the installation.

In addition to the above criteria, when the precast units are used on facilities with a posted regulatory speed limit of 80 km/h or higher, any unit that fails one or more of the following acceptance criteria shall be rejected:

- a) Damage to edges shall not extend more than 100 mm onto any adjacent face. When edge damage extends more than 50 mm onto such a face, damage to the opposite side of that edge shall not extend more than 50 mm onto the opposite face.
- b) The total length of concrete breakout damage to edges flanking the connecting devices, whether repaired or not, shall not exceed 25% of the respective connecting device length on each side of each connecting device.
- c) The concrete damage in the area of the drainage recess shall not reach higher than one third of the lower sloped surface containing the recess.
- d) Concrete breakouts on the traffic faces or on the top of the precast unit other than addressed in a) to c) above shall not be greater than 150 mm in any direction measured on the surface, nor shall the breakout depth at any point exceed 25 mm measured perpendicularly to the face.
- e) Accumulated total concrete breakouts addressed in d) on the traffic sides of the unit shall not exceed 10% of the total surface area of the respective side.
- f) Drilled holes into the barrier shall not have diameter greater than 40 mm.
- g) The horizontal and vertical alignment discontinuity between adjacent units shall not exceed 20 mm, as measured with a 1 m straightedge.

741.07.02 Drainage Gaps for Temporary Concrete Barrier

Gaps for drainage shall be installed according to the Contract Documents and at locations specified in the Contract Documents.

741.07.03 Temporary Concrete Barrier Restraint Systems, Type M Connection Only

741.07.03.01 General

Type M temporary concrete barrier used for temporary concrete barrier restraint systems shall have been manufactured after October 2011, as verified by the markings.

Restraint systems shall be installed at locations specified in the Contract Documents.

Mechanical and adhesive anchoring systems shall be installed according to the manufacturer's specifications to the minimum embedment depth specified in the Contract Documents.

All welds shall be according to CSA W59.

741.07.03.02 Restoration of Asphalt and Concrete Surfaces

Restoration of asphalt and concrete disturbed during the installation and removal of restrained temporary concrete barrier shall be as specified in the Contract Documents.

741.07.03.03 Transitions

Transitions between restrained temporary concrete barrier and unrestrained temporary concrete barrier shall be as specified in the Contract Documents.

Transitions between unrestrained temporary concrete barrier and permanent concrete barrier shall be as specified in the Contract Documents.

741.07.04 Delineators

Delineators according to OTM Book 11 shall be installed at 4 m intervals.

Delineators shall be securely fastened to the top of the temporary concrete barrier with reflective surfaces clearly visible.

Delineators shall be maintained at all times.

741.07.05 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

741.08 QUALITY ASSURANCE

741.08.01 General

The Owner may conduct random Quality Assurance checks on units that have been supplied and installed or relocated to verify the Contractor's ability to ensure compliance with the acceptance criteria. Units that are identified by the Owner's representative as not meeting the acceptance criteria or those units that have been repaired and do not have documentation certifying the method of repair must be removed and replaced with units that meet the acceptance criteria for temporary precast concrete barrier. This shall be done within a 48 hour period of notice to the Contractor, unless agreed otherwise in writing.

741.09 MEASUREMENT FOR PAYMENT

741.09.01 Actual Measurement

741.09.01.01 Temporary Concrete Barrier

Measurement of barriers shall be by length in metres along the centreline of the barrier, from end to end, including temporary end sections installed and removed, up to the maximum length of barriers required to be placed at any one time during the Contract.

741.09.01.02 Temporary Concrete Barrier, Relocation

Measurement of barriers shall be by length in metres along the centreline of the barrier, from end to end, including temporary end sections relocated.

Barriers that are temporarily surplus, but are required for future stages shall be paid for as one relocation for the combined moves into and out of storage, including any off-site storage required due to on-site restrictions.

741.09.01.03 Temporary Concrete Barrier, Drainage Gap

For measurement purposes, a count shall be made of the number of temporary concrete barrier drainage gaps delivered and accepted.

741.09.01.04 Temporary Concrete Barrier Restraint System, Pinned Temporary Concrete Barrier Restraint System, Strapped Temporary Concrete Barrier Restraint System, Bolted

Measurement of barrier restraint systems shall be by length in metres along the centreline of the barrier restraint system, from end to end, installed and removed. Transitions shall be included with the appropriate restraint system.

741.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

741.10

BASIS OF PAYMENT

741.10.01

Temporary Concrete Barrier - Item
Temporary Concrete Barrier, Relocation - Item
Temporary Concrete Barrier, Drainage Gap - Item
Temporary Concrete Barrier Restraint System, Pinned - Item
Temporary Concrete Barrier Restraint System, Strapped - Item
Temporary Concrete Barrier Restraint System, Bolted - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the Work.

Costs associated with any required removals and replacements of defective workmanship or materials shall be the Contractor's responsibility at no cost to the Owner.

Appendix 741-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Locations where temporary concrete barriers are required. (741.07.01)
- Drainage gap locations. (741.07.02)
- Locations where temporary concrete barriers are restrained. Temporary concrete barrier restraint systems should be considered for use on a high speed roadway, typically with a posted speed of 70 km/h or more, when barrier protection is required within 0.5 m of an excavation, within 1.0 m of structures not designed for impacts (e.g., scaffolding), or within 1.0 m of the edge of a bridge deck. (741.07.03.01)
- Details should be provided to cover the method and payment for the restoration of asphalt and concrete surfaces that are disturbed during the installation and removal of temporary concrete barrier restraint systems. (741.07.03.02)
- Locations where transitions are required between unrestrained temporary concrete barrier and restrained temporary concrete barrier and between unrestrained temporary concrete barrier and permanent concrete barrier. (741.07.03.03)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 911.140 to OPSD 911.430 Guide Rail System, Concrete Barrier Drawings



CONSTRUCTION SPECIFICATION FOR CONNECTICUT IMPACT ATTENUATION SYSTEM (CIAS)

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753-A	Commentary

753.01	SCOPE

This specification covers the requirements for the installation of Connecticut Impact Attenuation Systems (CIAS).

753.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

753.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

753.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 314	Untreated Granular, Subbase, Base, Surface, Shoulder, and Stockpiling
OPSS 904	Concrete Structures

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete

CSA Standards

G40.20-04/G40.21-04	Rolled or Welded Structural Quality Steels
W47.1-03	Certification of Companies for Fusion Welding of Steel
W59-03	Welded Steel Construction (Metal Arc Welding)

ASTM International

A 53/A 53M-07	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A 123/A 123M-09	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 153/A 153M-03	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 307-07	Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

753.05 MATERIALS

753.05.01 Concrete

Concrete shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 30 MPa.

753.05.02 Granular Base

Granular base shall be Granular A according to OPSS 1010.

753.05.03 Reinforcing Steel Bars

Reinforcing steel bars for concrete backwall shall be according to OPSS 1440.

753.05.04 Fasteners

Bolts, nuts, washers, and spacers shall be according to ASTM A 307 and hot dip galvanized according to ASTM A 153.

753.05.05 Steel Cylinders

Cylinders shall be fabricated from steel according to CSA G40.21, Grade 300W, and hot dip galvanized after fabrication to provide a zinc coating not less than 610 g/m² according to ASTM A 123.

Cylinders shall be cut square and seamless or electric welded. The finished cylinder shall be within 15 mm of true round. Each cylinder shall be labelled at the top with the designated A to N alphabetical character.

All edges shall be machined and free of burrs and sharp edges.

753.05.06 Steel Rails

Steel rails shall be fabricated as specified in the Contract Documents from flat stock steel according to CSA G40.21, Grade 300W, and hot dip galvanized after fabrication to provide a zinc coating not less than 610 g/m² according to ASTM A 123.

753.05.07 Steel Straps, Lid Support Angles, and Lifting Devices

Steel straps, lid support angles, and lifting devices shall be steel according to CSA G40.21, Grade 300W. All straps shall be cut to the width and length and welded to the cylinder as specified in the Contract Documents.

753.05.08 Steel Pipes

Steel pipes shall be 48.3 mm OD, standard weight, Schedule 40 steel pipe according to ASTM A 53 and welded to one side of the cylinder as specified in the Contract Documents.

753.05.09 Steel Pipe Retainers

Steel pipe retainers shall be 50 mm by 32 mm OD, standard weight, Schedule 40 steel pipe according to ASTM A 53 and welded to the side of the cylinder as specified in the Contract Documents.

753.05.10 Lids

Lids shall be fabricated from low-density polyethylene composed of 25% recycled plastic materials. Lids shall be black in colour and UV stabilized to a minimum rating of UV8D. The lid shall be of sufficient strength to support a centred point load having a mass of 60 kg producing a maximum deflection of 100 mm.

Each lid shall have a steel restraining chain for attachment of the lid to the cylinder.

Associated metal hardware for the lids, such as washers, eye bolts, chains, and screws shall be hot dip galvanized according to ASTM A 153 or equivalent electroplated or anodized treated.

753.05.11 Welds

All welding shall be according to CSA W47.1 and CSA W59.

753.07 CONSTRUCTION

753.07.01 General

Connecticut Impact Attenuation Systems shall be installed according to and at locations specified in the Contract Documents.

753.07.02 Concrete Pads and Backwalls

Levelling and site preparation required for the existing granular base shall be performed prior to placing the concrete pad and backwall.

Concrete pads and backwalls shall be constructed as specified in the Contract Documents. Concrete shall be placed, cured, and finished according to OPSS 904. Cross fall of the concrete pad is desirably 6% or less and shall not exceed 10%. All exposed edges of the backwall shall have a 25 mm chamfer. Drilling of anchor holes shall commence a minimum of five days after concrete has been placed.

753.07.03 Granular Base

The granular base below the concrete pad shall be a minimum depth of 150 mm and shall be placed according to OPSS 314. The granular material shall be compacted to 95% of the maximum dry density.

753.07.04 Connection to Barriers

The concrete backwall shall be connected to the barrier as specified in the Contract Documents.

753.07.05 Delineation

Delineation shall be provided as specified in the Contract Documents.

753.07.06 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

753.09 MEASUREMENT FOR PAYMENT

753.09.01 Actual Measurement

753.09.01.01 Connecticut Impact Attenuation System

For measurement purposes, a count shall be made of the number of complete Connecticut Impact Attenuation Systems installed.

753.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

753.10 BASIS OF PAYMENT

753.10.01 Connecticut Impact Attenuation System - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Costs associated with any required removals and replacement or repairs of defective work and materials shall be the Contractor's responsibility at no additional cost to the Owner.

Appendix 753-A, November 2013 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Connecticut Impact Attenuation System locations. (753.07.01)

The designer should determine to which standard Connecticut Impact Attenuation Systems should be installed and specify it in the Contract Documents:

- a) The Connecticut Impact Attenuation System should only be installed at a 10° skew to the centreline of the roadway when the length of the median hazard and the median width can accommodate a Connecticut Impact Attenuation System at each end of the hazard within the limits specified in OPSD 923.245. In this case, the designer should specify that the system be installed according to OPSD 923.245.
- b) The Connecticut Impact Attenuation System should only be installed at a 0° skew to the centreline of the roadway when the length of the median hazard is too long and the median width is too narrow to accommodate a Connecticut Impact Attenuation System at each end of the hazard within the limits specified in OPSD 923.245. In this case, the designer should specify that the system be installed according to OPSD 923.244.

Wherever possible, the designer should eliminate the use of curb with gutter, in advance of and along the length of end treatments and crash cushions. See the MTO Roadside Safety Manual for additional information.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 923.201	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Component - Steel Cylinder
OPSD 923.202	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Component - Polyethylene Lid
OPSD 923.204	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Component - Concrete Backwall
OPSD 923.242	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Installation
OPSD 923.244	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Installation - Long Median Hazard
OPSD 923.245	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Installation - Short Median Hazard
OPSD 984.205	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Delineation, Installation - Permanent



CONSTRUCTION SPECIFICATION FOR NOISE BARRIER SYSTEMS

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760-A	Commentary

760.01 SCOPE

This specification covers the requirements for the installation of noise barrier systems.

760.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

760.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

760.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 501	Compacting
OPSS 510	Removal
OPSS 609	Grounding
OPSS 904	Concrete Structures
OPSS 906	Structural Steel for Bridges

Ontario Provincial Standard Specifications, Material

OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete

CSA Standards

S6-06	Canadian Highway Bridge Design Code

ASTM International

A 123/A 123M-13	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 780/ A 780M-09	Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings
B 209-10	Aluminum and Aluminum-Alloy Sheet and Plate

760.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Manufacturer means the party that supplies and/or specifies the design, materials, and components for the proprietary noise barrier system selected by the Contractor.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

760.04 DESIGN AND SUBMISSION REQUIREMENTS

760.04.01 Design Requirements

Noise barrier system design shall be as specified in the Contract Documents and according to the manufacturer's specifications.

760.04.01.01 Footings

760.04.01.01.01 General

Depth of footings shall be according to CAN/CSA S6 and based on the soil design parameters and wind load as specified in the Contract Documents.

760.04.01.01.02 Footings in Earth

When footings are to be installed on or within 1 m from a downward slope of 3H:1V or steeper, the Working Drawings shall reflect this and shall note an increase in embedment depth of a minimum of 0.5 m greater than the requirements specified in CAN/CSA S6.

760.04.01.01.03 Footing in Rock

When rock is encountered within the specified excavation depth for footings in earth, the footing shall be designed and constructed according to the Footings in Earth clause based on soil properties and wind load as specified in the Contract Documents. Alternatively, the design depth into rock shall be designed based on rock properties provided by the Owner. The minimum design depth below final grade shall not be less than 1.5 m or to the frost depth, whichever is the greater.

760.04.02 Submission Requirements

760.04.02.01 Working Drawings

The Contractor shall submit 6 copies of Working Drawings for the noise barrier system to the Contract Administrator at least 4 weeks prior to the commencement of construction. The Working Drawings shall show full details of noise barrier related items, erection procedures and, if applicable, connections to structures. An Engineer's seal and signature shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

760.05 MATERIALS

760.05.01 General

All components for noise barrier systems shall be according to the manufacturer's specifications and as specified in the Contract Documents.

760.05.02 Granular Materials

Granular material shall be as specified in the Contract Documents.

760.05.03 Footings

Cast-in-place concrete in footings shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 30 MPa.

760.05.04 Steel Reinforcement

Steel reinforcement for the footings shall be according to OPSS 1440.

760.07 CONSTRUCTION

760.07.01 General

Noise barrier systems shall be installed according to manufacturer's specifications at locations specified in the Contract Documents.

760.07.02 Site Grading and Preparation

Grading and berm construction associated with the barrier installation shall be completed to within 25 mm below the bottom of the barrier prior to constructing the barrier footings. Grading up to 300 mm shall be part of installation of noise barrier system.

All grading shall be according to OPSS 206.

Earth and granular materials shall be compacted according to OPSS 501.

There shall be no visible gaps between any barrier panels or beneath the bottom panels after completion of the barrier.

Tree pruning and removal shall be kept to a minimum and shall be subject to the approval of the Contract Administrator prior to the commencement of any pruning and removal.

760.07.03 Footings

Concrete shall be according to OPSS 904.

Concrete for drilled footings shall be cast entirely against undisturbed soil.

For other footings, the footing shall be formed and the excavation shall be backfilled with granular materials and compacted to at least 95% standard Proctor maximum dry density.

When required, the top of all footings shall be shaped to provide for full horizontal seating of panels and the remaining surface area shall be sloped away from the post to shed water. Stepped footings shall be constructed to suit grade changes.

Concrete in the footings shall be cured to meet design strength as specified by the Engineer prior to the installation of noise barrier panels.

All excavations into rock shall be backfilled entirely with concrete. Excavation above the top of rock shall be formed to the required dimensions and the remainder of the excavation backfilled with granular material.

760.07.04 Posts

Structural steel posts shall be according to OPSS 906.

Steel posts and components shall be hot dip galvanized after fabrication according to ASTM A 123. Galvanized surfaces that are abraded shall be cleaned and painted with a zinc-rich paint according to ASTM A 780.

The top of footing and underside of post base plate shall be filled with non-shrink grout according to the manufacturer's specifications.

Tolerance for post plumb shall be according to the manufacturer's specifications.

760.07.05 Panels

Panels shall be installed horizontally and stepped when necessary to match the elevation profile specified on the Working Drawings. Changes in horizontal direction shall be made using special arrangements of the posts according to the manufacturer's specifications.

All panels shall be cleaned of any oils, dirt, and debris.

760.07.06 Noise Barriers on Structures

Noise barrier system shall be attached to the structure as specified in the Contract Documents.

Flashing shall be installed and sealed in a manner so that water will not pond on the structure according to the manufacturer's specifications.

760.07.07 Precast Noise and Traffic Barriers

Precast noise or traffic barrier units or both shall be constructed to the line and grades as specified in the Contract Documents with a tolerance of ± 10 mm.

When changes in horizontal alignment are greater than 2° or when changes in vertical alignment are greater than 2% between adjacent units occur, the ends of the units shall be manufactured with the appropriate skewed end detail. Units required to match ground profiles with grades in excess of 2% shall be manufactured with skewed ends to match the vertical post detail. The space between each unit on the traffic side surface shall not exceed 25 mm at the base of the traffic barrier. The difference in elevation between adjacent units shall not exceed 25 mm. Any levelling or plumbing of units shall be done according to the manufacturer's specifications.

Granular base for the precast noise or traffic barrier units or both shall be placed in a manner to ensure that there are no voids between the bottom surface of units and the granular material and that the units are set to the correct line and grades.

Precast noise or traffic barrier units or both shall be set according to the manufacturer's specifications. Top of footings shall be clear of foreign material, ice, snow, or water.

Precast noise or traffic barrier units or both shall be positioned to have complete contact with the post flange along the traffic side of the units.

Top of the noise or traffic barrier units or both shall be cleared of any foreign or loose material, ice, snow, or water prior to installing the noise barrier panels.

The point of contact between the top of the precast noise or traffic unit or both and the bottom of the noise barrier panels shall be sealed according to manufacturer's specifications.

760.07.08 Noise Barrier Access Openings

Openings, frames, doors, and hardware for noise barrier access shall be supplied and installed in accordance with the manufacturer's Working Drawings and installation instructions at the locations and of the types specified in the Contract Documents.

Openings shall be cut a minimum distance of 1,000 mm from the centerline of the noise barrier post to the centerline of the opening.

The centre of fire hose access openings shall be located within the range of 1,300 to 1,500 mm measured from the finished ground surface.

Standard opening sizes for fire hose access and person door access are shown in Table 1. Dimensions and details for all other access opening types including, but not limited to electrical access, vehicle access, and hydraulic access are as specified in the Contract Documents. The openings shall meet the specified dimensions and shall be centred between adjacent posts.

Each noise barrier access opening shall be fitted with a hinged door that opens away from the roadway to a minimum opening angle of 110°.

When doors are in the closed position, there shall be no impact to the acoustical characteristics of the noise barrier system. All gaps between openings and frames shall be sealed to ensure that there are no gaps.

760.07.09 Connection to Existing Fence

When sections of an existing parallel or cross fence are to be removed or replaced or both with a noise barrier system, the Contractor shall ensure that a sufficient length of existing fence is maintained in good condition to adequately allow for connection to a new post at locations shown in the Contract Documents.

Removal of any fence shall be according to OPSS 510.

760.07.10 Underground Utility and Drainage Crossings

Reduced post spacing shall be allowed according to the manufacturer's specifications to avoid placing posts on top of utilities and drainage facilities.

760.07.11 Existing Overhead High Voltage Lines

When the potential of arcing exists due to the close proximity of existing overhead high voltage lines, steel noise barrier panels and posts shall be grounded according to OPSS 609.

760.07.12 Marking

Identification plates, provided by the manufacturer, shall be attached to the completed noise barrier system at the following intervals:

- a) At the start and end of noise barrier system.
- b) At a maximum interval of 300 m.

The identification plate shall be located within 300 mm of a terminal post with the top of the plate located approximately 1.2 m above the ground. The maximum dimensions of the plate shall be 200 by 200 mm. The plate shall be made from 0.81 mm thick anodized aluminum sheet according to ASTM B 209 series 1100 or 5005-H34.

Each plate shall be engraved with the following information:

- a) Contract number.
- b) Name of manufacturer of noise barrier system.
- c) Name of Subcontractor that installed the noise barrier system.
- d) Date of completed installation (i.e., yyyy-mm).

The height of the letters and numerals shall be within the range of 6 to 32 mm.

760.07.13 Quality Control

760.07.13.01 Interim Inspection of Footings and Posts

During construction of the noise barrier footings and posts and prior to the installation of the noise barrier panels from the fabrication facility, the Quality Verification Engineer shall conduct an inspection during the work to verify that the footings and posts have been constructed in general conformance with the Contract Documents and issue the Contractor written permission to proceed with the work. A copy of the written permission to proceed shall be submitted to the Contract Administrator prior to commencement of the next operation.

760.07.13.02 Certificate of Conformance

A completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the installation of the noise barrier system. The Quality Verification Engineer shall affix his or her seal and signature to the completed Certificate of Conformance confirming that the installation has been carried out in general conformance with the Contract Documents and manufacturer's specifications.

760.07.14 Site Restoration

After noise barrier system installation, the site shall be cleaned and trimmed and the ground restored to a neat condition.

760.07.15 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

760.08 QUALITY ASSURANCE

760.08.01 Construction

Noise barrier components damaged in transit or during placement shall be replaced by the Contractor at no cost to the Owner.

The Contractor shall install noise barrier materials that are visually uniform in appearance in terms of colour, pattern, and texture. Uniformity of appearance is subject to approval of the Contract Administrator. Noise barrier panels shall visually match adjacent panels. Inspection shall occur at a distance of approximately 15 metres from the noise barrier system.

Final inspection of the complete noise barrier system shall not be made until it has been installed.

760.09 MEASUREMENT FOR PAYMENT

760.09.01 Actual Measurement

**760.09.01.01 Noise Barrier System
Noise Barrier System Including Precast Noise/Traffic Barrier
Noise Barrier System on Structures**

Measurement of noise barrier system shall be along the horizontal length in metres of the specified height. Transitions between barrier heights shall form part of the higher barrier and terminations shall form part of the adjoining barrier.

At the discretion of the Contract Administrator, if unidentified difficult soil conditions (i.e., rock, shale, or unstable earth) are encountered above the design footing depths, work necessary to complete the design requirements such as caissons, dewatering, additional concrete, or different augering equipment, shall be paid for as Additional Work.

760.09.01.02 Noise Barrier Access

For measurement purposes, a count shall be made of the number of accesses installed.

760.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

760.10 BASIS OF PAYMENT

**760.10.01 “height” Noise Barrier System - Item
“height” Noise Barrier System Including Precast Noise/Traffic Barrier - Item
“height” Noise Barrier System on Structures - Item
Noise Barrier Access - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Grading up to 300 mm shall be included as part of the noise barrier system item. For earth grading requirements greater than 300 mm, the full grading is provided under the earth excavation item.

760.10.02 Removals and Replacements

Cost associated with any required removals and replacements of defective workmanship or materials shall be the Contractor's responsibility at no cost to the Owner.

TABLE 1
Noise Barrier Access Standard Opening Sizes

Type of Door / Opening	Opening Size (W mm x H mm)
Fire Hose Access	254 x 254
Person Door Access	915 x 2438

Appendix 760-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Noise barrier system design requirements should include the following: (760.04.01)

a) Acoustics

The noise barrier system shall be designed for one of the following acoustical characteristic:

- i. Either sound absorptive or reflective
- ii. Sound absorptive on the highway side
- iii. Sound absorptive on the residential side
- iv. Sound absorptive on both sides.

If more than one acoustical characteristic apply to this Contract for various sections, then each section shall be designed accordingly with clearly defined limits.

b) Height

The designer shall select an appropriate height according to the acoustical requirements, which shall not be more than 5 metres.

c) Aesthetics

The designer shall plan the number of colours and textures for the Contract. The designer shall also specify the patterns and proportions in which each is required. The exact colour, texture, and pattern for the noise barrier system shall be specified following the award of the Contract, but will be within the following parameters:

The number of colours adjacent to highway is _____;

in the proportion of: _____

The number of textures is _____;

in the proportion of: _____

The number of colours adjacent to residential property is _____;

in the proportion of: _____

The number of textures is: _____;

in the proportion of: _____

Appendix 760-A

Final colour selections shall be determined by the Contract Administrator at the point of manufacture from samples prepared by the manufacturer.

If only one colour and texture are to be used, the noise barrier shall be constructed using only one colour and texture, which shall be specified by the Contract Administrator following the award of the Contract. Final colour selection shall be determined at the point of manufacture from samples prepared by the manufacturer.

d) Noise Barrier Access

The designer should provide station and offset (Lt. or Rt.) locations for all required barrier access points and indicate the type of access opening required at each location. Opening sizes for fire hose access and person access are standard. Opening sizes for other types of access including, but not limited to electrical access, vehicle access, and hydraulic access are site specific and should be specified by location and opening size.

- Soil design parameters and wind loads for footings should include the following: (760.04.01.01.01)

a) Footings

The designer shall design the noise barrier system footings according to CAN/CSA S6 with the assistance of soil design parameters. The designer shall also provide the soil design parameters as per the example below.

Station to Station	Soil Design Parameter
<u>East Bound Lane</u> 17+320 to 17+790 (shoulder)	$\phi = 28^\circ$
<u>West Bound Lanes</u> 17+100 to 17+600 (ROW) 17+600 to 17+720 (ROW) 17+700 to 18+050 (shoulder)	$\phi = 28^\circ$ Cu = 12 Kpa $\phi = 28^\circ$

b) Wind Pressure

The wind pressure information shall be used from CAN/CSA S6 for the city where the project is located (e.g., 415 Pa for Hamilton area).

- Noise barrier system material requirements. (760.05.01)
- Granular material to be used. (760.05.02)
- Noise barrier system locations. (760.07.01)
- Attachment requirements for noise barrier system to structure. (760.07.06)
- Line and grade specifications for precast noise/traffic barrier units. (760.07.07)
- Noise barrier access opening requirements. (760.07.08)

Appendix 760-A

- Locations where noise barrier system connects to existing fence.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



NOTICE TO USERS OF OPSS 771

CONSTRUCTION SPECIFICATION FOR STANDARD HIGHWAY FENCE

OPSS 771 has been removed from this
OPS volume

The provincial version of OPSS 771 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 771

The municipal version of OPSS 771 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 771

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



CONSTRUCTION SPECIFICATION FOR CHAIN-LINK FENCE

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772.01 SCOPE

This specification covers the requirements for the installation of chain-link fence.

772.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

772.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

772.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 904 Concrete Structures

Ontario Provincial Standard Specifications, Material

OPSS 1541 Chain-Link Fence Components

CSA Standards

W59-03 (R2008) Welded Steel Construction (Metal Arc Welding)

ASTM International

A 123/A 123M-09 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel
A 780M-09 Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings
B 209-10 Aluminum Alloy Sheet and Plate

For the purpose of this specification, the following definitions shall apply:

Barbed Wire means the twisted longitudinal wires, termed line wires, to which the barbs are attached.

Barbed Wire Arm means the metal arm to support the barbed wire.

Bottom Wire means the wire installed at the bottom of fence and fastened to the bottom of the fence fabric and extending throughout each section of fence between terminal posts.

Brace Band means a symmetrically formed strip of metal shaped to fit around a post and used with a carriage bolt and nut to attach the rail end or brace rail end to the post. Also, used for attaching barbed wire, tension wire, and other items to a terminal post.

Brace Rail means a tubular or fabricated steel section used for bracing terminal posts.

Corner Post means a terminal post when the direction of the line of fence changes in two or more directions.

Diagonal Brace Wire means the wire used for bracing terminal posts.

End Post means the fence post positioned at the ends of a section of fence.

Fence Post means an upright tubular or fabricated steel member for supporting fencing material.

Fitting means the mechanical connection of various designs, shapes, and metals to join fence components into an integral structure.

Gatepost means a terminal post on each side of a gate forming a gateway.

Hog Ring means a preformed open wire clip designed to close up into a ring to secure chain-link fabric to horizontal top and bottom wires.

Knuckled means the type of selvage obtained by interlocking adjacent wire ends in pairs and then bending the wire ends back into a closed loop.

Line Post means the fence post spaced at regular intervals between terminal posts throughout each section of fence.

Line Post Cap means a cap or top with a loop or hole used to position the top rail or top wire on top of the line posts. It also prevents water from entering the tubular post.

Marcelled Tension Wire means a type of wire manufactured with either a uniform helix or a series of waves put into the wire to facilitate tensioning the wire when installed to support the top or bottom of the chain-link fence fabric.

Post Sleeve means a specified length of tube or pipe set into a concrete retaining wall into which fence posts are placed.

Rail End means a cup-shaped fitting used with a brace band to connect the top rail or brace to a post.

Selvage means the edge finish on woven chain-link fabric joining pairs of pickets. The selvage may be knuckled or twisted.

Straining Post (or Pull Post) means a terminal post in a line of fence to brace a long stretch or to effect a change in elevation along a fence line.

Tension Band means an offset strip of metal shaped to fit around the terminal post and used with a carriage bolt and nut to attach the tension bar to the post.

Tension Bar means the bar used with tension bands to secure the fence fabric to a terminal post.

Terminal Post means end, gate, corner, and straining post.

Terminal Post Cap means a cap atop a post (end, gate, corner or straining post) that prevents water from entering the tubular post.

Top Rail means a tubular or fabricated steel section continuously joined by means of sleeves or couplings throughout all sections of fence extending between terminal posts.

Top Rail Sleeve means a fitting used to join two pieces of top rail when swedged top rail is not used.

Top Wire means the wire installed at the top of fence and extending continuously throughout all sections of fence between terminal posts.

Twisted means the type of selva obtained by interlocking adjacent wire ends in pairs and then twisting the wire at least two turns with the wire ends above the twist.

Wire Ties means the wire used to tie chain-link fence fabric to line posts, bottom wires, and top rails or top wires.

772.05 MATERIALS

772.05.01 Chain-Link Fence

Chain-link fence components shall be according to OPSS 1541.

772.05.02 Concrete

Concrete shall have a nominal minimum 28-Day compressive strength of 20 MPa.

772.07 CONSTRUCTION

772.07.01 Site Preparation

Prior to the commencement of fencing operations, all debris shall be removed and ground undulations shall be corrected along the fenceline to obtain a smooth and uniform gradient.

All trees, stumps, and brush along the fenceline shall be cut off at ground level and all logs and overhanging branches that interfere with the installation of the fence shall be removed.

772.07.02 Chain-Link Fence

772.07.02.01 General

Chain-link fence shall be installed at locations specified in the Contract Documents.

Survey reference points or permanent property boundary markers shall not be disturbed or moved without the authorization of the Contract Administrator. When it is necessary to set posts adjacent to such points, the posts shall be placed on the roadway side of the property line as close as feasible to the monuments or markers.

772.07.02.02 Post Installation

772.07.02.02.01 General

All posts shall be installed plumb and to the depth specified in the Contract Documents.

Posts shall be cut to the required height above the ground to present a smooth and uniform profile. Line post spacing shall be in equal horizontal distances with a maximum of 3,000 mm between line posts.

All posts shall be fitted with waterproof metal caps designed to fit and fasten securely over the posts. All line post caps shall carry either the top rail or top wire as specified in the Contract Documents.

Corner posts shall be installed at horizontal deflections in the fence line of 10 degrees or more.

Straining posts shall be installed at equal intervals not exceeding 150 m. Additional straining posts shall be installed when changes in vertical alignment of the fence exceed 30 degrees.

772.07.02.02.02 Posts On Concrete Barrier

All posts installed on concrete barrier shall be according to the Contract Documents.

Each post shall be fabricated with a welded steel base plate grade 300W, hot dip galvanized according to ASTM A 123, and according to the Contract Documents. All welds shall be to a low hydrogen classification according to CSA W59. Manual electrodes shall be E7015, E7016, or E7018. All welds shall be continuous.

772.07.02.02.03 Footings

All posts shall be installed according to the Contract Documents.

Concrete placing, curing, and protection from the elements shall be according to OPSS 904.

772.07.02.03 Bracing

A brace rail or brace wire shall be placed diagonally across the panel at all ends and gateposts. Corner and straining posts shall be supported with diagonal braces placed on both sides of the post. The higher end of the diagonal brace shall be connected at the terminal post.

End fittings shall be secured by a 6 mm bolt placed through the fitting and braced at both ends of the brace.

772.07.02.04 Top Rails, Top Wires, and Bottom Wires

Top rails or top wires shall be installed as specified in the Contract Documents.

Top rails or top wires shall be fastened securely to line post tops using waterproof caps.

In sag locations, the post and cap shall be drilled and fastened with a self-tapping screw to ensure a secure fit.

Top rails shall be fastened to terminal posts with centre bands.

Top and bottom wires shall be stretched tight and securely fastened to terminal posts with turnbuckles and centre bands.

One turnbuckle shall be used between terminal posts.

772.07.02.05 Fence Fabric

Fence fabric shall not be installed until the concrete footings have cured for a minimum of 5 Days.

The fabric shall be stretched tight and securely fastened to terminal posts with steel tension bars and steel or aluminum tension bands. The longitudinal axis of the diamond pattern shall be perpendicular to the slope of the top rail or top wire.

The fabric shall be placed on the side of the post nearest the roadway with the barbed edge at the top, except on curves of 50 m or smaller radius, the fabric shall be placed on the side of the post away from the centre of the curve.

The fabric shall be securely fastened to the line posts, bottom wire, and top rail or top wire with wire ties. The fabric shall not be fastened to any diagonal braces.

Manually fastened round wire ties shall engage one strand of the chain-link fence fabric with one end of the tie by wrapping it with two 360 degree turns and then wrapping the body of the tie around the post or top rail a minimum of 180 degrees. The remaining end of the tie shall be secured to the second strand of the chain-link fence fabric by wrapping it with two 360 degree turns. The fabric and the main body of the tie shall be drawn tightly to the rail or post.

Power fastened wire ties shall engage two strands of the chain-link fence fabric at a diamond joint closest to the post or top rail. The manufacturer's installation instructions shall be followed to complete the operation. The ends shall be twisted three full twists or one and one half machine turns. The end of the tie shall be positioned on the post or rail so that it is parallel to the chain-link fence fabric.

The ends of wire ties shall not protrude beyond the vertical plane on either side of the chain-link fence fabric. Protruding ends of wire ties shall be removed.

The hog rings on top and bottom wires shall be installed according to the Contract Documents.

772.07.02.06 Barbed Wire

Barbed wire shall be installed when specified in the Contract Documents. The barbed wire shall be pulled taut to remove all slack and shall be firmly installed in the slots of the barbed wire arms. The ends of the barbed wire shall be securely connected at the terminal posts with brace bands. Barbed wire arms shall be installed with the arm pointing away from the roadway.

772.07.03 Gates

Gates shall be installed at locations and of the type and size as specified in the Contract Documents.

772.07.03.01 Gate Installation

Gates shall be constructed with the fabric on the side furthest from the roadway with the barbed edge at the top.

All gates shall have a chain hook to hold gates open and double gates shall have a steel gate centre rest with a drop bolt for the closed position.

The surface grade within the required gate sweep area shall be low enough to permit free movement of the gate.

772.07.04 Marking

Identification plates, provided by the material supplier, shall be securely attached to the completed fence installation at the following intervals:

- a) At the start and end of each fence installation.
- b) At a maximum interval of 300 m.

The fence identification plate shall be located within 300 mm of a terminal post with the top of the plate located approximately 300 mm from the top of the fence fabric. The maximum dimensions of the plate shall be 200 by 200 mm. The plate shall be made from 0.81 mm thick anodized aluminum sheet according to ASTM B 209 series 1100 or 5005-H34.

Each fence identification plate shall be engraved with the following information:

- a) Contract number.
- b) Name or trademark of fence Subcontractor.
- c) Name or trademark of fence supplier (i.e., supplier(s) of fence fabric and posts)
- d) Date of completed installation (i.e., yyyy-mm).

The height of the letters and numerals shall be within the range of 6 to 32 mm.

772.07.05 Zinc Coating Repairs

Cut ends, field drilled holes, and damaged areas of hot dip galvanized coatings on galvanized components shall be repaired according to ASTM A 780.

772.07.06 Site Restoration

After fence installation, the site shall be cleaned and trimmed and the ground restored to a neat and original condition existent prior to the fencing operations.

772.07.07 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

772.08 QUALITY ASSURANCE

772.08.01 Construction

The Contract Administrator may perform a spot visual inspection to determine conformance with the workmanship, design, and dimensional requirements of this specification.

Failure to conform to the specification may result in a partial or complete inspection of the installation and removal and replacement of all defective workmanship or materials.

772.08.02 Material Certification

Certificates of compliance for each fence component used in the installation shall be provided to the Contract Administrator. The certificate of compliance shall indicate that the material was manufactured, sampled, tested, and inspected in accordance with the reference specification and has been found to meet the requirements.

Each certificate of compliance shall include the following information typed on company letterhead:

- a) Manufacturer's name or trademark.
- b) General description of the component.
- c) Reference specification for material (e.g., CGSB 138.1 Fence Fabric for Chain-Link Fence).
- d) Signed and dated by the manufacturer's authorized representative.

All certificates of compliance shall be assembled and submitted to the Contract Administrator prior to completion of the Work.

772.08.03 Material Sampling

The Contract Administrator may obtain and test samples to ensure compliance with the specifications. Products represented by the test samples that are not in compliance shall be removed from the Work Area and replaced.

772.09 MEASUREMENT FOR PAYMENT

772.09.01 Actual Measurement

772.09.01.01 Chain-Link Fence

Measurement of chain-link fence shall be by length in metres along the contour of the ground for the actual length of fence installed and shall include gate openings.

772.09.01.02 Gates

For measurement purposes, a count shall be made of the number of gates installed, regardless of the size and type. Double gates shall be counted as one gate.

772.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

772.10 BASIS OF PAYMENT

**772.10.01 Chain-Link Fence - Item
Gates - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

772.10.02 Removals and Replacements

Costs associated with any required removals and replacements of defective workmanship or materials shall be the Contractor's responsibility at no cost to the Owner.

Appendix 772-A, November 2012 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Chain-link fence locations. (772.07.02.01)
- Locations of top rail or top wire to be used. (772.07.02.02.01)
- Barbed wire locations. (772.07.02.06)
- Gate locations, type, and size. (772.07.03)

The designer should consider the placement of the fence fabric in relation to the post when the fence is located between two roadways and when snow loading from ploughing operations could separate the fence fabric from the post, (e.g., freeway and service road).

When chain-link fence is located adjacent to a highway, a top rail represents a potential spearing hazard. The default installation method will be to install chain-link fence with top wire. For those installations where the chain-link fence will be installed in a non-roadside installation (e.g., park, recreation facility, storm water management facility, etc.), when, as a minimum, the chain-link fence is located beyond the clear zone, the designer may specify a top rail when desired. (772.07.02.02.01 and 772.07.02.04)

See MTO Roadside Safety Manual for additional information.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 972.101	Fence, Chain-Link, Component - Barbed Wire
OPSD 972.102	Fence, Chain-Link, Component - Gate
OPSD 972.130	Fence, Chain-Link, Installation - Roadway
OPSD 972.131	Fence, Chain-Link, Installation - Concrete Barrier
OPSD 972.132	Fence, Chain-Link, Details and Table



**CONSTRUCTION SPECIFICATION FOR
EXPANDED METAL ANTI-GLARE SCREEN**

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791-A	Commentary

791.01 SCOPE

This specification covers the requirements for the installation of expanded metal anti-glare screens on concrete barrier, steel beam guide rail, and chain-link fence.

791.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

791.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

791.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Canadian General Standards Board (CGSB)

138.2-96 Steel Framework for Chain Link Fence

CSA Standards

W59-13 Welded Steel Construction (Metal Arc Welding)

ASTM International

A 27/A 27M-13	Steel Castings, Carbon, for General Application
A 123/A 123M-13	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 153/A 153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 325-10	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
A 824-01 (2012)	Metallic-Coated Steel Marcellled Tension Wire for Use With Chain-Link Fence
A 1011/A 1011M-14	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
B 209-10	Aluminum and Aluminum-Alloy Sheet and Plate

791.05 MATERIALS**791.05.01 Mesh**

Steel mesh panels shall be fabricated from expanding quality hot rolled sheets according to ASTM A 1011M.

Aluminum mesh panels shall be fabricated from expanding utility grade 3003 H14 sheets or 1100 H14 rolls.

Mesh panels shall consist of regular 19 mm diamond shaped patterns formed by expanding 1.6 mm thick panels to provide panels 600 mm or 1,200 mm in width and a minimum of 2,400 mm plus one diamond width in length. The diamonds shall be according to the following:

- a) Width of diamond, centre to centre of strand shall be 22 mm.
- b) Length of diamond, centre to centre of strand shall be 50 mm.
- c) Width of strand shall be 5 mm.
- d) Cut-off angle shall be a minimum of 21 degrees.

Mesh panels installed on concrete barrier and steel beam guide rail shall be 600 mm in width.

Mesh panels installed on chain-link fence shall be 1,200 mm in width.

The size of the finished mesh panels shall not deviate more than 3 mm from the specified width and more than 12 mm from the specified length.

Mesh panels shall be levelled and wire brushed after the expanding operation.

Mesh panels fabricated from steel sheets shall be hot dip galvanized after fabrication to provide a mass of zinc coating not less than 610 g/m^2 of total surface.

791.05.02 Posts and Wire Fasteners

Posts shall be steel pipe and according to CAN/CGSB 138.2.

Posts installed on concrete barrier shall be fabricated with a welded steel base plate grade 300W, hot dip galvanized after fabrication according to ASTM A 123, and according to the Contract Documents. All welds shall be to a low hydrogen classification according to CSA W59. Manual electrodes shall be E7015, E7016, or E7018. All welds shall be continuous.

Wire fasteners for fastening the mesh panels to the line posts shall be made of aluminum, galvanized steel, or stainless steel.

791.05.03 Top Wires, Bottom Wires, Diagonal Brace Wires, and Tie Wires

Top wires, bottom wires, and diagonal brace wires shall be 4.5 mm diameter marcelled tension wire Type II according to ASTM A 824 with a minimum Class 5 galvanized coating.

Tie wires shall be 3.5 mm diameter aluminum or galvanized steel or 1.0 mm diameter stainless steel wire. Tie wires shall be made with the same type of material as the mesh panels or stainless steel.

791.05.04 Miscellaneous Hardware

Washers, nuts, and bolts shall be according to ASTM A 325. All hardware shall be galvanized according to ASTM A 153 and to provide a mass of zinc coating of not less than 305 g/m² of total surface.

Metal discs used to fasten mesh panels to the chain-link fence fabric shall be fabricated from 1.6 mm thick steel and hot dip galvanized after fabrication to provide a mass of zinc coating of not less than 610 g/m² of the total surface.

791.05.05 Post Caps

All posts shall be fitted with waterproof metal caps according to ASTM F 626 and in a colour matching the posts. Post caps shall be designed to fit and fasten securely over the posts. All line post caps shall carry the top wire as specified in the Contract Documents.

791.05.06 Turnbuckles

Turnbuckles shall be drop forged steel according to ASTM A 27 and shall be galvanized according to ASTM A 153.

The average overall length shall be approximately 300 mm with ends in the closed position. Bolt diameter shall be approximately 10 mm and capable of taking up a minimum of 150 mm slack.

791.07 CONSTRUCTION

791.07.01 General

Expanded metal anti-glare screens shall be installed at locations specified in the Contract Documents. Mesh panels shall be oriented as specified in the Contract Documents.

791.07.02 Expanded Metal Anti-Glare Screens on Concrete Barrier

Mesh panels and posts shall be fastened to the concrete barrier as specified in the Contract Documents.

791.07.03 Expanded Metal Anti-Glare Screens on Steel Beam Guide Rail

Tops of guide rail posts shall be cut to accommodate the mesh panels as specified in the Contract Documents. Exposed surfaces of the guide rail posts shall be field treated with two applications of a preservative compatible with that used for the pressure treatment of the post.

791.07.04 Expanded Metal Anti-Glare Screens on Chain-Link Fence

Mesh panels shall be fastened to the chain-link fence as specified in the Contract Documents.

791.07.05 Marking

Identification plates, provided by the material supplier, shall be securely attached to the completed expanded metal anti-glare screen installation at the following intervals:

- a) At the start and end of each expanded metal anti-glare screen installation.
- b) At a maximum interval of 300 m.

The expanded metal anti-glare screen identification plate shall be located within 300 mm of a terminal post with the top of the plate located approximately 300 mm from the top of the expanded metal anti-glare screen. The maximum dimensions of the plate shall be 200 by 200 mm. The plate shall be made from 0.81 mm thick anodized aluminum sheet according to ASTM B 209 series 1100 or 5005-H34.

Each expanded metal anti-glare screen identification plate shall be engraved with the following information:

- a) Contract number.
- b) Name or trademark of anti-glare screen Subcontractor.
- c) Name or trademark of anti-glare screen supplier (i.e., suppliers) of expanded metal anti-glare screen and posts).
- d) Date of completed installation (i.e., yyyy-mm).

The height of the letters and numerals shall be within the range of 6 to 32 mm.

791.07.06 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

791.08 QUALITY ASSURANCE

791.08.01 Construction

The Contract Administrator may perform a spot visual inspection to determine conformance with the workmanship, design, and dimensional requirements of this specification.

Failure to conform to the specifications may result in a partial or complete inspection of the installation and removal and replacement of all defective workmanship or materials.

791.09 MEASUREMENT FOR PAYMENT

791.09.01 Actual Measurement

791.09.01.01 Expanded Metal Anti-Glare Screen

Measurement of expanded metal anti-glare screen shall be by length in metres along the length of concrete barrier, steel beam guide rail, or chain-link fence for the actual length of screen installed.

791.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

791.10 BASIS OF PAYMENT

791.10.01 Expanded Metal Anti-Glare Screen - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 791-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Locations of expanded metal anti-glare screens. (791.07.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 991.130	Expanded Metal Anti-Glare Screen, Installation - Concrete Barrier
OPSD 991.131	Expanded Metal Anti-Glare Screen, Installation - Steel Beam Guide Rail with Wooden Post
OPSD 991.132	Expanded Metal Anti-Glare Screen, Installation - Chain-Link Fence



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS 801
NOVEMBER 2010**
(Formerly OPSS 565, November 2007)

**CONSTRUCTION SPECIFICATION FOR
THE PROTECTION OF TREES**

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801.07	CONSTRUCTION
801.08	QUALITY ASSURANCE - Not Used
801.09	MEASUREMENT FOR PAYMENT
801.10	BASIS OF PAYMENT

APPENDICES

801-A	Commentary

801.01 SCOPE

This specification describes the measures required to protect trees not designated for removal.

801.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

801.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

801.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Barrier means a fence placed around a single tree or group of trees to protect them from removal and injury.

Dripline means the location on the ground surface directly beneath the theoretical vertical line from the tips of the outermost branches of the trees.

801.07 CONSTRUCTION

801.07.01 Operational Constraints

Trees not designated for removal shall not be damaged and shall be protected from flooding and sediment deposits from construction operations.

Equipment and vehicles shall not be operated within the dripline of trees not designated for removal unless specified in the Contract Documents. In such cases, operation of equipment shall be kept to the minimum necessary to perform the work required.

Equipment or vehicles shall not be parked, repaired, or fuelled within the dripline of any tree not designated for removal.

Construction materials and earth shall not be stockpiled within the dripline of any tree not designated for removal.

801.07.02 Barrier for Tree Protection

Barriers for tree protection shall be a minimum height of 1.2 m consisting of material approved by the Contract Administrator, supported by steel posts. The number of steel posts shall be enough to keep the material from sagging and the fence erect.

The barriers shall be erected at the dripline of trees or woodlot edges within the Working Area, prior to commencement of construction operations at locations specified in the Contract Documents. Where a clearance zone of 1.5 m cannot be established between the barrier at the dripline and the limit of grading, the barrier may be placed within the dripline, subject to the approval of the Contract Administrator. When the barrier is placed within the dripline,

- a) a minimum distance of 0.75 m shall be maintained between the trunk of the tree and the barrier, and
- b) a distance of 1.5 m shall be maintained between the barrier and the limit of grading.

When the trunks of trees are less than 4.5 m apart, the trees shall be considered a woodlot and the barrier shall be placed so it forms a continuous barricade around the woodlot as specified in the Contract Documents.

A barrier is not required where an existing fence serves the same purpose. At such locations, the barrier shall terminate at the existing fence so that a continuous barricade is provided between the trees and the area of work.

The barriers shall be maintained erect and in good repair throughout the duration of construction operations without breaks and unsupported sections and shall be removed upon completion of the work.

801.07.03 Tree Repair

Trees not designated for removal that are damaged by construction operations shall be repaired as follows, within 5 Days of the damage:

- a) Branches 25 mm or greater in diameter that are broken shall be cut back cleanly on the tree side of the break or to within 10 mm of their base, if a substantial portion of the branch is damaged.
- b) Roots 25 mm or larger in diameter that are exposed shall be cut back cleanly to the soil surface.
- c) Bark that is damaged shall be neatly trimmed back to uninjured bark without causing further injury to the tree.

801.07.04 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

801.09 MEASUREMENT FOR PAYMENT

801.09.01 Actual Measurement

801.09.01.01 Barrier for Tree Protection

Measurement shall be in linear metres measured along the length of the barrier. Overlaps shall not be measured.

801.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

801.10**BASIS FOR PAYMENT****801.10.01****Barrier for Tree Protection - Item**

Payment at the Contract price for the above item shall be full compensation for all labour, Equipment, and Material required to do the work.

Progress payments shall be based on the following percentage of the Contract price:

- 60% for supply and erection
- 25% for maintenance
- 15% for removal

When there is not a separate item for Barrier for Tree Protection, payment at the Contract price for the applicable tender items of the Contract that necessitate the placing of barriers for tree protection shall include full compensation for all labour, Equipment, and Material to do the work of protecting and repairing trees not designated for removal.

Appendix 801-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Locations of barriers for tree protection at trees or woodlot edges. (801.07.02)

The designer should determine the following are required and, if so, the requirements should be included in the Contract Documents:

- The need to operate equipment and vehicles within the dripline of trees not designated for removal. (801.07.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 220.010 Barrier for Tree Protection



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS 802
NOVEMBER 2010**
(Formerly OPSS 570, November 2007)

**CONSTRUCTION SPECIFICATION FOR
TOPSOIL**

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802.05	MATERIALS
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802.08	QUALITY ASSURANCE - Not Used
802.09	MEASUREMENT FOR PAYMENT
802.10	BASIS OF PAYMENT

APPENDICES

802-A	Commentary

802.01 SCOPE

This specification covers the requirements for stockpiling, supplying, and placing topsoil.

802.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

802.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

802.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206 Grading

802.05 MATERIALS

802.05.01 Topsoil

Topsoil shall be a fertile loam material that is free of roots, vegetation, or other debris of a size and quantity that prevents proper placement of the topsoil. The topsoil shall not contain material greater than 25 mm in size, such as stones and clods.

Imported topsoil shall not have contaminants that adversely affect plant growth.

Soil from swamps or muskeg areas may be used in place of topsoil, when approved by the Contract Administrator.

802.07 CONSTRUCTION

802.07.01 Stockpiling Topsoil

Topsoil shall be removed, stockpiled, and managed according to the Contract Documents. Stockpiles shall be constructed neatly with uniform surfaces. When required, the top surface shall be dished.

802.07.02 Preparation for Topsoil

Areas where topsoil is to be placed shall be fine graded to a uniform surface according to OPSS 206. The surface shall be loosened to a depth of 25 mm. It shall be free of all vegetation, debris, and stones which would not be covered by the depth of topsoil specified in the Placement of Topsoil subsection.

These areas shall be maintained in the condition described above until the topsoil is placed.

802.07.03 Placement of Topsoil

Topsoil shall be placed to a uniform depth of 50 mm on areas specified in the Contract Documents and up to the subgrade elevation on the roadway front slope.

Soil from swamps or muskeg areas, when used in place of topsoil, shall be placed according to the Contract Documents to a uniform depth of 75 mm, with no woody material protruding more than 50 mm above the surface.

802.07.04 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

802.09 MEASUREMENT FOR PAYMENT

802.09.01 Actual Measurement

802.09.01.01 Topsoil from Stockpiles

Measurement shall be by volume in cubic metres of topsoil placed from a stockpile.

802.09.01.02 Topsoil, Imported

Measurement shall be by volume in cubic metres of topsoil imported and placed.

802.10 BASIS OF PAYMENT

802.10.01 Preparation for Topsoil - Item

Payment at the Contract price for the above item shall be full compensation for all labour, Equipment, and Material to do the work.

Payment for this item shall be on surfaces graded under a previous Contract that require preparation for topsoil.

There is no payment for this item on surfaces constructed on this Contract.

802.10.02 Topsoil from Stockpiles - Item

Payment at the Contract price for the above item shall be full compensation for all labour, Equipment, and Material to do the work.

802.10.03 Topsoil, Imported - Item

Payment at the Contract price for the above item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 802-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Topsoil removal and stockpiling areas. (802.07.01)
- Topsoil placement areas. (802.07.03)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR SODDING

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803.07	CONSTRUCTION
803.08	QUALITY ASSURANCE
803.09	MEASUREMENT FOR PAYMENT
803.10	BASIS OF PAYMENT

APPENDICES

803-A	Commentary

803.01 SCOPE

This specification covers the requirements for sodding.

803.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

803.01.02

Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

803.02

REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 802 Topsoil

Nursery Sod Growers Association of Ontario

Specifications, Classifications and Use of Turfgrass Sod for Ontario

Federal Statute

Fertilizers Act (R.S., 1985, c. F-10)

803.05 MATERIALS

803.05.01 Sod

Sod shall be a Commercial Grade Turfgrass Nursery Sod, either Kentucky Bluegrass or Kentucky Bluegrass/Fine Fescue as specified in the Contract Documents and according to the Specifications, Classifications and Use of Turfgrass Sod for Ontario.

Sod shall be seeded and established in nursery sod fields as a turfgrass sod. Sod shall be uniform in texture, and in good healthy condition with no sign of decay. There shall be no more than 5 broadleaf weeds per 40 m² of sod and up to 20% non-specified grass seed. Sod shall be of sufficient density that no surface soil is visible. The grass height shall be 30 mm minimum and 70 mm maximum.

The soil portion of the sod shall be a good mineral type soil with a thickness of 10 mm minimum and 15 mm maximum. Each sod piece shall be well permeated with roots. Individual sod pieces shall be in such condition so that each may be lifted, rolled, transported, and placed without breaking or tearing and without loss of soil under normal handling conditions.

Sod shall contain sufficient moisture to maintain its vitality during transportation and placement.

803.05.02 Stakes

Stakes for fastening sod to the earth grade shall be a minimum 150 mm in length.

803.05.03 Fertilizer

Fertilizer shall be according to the Canada Fertilizers Act. Fertilizer shall be supplied in bags bearing the manufacturer's label indicating net weight and guaranteed analysis.

Fertilizer shall be in granular form, dry, free flowing without lumps. Fertilizer shall be supplied with a minimum analysis of 16% nitrogen, 3% phosphorus, and 15% potash. The guaranteed analysis ratio shall be 3-1-2.

The total nitrogen component of the fertilizer shall be a minimum 30% water insoluble nitrogen (controlled, slow release nitrogen) by weight.

803.05.04 Water

Water shall not have contaminants or impurities that would adversely affect the germination and growth of vegetation.

803.07 CONSTRUCTION

803.07.01 Operational Constraints

Sodding shall not commence until the surface preparation has been approved in writing by the Contract Administrator.

Sodding shall commence within 7 Days of surface preparation.

The Contractor shall maintain the surface and control erosion until the sod is in place.

Sod shall not be placed when in a frozen condition, under adverse field conditions such as high wind, frozen soil or soil covered with snow, ice, or standing water.

803.07.02 Surface Preparation for Sodding

Where topsoil is specified, it shall be according to OPSS 802.

At the time of sodding, all surface areas designated for sodding shall be free of erosion and shall have a fine graded uniform surface. The surface shall be uniformly cultivated to a minimum depth of 50 mm and shall not have surface materials greater than 25 mm in size, such as stones and clods and weeds or other unwanted vegetation.

Surface litter and debris shall be removed immediately prior to sod placement.

803.07.03 Fertilizer Application

Fertilizer shall be applied uniformly to the surface area designated for sodding, a maximum of 48 hours prior to sod placement, at the rate specified on its bag by the manufacturer.

803.07.04 Placement of Sod

Sod shall be placed in locations and as specified in the Contract Documents. Voids shall not be left between the soil portion of the sod and the underlying ground surface. Sod shall be securely placed lengthwise across the face of slopes and parallel to the centreline of ditches. End joints of adjacent sod pieces shall be staggered. The edges of adjacent sod pieces shall be placed tightly against one another without overlapping. Sod shall be countersunk to existing grade level at all edges. Joints shall be tamped to a uniform surface. Sod shall be placed up to the subgrade elevation on the roadway front slope. Where required, sod should be staked to the grade to avoid movement.

Sod shall not be separated from its mineral soil base and not damaged during transportation, handling, and placement.

803.07.05 Maintenance of Completed Sodding

Sod shall be maintained for 30 Days following completion of placement. During this period, the placed sod shall be kept healthy, actively growing, and green in leaf colour. This requirement shall be suspended during the winter dormant period shown in Table 1.

803.07.06 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

803.08 QUALITY ASSURANCE

803.08.01 Performance Measure

At the end of the 30-Day maintenance period, the Contract Administrator shall make an inspection of all placed sod. The condition of the sod shall be as specified in the Maintenance of Completed Sodding subsection. The sod shall be in the same location as originally placed and shall not have moved, eroded, slipped, or sloughed. Sod shall show evidence of rooting into the underlying soil. The sod shall be of sufficient density that no surface soil is visible and there shall be no competitive growth, beyond that specified in the Sod subsection, emerging from the sod or from between the sod joints.

803.08.02 Acceptance

When the work does not meet the requirements specified herein, the Contract Administrator shall notify the Contractor in writing, and the Contractor shall re-apply the specified materials according to this specification within 14 Days of receiving the notification.

The Contractor shall maintain the site and control erosion as specified in this specification until the sod has been replaced.

Replaced sod shall be subject to the requirements specified herein and to a further maintenance period of 30 Days.

803.09 MEASUREMENT FOR PAYMENT

803.09.01 Actual Measurement

803.09.01.01 Sod

Measurement shall be by area in square metres following the contours of the ground.

803.09.01.02 Plan Quantity Payment

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

803.10 BASIS OF PAYMENT

803.10.01 Sod - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

TABLE 1
Winter Dormant Period

SOUTHWESTERN ONTARIO	SOUTHERN ONTARIO	NORTHERN ONTARIO
That area of Ontario south of a line joining Grand Bend and Clarkson	That area of Ontario between the northern and southern boundaries of Southwestern Ontario and Northern Ontario respectively	That area of Ontario north of a line joining Waubauskene, Severn Bridge, Bancroft and Ottawa
Nov 15 to April 15 inclusive	Nov 1 to April 30 inclusive	Oct 15 to May 15 inclusive

Appendix 803-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- The use of either Kentucky Bluegrass sod or a Kentucky Bluegrass/Fine Fescue sod. (803.05.01)
- Location of sod. (803.07.04)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

None



NOTICE TO USERS OF OPSS 804

CONSTRUCTION SPECIFICATION FOR SEED AND COVER

OPSS 804 has been removed from this
OPS volume

The provincial version of OPSS 804 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 804

The municipal version of OPSS 804 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 804

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



CONSTRUCTION SPECIFICATION FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES

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805.08	QUALITY ASSURANCE - Not Used
805.09	MEASUREMENT FOR PAYMENT
805.10	BASIS OF PAYMENT

APPENDICES

805-A	Commentary

805.01 SCOPE

This specification describes the requirements for the installation, maintenance, and removal of temporary erosion and sediment control measures.

805.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

805.01.02

Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

805.02

REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 518	Control of Water from Dewatering Operations
OPSS 804	Seed and Cover

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1801	Corrugated Steel Pipe Products
OPSS 1840	Non-Pressure Polyethylene Plastic Pipe Products
OPSS 1860	Geotextiles

Canadian and Provincial Statutes

Ontario Water Resources Act, R.S.O. 1990, c. 0.40

Canadian General Standards Board (CGSB)

148.1 No 7.3-92	Methods of Testing Geosynthetics and Geomembranes - Grab Tensile Test for Geotextiles
148.1 No 10-94	Methods of Testing Geosynthetics - Geotextiles - Filtration Opening Size

805.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Diversion Ditch means a temporary channel to intercept and convey overland flow away from areas of disturbed or erodible soil and to minimize erosion of slopes from sheet flow.

Earth means as defined in OPSS 206.

Erosion means the physical removal or detachment of soil particles from an earth surface, followed by the transport of detached particles to another location by the action of a mobile agent including rain, flowing water, wind, equipment and vehicles.

Fibre Roll means an assembled or commercially available flexible, tubular structure that provides sediment control and may provide run-off filtration and includes wattles, filter socks and filter berms.

High Water Level means the highest point on the bank or floodplain of a waterbody where the water level reaches during high flow events or periods.

Riparian Vegetation means vegetation within 30 m of a waterbody.

Sediment means soil particles detached from an earth surface by erosion.

Waterbody means any permanent or intermittent, natural or constructed body of water including lakes, ponds, wetlands and watercourses, but does not include sewage works as defined in the Ontario Water Resources Act.

Waterbody Bank means the slope on or adjacent to a waterbody from the normal water level to the top of slope.

Watercourse means a stream, creek, river, or channel including ditches, in which the flow of water is permanent, intermittent, or temporary.

805.05 MATERIALS

805.05.01 Straw and Straw Bales

Straw shall be either wheat or oat straw.

Straw bales shall be dry and firm, be tied tightly in at least two places, show no evidence of straw or tie decay, and be free of sediment. They shall be of agricultural, rectangular formation and dimensions, as specified in the Contract Documents.

805.05.02 Geosynthetics

805.05.02.01 Geotextile

Geotextile shall be free of holes, tears, and punctures.

805.05.02.02 Silt Fence Geotextile

Geotextile for silt fence shall be according to OPSS 1860, Table 3.

Geotextile for silt fence may be separate from the stakes used to install it as a sediment barrier.

805.05.02.03 Berm Barrier and Rock Flow Check Dam Geotextile

Geotextile for berm barriers and rock flow check dams shall be a woven, Class II geotextile according to OPSS 1860. The filtration opening size (FOS) shall be no greater than 300 µm.

805.05.02.04 Turbidity Curtain Geosynthetic

Turbidity curtain geosynthetics shall have a grab tensile strength of at least 990 N, meeting CAN/CGSB 148.1, No. 7.3 and be one of geotextile or geomembrane.

Geotextile shall be a woven material. The filtration opening size (FOS) shall be no greater than 300 µm, meeting CAN/CGSB 148.1, No. 10.

Geomembrane shall be a low-permeability synthetic material or a geotextile impregnated with elastomeric spray.

805.05.02.05 Filter Bags

Geotextile for filter bags shall be non-woven, polypropylene, Class I according to Table 1 of OPSS 1860 unless otherwise specified in the Contract Documents.

805.05.03 Plastic Sheeting

Plastic sheeting used to wrap berm barriers or other sediment control measures shall be 6 mm polyethylene of maximum available width.

805.05.04 Stakes

Stakes shall be of sufficient strength and length to satisfy control measure installation, performance and maintenance requirements.

805.05.05 Control Measure Support

Control measure support for heavy-duty silt fence barrier shall be a separate product or one bonded to silt fence geotextile and be either plastic snow fence mesh, 0.81 mm diameter galvanized wire mesh or 1.63 mm diameter galvanized steel fence with a 5 cm by 10 cm weave and a 0.91 m height.

When a heavy-duty silt fence barrier is installed using a product manufactured with the control measure support bonded to the geotextile it shall be installed with the geotextile on the upstream side or front of the control measure support.

805.05.05.01 Posts

Posts to support heavy duty wire-backed silt fence barriers shall be metal T-posts. Metal ties shall be used to secure the silt fence to the metal T-posts.

805.05.06 Berm Barriers

Berm barriers shall be constructed using earth, sand, gravel, brush or compost.

805.05.07 Sandbags

Sandbags shall be made from heavy gauge plastic, agricultural burlap, or silt fence geotextile. Heavy gauge plastic shall contain stabilizers or inhibitors resistant to deterioration by ultraviolet radiation. Sandbags shall be filled with clean sand, 19 mm gravel or 6 mm pea gravel, containing no silt or clay.

805.05.08 Fibre Rolls

Fibre rolls shall be of a consistent internal thickness with even fibre distribution throughout the roll.

Fibre rolls shall be covered on the outside with an open-weave, biodegradable and photodegradable mesh or netting that securely contains the fibres within the rolls.

Fibre rolls shall be filled with 100% organic, biodegradable material such as shredded straw, wood fibres or compost and may contain seed.

805.05.09 Turbidity Curtain Hardware

805.05.09.01 Floatation

Turbidity curtain floatation shall be a material that has sufficient buoyancy to provide the curtain with continuous support, and a minimum of freeboard as specified in the Contract Documents.

805.05.09.02 Load Lines

Turbidity curtain load lines shall be 8 mm diameter steel cable or 19 mm diameter nylon or polypropylene rope.

805.05.09.03 Ballast

Turbidity curtain ballast shall be 8 mm steel chain.

805.05.09.04 Anchors

Turbidity curtain anchors shall be mushroom or kedge anchors with a minimum mass of 34 kg for firm mud bottoms or self-burying anchors with a minimum mass of 5 kg for sandy bottoms.

805.05.09.05 Mooring Buoys

Turbidity curtain mooring buoys shall have provision for the mooring line to be securely attached and be sufficiently buoyant to remain afloat under normal load conditions.

805.05.09.06 Mooring Lines

Turbidity curtain mooring lines shall be 19 mm diameter nylon or polypropylene rope.

805.05.09.07 Adjustment Lines

Turbidity curtain adjustment lines shall be 13 mm diameter nylon or polypropylene rope.

805.05.10 Rock

Rock for rock flow check dams shall be according to the requirements for rip-rap and gabion stone according to OPSS 1004.

805.05.11 Corrugated Pipe

Corrugated pipe slope drains shall be non-perforated, corrugated steel pipe according to OPSS 1801 or polyethylene plastic pipe according OPSS 1840. Pipe diameter shall be as specified in the Contract Documents.

805.05.12 End Sections

End sections for the inlet and outlet of slope drains shall be according to OPSS 1801, regardless of the material type of the pipe used.

805.05.13 Erosion Control Blankets

Erosion control blankets for diversion ditches shall be as specified in OPSS 804.

805.07 CONSTRUCTION

805.07.01 Operational Constraints

805.07.01.01 Retention of Riparian Vegetation

The area over which vegetation is removed on site shall affect no more than one third (1/3) of the total woody vegetation in the right-of-way within 30 m of the high water level of any waterbody unless otherwise specified in the Contract Documents.

805.07.01.02 Protection of Stockpiled Materials

All stockpiles of erodible construction materials and excess or surplus materials shall be protected from erosion and sediment transport within 48 hours of being built unless otherwise specified in the Contract Documents.

805.07.01.03 Dewatering

Dewatering effluent shall be controlled to prevent passage of sediment into waterbodies and other sensitive environmental features as specified in the Contract Documents or onto adjacent properties. Discharge of dewatering effluent to sediment traps for dewatering shall be controlled to avoid exceeding trap capacity and to prevent scour and washout.

Discharge of water from sediment traps for dewatering shall be according to OPSS 518.

805.07.01.04 Slope Drains

When slope drains are specified in the Contract Documents, the slope drain and associated berm barrier shall be constructed in the same day.

805.07.01.05 Turbidity Curtains and Cofferdams

Equipment shall not be operated in a waterbody outside a turbidity curtain or cofferdam other than hand held equipment or boats.

805.07.01.06 Construction and Removal of Measures

The construction and removal times for temporary erosion and sediment control measures shall be as specified in the Contract Documents.

805.07.02 Light-Duty Sediment Barriers, General

Light-duty sediment barriers are light-duty straw bale barriers, light-duty silt fence barriers, or light duty fibre roll barriers.

Light-duty sediment barriers shall be constructed as specified in the Contract Documents.

Light-duty sediment barriers shall not be installed in or across waterbodies.

When the Light-Duty Sediment Barriers item is specified in the Contract Documents, any light-duty sediment barriers may be used. When a specific light-duty sediment barrier is specified in the Contract Documents, there shall be no option of substitution for the control measure.

Light-duty sediment barriers shall include protection placed against the downslope side at the low points of the barrier so that any overflow of the barrier is prevented from causing soil scour and erosion.

805.07.02.01 Light-Duty Straw Bale Barriers

Light-duty straw bale barriers shall be constructed as specified in the Contract Documents.

When specified to be installed around catch basins, straw bales shall be placed completely around catch basins and ditch inlets without gaps. When a double row of straw bales is specified in the Contract Documents, the straw bales shall be placed such that the joints between the straw bales of each row are not in-line with the joints of the straw bales of the adjacent row.

Stakes securing the bales shall be driven through the bales without breaking the bale ties or otherwise disturbing bale firmness and shape.

Maintenance shall include the replacement of each bale at intervals not exceeding 45 Days.

805.07.02.02 Light-Duty Silt Fence Barriers

Light-duty silt fence barriers shall be constructed as specified in the Contract Documents.

Light-duty silt fence barriers shall not be used for perimeter control or property line delineation unless specified in the Contract Documents.

Light-duty silt fence barriers shall be installed within a trench excavated along the contour of the ground such that the elevation of the above ground portion of the fence is the same along its entire length except at the ends. Light-duty silt fence barriers shall be installed without breaks or gaps along their entire length. Light-duty silt fence barriers shall only be installed on flat ground with a minimum offset of 2 m from the toe of the slope being protected. When a longer sediment barrier is required, another light-duty silt fence barrier shall be installed as specified in the Contract Documents.

The geotextile shall be attached firmly, without sagging, to the upslope side of the stakes. Stakes shall be spaced to ensure the geotextile remains vertical. Where the geotextile is joined to provide a continuous run, the ends shall be overlapped a minimum of 500 mm and securely fastened to the stakes using cable ties or soft wire at the top of the geotextile only. The geotextile shall be angled upslope at the ends of each run in a "J" pattern and so that the ends are at a higher elevation than the bottom of the run.

When geotextile is supplied without stakes attached, the geotextile shall be installed into the trench in the ground first, the stakes shall be driven into the ground behind the geotextile, and the geotextile shall be attached to the upslope side of the stakes using cable ties or soft wire at the top of geotextile only.

805.07.02.03 Light-Duty Fibre Roll Barriers

Light-duty fibre roll barriers shall be sized and constructed as specified in the Contract Documents.

Light-duty fibre roll barriers shall be installed along the contour of the ground into trenches that have been excavated into the soil perpendicular to the slope face to a depth of approximately one half the roll diameter and width across the width of the slope.

Any rills and gullies shall be filled in where light-duty fibre roll barriers are to be installed. Light-duty fibre roll barriers shall only be installed on flat ground with a minimum offset of 2 m from the toe of the slope being protected. When a longer sediment barrier is required, another light-duty fibre roll barrier shall be installed tightly butted against the first one.

Light-duty fibre roll barriers shall be installed so that their base is in continuous contact with the underlying soil along their entire length without gaps and angled upslope at each end run in a "J" pattern. The ends of adjacent fibre roll segments shall be tightly butted against each other and shall not be overlapped vertically or horizontally.

A metal bar shall be used to make pilot holes perpendicular to the slope face through the centre of the fibre rolls as specified in the Contract Documents. Pilot holes shall also be made at the ends of each fibre roll segment angled towards the next abutting fibre roll to hold adjacent rolls together.

Wooden stakes shall be driven into the pilot holes as specified in the Contract Documents.

Soil excavated from the trenches shall be placed along the upslope side of the fibre rolls and compacted into the front of the trench to minimize possible undermining by runoff.

The soil on the upslope and downslope sides of the fibre rolls shall be seeded according to OPSS 804.

805.07.03 Heavy-Duty Sediment Barriers, General

Heavy-duty sediment barriers are heavy-duty silt fence barriers, heavy-duty wire-backed silt fence barriers, berm barriers, or sandbag barriers.

Heavy-duty sediment barriers shall be constructed as specified in the Contract Documents, without gaps and without undermining to prevent sediment passage through, under, or around the barrier.

When heavy-duty sediment barriers are specified in the Contract Documents, the Contractor has the option to select any of the heavy-duty sediment barriers or any combination of them. When a specific heavy-duty sediment barrier is specified in the Contract Documents, there shall be no option of substitution for the control measure.

Heavy-duty silt fence barriers shall include control measure support placed against the downstream side at the low points of the barrier so that any overflow of the barrier is prevented from causing soil scour and erosion.

805.07.03.01 Heavy-Duty Silt Fence Barriers

Heavy-duty silt fence barriers shall be constructed as specified in the Contract Documents.

Heavy-duty silt fence barriers shall not be used for perimeter control or property line delineation unless specified in the Contract Documents.

Heavy-duty silt fence barriers shall be installed within a trench excavated along the contour of the ground such that the elevation of the bottom of the fence is the same along its entire length except at the ends. Heavy-duty silt fence barriers shall be installed without breaks or gaps along their entire length. Heavy-duty silt fence barriers shall only be installed on flat ground with a minimum offset of 2 m from the toe of

the slope being protected. When a longer sediment barrier is required, another heavy-duty silt fence barrier shall be installed as specified in the Contract Documents.

The geotextile shall be attached firmly to the upstream side of the control measure support and the stakes. Stakes shall be spaced to ensure the geotextile and the control measure support remains vertical. Where the geotextile or the control measure support is joined to itself to provide a continuous run, the ends shall be overlapped a minimum of 500 mm and securely fastened to stakes using wire ties at the top of the geotextile or the control measure support only. The geotextile and control measure support shall be angled upslope at the ends of each run in a "J" pattern and so that the ends are at a higher elevation than the bottom of the run.

When geotextile is supplied without the control measure support or stakes attached, the control measure support shall be installed into the trench in the ground first, the geotextile shall be installed into the trench on the upslope side of the control measures support, the stakes shall be driven into the ground behind the geotextile and the control measure support, and the geotextile and control measure support shall be attached to the stakes using wire ties at the top of the geotextile and control measure support and only.

805.07.03.02 Heavy-Duty Wire-Backed Silt Fence Barriers

Heavy-duty wire-backed silt fence barriers shall be constructed as specified in the Contract Documents.

Heavy-duty wire-backed silt fence barriers shall not be used for perimeter control or property line delineation unless specified in the Contract Documents.

Heavy-duty wire-backed silt fence barriers shall be installed in a trench excavated along the contour of the ground such that the elevation of the bottom of the fence is the same along its entire length except at the ends. Heavy-duty wire-backed silt fence shall be installed without breaks or gaps along their entire length. Heavy-duty wire-backed silt fence barriers shall only be installed on flat ground with a minimum offset of 2 m from the toe of the slope being protected. When a longer sediment barrier is required, another heavy-duty wire-backed silt fence barrier shall be installed as specified in the Contract Documents.

The wire control measure support shall be installed into the trench in the ground. The geotextile shall be installed into the trench on the upslope side of the wire control measure support. T-posts shall be installed into the ground behind the geotextile and wire control measure support and spaced to ensure the geotextile and wire control measure support remain vertical. The geotextile and the wire control measure support shall be attached securely to the T-posts using wire ties at the top of the geotextile and wire control measure support only. Where the geotextile or the wire control measure support is joined to itself to provide a continuous run, the ends shall be overlapped a minimum of 500 mm and securely fastened to T-posts using wire ties at the top of the geotextile or wire control measure support only. The geotextile wire control measure support shall be angled upslope at the ends of each run in a "J" pattern and so that the ends are at a higher elevation than the bottom of the run.

805.07.03.03 Berm Barriers

Berm barriers shall be constructed and wrapped in geotextile or plastic sheeting as specified in the Contract Documents. The geotextile or plastic sheeting shall be secured to the ground.

805.07.03.04 Sandbag Barriers

Sandbags shall be securely tied at the top.

Sandbag barriers shall be constructed as specified in the Contract Documents

Sandbags within each row shall be placed with the sides of the bags butted tightly against one another without gaps. The ends of sandbags in adjacent rows shall be butted tightly against one another without gaps.

When sandbag barriers are constructed on earth surfaces, the trench into which the sandbags are placed shall be backfilled around the sandbags to existing grade and compacted.

When sandbag barriers are to be constructed on sod, erosion control blanket, existing turf, or bedrock, they shall be placed so there are no gaps between the sandbags and the underlying surface.

Sandbag barriers shall be maintained with undamaged bags that are firmly seated.

805.07.04 Fibre Roll Grade Breaks

Fibre roll grade breaks shall be constructed as specified in the Contract Documents.

Fibre rolls shall be installed horizontally starting from the toe of the slope and working up to the top of the slope. Any rills and gullies on the slope face shall be filled in as the fibre rolls are installed.

Fibre rolls shall be installed along the contour of the ground into trenches that have been excavated into the soil perpendicular to the slope face and width across the slope.

Fibre rolls shall be installed so that their base is in continuous contact with the underlying soil along their entire length without gaps and angled upslope at each end run in a "J" pattern. The ends of adjacent fibre roll segments shall be tightly butted up against each other and shall not be overlapped vertically or horizontally.

A metal bar shall be used to make pilot holes perpendicular to the slope face through the centre of the fibre rolls as specified in the Contract Documents. Pilot holes shall also be made at the ends of each fibre roll segment angled towards the next abutting fibre roll to hold adjacent rolls together.

Wooden stakes shall be driven into the pilot holes perpendicular to the slope face to secure the fibre rolls to the slope along their entire length. Additional stakes shall be driven into the fibre rolls along the downslope side at every grade change or if soils are very loose and uncompacted or the slope is steep.

Soil excavated from the trenches shall be placed along the upslope side of the fibre rolls and well compacted into the front of the trench to minimize possible undermining by runoff.

The soil on the upslope and downslope sides of the fibre rolls shall be seeded as specified in the Contract Documents.

805.07.05 Flow Check Dams - General

Flow check dams are straw bale flow check dams, fibre roll flow check dams, sandbag flow check dams, or rock flow check dams.

Flow check dams shall be constructed as specified in the Contract Documents such that the spillway level of the downstream flow check dam is the same as the base of the upstream flow check dam when they are specified in series. Flow check dams shall be constructed without gaps and without undermining to prevent sediment passage through, under, or around the flow check dam.

When the Flow Check Dams item is specified in the Contract Documents, any of the flow check dams or any combination of them may be used. When a specific flow check dam is specified in the Contract Documents, there shall be no option of substitution for the control measure.

Flow check dams shall include protection placed against the downstream side at the lowest point of the flow check dam so that any overflow of the flow check dam is prevented from causing soil scour and erosion.

805.07.05.01 Straw Bale Flow Check Dams

Straw bale flow check dams shall be constructed as specified in the Contract Documents and shall be replaced every 45 days.

805.07.05.02 Fibre Roll Flow Check Dams

Fibre roll flow check dams shall be constructed as specified in the Contract Documents.

805.07.05.03 Sandbag Flow Check Dams

Sandbag flow check dams shall be constructed as specified in the Contract Documents.

805.07.05.04 Rock Flow Check Dams

Rock flow check dams shall be constructed as specified in the Contract Documents.

805.07.06 Sediment Traps

Sediment traps shall be constructed as specified in the Contract Documents to prevent sediment passage from the upstream to the downstream side of the trap and so that the majority of the sediment is collected in the excavated basin.

Sediment traps shall be constructed as a single control measure consisting of an excavated basin and a rock flow check dam.

A temporary fence shall be erected around the sediment trap to restrict public access.

805.07.07 Slope Drains

Slope drains shall be constructed as specified in the Contract Documents.

Slope drains shall be constructed as a single control measure consisting of a corrugated pipe, two end sections including an inlet and an outlet, and a sediment trap constructed at the outlet end of the pipe.

The pipe inlet shall be placed through a berm barrier in such a manner that flow is directed to the pipe inlet without scouring of the berm. The toe plate of the inlet end section shall be fully imbedded into the ground surface.

Pipes shall be maintained in place without gaps and without undermining so that water is conveyed from the upstream side of the berm and collected in the sediment trap.

805.07.08 Diversion Ditches

Diversion ditches shall be constructed as specified in the Contract Documents.

When diversion ditches are specified to be lined with rolled erosion control blanket along their entire length it shall be according to OPSS 804.

Flow check dams shall be installed at regular intervals along the entire length of diversion ditches as specified in the Contract Documents.

Where diversion ditches are specified to be lined with rip-rap or granular it shall be according to OPSS 1004.

805.07.09 Sediment Traps for Dewatering

Sediment traps for dewatering shall be constructed as specified in the Contract Documents.

Sediment traps for dewatering shall be constructed a minimum of 30 m away from waterbodies or as far away as practicable from the top of the bank of any waterbody.

The shape of the excavated basin may be varied to suit the characteristics of the area surrounding it.

The sediment barrier and rock flow check dam shall be constructed as specified in the Contract Documents.

Construction of the sediment barrier shall be according to the requirements for light-duty sediment barriers with the following exceptions:

- a) End runs are not required.
- b) The rock flow check dam shall be located at the low point of the light-duty sediment barrier.

A temporary fence shall be erected around the sediment trap to restrict public access.

Discharge of water from sediment traps for dewatering shall be according to OPSS 518.

805.07.10 Filter Bags

Filter bags, hoses and pumps shall be sized appropriately to the volume as specified in the Contract Documents of water to be filtered. Bags shall have a FOS as specified in the Contract Documents.

Filter bags shall be situated in a vegetated area or placed on a permeable surface on a slight slope with the opening of the bag facing upslope a minimum of 30 m away from waterbodies or as far as practicable from the top of the bank of any waterbody.

The opening of the filter bag shall be securely attached with mechanical connections to the discharge hose using commercially available hose couplers and placed in the retention facility to be dewatered.

Discharge of water from filter bags shall be according to OPSS 518.

805.07.11 Turbidity Curtains

Turbidity curtains shall be constructed as specified in the Contract Documents. Turbidity curtains shall be free of tears and gaps, and the bottom edge of the curtain shall be continuously in contact with the waterbody bed so that sediment passage from the enclosed area is prevented.

Turbidity curtains shall be constructed according to the following:

- a) Breaks may be made in the lower sleeve to facilitate pulling of the ballast, provided they are a maximum 100 mm in size and spaced at minimum 3 m intervals.
- b) Where turbidity curtain geosynthetic is joined to provide a continuous run, the sections shall be connected to provide a continuous seal to prevent the escape of turbid water between the sections.
- c) The turbidity curtain shall be of sufficient width to account for water depth and wave action.

- d) The turbidity curtain shall be prepared for installation by furling and tying securely with furling ties every 1.5 m for the entire length of the curtain.
- e) Anchor locations shall be established as necessary to maintain the turbidity curtain in place and functioning.

The sequence of installation shall be according to the following:

- a) Tie-downs shall firmly anchor the turbidity curtain to the shoreline.
- b) One end of the furled curtain shall be firmly attached to the upstream tie-down.
- c) The furled curtain shall be launched and placed.
- d) The other end of the furled curtain shall be attached to the downstream tie-down.
- e) Each anchor shall be attached to the turbidity curtain load line with a mooring line.
- f) Mooring buoys shall be attached to the mooring line at a distance of 1 m from the load line to keep the turbidity curtain in place at locations where it changes direction.
- g) The furling ties shall be released to allow the turbidity curtain ballast to sink to its maximum depth.
- h) The location and depth of the ballast shall be adjusted as necessary using the adjustment lines.

Equipment is permitted in the working area enclosed by the turbidity curtain.

Folds in the turbidity curtain that form next to the floatation collar shall be regularly monitored and cleared of collected sediment.

805.07.12 Cofferdams

Cofferdams shall be constructed as specified in the Contract Documents to:

- a) Isolate the working area from the waterbody.
- b) Prevent the release of sediment and debris into the surrounding waterbody.

Equipment is permitted in the working area enclosed by the cofferdam.

805.07.13 Monitoring

All temporary erosion and sediment control measures shall be monitored to ensure they are in effective working order. Monitoring shall be once a week, at minimum, prior to any forecast rain event and following any rain event.

805.07.14 Maintenance

All temporary erosion and sediment control measures constructed under this specification shall be maintained in an effective, functioning, stable condition.

805.07.15 Sediment Removal

The work shall consist of the removal and management of accumulated sediment.

Sediment that is accumulated by the temporary erosion and sediment control measures shall be removed in a manner that avoids escape of the sediment to the downstream side of the control measure and avoids damage to the control measure. Sediment shall be removed to the level of the grade existing at the time the control measure was constructed and be according to the following:

- a) For light-duty sediment barriers and flow check dams, accumulated sediment shall be removed once it reaches the lesser of the following:
 - i. A depth of one-half the effective height of the control measure. For flow check dams, the effective height shall be determined relative to the lowest point of the flow check dam.
 - ii. A depth of 300 mm immediately upstream of the control measure.
- b) For heavy-duty sediment barriers, sediment traps, and sediment traps for dewatering, accumulated sediment shall be removed once it reaches one-half the effective height or depth of the control measure.
- c) For all control measures, accumulated sediment shall be removed as necessary to perform maintenance repairs.
- d) Accumulated sediment shall be removed immediately prior to the removal of the control measure.

805.07.16 Control Measure Removal

Ditch, permanent slope, and any other embankment cover specified elsewhere in the Contract Documents to be placed within the area controlled by the temporary erosion and sediment control measure shall be in place and established prior to the removal of such control measure.

Temporary erosion and sediment control measures shall be removed and associated excavations backfilled and compacted when the measures are no longer required.

Temporary erosion and sediment control measures shall be removed in a manner that:

- a) Prevents entry of equipment, other than hand-held equipment or boats, to any waterbody.
- b) Prevents release of sediment and debris to any waterbody.

Prior to removal of the in-water control measures, the area enclosed by turbidity curtains and cofferdams shall be cleaned of all debris. For cofferdams, accumulated sediment shall be removed prior to removal of the sediment control measure.

Any seeding and mulching, temporary cover, sod, other surface application, or original turf cover disturbed by removal or backfilling of erosion and sediment control measures and removal of accumulated sediment, shall be brought to final grade and restored as specified in the Contract Documents.

805.07.17 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

805.07.18 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be as specified in the Contract Documents.

805.09 MEASUREMENT FOR PAYMENT

805.09.01 Actual Measurement

805.09.01.01

- Light-Duty Sediment Barriers**
- Light-Duty Straw Bale Barriers**
- Light-Duty Silt Fence Barriers**
- Light-Duty Fibre Roll Barriers**
- Heavy-Duty Sediment Barriers**
- Heavy-Duty Silt Fence Barriers**
- Heavy-Duty Wire-Backed Silt Fence Barriers**
- Berm Barriers**
- Sandbag Barriers**
- Fibre Roll Grade Breaks**

Measurement shall be the length in lineal metres from end to end of the barrier constructed, maintained, and removed, following the contours of the ground.

805.09.01.02

- Flow Check Dams**
- Straw Bale Flow Check Dams**
- Fibre Roll Flow Check Dams**
- Sandbag Flow Check Dams**
- Rock Flow Check Dams**

For measurement purposes, a count shall be made of the flow check dams constructed, maintained, and removed.

805.09.01.03

- Sediment Traps**
- Slope Drains**
- Diversion Ditches**
- Sediment Traps for Dewatering**
- Filter Bags**

For measurement purposes, a count shall be made of the number of sediment traps, slope drains, diversion ditches, sediment traps for dewatering and filter bags constructed or installed, maintained, and removed. Component parts shall not be counted separately for payment.

805.09.01.04 Turbidity Curtains

Measurement of turbidity curtain shall be made in lineal metres along its length from end to end between tie-downs for each turbidity curtain installed, maintained, and removed.

805.09.01.05 Cofferdams

For measurement purposes, a count shall be made of the number of cofferdams constructed, maintained, and removed.

805.09.01.06 Sediment Removal

Measurement shall be as specified in the Contract Documents by the volume of sediment excavated in cubic meters or by the number of hours required for excavation of sediment.

805.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

805.10**BASIS OF PAYMENT****805.10.01**

Light-Duty Sediment Barriers - Item
Light-Duty Straw Bale Barriers - Item
Light-Duty Silt Fence Barriers – Item
Light-Duty Fibre Roll Barriers - Item
Heavy-Duty Sediment Barriers - Item
Heavy-Duty Silt Fence Barriers – Item
Heavy-Duty Wire-Backed Silt Fence Barriers – Item
Berm Barriers - Item
Sandbag Barriers - Item
Fibre Roll Grade Breaks – Item
Flow Check Dams - Item
Straw Bale Flow Check Dams - Item
Fibre Roll Flow Check Dams - Item
Sandbag Flow Check Dams - Item
Rock Flow Check Dams – Item
Sediment Traps - Item
Slope Drains – Item
Diversion Ditches - Item
Sediment Traps for Dewatering – Item
Filter Bags - Item
Turbidity Curtains - Item
Cofferdams - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material required to do the work.

Progress payments for the temporary erosion and sediment control measures shall be made as follows:

- a) 30% for initial construction.
- b) 50% for maintenance.
- c) 20% for removal.

805.10.02**Sediment Removal - Item**

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

When the Contract Documents do not have a separate item for sediment removal, payment at the Contract price for the appropriate tender item for the installation of the sediment control measures shall be full compensation for all labour, Material, and Equipment to do the work of sediment removal.

Appendix 805-A, November 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Installation and removal times for temporary erosion and sediment control measures. (805.07.01.06)
- Grading requirements for control measure removal. (805.07.16)
- Sediment removal measurement for payment. (805.09.01.06)

The designer should determine the need for barrier installation. The desirable slope grade is maximum 5%. (805.07.02 and 805.07.03)

The designer should determine the following and, if they are required, the requirements should be included in the Contract Documents:

- Sensitive environmental features. (805.07.01.03)
- The need for a specific light-duty sediment barrier. Where the light-duty sediment barrier is to be built using fibre rolls, the diameter of the fibre rolls to be used and whether and how they may be stacked vertically. (805.07.02)
- The type of seed mix to be applied to the upslope and downslope sides of fibre roll grade breaks. (805.07.02.03)
- The need for a specific heavy-duty sediment barrier. Where the heavy-duty sediment barrier is to be built using fibre rolls, the diameter of the fibre rolls to be used and whether and how they may be stacked vertically. (805.07.03)
- The need for wire backing for a heavy-duty silt fence barrier. (805.07.03.02)
- The need for fibre roll grade breaks and the number, diameter and spacing of fibre rolls required. (805.07.04)
- The need for a specific flow check dam, the number of flow check dams in series required and the spacing of the flow check dams. (805.07.05)
- The need for a sediment trap(s). When a sediment trap is to be constructed in a ditch the outside edge shall be sized to extend beyond the base of the ditch. (805.07.06)
- The need for a slope drain(s). (805.07.07)

Identify the need for a diversion ditch(s). Design dimensions and direction of flow along contour of ground. Outlet details including scour protection and sediment control. The need for, type and number of flow check dam(s), and type of erosion control lining. (805.07.08)

- The need for a sediment trap(s) for dewatering. Ensure that sediment traps for dewatering are sized appropriately for the catchment area and that there is enough space available to construct them. (805.07.09)
- The need for filter bags, and the type, Class and filtration opening size (FOS) of geotextile to be used. (805.07.10)
- Appropriate volume of water to be filtered. (805.07.10)
- The need for a turbidity curtain(s). (805.07.11)
- The need for and design of a cofferdam(s). (805.07.12)
- Whether sediment removal is to be measured by volume or time. (805.09.01.06)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 219.100	Light-Duty Straw Bale Barrier
OPSD 219.110	Light-Duty Silt Fence Barrier
OPSD 219.120	Light-Duty Fibre Roll Barrier
OPSD 219.130	Heavy-Duty Silt Fence Barrier
OPSD 219.131	Heavy-Duty Wire-Backed Silt Fence Barrier
OPSD 219.150	Sandbag Barrier
OPSD 219.160	Fibre Roll Grade Breaks
OPSD 219.180	Straw Bale Flow Check Dam
OPSD 219.191	Fibre Roll Flow Check Dam
OPSD 219.200	Sandbag Flow Check Dam
OPSD 219.210	Temporary Rock Flow Check Dam V-Ditch
OPSD 219.211	Temporary Rock Flow Check Dam Flat Bottom Ditch
OPSD 219.220	Sediment Trap In Ditch
OPSD 219.230	Temporary Slope Drain For Sediment Trap
OPSD 219.231	Temporary Berm Barrier
OPSD 219.240	Sediment Trap for Dewatering
OPSD 219.260	Turbidity Curtain
OPSD 219.261	Turbidity Curtain Seam Detail



CONSTRUCTION SPECIFICATION FOR ROOTWAD STRUCTURES FOR WATERBODY BANKS

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APPENDICES

810-A	Commentary

810.01 SCOPE

This specification covers the requirements for the installation of rootwad structures to provide waterbody bank stabilization and to improve fish habitat.

810.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

This specification applies to the work associated with installing rootwad structures without limiting the conditions and approvals imposed by statute.

810.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

810.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206 Grading

Ontario Provincial Standard Specifications, Material

OPSS 1440 Steel Reinforcement for Concrete

Canadian and Provincial Statutes

Fisheries Act, R.S.C., 1985, c. F-14

Ontario Water Resources Act, R.S.O. 1990, c. 0.40

810.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Anchoring Stone means large stones used to anchor rootwad structures into a waterbody bank.

Deleterious Substance means as defined in the Fisheries Act.

Excavated Bank Material means the existing earth material removed from the waterbody bank prior to the installation of a rootwad structure and replaced on top of the anchoring stone when backfilling the installation.

Footer Log means a log used to provide support under the rootwad trunk of a rootwad structure installed into a waterbody bank.

High Water Level means the highest point on the bank or floodplain of a waterbody that the water level reaches during high flow events or periods.

Low Water Level means the lowest point on the bank or streambed of a waterbody that the water level recedes to during low flow events or periods.

Normal Water Level means the average water level that occurs between high water level events or periods and low water level events or periods.

Rootfan means the root mass at the end of a rootwad trunk.

Rootwad Structure means the trunk of a tree with the limbs removed and the rootfan attached and exposed from earth that is installed along the toe of a waterbody bank to stabilize the slope and provide fish habitat, and includes a footer log, anchoring stone, and may include reinforcing steel.

Rootwad Trunk means the trunk of a tree used in a rootwad structure.

Waterbody means any permanent or intermittent, natural or constructed body of water including lakes, ponds, wetlands and watercourses, but does not include sewage works as defined in the Ontario Water Resources Act.

Waterbody Bank means the area of slope on or adjacent to a waterbody from the normal water level to the top of slope.

Watercourse means a stream, creek, river, or channel including ditches, in which the flow of water is permanent, intermittent, or temporary.

810.05

MATERIALS

810.05.01

General

All materials shall be free of deleterious substances.

810.05.02

Trees

Trees used for rootwad structures and footer logs shall be natural and untreated oak, maple, cedar, spruce, pine, or beech, unless otherwise specified in the Contract Documents.

Preference shall be given to trees sourced on-site.

810.05.03 Rootwad Trunk

The rootwad trunk shall be sized as specified in the Contract Documents. All limbs shall be removed from the rootwad trunk.

810.05.04 Rootfan

The rootfan shall be maintained intact at the end of the rootwad trunk.

810.05.05 Footer Log

Footer logs shall be generally straight and sized as specified in the Contract Documents.

810.05.06 Anchoring Stone

Anchoring stone shall be large field stone or quarried bedrock.

810.05.07 Reinforcing Steel

Reinforcing steel shall be according to OPSS 1440.

810.07 CONSTRUCTION

810.07.01 General

Rootwad structures shall be installed in the dry. The outside edge of the rootfan of a rootwad structure shall be installed so that it is no lower than the bottom of the waterbody or otherwise so that it is 1/3 below the low water level of the waterbody as specified in the Contract Documents.

810.07.02 Installation

Installation of rootwad structures shall be completed in the following sequence:

- a) The waterbody bank shall be excavated to accommodate the entire length of the rootwad trunk and the footer log. The excavation shall be slightly angled to become deeper further inland from the edge of the waterbody.
- b) The excavated bank materials shall be reused for the final layer when backfilling.
- c) The footer log shall be installed so that it sits at the waterbody edge of the excavation, parallel to the waterbody bank, and at the depth specified in the Contract Documents. When more than one rootwad structure is to be installed in series, the footer logs shall be installed starting at the downstream end of the installation.
- d) The rootwad trunk shall be placed in the excavation resting on the footer log so that it is embedded into the waterbody bank up to the rootfan. The rootwad trunk shall be angled slightly in the excavation so that the rootwad structure is facing upstream at an angle, as specified in the Contract Documents, to the waterbody bank and shall be anchored into the bank with reinforcing steel if specified in the Contract Documents.
- e) Anchoring stone shall be installed on the rootwad trunk and footer log to secure the rootwad structure in place. The anchoring stone shall cover minimum 1.5 times the diameter of the rootwad trunk, both in horizontal and vertical directions, and the entire length of the rootwad trunk and the footer log so that neither is visible from above.

- f) The previously excavated bank material shall be placed over the anchoring stone and graded according to OPSS 206.
- g) Vegetative cover shall be applied to the graded area as specified in the Contract Documents.

810.07.03 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be as specified in the Contract Documents.

810.07.04 Temporary Flow Control

Temporary flow control shall be as specified in the Contract Documents.

810.07.05 Management of Excess Materials

Management of excess materials shall be as specified in the Contract Documents.

810.09 MEASUREMENT FOR PAYMENT

810.09.01 Actual Measurement

810.09.01.01 Rootwad Structure

For measurement purposes, a count shall be made of the number of rootwad structures installed along the waterbody bank.

810.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

810.10 BASIS OF PAYMENT

810.10.01 Rootwad Structure - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 810-A, November 2013
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The following should be specified in the Contract Documents:

- Trees used for rootwad structures and footer logs other than natural and untreated oak, maple, cedar, spruce, pine, or beech and when other than on-site materials may be used. (810.05.02)
- Size of the rootwad trunk if other than typical size. (810.05.03)
- Size of footer log if other than typical size. (810.05.05)
- Requirement of reinforcing steel for anchoring into the bank. (810.07.02)
- Application of vegetative cover to the graded area. (810.07.02)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 222.010 Rootwad Structures for Waterbody Banks



CONSTRUCTION SPECIFICATION FOR LARGE WOODY DEBRIS FOR WATERBODY BANKS

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APPENDICES

811-A	Commentary

811.01 SCOPE

This specification covers the requirements for the installation of large woody debris to provide waterbody bank stabilization and improve fish habitat.

811.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

This specification applies to the work associated with installing large woody debris without limiting the conditions and approvals imposed by statute.

811.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

811.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206 Grading

Ontario Provincial Standard Specifications, Material

OPSS 1004 Aggregates - Miscellaneous

Canadian and Provincial Statutes

Ontario Water Resources Act, R.S.O. 1990, c. 0.40

811.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Backfill Stone means a stone mixture used to hold in place large woody debris installed at the toe of a waterbody bank.

Excavated Bank Material means the existing earth material removed from the waterbody bank prior to the installation of large woody debris and replaced on top of the backfill stone when backfilling the installation.

High Water Level means the highest point on the bank or floodplain of a waterbody that the water level reaches during high flow events or periods.

Large Woody Debris means one or more woody materials including, natural logs, tree trunks and limbs, or tree stumps with rootfans intertwined together and applied along the toe of a waterbody bank when the toe of the waterbody bank is being eroded and includes backfill stone.

Low Water Level means the lowest point on the bank or streambed of a waterbody that the water level recedes to during low flow events or periods.

Normal Water Level means the average water level that occurs between high water level events or periods and low water level events or periods.

Rootfan means the root mass at the end of the trunk of a tree.

Waterbody means any permanent or intermittent, natural or constructed body of water including lakes, ponds, wetlands and watercourses, but does not include sewage works as defined in the Ontario Water Resources Act.

Waterbody Bank means the area of slope on or adjacent to a waterbody from the normal water level to the top of slope.

Watercourse means a stream, creek, river, or channel including ditches, in which the flow of water is permanent, intermittent, or temporary.

811.05

MATERIALS

811.05.01

Large Woody Debris

Large woody debris materials shall be sized as specified in the Contract Documents.

Preference shall be given to wood debris and dead trees sourced on-site.

811.05.02

Backfill Stone

Backfill stone shall be pit run material according to OPSS 1004 and shall be 300 mm maximum diameter. Alternatively, previously excavated waterbody bank material may be used if specified in the Contract Documents.

811.07 CONSTRUCTION

811.07.01 General

Large woody debris shall be installed in the dry.

Adjacent to, but not within the installation area, the large woody debris shall be intertwined to create a mass, sized as specified in the Contract Documents.

811.07.02 Installation

Installation of large woody debris shall be completed in the following sequence:

- a) The installation area shall be excavated as specified in the Contract Documents. Excavated bank material shall be reused for the final layer when backfilling.
- b) The large woody debris shall be intertwined together to create a mass. The mass shall be placed in the excavation, ensuring that the large woody debris is situated in an irregular fashion as specified in the Contract Documents to create roughness on the waterbody bank. The large woody debris mass shall extend to the back of the excavation and also extend into the waterbody as specified in the Contract Documents.
- c) The large woody debris shall be covered with backfill stone as specified in the Contract Documents and tamped down. The backfill stone shall be covered with a layer of the previously excavated bank material and graded according to OPSS 206.
- d) Vegetative cover shall be applied to the graded area as specified in the Contract Documents.

811.07.03 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be as specified in the Contract Documents.

811.07.04 Temporary Flow Control

Temporary flow control shall be as specified in the Contract Documents.

811.07.05 Management of Excess Materials

Management of excess materials shall be as specified in the Contract Documents.

811.09 MEASUREMENT FOR PAYMENT

811.09.01 Actual Measurement

811.09.01.01 Large Woody Debris

Measurement of large woody debris shall be in linear metres, in place, as measured along the top of the waterbody bank.

811.10**BASIS OF PAYMENT****811.10.01****Large Woody Debris - Item**

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 811-A, November 2013
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The following should be specified in the Contract Documents:

- Size of large woody debris materials. (811.05.01)
- Use of previously excavated waterbody bank material. (811.05.02)
- Application of vegetative cover to the graded area. (811.07.02)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 222.020 Large Woody Debris for Waterbody Banks



CONSTRUCTION SPECIFICATION FOR LUNKERS

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812.08	QUALITY ASSURANCE - Not Used
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812.10	BASIS OF PAYMENT

APPENDICES

812-A	Commentary

812.01 SCOPE

This specification covers the requirements for the construction of little underwater neighbourhood keepers encompassing rheotactic salmonids (LUNKERS) for the enhancement of waterbody slope stability and fish habitat.

812.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

812.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

812.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206 Grading

Ontario Provincial Standard Specifications, Materials

OPSS 1010 Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1440 Steel Reinforcement for Concrete

Canadian and Provincial Statutes

Fisheries Act, R.S.C., 1985, c. F-14
Ontario Water Resources Act, R.S.O. 1990, c. 0.40

812.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Base Stabilizing Stone means stone placed in the stream bed to create a flat, stable base for stone LUNKERS.

Cover Stone means one or more large stones used to create the top of stone LUNKERS.

Deleterious Substance means as defined in the Fisheries Act.

Excavated Bank Material means the existing earth material removed from the waterbody bank prior to the installation of LUNKERS and replaced onto the large backfill stone when backfilling the installation.

High Water Level means the highest point on the bank or floodplain of a waterbody that the water level reaches during high flow events or periods.

Large Backfill Stone means stone placed on LUNKERS to re-establish the waterbody bank.

Low Water Level means the lowest point on the bank or streambed of a waterbody that the water level recedes to during low flow events or periods.

LUNKERS means an acronym for Little Underwater Neighbourhood Keepers Encompassing Rheotactic Salmonids that are crib-like, wooden, or stone structures installed along the toe of a waterbody bank to create overhead bank cover and resting areas for fish and may include base stabilizing stone, large backfill stone, spacer stones, a cover stone, and reinforcing steel.

Spacer Stone means a stone installed under the cover stone of stone LUNKERS and on top of the base stabilizing stone to create space under the cover stone for fish to rest in.

Streambed means the bottom of the channel when a watercourse flows.

Waterbody means any permanent or intermittent, natural or constructed body of water including lakes, ponds, wetlands and watercourses, but does not include sewage works as defined in the Ontario Water Resources Act.

Waterbody Bank means the area of slope on or adjacent to a waterbody from the normal water level to the top of slope.

Watercourse means a stream, creek, river, or channel including ditches, in which the flow of water is permanent, intermittent, or temporary.

812.05

MATERIALS

812.05.01

General

All materials shall be free of deleterious substances.

812.05.02

Wood

Wood LUNKERS shall be constructed of local wood, untreated lumber, or rough-hewn logs.

Wood LUNKERS planks, stringers, backboards, and posts shall be as specified in the Contract Documents.

Planks shall be placed side-by-side, without any gaps.

812.05.03 Base Stabilizing Stone

Base stabilizing stone shall be as specified in the Contract Documents.

812.05.04 Large Backfill Stone

Large backfill stone shall be as specified in the Contract Documents.

812.05.05 Granular B Aggregate

Granular B aggregate shall be according to OPSS 1010, except that it may not contain reclaimed asphalt pavement, reclaimed concrete material, glass, ceramic, fly ash, any type of slag, or any other industrial by-product, and shall be made from unwashed, quarried bedrock.

812.05.06 Spacer and Cover Stones

Spacer and cover stones shall be as specified in the Contract Documents.

812.05.07 Reinforcing Steel

Reinforcing steel shall be according to OPSS 1440.

812.07 CONSTRUCTION

812.07.01 General

LUNKERS shall be installed in the dry.

812.07.01 Installation

812.07.01.01 Wood LUNKERS

Wood LUNKERS shall be constructed on land outside the waterbody as specified in the Contract Documents, prior to installation in the waterbody bank.

Installation of wood LUNKERS shall be completed in the following sequence:

- a) The waterbody bank and streambed shall be excavated to accommodate wood LUNKERS as specified in the Contract Documents. Excavated bank materials shall be reused for the final layer when backfilling.
- b) Wood LUNKERS shall be installed in the excavation as specified in the Contract Documents. Adjustments to level and stabilize wood LUNKERS shall be made by hand.
- c) Holes shall be drilled through the posts of wood LUNKERS to accommodate the reinforcing steel and the reinforcing steel shall be driven through wood LUNKERS and into the streambed.
- d) Backfill stone shall be placed on wood LUNKERS to re-establish the waterbody bank. The large backfill stone shall extend to the high water level of the waterbody as specified in the Contract Documents. Granular B aggregate shall be installed at the rear of the excavation as specified in the Contract Documents.

The previously excavated bank material shall be installed on top of the backfill stone and graded according to OPSS 206.

Vegetative cover shall be applied to the graded area as specified in the Contract Documents.

812.07.01.02 Stone LUNKERS

Stone LUNKERS shall be installed in the dry.

Installation of stone LUNKERS shall be completed in the following sequence:

- a) The waterbody bank and streambed shall be excavated to accommodate stone LUNKERS as specified in the Contract Documents. Excavated bank material shall be reused for the final layer when backfilling.
- b) Base stabilizing stone shall be placed on the streambed to create a flat, stable base for stone LUNKERS.
- c) Spacer stones shall be installed on the base stabilizing stone. Spacer stones shall be installed to be at the mid-point and at each end of the length of the cover stone. The cover stone shall then be lowered onto the spacer stones. Adjustments shall be made to level and stabilize stone LUNKERS.
- d) Backfill stone shall be placed on the cover stone of stone LUNKERS to re-establish the waterbody bank. The backfill stone shall extend to the high water level of the waterbody as specified in the Contract Documents. Granular B aggregate shall be installed at the rear of the excavation as specified in the Contract Documents.
- e) The previously excavated bank material shall be placed over the anchoring stone and graded according to OPSS 206.
- f) Vegetative cover shall be applied to the graded area as specified in the Contract Documents.

812.07.02 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be as specified in the Contract Documents.

812.07.03 Temporary Flow Control

Temporary flow control shall be as specified in the Contract Documents.

812.07.04 Management of Excess Materials

Management of excess materials shall be as specified in the Contract Documents.

812.09 MEASUREMENT FOR PAYMENT

812.09.01 Actual Measurement

812.09.01 Wood LUNKERS Stone LUNKERS

Measurement of wood and stone LUNKERS shall be in linear metres, in place, as measured along the top of the waterbody bank.

812.10

BASIS OF PAYMENT

812.10.01

Wood LUNKERS - Item

Stone LUNKERS - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 812-A, November 2013
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The following should be specified in the Contract Documents:

- Planks, stringers, backboards, and posts for wood LUNKERS. (812.05.02)
- Application of vegetative cover to the graded area for wood LUNKERS. (812.07.01.01)
- Application of vegetative cover to the graded area for stone LUNKERS. (812.07.01.02)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 222.030	Stone LUNKERS
OPSD 222.040	Wood LUNKERS



CONSTRUCTION SPECIFICATION FOR RIFFLES ON STREAMBEDS

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820.08	QUALITY ASSURANCE - Not Used
820.09	MEASUREMENT FOR PAYMENT
820.10	BASIS OF PAYMENT

APPENDICES

820-A	Commentary

820.01	SCOPE

This specification covers the requirements for the construction of riffles on streambeds.

820.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

820.01.02

Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

820.02

REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 823 Low Flow Channels

Ontario Provincial Standard Specifications, Material

OPSS 1005 Aggregates - Streambed Material

Canadian and Provincial Statutes

Fisheries Act, R.S.C., 1985, c. F-14, as amended
Ontario Water Resources Act, R.S.O. 1990, c. 0.40, as amended

820.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Anchor Stones means of large stones (i.e., boulders) used to create a stable base.

Deleterious Substance means as defined in the Fisheries Act.

High Water Level means the highest point on the bank or floodplain of a waterbody where the water level reaches during high flow events or periods.

Interstitial Space means an empty space or gap between spaces full of structure or matter.

Low Flow Channel means the part of a streambed occupied by water during periods of low flow that is critical for fish passage.

Low Water Level means the lowest point on the bank or streambed of a waterbody where the water level recedes to during low flow events or periods.

Normal Water Level means the average water level that occurs between high water level events or periods and low water level events or periods.

Riffles means shallow areas of a waterbody with the steepest streambed slopes and shallowest depths where rocks break up the flow of water.

Riffle Crest means the highest point of a riffle at its upstream end.

Streambed means the bottom of the channel where a watercourse flows.

Streambed Material means the material that rests on the bottom of a waterbody and typically consists of natural sand, gravel, cobble, and boulders.

Waterbody means any permanent or intermittent, natural or constructed body of water, including lakes, ponds, wetlands, and watercourses, but does not include sewage works as defined in the Ontario Water Resources Act.

Waterbody Bank means the slope on or adjacent to a waterbody from the normal water level to the top of slope.

Watercourse means a stream, creek, river, or channel including ditches, in which the flow of water is permanent, intermittent, or temporary.

820.05

MATERIALS

820.05.01

Streambed Material

Streambed material shall be according to OPSS 1005 and as specified in the Contract Documents.

820.07

CONSTRUCTION

820.07.01

General

Riffles shall be constructed in the dry.

820.07.02 Channel Excavation

All required channel excavation shall be carried out as specified in the Contract Documents.

820.07.03 Streambed Material

The streambed material shall be blended on site and as specified in the Contract Documents. Approximately 10 - 20% of the largest size of streambed material to be used shall be set aside and positioned on top of the smaller streambed material to direct the stream flow.

Streambed material placement shall commence at the downstream end of the waterbody as specified in the Contract Documents and progress to the upstream end. Streambed material shall be compacted and interstitial spaces shall be filled as specified in the Contract Documents.

The riffle crest shall be constructed across the stream with large diameter boulders backed up with the next largest stone size downstream. Anchor stones shall be placed on the streambed as specified in the Contract Documents to create the upstream slope of the riffle and shall extend to the high water level of the waterbody. The thickness of each riffle crest shall be two to three times the diameter of the largest streambed material size.

The surface of the downstream face of the riffle shall have large streambed material placed so that they are spaced 20 - 30 cm apart to form gaps as specified in the Contract Documents.

Both waterbody banks adjacent to the riffle site shall have streambed material placed up to the high water level of the waterbody as specified in the Contract Documents.

Once placed, the streambed material shall form a non-uniform surface with larger stones protruding above smaller stones.

820.07.04 Low Flow Channel

A low flow channel shall be installed within the riffle according to OPSS 823 so that it has a 'V' shape in cross section at the center of the riffle.

820.07.05 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be according to the Contract Documents.

820.07.06 Temporary Flow Control for Construction in Waterbodies

Temporary flow control for construction in waterbodies shall be according to the Contract Documents.

820.07.07 Management of Excess Materials

Management of excess materials shall be according to the Contract Documents.

820.09 MEASUREMENT FOR PAYMENT

820.09.01 Actual Measurement

820.09.01.01 Riffles

Measurement for riffles shall be by horizontal area in square metres.

820.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

820.10 BASIS OF PAYMENT

820.10.01 Riffles - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 820-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Streambed material. (820.05.01)
- Channel excavation. (820.07.02)
- The locations and dimensions of the riffles on the streambeds at the Contract site including locations where streambed material should extend up the waterbody banks to the high water level of the waterbody. (820.07.03)
- The gradation of the various components of streambed material including anchor stones according to OPSS 1005 required to construct the riffles that are suitable to the Contract site. (820.07.03)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 222.050 Riffles on Streambeds



CONSTRUCTION SPECIFICATION FOR POOLS IN STREAMBEDS

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APPENDICES

821-A	Commentary

821.01	SCOPE

This specification covers the requirements for the construction of pools in streambeds.

821.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

821.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

821.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Material

OPSS 1005 Aggregates - Streambed Material

Canadian and Provincial Statutes

Fisheries Act, R.S.C., 1985, c. F-14
Ontario Water Resources Act, R.S.O. 1990, c. 0.40

821.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Deleterious Substance means as defined in the Fisheries Act.

Pools means hydrologic segments of a waterbody where the water is deeper and slower.

Streambed means the bottom of the channel where a watercourse flows.

Streambed Material means the material that rests on the bed of a waterbody and typically consists of natural sand, gravel, cobble, and boulders.

Waterbody means any permanent or intermittent, natural or constructed body of water, including lakes, ponds, wetlands, and watercourses, but does not include sewage works as defined in the Ontario Water Resources Act.

Watercourse means a stream, creek, river, or channel including ditches, in which the flow of water is permanent, intermittent, or temporary.

821.05 MATERIALS

821.05.01 Streambed Material

Streambed material shall be according to OPSS 1005 and as specified in the Contract Documents.

821.07 CONSTRUCTION

821.07.01 General

Pools shall be excavated in the dry.

821.07.02 Pools

Pools shall be excavated in the streambed as specified in the Contract Documents.

Any materials to be reused that must be temporarily removed from the streambed shall be stored on-site as specified in the Contract Documents.

821.07.03 Streambed Material

Streambed material shall be installed on the streambed within the pools as specified in the Contract Documents.

821.07.04 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be according to the Contract Documents.

821.07.05 Temporary Flow Control for Construction in Waterbodies

Temporary flow control for construction in waterbodies shall be according to the Contract Documents.

821.07.06 Management of Excess Materials

Management of excess materials shall be according to the Contract Documents.

821.09 MEASUREMENT FOR PAYMENT

821.09.01 Actual Measurement

821.09.01.01 Pools

Measurement for pools shall be by horizontal area in square metres.

821.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

821.10 BASIS OF PAYMENT

821.10.01 Pools - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 821-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Streambed material. (821.05.01)
- Pool excavation. (821.07.02)
- The gradation of the various components of streambed material according to OPSS 1005 required to be installed within the pools that are suitable to the Contract site. (821.07.03)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 222.060 Pools in Streambeds



CONSTRUCTION SPECIFICATION FOR ROCKY RAMPS ON STREAMBEDS

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822.10	BASIS OF PAYMENT

APPENDICES

822-A	Commentary

822.01	SCOPE

This specification covers the requirements for the construction of rocky ramps on streambeds.

822.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

822.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

822.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Material

OPSS 1005 Aggregates - Streambed Material

Canadian and Provincial Statutes

Fisheries Act, R.S.C., 1985, c. F-14, as amended
Ontario Water Resources Act, R.S.O. 1990, c. 0.40, as amended

822.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Anchor Stones means streambed material consisting of large stones (i.e., boulders) used to create a stable base.

Boulder Weir means a grade control structure to slow water behind it.

Boulder Weir Crest means the top of the boulder weir.

Deleterious Substance means as defined in the Fisheries Act.

High Water Level means the highest point on the bank or floodplain of a waterbody where the water level reaches during high flow events or periods.

In-stream Obstruction means a barrier in a waterbody that prohibits fish passage.

Low Flow Channel means the part of a streambed occupied by water during periods of low flow that is critical for fish passage.

Low Water Level means the lowest point on the bank or streambed of a waterbody where the water level recedes to during low flow events or periods.

Normal Water Level means the average water level that occurs between high water level events or periods and low water level events or periods.

Pool means a hydrologic segment of a waterbody where the water is deeper and slower.

Rocky Ramp means a longitudinal series of boulder weirs and pools creating a low slope that simulates a rocky streambed.

Streambed means the bottom of the channel where a watercourse flows.

Streambed Material means the material that rests on the bottom of a waterbody and typically consists of natural sand, gravel, cobble, and boulders.

Waterbody means any permanent or intermittent, natural or constructed body of water, including lakes, ponds, wetlands, and watercourses, but does not include sewage works as defined in the Ontario Water Resources Act.

Waterbody Bank means the slope on or adjacent to a waterbody from the normal water level to the top of slope.

Watercourse means a stream, creek, river, or channel including ditches, in which the flow of water is permanent, intermittent, or temporary.

822.05 MATERIALS

822.05.01 General

Rocky ramps shall be constructed in the dry.

822.05.01 Streambed Material

Streambed material shall be according to OPSS 1005 and as specified in the Contract Documents.

822.07 CONSTRUCTION

822.07.01 General

Rocky ramps shall be installed in the dry.

822.07.02 Removal of In-Stream Obstructions to Fish Passage from Waterbodies

Pre-existing, in-stream obstructions to fish passage shall be removed from the waterbody as specified in the Contract Documents.

822.07.03 Channel Excavation

Prior to construction of rocky ramps, the streambed shall be graded to create the slope and pools as specified in the Contract Documents.

The top layer of the excavated streambed material shall be stockpiled on-site and reused later as the top layer of the rocky ramp as specified in the Contract Documents.

822.07.04 Streambed Material

All imported streambed material shall be stockpiled within graded piles on-site adjacent to the rocky ramp construction location.

The downstream end of the rocky ramp shall be flatter than the rest of the ramp, approximately 10H: 1V or as specified in the Contract Documents.

Streambed material placement shall commence at the downstream end of the waterbody as specified in the Contract Documents and progress to the upstream end. Streambed material shall be placed first in the centre of the boulder weir crest and then outwards toward the waterbody banks.

Each boulder weir shall be shaped like an arch so that adjacent streambed materials support each other along the length of the boulder weir. Individual pieces of streambed material shall be carefully placed in a manner that allows the material to be rotated for precise alignment and fitting during construction.

Anchor stones shall form the first layer of streambed material and be placed below the elevation of the final grade to support a second row of streambed material.

The top row of streambed material shall then be placed against the anchor stones and slightly upstream of them so that they are supported with multiple points of contact.

When the arch of the boulder weir is complete, each boulder shall bear against its downstream neighbour and against the two anchor stones below it.

Anchor stones shall also be placed at the ends of each boulder weir well into the waterbody banks to the high water level and backfilled as specified in the Contract Documents.

Each pool shall be lined with streambed material as specified in the Contract Documents.

The bottom of each subsequent boulder weir shall be equal to the elevation of the crest of the boulder weir immediately downstream as specified in the Contract Documents.

Well-graded streambed material with some fines shall be placed on the upstream side of the boulder weir as specified in the Contract Documents.

Upon completion of construction of the rocky ramp, the center stone of each boulder weir crest shall be removed to form a notch for a low flow channel.

822.07.05 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be according to the Contract Documents.

822.07.06 Temporary Flow Control for Construction in Waterbodies

Temporary flow control for construction in waterbodies shall be according to the Contract Documents.

822.07.07 Management of Excess Materials

Management of excess materials shall be according to the Contract Documents.

822.09 MEASUREMENT FOR PAYMENT

822.09.01 Actual Measurement

822.09.01.01 Rocky Ramps

Measurement for rocky ramps shall be by horizontal area in square metres.

822.10 BASIS OF PAYMENT

822.10.01 Rocky Ramps - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 822-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Streambed material. (822.05.01)
- Pre-existing in-stream obstructions to fish passage to be removed. (822.07.02)
- The location, dimensions, and slope of the rocky ramps on the streambed at the Contract site. (822.07.03)
- The gradation of the various components of streambed material including anchor stones according to OPSS 1005 required to construct the rocky ramps that are suitable to the Contract site. (822.07.04)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 222.070 Rocky Ramps on Streambeds



CONSTRUCTION SPECIFICATION FOR LOW FLOW CHANNELS

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823.09	MEASUREMENT FOR PAYMENT
823.10	BASIS OF PAYMENT

APPENDICES

823-A	Commentary

823.01 SCOPE

This specification covers the requirements for the construction of low flow channels to maintain and enhance fish passage in a waterbody or a culvert.

823.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

823.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

823.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Materials

OPSS 1005 Aggregates - Streambed Material

Canadian and Provincial Statutes

Fisheries Act, R.S.C., 1985, c. F-14, as amended
Ontario Water Resources Act, R.S.O. 1990, c. 0.40, as amended

823.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Low Flow Channel means the part of a streambed occupied by water during periods of low flow.

Streambed means the bottom of the channel where a watercourse flows.

Streambed Material means the material that rests at the bottom of a waterbody and typically consists of natural sand, gravel, cobble, and boulders.

Waterbody means any permanent or intermittent, natural or constructed body of water, including lakes, ponds, wetlands, and watercourses, but does not include sewage works as defined in the Ontario Water Resources Act.

Watercourse means a stream, creek, river, or channel including ditches, in which the flow of water is permanent, intermittent, or temporary.

823.05 MATERIALS

823.05.01 Streambed Material

When the installation of a low flow channel includes supply of streambed material, it shall be according to OPSS 1005 and as specified in the Contract Documents.

823.07 CONSTRUCTION

823.07.01 General

Low flow channels shall be installed in the dry.

Excavation of the streambed and supply of streambed material from off-site may not be required if the existing streambed material can be adjusted to create the required low flow channel as specified in the Contract Documents.

When excavation of the streambed and supply of streambed material are required to achieve the design as specified in the Contract Documents, any materials that are suitable for reuse that must be temporarily removed from the streambed shall be stored on-site as specified in the Contract Documents.

823.07.02 Low Flow Channel

Once the streambed has been prepared, streambed material according to OPSS 1005 shall be installed as specified in the Contract Documents.

Streambed material placement shall be adjusted as necessary to achieve the design as specified in the Contract Documents.

Proper function shall be verified to ensure the flow is contained within the low flow channel, as constructed, when water is returned to the channel and that the grade and transition areas from the low flow channel to the waterbody do not present any barriers to flow or fish passage or direct flow outward towards the waterbody banks.

Streambed material placement may need to be adjusted to rectify any of these conditions.

823.07.03 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be according to the Contract Documents.

823.07.04 Temporary Flow Control for Construction in Waterbodies

Temporary flow control for construction in waterbodies shall be according to the Contract Documents.

823.07.05 Management of Excess Materials

Management of excess materials shall be according to the Contract Documents.

823.09 MEASUREMENT FOR PAYMENT

823.09.01 Actual Measurement

823.09.01.01 Low Flow Channel

Measurement of low flow channels using existing streambed material shall be in linear metres installed.

Measurement of low flow channels that include supply of streambed material shall be by mass in tonnes of streambed material.

823.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

823.10 BASIS OF PAYMENT

823.10.01 Low Flow Channel - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 823-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Streambed material. (823.05.01)
- When supply of streambed material is required to construct low flow channels. (823.07.01)
- The gradation of the various components of streambed material according to OPSS 1005 required to construct the low flow channels that are suitable to the Contract site. (823.07.02)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPS D222.080 Low Flow Channel



CONSTRUCTION SPECIFICATION FOR BAFFLES IN A CULVERT

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824-A	Commentary

824.01 SCOPE

This specification covers the requirements for the construction of baffles in culverts using streambed material to direct the flow of water within the culverts and to enhance fish passage through the culverts.

824.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

824.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

824.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Materials

OPSS 1005 Aggregates - Streambed Material

Canadian and Provincial Statutes

Fisheries Act, R.S.C., 1985, c. F-14, as amended
Ontario Water Resources Act, R.S.O. 1990, c. O.40, as amended

824.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Baffle means one or a series of partial obstructions in a channel designed to increase flow depth or dissipate the energy of water flowing at high velocity while at the same time providing fish passage.

Culvert means a structure that provides an opening through an embankment and to which roadway loads are distributed through fill or that is designated as a culvert in the Contract Documents.

Deleterious Substance means as defined in the Fisheries Act.

Low Flow Channel means the part of a streambed occupied by water during periods of low flow.

Streambed means the bottom of the channel where a watercourse flows.

Streambed Material means the material that rests at the bottom of a waterbody and typically consists of natural sand, gravel, cobble, and boulders.

Waterbody means any permanent or intermittent, natural or constructed body of water, including lakes, ponds, wetlands, and watercourses, but does not include sewage works as defined in the Ontario Water Resources Act.

Watercourse means a stream, creek, river, or channel including ditches, in which the flow of water is permanent, intermittent, or temporary.

824.05 MATERIALS

824.05.01 Streambed Material

Streambed material used to construct baffles in a culvert shall be according to OPSS 1005 and as specified in the Contract Documents.

824.07 CONSTRUCTION

824.07.01 General

All baffles shall be constructed in the dry.

824.07.02 Baffles in a Culvert

Baffles shall be installed in a culvert to be a permanent feature within the culvert as specified in the Contract Documents.

When the construction of the baffles in a culvert is complete and the waterbody flow has been reinstated, streambed material placement shall be adjusted by hand to achieve the design specified in the Contract Documents.

The baffles in a culvert shall be monitored after installation is complete to verify that the grade and transition of flow to the low flow channel within the culvert does not present any barriers to fish passage.

The placement of streambed material shall be adjusted to rectify any barriers to fish passage.

824.07.03 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be according to the Contract Documents.

824.07.04 Temporary Flow Control for Construction in Waterbodies

Temporary flow control for construction in waterbodies shall be according to the Contract Documents.

824.07.05 Management of Excess Materials

Management of excess materials shall be according to the Contract Documents.

824.09 MEASUREMENT FOR PAYMENT

824.09.01 Actual Measurement

824.09.01.01 Baffles in a Culvert

For measurement purposes, a count shall be made of the number of baffles installed in a culvert.

824.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

824.10 BASIS OF PAYMENT

824.10.01 Baffles in a Culvert - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 824-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

- The designer should specify the following in the Contract Documents:
- The gradation of the various components of streambed material as specified in OPSS 1005 required to construct the baffles in the culverts that are suitable to the Contract site. (824.05.01)
- Any other materials required to form the base of the baffles.

The designer should consider the following and specify it in the Contract Documents:

- The use of baffles in culverts should be limited to retrofit situations only.
- Whereas, baffles can be used to direct and reduce flow velocity in a culvert where it may be too high for fish passage, it must be verified that the hydraulics and flow carrying capacity of the culverts are sufficient to accommodate the altered flow that baffles will produce, when specifying their use in a Contract using this specification.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 222.090 Baffles in a Culvert



CONSTRUCTION SPECIFICATION FOR LOCAL SEED BANK

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830-A	Commentary

830.01 SCOPE

This specification covers the requirements for the installation of local seed banks.

830.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

830.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

830.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206 Grading

Ontario Ministry of the Environment and Climate Change Publications

Ontario Water Resources Act, - R.S.O. 1990, c O.40

830.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Normal Water Level means the average water level that occurs between high water level events or periods and low water level events or periods.

Local Seed Bank means all the seeds existing in the highest quality topsoil, stripped from the top 100 - 300 mm of the site, in a riparian vegetation area containing species native to the project site.

Riparian Vegetation Areas means vegetation areas within 30 m of the top of a waterbody bank.

Waterbody means any permanent or intermittent, natural or constructed body of water including lakes, ponds, wetlands and watercourses, but does not include sewage works as defined in the Ontario Water Resources Act.

Waterbody Bank means the slope on or adjacent to a waterbody from the normal water level to the top of slope.

Watercourse means a stream, creek, river, or channel including ditches, in which the flow of water is permanent, intermittent, or temporary.

830.05 MATERIALS

830.05.01 Local Seed Bank

Local seed bank shall be sourced on-site from existing topsoil in riparian vegetation areas removed to a depth as specified in the Contract Documents.

830.07 CONSTRUCTION

830.07.01 Salvaging Seed Bank

Removal of local seed bank shall occur by the removal of the topsoil layer prior to any other construction activities occurring within the areas specified in the Contract Documents.

Areas designated to have seed bank salvaged shall be excavated to a depth of 50 – 300 mm.

Areas that show evidence of non-native or invasive species shall not be used.

830.07.02 Seed Bank Stockpiles

The collected local seed bank shall be stockpiled in the locations specified in the Contract Documents.

Stock piles should not exceed 1500 mm in height. Avoid compacting the seedbank stockpiles. If possible strip and spread on receiving sites immediately, If stored, Storage shall be for less than 6 months. Cover with tarps or woven geotextile material to prevent soil erosion and contamination by weeds during storage. Alternatively, topsoil stockpiles can be stabilized by temporarily establishing groundcover vegetation composed of non-invasive species. Installation of ground cover seeds shall be by application of seeded compost or seeded biodegradable mats.

Surround stockpile with silt fencing or compost filter socks.

No machinery shall be allowed on the top of any stockpiles.

Local seed bank stockpiles are to be kept moist to prevent drying of seeds.

D. 830.07.03 Installation

Application of stockpiled local seed bank to the areas specified in the Contract Documents shall occur during the growing season (May – September).

The areas to be treated with local seed bank shall be graded prior to placement according to OPSS 206. Scarification to a depth of 150 mm is required prior to placement. Apply topsoil to a depth of 150 mm.

The stockpiled local seed bank shall be spread out in an even layer ontop of the topsoil to a thickness of 150 mm.

If any areas treated with local seed bank is subsequently re-graded for any reason, local seed bank shall be re-collected and re-applied according to this specification. Should local seed bank no longer be available, the area should be reseeded with a seed mix specified by the Contract Administrator

830.07.04 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be according to the Contract Documents.

830.07.05 Management of Excess Materials

Management of excess materials shall be according to the Contract Documents.

830.09 MEASUREMENT FOR PAYMENT

830.09.01 Actual Measurement

830.09.01.01 Local Seed Bank

Measurement of local seed bank shall be by area in square metres.

804.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

830.10 BASIS OF PAYMENT

830.10.01 Local Seed Bank – Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 830-A, November 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The following should be specified in the Contract Documents:

- Specify the removal depth of existing topsoil in riparian vegetation areas (830.05.01)
- Natural heritage survey to identify evidence of a native seed bank; (830.07.01)
- Specify the location(s) where local seed bank is to be sourced on-site; (830.07.01)
- Specify the duration and location(s) of where local seed bank is to be stockpiled on-site; (830.07.01)
- Specify the locations where local seed bank is to be installed on-site; (830.07.04)
- Specify the thickness of spread local seed bank stockpile. (830.07.04)
- Specify erosion and sediment control measures as necessary to protect waterbodies during grading and installation of local seed bank. (830.07.05)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR EXCAVATING AND BACKFILLING - STRUCTURES

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902-A	Commentary
902-B	Supplemental Requirements for Using OPSS 902 in Municipal Contracts

902.01 SCOPE

This specification covers the requirements for excavating and backfilling for structures, including dewatering.

902.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

902.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

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Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

902.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following specifications, standards, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 501	Compacting
OPSS 510	Removal
OPSS 518	Control of Water from Dewatering Operations
OPSS 539	Temporary Protection Systems

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1205	Clay Seal
OPSS 1860	Geotextiles

902.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Bedding means granular material to be placed in areas so designated in the Contract Documents.

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in General Conformance with the requirements of the Contract Documents.

Channel means a natural or artificial watercourse.

Culvert means a structure that provides an opening through an embankment and to which roadway loads are distributed through fill or that is designated as a culvert in the Contract Documents.

Designated Payment Surface means the original ground surface shown in the Contract Documents, unless a specially designated payment surface is shown either by elevation or by profile. The specially designated payment surface is horizontal in the transverse direction.

For rock excavation the designated payment surface shall be the existing rock surface as established in the field before rock excavation begins, unless another designated payment surface is specified.

Earth means all soils except those defined as rock, and excludes stone masonry, concrete and other manufactured materials.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Foundation means that portion of the ground below the structure base or footings that supports the structure or that portion of the ground supporting the pile caps.

Quality Verification Engineer means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Rock means natural beds or massive fragments, of the hard, stable, cemented part of the earth's crust, igneous, metamorphic, or sedimentary in origin, which may or may not be weathered, and includes boulders having a volume of 1 cubic m or greater.

Soil means all loose or moderately cohesive organic or inorganic deposits of the earth's crust such as silt, sand, gravel, or clay or any of their mixtures.

Structure means any bridge, tunnel, concrete culvert, retaining wall, dock, guideway, or sign support.

902.04

DESIGN AND SUBMISSION REQUIREMENTS

902.04.01

Design Requirements

902.04.01.01

Dewatering

Where dewatering is required, the Contractor shall be responsible for the design of the dewatering scheme for the intended purpose.

902.04.02 Submission Requirements

902.04.02.01 Preconstruction Survey

Prior to commencing the work, a condition survey of property and structures that may be affected by the work shall be submitted to the Contract Administrator. The survey shall include the locations and conditions of adjacent properties; buildings; underground structures; Utility services; and structures, such as walls abutting the site.

902.04.02.02 Milestone Inspections

The Quality Verification Engineer shall witness the following Interim Inspections of the work:

- a) Dewatering of excavation for structure.
- b) Completion of excavation for foundation.
- c) Excavation for backfill and frost tapers.
- d) Backfilling.

A copy of the written permission to proceed shall be submitted to the Contract Administrator prior to commencement of the successive operation.

902.05 MATERIALS

902.05.01 Granular

Granular material to be used for backfill, bedding, and frost tapers shall be according to OPSS 1010.

The 19.0 mm clear stone to be used for wall drains shall be according to OPSS 1004.

902.05.02 Native Backfill

Native and imported material shall be approved by the Contract Administrator. All material shall be free from frozen lumps, cinders, ashes, refuse, vegetable or organic matter, rocks and boulders over 150 mm in any dimension, and other deleterious material.

902.05.03 Clay Seal

Clay seal shall be according to OPSS 1205.

902.05.04 Geotextile

Geotextile shall be according to OPSS 1860 and be of the type, class, and filtration opening size (FOS) range specified in the Contract Documents.

902.06 EQUIPMENT

902.06.01 Compaction Equipment

Compaction equipment shall be according to OPSS 501.

902.07 CONSTRUCTION

902.07.01 Removals

Removals shall be according to OPSS 510.

902.07.02 Removal of Ice and Snow

All ice and snow shall be removed from all portions of the work area before any excavation and backfill operations proceed. Frozen materials shall not be incorporated into the work. Material shall not be placed over frozen ground, ice, or snow.

902.07.03 Protection Systems

Protection systems shall be according to OPSS 539.

Protection systems shall be installed:

- a) Where the stability, safety, or function of an existing structure, roadway, railway, or other facility can be impaired by an excavation or temporary slope.
- b) To permit excavation where there is a necessity to retain the sidewalls of an excavation and to permit dewatering by restricting water flow and facilitating safe execution of the work.

902.07.04 Dewatering Structure Excavation

Until backfilling has been completed and to permit the placing of concrete in the dry, the Contractor shall carry out all work necessary to control the flow of water into the excavation and to prevent disturbance of the founding material.

Control of water shall be according to OPSS 518.

All temporary dewatering shall remain the property of the Contractor and shall be removed from the right-of-way when they are no longer required.

902.07.05 Excavation

902.07.05.01 General

Deterioration of the foundation soil or rock, surface water from entering and eroding the face of the excavation, and build up of hydrostatic pressures that may have harmful effects upon the temporary or permanent structures shall be prevented.

902.07.05.02 Excavation for Foundations

Excavation for footings, working slabs, and granular pads shall be to the neat lines specified in the Contract Documents.

The bottom of the excavation on which the footing, working slab, or granular pad is to rest shall not be disturbed. In soft conditions, construction of the footing or structural slab shall commence immediately after the final removal of material to the foundation level has been completed.

In the case of concrete culverts of the open footing type, no excavation shall be made between the footings below the level of the stream bed or the top of the footings, whichever elevation is lower, unless authorized in writing by the Contract Administrator.

The elevation of the bottom of the footing, working slab, or granular pad shall not be changed without the approval of the Contract Administrator.

Overexcavated areas shall be restored to their original conditions. Overexcavated areas shall be backfilled with a material suitable for the particular application and approved by the Contract Administrator. Concrete fill shall be used for overexcavation in rock. Where material other than concrete is used, the material shall be compacted to the dry density specified in OPSS 501.

When authorized by the Contract Administrator, additional excavation, as may be required, shall be carried out.

902.07.05.03 Excavation for Backfill and Frost Tapers

Excavation for backfill and frost tapers shall be to the neat lines specified in the Contract Documents.

Overexcavated areas shall be restored with material approved by the Contract Administrator. The material shall be compacted to the dry density specified in OPSS 501.

902.07.05.04 Preservation of Channel

Where a channel cross-section is altered, it shall be restored to its original condition.

902.07.06 Backfilling

902.07.06.01 General

Frozen materials shall not be incorporated into the work.

Footings shall be protected against frost action.

Other than the backfill placed to the tops of the footings, no fill shall be placed against an abutment, wingwall, retaining wall, or concrete culvert until the concrete has reached 70% of its design strength.

Backfilling around culverts, arches, rigid frames, and piers shall proceed simultaneously and evenly on both sides of the structure. The differential in surface elevation of the backfill material on each side of the structure and individual component shall not be greater than 500 mm.

All voids around abutments, piers, or other permanent work shall be backfilled to the level of the surrounding ground or to the grade specified in the Contract Documents, whichever is the lower before the general backfilling commences.

When rock fill is to be placed around a structure the structure shall be protected to prevent damage from the rock fill.

The minimum height of fill specified in the Contract Documents shall be placed before traffic or construction equipment shall pass over the culvert.

Granular material shall be placed within the lines and grades specified in the Contract Documents.

Wall drains shall have a 0.05 m³ pocket of 19 mm minimum size clear stone wrapped in geotextile placed over the opening of the wall drain at the backfilled side of the wall.

902.07.06.02 Compaction

Backfill shall be placed according to OPSS 206 and compacted according to OPSS 501.

Only hand operated vibratory type compaction equipment shall be used for compaction of fill material within the restricted zone behind all earth retaining structures.

902.07.07 Clay Seal

When specified in the Contract Documents, clay seals shall be placed to the dimensions shown.

902.07.08 Certificate of Conformance

A completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Qualification Verification Engineer's seal and signature shall be affixed on the completed Certificate of Conformance confirming that the work has been carried out in general conformance with the Contract Documents.

902.07.09 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

902.09 MEASUREMENT FOR PAYMENT

902.09.01 Actual Measurement

902.09.01.01 Excavation for Structure

Measurement of earth or rock excavation for structure shall be by volume in cubic metres.

Measurement of excavation for footings shall be based on the neat horizontal dimensions of the footing to the depth of the bottom of the footing, working slab, or granular pad.

Except as noted below, the quantity of excavation shall include only the quantities below the designated payment surface within the neat lines specified in the Contract Documents.

The above measurement also includes:

- a) Removal of asphalt pavement, except where there is a separate tender item for pavement removal that includes pavement overlapping the area of structure excavation.
- b) The excavation quantities, below the designated payment surface, required for placing granular backfill and granular frost tapers.
- c) For open footing culverts, the excavation quantities as measured below the designated payment surface but between the plan areas of the footings and above the stream bed or the tops of the footings, whichever is higher.

Where the structure excavation overlaps excavation required for other work, the measurement shall be made as specified in the Contract Documents with no deductions for overlap.

The volume of boulders in an excavation shall be calculated from the three maximum rectilinear dimensions. The following provisions shall apply:

- a) Only the amount removed shall be considered for payment.
- b) The volume of the boulders removed shall be deducted from the volume of excavation as calculated above.

The measurement of the total volume of materials considered for payment shall not exceed the calculated volume of excavation within the theoretical lines.

902.09.01.02 Granular Backfill

Measurement for payment of granular backfill shall be by volume in cubic metres or tonnes as specified in the Contract Documents.

The quantity of granular backfill and granular bedding shall include only those quantities measured below the subgrade and as measured within the theoretical line and grades specified in the Contract Documents.

Where the Contractor has excavated beyond the limits specified in the Contract Documents, the conversion factor of 2 t/m³ shall be used in measurement of the excess volume when it is replaced with granular on a tonne basis.

The weighing of granular material supplied on a tonnage basis shall be according to the Contract Documents.

902.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

902.10 BASIS OF PAYMENT

902.10.01 Earth Excavation for Structure - Item Rock Excavation for Structure - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

When the Contract Administrator requests excavation for concrete working slabs, granular working pads, or granular bedding, payment shall be at the Contract price for the type of excavation required.

902.10.02 Dewatering Structure Excavations - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

902.10.03 Granular Backfill to Structure - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material required to do the work.

When the Contract Documents do not include a separate item for granular backfill to structure, the Contract price for the items directly associated with the granular backfill to structure shall be full compensation for all labour, Equipment, and Material required to do the work.

902.10.04 Clay Seal - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

902.10.05 Overexcavation

Payment shall not be made for overexcavation that has not been approved by the Contract Administrator or for backfill restoration of such overexcavation.

Appendix 902-A, November 2010 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Geotextile requirements. (902.05.04)
- Neat lines of excavations for footings, working slabs, and granular pads. (902.07.05.02)
- Neat lines of excavation for backfill and frost tapers. (902.07.05.03)
- Grade of backfill around abutments, piers, and other permanent work. (902.06.01)
- Lines and grades for granular materials. (902.06.01)
- Measurement units for granular material. (902.09.01.02)

The designer should determine if the following is required and, if so, it should be specified in the Contract Documents:

- Clay seals and dimensions for clay seals. (902.07.07)

OPSS 902 contains information written for provincial contracts. To ensure completeness of municipal Contract Documents, the designer should invoke Appendix 902-B. The appendix contains supplemental requirements that modify OPSS 902 so it can be used by a municipality in its contracts.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 3090.100	Foundation, Frost Penetration Depths for Northern Ontario
OPSD 3090.101	Foundation, Frost Penetration Depths for Southern Ontario
OPSD 3101.150	Walls, Abutment, Backfill, Minimum Granular Requirement
OPSD 3101.200	Walls, Abutment, Backfill, Rock
OPSD 3102.100	Walls, Abutment, Backfill Drain
OPSD 3120.100	Walls, Retaining, Concrete Toe Wall
OPSD 3121.150	Walls, Retaining, Backfill, Minimum Granular Requirement
OPSD 3190.100	Walls, Retaining and Abutment, Wall Drain

Appendix 902-B, November 2010

FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

Supplemental Requirements for Using OPSS 902 in Municipal Contracts

OPSS 902 Excavation and Backfilling - Structures, is amended as follows:

902.03 Definitions

Section 902.03 is amended by the deletion of the definitions for Certificate of Conformance and for Quality Verification Engineer.

902.04.02.02 Milestone Inspections

Clause 902.04.02.02 is deleted in its entirety and replaced with the following:

The Contract Administrator shall witness the following interim inspections of the work:

- a) Dewatering of excavation for structure.
- b) Completion of excavation for foundation.
- c) Excavation for backfill and frost tapers.
- d) Backfilling.

The next operation shall not proceed until the Contract Administrator has examined the excavation and given approval in writing to perform subsequent work.

902.07.04 Dewatering Structure Excavation

The third paragraph of clause 902.07.04 is deleted in its entirety and replaced with the following:

After the dewatering, the excavation shall be inspected and accepted by the Contract Administrator prior to construction of the footing. The Contractor shall not proceed with subsequent work until the Contract Administrator has given permission in writing.

902.07.08 Certificate of Conformance

Subsection 902.07.08 is deleted in its entirety.



NOTICE TO USERS OF OPSS 903

CONSTRUCTION SPECIFICATION FOR DEEP FOUNDATIONS

OPSS 903 has been removed from this
OPS volume

The provincial version of OPSS 903 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 903

The municipal version of OPSS 903 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 903

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



NOTICE TO USERS OF OPSS 904

CONSTRUCTION SPECIFICATION FOR CONCRETE STRUCTURES

OPSS 904 has been removed from this
OPS volume

The provincial version of OPSS 904 is now in:

OPS Volume 5,
Provincial-Oriented
MTO General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.PROV 904

The municipal version of OPSS 904 is now in:

OPS Volume 7,
Municipal-Oriented
OPS General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.MUNI 904

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



NOTICE TO USERS OF OPSS 905

CONSTRUCTION SPECIFICATION FOR STEEL REINFORCEMENT FOR CONCRETE

OPSS 905 has been removed from this
OPS volume

The provincial version of OPSS 905 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 905

The municipal version of OPSS 905 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 905

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



CONSTRUCTION SPECIFICATION FOR STRUCTURAL STEEL FOR BRIDGES

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906.01 SCOPE

This specification covers the construction requirements for the fabrication, delivery, and erection of structural steel for highway bridges.

906.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

906.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

906.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 911	Coating Structural Steel
OPSS 919	Formwork and Falsework
OPSS 922	Installation of Bearings

Ontario Provincial Standard Specifications, Materials

OPSS 1202	Bearings-Elastomeric Plain and Steel Laminated
OPSS 1203	Bearings-Rotational and Sliding Surface

Ontario Ministry of Transportation Publications

Structural Manual

CSA Standards

G40.20/40.21-04 (R2009)	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
S16-09	Design of Steel Structures
W47.1-09	Certification of Companies for Fusion Welding of Steel
W48-06 (R2011)	Filler Metals and Allied Materials for Metal Arc Welding
W59-03 (R2008)	Welded Steel Construction (Metal Arc Welding)
W178.1-08	Certification of Welding Inspection Organizations
W178.2-08	Certification of Welding Inspectors
S6-06	Canadian Highway Bridge Design Code

ASTM International

A 325M-09	Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength [Metric]
A 490M-09	Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
A 563M-07	Carbon and Alloy Steel Nuts
A 588/ A 588M-10	High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, With Atmospheric Corrosion Resistance
F 436M-11	Hardened Steel Washers

American Society of Mechanical Engineers (ASME)

B46.1-09	Surface Texture (Surface Roughness, Waviness, and Lay)

International Organization for Standardization/International Electrotechnical Commission (ISO/IEC)

17025-2005	General Requirements for the Competence of the Testing and Calibration Laboratories

Joint Publications of the Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE)

SSPC-SP6/NACE No. 3-2007	Commercial Blast Cleaning

906.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Bearing Contact Area means two planes that are in contact or have a separation between them not exceeding 0.12 mm.

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the province of Ontario

Erection Diagrams means drawings showing the dimensioned layout of the steel structure, from which shop details are made, and that correlate the fabricator's piece markings with the location in the structure.

Faying Surface means the mating surface of a member that is in contact with another member to which it is to be joined.

Flush means a profile of weld reinforcement in which there is a smooth gradual transition between the base and weld metal involving grinding where necessary. Weld reinforcement not exceeding 1 mm in height may remain on each surface, unless the weld is part of a faying surface when all reinforcement is removed.

Fracture Critical Member means a member, including attachments, in a single load path structure that is subject to tensile stress and whose failure could lead to collapse of the structure.

Inspector means an individual who is a Canadian Welding Bureau (CWB) certified Level II or Level III inspector according to the requirements of CSA W178.2 and has documented evidence of professional knowledge, skill, and experience in the inspection of fabrication and erection of steel bridges.

New Steel means structural steel that has not previously been used.

Non-Destructive Testing Technician means an individual who has documented evidence of training, professional knowledge, skill, and experience in non-destructive testing of structural steel welds and material, and has a valid certificate showing qualification to a Level II or III according to CAN/CGSB 48.9712 and the CWB for the non-destructive testing specified.

Primary Tension Member means a member including attachments that are subject to tension stress.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Smooth means a profile of weld reinforcement, in which the surface finish or weld reinforcement has sufficient smooth gradual transition, involving grinding where necessary. Weld reinforcement not exceeding the following limits, may remain on each surface:

- 2 mm for plate thickness ≤ 50 mm
- 3 mm for plate thickness > 50 mm

Snug Tight means the tightness attained by a few impacts of an impact wrench or the full effort of a person using a spud wrench.

906.04 DESIGN AND SUBMISSION REQUIREMENTS

906.04.01 Design Requirements

906.04.01.01 General

Design shall be according to CAN/CSA S6 and the Structural Manual.

906.04.01.02 Welding

Welding design shall be according to CSA W59.

Welding procedures shall be according to CSA W47.1 and CSA W59, except where modified by CAN/CSA-S6, Clause 10.24.5.

Symbols for welding and non-destructive testing shall be according to CSA W59.

906.04.02 Submissions

906.04.02.01 General

When other authorities are involved in the approval of the design or construction of a highway structure, submissions shall be made at least 5 weeks prior to commencement of work and one additional copy of the submission shall be provided for each authority.

The requirements of each authority shall be satisfied prior to commencement of fabrication.

906.04.02.02 Shop Details and Welding Procedures

The Contractor shall submit 3 sets of the shop details and welding procedures to the Contract Administrator at least 7 Days prior to commencement of fabrication, for information purposes only. Prior to making a submission, an Engineer's seal and signature shall be affixed on the shop details and welding procedures verifying that the details and procedures are consistent with the Contract Documents.

The shop details shall include at least the following:

- a) Full detail dimensions and sizes of all component parts of the structure. These dimensions shall make allowance for changes in shape due to weld shrinkage, camber, and any other effects that cause finished dimensions to differ from initial dimensions.
- b) Erection marks.
- c) All necessary specifications for the materials to be used.
- d) Identification of areas requiring special surface treatment.
- e) Identification of fracture-critical and primary tension members and component parts. Attachments having a length of more than 100 mm in the direction of tension and welded to the tension zone of a fracture-critical or primary tension member shall be treated as part of that member.
- f) Bolt installation requirements, including number of fitting up bolts required at each connection and oversize and slotted holes.
- g) Details of all welds.
- h) Identification of material and welds requiring non-destructive testing, including the limits of the weld undergoing testing and the frequency and type of testing.
- i) Temporary welds.
- j) Location of shop and field splices.

The fabricator shall not commence fabrication until he has received one set of shop detail drawings and welding procedures sealed and signed by an Engineer.

The fabricator shall have a copy of the shop detail drawings and welding procedures at the manufacturing plant during fabrication.

906.04.02.03 Erection Diagrams and Erection Procedure Drawings and Calculations

The Contractor shall submit 3 sets of the erection diagrams and erection procedure drawings and calculations to the Contract Administrator at least 7 Days prior to commencement of erection, for information purposes only. Prior to making a submission, an Engineer's seal and signature shall be

affixed on the erection diagrams and erection procedure drawings and calculations verifying that the erection diagrams and erection procedure drawings and calculations are consistent with the Contract Documents.

Erection diagrams and erection procedure drawings shall include at least the following:

- a) Principal dimensions of the bridge.
- b) Erection marks.
- c) Sizes of all members.
- d) Field welding requirements, including identification of welds requiring non-destructive testing.
- e) Size and type of bolts.
- f) Bolt installation requirements, including the number of fitting up bolts required at each connection and identification of oversize and slotted holes.
- g) Bracing during erection of structural steel.
- h) Treatment at faying surfaces for joints designed as slip critical.

The Contractor shall not commence erection until he has received one set of erection diagrams and erection procedure drawings and calculations sealed and signed by an Engineer.

The Contractor shall have a copy of the erection diagrams and the erection procedure drawings and calculations at the site during erection.

906.04.02.04 Mill Test Certificates

Prior to the use of any material in fabrication, 2 copies of the mill test certificates for that material shall be submitted to the Contract Administrator, confirming that the material is according to the Contract Documents.

Copies of the mill test certificates for all material to be used in the fabrication shall be available for review at the fabricating plant during fabrication. The certificates shall show that the material is according to the Contract Documents.

If the material cannot be identified by mill test certificates, coupons shall be taken and tested and these test certificates shall be made available.

When mill test certificates originate from a mill outside of Canada or the United States of America, the Contractor shall have the information on the mill test certificate verified by testing at a Canadian laboratory. This laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian laboratory and appropriate wording stating that the material is according to the specified Contract requirements. The stamp shall include the appropriate material specification number, testing date (i.e., yyyy-mm-dd), and the signature of an authorized officer of the Canadian laboratory.

906.04.02.05 Test Reports for Fasteners

Proof that the bolts, nuts, and washers meet the chemical composition, mechanical properties, dimensions, workmanship, and head burst as required by ASTM A 325M, ASTM A 490M, ASTM A 563M,

or ASTM F 436M shall be submitted to the Contract Administrator. Verification of the acceptability of assemblage of zinc-coated bolts, nuts, and washers delivered to the job site shall also be submitted to the Contract Administrator.

For bolts, nuts, and washers supplied from a manufacturer outside Canada or the United States of America, the above information shall be verified by testing at a Canadian laboratory as outlined in the Mill Test Certificates clause.

906.04.03 Interim Inspection after Fabrication of Components

Upon completion of fabrication of the components, and prior to erection, the Quality Verification Engineer shall conduct an interim inspection of the work to verify that the fabrication of components has been carried out in general conformance with the shop details, welding procedures, and Contract Documents and issue the fabricator written permission to proceed with the work.

906.05 MATERIALS

906.05.01 Steel

Structural steel shall be new and of the grade and category specified in the Contract Documents and shall be according to CAN/CSA G40.21.

ASTM A 588 may be substituted when either of the following steel grades have been specified:

- a) CAN/CSA G40.21, Grade 350A.
- b) CAN/CSA G40.21, Grade 350AT, when the Charpy impact energy requirements are verified by the submission of test documentation.

Substitution of other material for size and grade is not permitted unless approved by the Contract Administrator.

The steel shall be identified as specified in the Control of Material clause.

906.05.02 High Strength Bolts, Nuts, and Washers

High strength bolts shall be according to ASTM A 325M or ASTM A 490M.

High strength nuts, and hardened washers shall be suitable for use with the types of bolts being specified and shall be according to ASTM A 563M and ASTM F 436M.

The nuts, bolts, and washers shall be supplied and shipped together as an assembly from the same manufacturer.

High strength bolts, nuts, and washers for use with unpainted corrosion-resistant steel shall be Type 3. Bolts, nuts, and washers used with steel specified in the Contract Documents to receive a paint coating or galvanizing shall be Type 1 and shall be galvanized. High strength ASTM A 490M bolts shall not be galvanized or plated.

906.05.03 Electrodes

Welding electrodes, electrode and flux or electrode and gas combinations shall be low hydrogen (level H16 or less) and shall be according to CSA W47.1, CSA W48, and Section 12 of CSA W59.

The weld filler metal in fracture-critical and primary tension members shall meet the Charpy V notch impact energy requirements of CAN/CSA-S6, Table 10.14.

Weld metal used with corrosion resistant steels shall have similar corrosion resistance and colour to the base metal and shall be according to CSA W59.

906.05.04 Shear Connectors

Material requirements for stud shear connectors shall be according to CSA W59, Appendix H. Only studs of Type B shall be used.

906.05.05 Pins and Rollers

Pins and rollers more than 175 mm in diameter shall be forged and annealed or forged and normalized. Pins and rollers 175 mm or less in diameter shall be forged and annealed, forged and normalized, or cold-finished carbon-steel shafting.

906.05.06 Bearings

Bearings shall be according to OPSS 1202 or OPSS 1203 or both.

906.07 CONSTRUCTION

906.07.01 Fabrication

906.07.01.01 General

The fabrication shall be according to CAN/CSA-S6, Clause 10.24.4.

All Atmospheric Corrosion Resistant (ACR) steel components shall be abrasive blast-cleaned according to SSPC-SP6/NACE No. 3 to completely remove mill scale, rust, coating, oxides, corrosion products, oil, grease, dust, dirt, and other foreign matter.

906.07.01.02 Plate Edges

Plasma arc cutting of plates up to and including 20 mm in thickness is permitted. Plasma arc cutting of plates thicker than 20 mm shall not be permitted unless approval is received in writing from the Contract Administrator. When permitted, plasma arc cutting of plates shall use oxygen as the cutting gas and all edges shall be free of dross.

Inspection and repair of planar discontinuities shall be according to CSA W59.

Corners of oxygen cut girder flanges shall be chamfered 1.5 to 2.0 mm by grinding.

906.07.01.03 Straightening Material

Material with sharp kinks shall be rejected. Straightening of bends shall only be done using mechanical means or by the application of controlled heating according to CSA W59. Details of the straightening procedure including testing requirements, signed and sealed by an Engineer shall be submitted to the Contract Administrator prior to the straightening, for information purposes only.

Straightening shall only be carried out in the presence of the Owner's inspector.

If necessary, the Contract Administrator shall specify additional testing to be performed by the Contractor. If evidence of damage is discovered, the material shall be rejected and the cost of testing shall be at the expense of the Contractor.

The Contract Administrator shall be given 7 Days prior notice to arrange for the inspection.

906.07.01.04 Cambering

When rolled sections are heat cambered, the details of the heat cambering procedure, signed and sealed by an Engineer, shall be submitted to the Contract Administrator 7 Days prior to cambering, for information purposes only.

Plate girders shall have the required camber cut into the web with suitable allowance for camber loss due to cutting and welding.

Steel box girders fabricated with webs in an upright position shall have the fabricated camber verified by subtracting ordinates for deflections for girder segments from the relaxed camber diagram ordinates.

The use of heat to alter the camber of fracture critical or primary tension members shall be subject to approval by the Contract Administrator prior to the application of heat.

The ends of cambered girders shall be vertical under full dead load.

906.07.01.05 Horizontally Curved Girders

906.07.01.05.01 Heat Curving of Rolled Beams and Welded Girders

Girders shall be cambered before heat curving.

A detailed procedure for the heat curving operation, signed and sealed by an Engineer, shall be submitted to the Contract Administrator 14 Days prior to heat curving, for information purposes only.

906.07.01.06 Identification Marking for Erection

Each member shall carry an erection mark for identification.

Permanent marking shall be affixed in an area not exposed to view in the finished structure.

906.07.01.07 Welded Construction

906.07.01.07.01 General

All welded construction shall be according to CSA W59 and Clause 10.24.5 of CAN/CSA-S6.

All welding shall be carried out by welders having a CSA W47.1 identification card valid for the type of welding to be done and for the duration of the welding work.

The fabrication weld metal requirements, base metal repairs, and repairs of weld in fracture critical and primary tension members shall be according to CAN/CSA-S6, Clause 10.23.5.

Any company undertaking welded fabrication or erection or both shall be certified according to CSA W47.1, Division 1 or 2.

906.07.01.07.02 Altering the Sweep of Fracture-Critical and Primary Tension Members

The use of heat to alter the sweep of fracture critical or primary tension members shall be subject to approval by the Contract Administrator, prior to the application of heat.

906.07.01.07.03 Submissions of Repair Procedures

Canadian Welding Bureau (CWB) accepted welding procedure specifications, data-sheets, and repair procedures for prequalification, signed and sealed by an Engineer, shall be submitted for approval to the Contract Administrator 14 Days prior to commencement of work.

906.07.01.07.04 Assembly for Welding

Assembly for welding shall be according to CSA W59 and the following:

- a) Bearing stiffeners shall be vertical under full dead load.
- b) Intermediate stiffeners shall be either true vertical or perpendicular to the horizontal work lines used to layout the girder.
- c) Bearing stiffeners fitted to bear shall have a minimum bearing contact area of 75% and a maximum separation of 1 mm over the remaining area.
- d) Fitted intermediate stiffeners shall have a minimum bearing contact area of 25% and a maximum separation of 2 mm.

906.07.01.07.05 Temporary Welds

Temporary welds shall not be used on fracture-critical and primary tension members.

Temporary welds shall not be used on flange material in compression, unless approved by the Contract Administrator.

906.07.01.07.06 Preheat, Interpass Temperature, and Heat Input Control

When making welding repairs to fracture-critical and primary tension members, the preheat requirements shall be according to CAN/CSA-S6, Table 10.15.

906.07.01.07.07 Profile of Welds

Profile of welds shall be according to CSA W59 and the Structural Manual.

906.07.01.07.08 Corrections

Welding corrections and repairs to fracture-critical and primary tension members shall be according to CAN/CSA S6, Clause 10.23.5.

Any steel members subjected to shape corrections or straightening shall be allowed to cool in still air.

906.07.01.07.09 Peening

Peening, when required, shall be subject to approval by the Contract Administrator.

906.07.01.07.10 Stress Relief-Heat Treatment

Stress relief-heat treatment temperatures shall be recorded using thermo-couples or other methods acceptable to the Contract Administrator. A record showing temperature and time data of the heat treating operation shall be maintained and be made available to the Contract Administrator upon request.

906.07.01.07.11 Welding Inspection

906.07.01.07.11.01 General

All welding inspection shall be according to CSA W59.

906.07.01.07.11.02 Identification Cards - Canadian Welding Bureau

Prior to commencement of welding, the Contractor shall make available to the Contract Administrator the Canadian Welding Bureau's transferable or non-transferable identification cards for each tacker, welder, or welding operator to be employed on the work. Such identification cards shall be currently valid and shall indicate the welding processes and the welding positions at which the personnel are qualified to weld.

906.07.01.07.11.03 Certification of the Independent Testing Organization

The independent organization undertaking welding testing under the Quality Control subsection shall be certified for testing bridges according to CSA W178.1. The certification shall encompass at least the following methods: radiographic, ultrasonic, and magnetic particle.

906.07.01.07.11.04 Certification of the Non-Destructive Testing Technician

The independent organization's non-destructive testing technician undertaking non-destructive testing of welds under the Quality Control subsection shall be certified for testing bridges according to CSA W178.2. Certification shall be to either Level II or III for the methods used, as required by CAN/CGSB 48.9712.

906.07.01.07.12 Welding Corrections and Repairs for Fracture-Critical and Primary Tension Members

906.07.01.07.12.01 General

All repair procedures requiring approval shall be submitted to the Contract Administrator at least 14 Days prior to commencement of the work.

Repair procedures shall be according to CAN/CSA-S6, Clause 10.23.5.

906.07.01.07.12.02 Approval for Non-Critical Repairs

Non-critical repairs are those listed in CAN/CSA-S6, Clause 10.23.5.

Repair procedures shall be prepared and submitted to the Contract Administrator. Work on the repair shall not commence until the Contract Administrator has given written approval to proceed.

906.07.01.07.12.03 Approval for Critical Repairs

Repair procedures that are more severe than those described in CAN/CSA-S6, Subclause 10.23.5.4 are considered critical and shall be individually approved by the Contract Administrator before repair welding proceeds.

Critical repairs include those listed in CAN/CSA-S6, Clause 10.23.5.

906.07.01.07.13 Non-Destructive Testing of Fracture Critical Members

The fabricator shall maintain documentation of all visual and non-destructive testing for review and confirmation by the Contract Administrator. Documentation shall be submitted to the Contract Administrator upon completion of the project.

906.07.01.07.14 Repair of Welds

Any section of weld that does not meet the acceptance standards shall be removed, re-welded, and re-examined.

906.07.01.07.15 Bolted Construction

906.07.01.07.15.01 General

Bolted construction shall be according to CAN/CSA-S6, Clause 10.24.6.

Bolts shall be sufficiently long to exclude threads from the shear plane.

906.07.01.07.15.02 Plasma Arc Cutting of Holes

Plasma arc cutting of holes shall only be permitted in plates up to and including 20 mm in thickness. Plasma arc cut holes shall be produced by mechanically guided means and the diameter of the holes shall be greater than or equal to the thickness of the plate. When plasma arc cutting of holes is permitted, the cutting gas as well as the shielding gas shall be oxygen and the surface roughness shall not exceed 13 microns (500 micro-inches) as defined in ASME B46.1. Occasional gouges not more than 1.5 mm in depth are permitted. Thermally cut holes shall be 2 mm larger than the nominal diameter of the bolt and the taper shall not exceed 0.5 degrees.

906.07.01.07.15.03 Holes Drilled Using Numerically Controlled Machines

As an alternative to the shop trial assembly requirements of CAN/CSA-S6 when numerically controlled machines have prepared the boltholes, a check assembly consisting of the first components of each type of bolthole pattern to be made shall be undertaken to adequately demonstrate the accuracy of the drilling. If the check assembly is satisfactory, further assemblies of like components are not required. If the check assembly is unsatisfactory, the work shall be redone or repaired in a manner acceptable to the Contract Administrator.

906.07.01.07.15.04 Inspection

Inspection shall be according to CAN/CSA-S6 as required.

906.07.01.07.16 Tolerances

906.07.01.07.16.01 Dimensional and Workmanship Tolerances

Dimensional and workmanship tolerances shall be according to CSA W59 and Clause 10.24.7 of CAN/CSA-S6.

906.07.02 Transportation, Delivery, and Storage

The Contractor shall perform all work necessary to ensure safe loading, delivery, unloading, and storage of structural steel.

The work shall consist of loading the members, transporting them, and unloading at the site and shall include temporary works for access.

Structural steel shall be loaded for shipping in such a manner that it can be transported and unloaded at its destination without being excessively stressed, deformed, or otherwise damaged. Plate girders shall be transported with their webs in a vertical plane. When girders cannot be shipped with their webs in the vertical plane, static and dynamic forces during handling, transportation, and storage shall be determined using a dynamic load allowance of 100%. Computed stresses shall be according to CAN/CSA-S6, Clause 10.10 and the maximum cyclic stress range shall not exceed the constant amplitude fatigue threshold for the appropriate fatigue categories specified in CAN/CSA-S6, Table 10.4. All the calculations and associated sketches, including reasons why the girders cannot be shipped with the webs in the vertical plane, shall be submitted by the Contractor to the Contract Administrator for approval 7 Days prior to shipping. The calculations and sketches shall be signed and sealed by an Engineer.

Structural steel shall be stockpiled to avoid excessive stress deformation or other damage while stored.

The delivery schedule shall be provided to the Contract Administrator not less than 5 Days before any shipping begins.

Advertising by means of removable signing is permitted on elements only while in transit to the specified site. Painting of advertisements directly on elements is not permitted.

906.07.03 Erection

906.07.03.01 General

Erection shall be according to CAN/CSA-S6, Clause 10.24.10. Additional permanent material may be provided to ensure that the member capacities are not exceeded during erection, if approved by the Contract Administrator. The additional material shall be shown in the erection diagram.

The Contract Administrator shall be notified in writing of the starting erection date at least 14 Days prior to the commencement of field operations.

Repairs to erected material shall only be permitted after the Contract Administrator has approved the repair procedure.

Welding shall not be used to fill misplaced holes.

Hammering that can damage or distort the members is not permitted.

906.07.03.02 Falsework

Falsework shall be according to OPSS 919.

906.07.03.03 Connections

Holes made in the field shall be drilled or sub-drilled and reamed.

Any error that prevents the proper assembly and fitting of parts shall be reported and the proposed method of correction shall be submitted to the Contract Administrator. Corrective measures shall not commence until the submitted proposal is accepted.

Bolt heads shall be located on the outside faces of the exterior girders.

Bolt heads in field splices for box girders shall be located on the exterior surfaces.

906.07.03.04 Maintaining Alignment and Camber

The bridge shall be erected to the alignment and elevations specified in the Contract Documents.

906.07.03.05 Bearings

The installation of bearings shall be according to OPSS 922.

906.07.03.06 Coatings

Coating of new structural steel shall be according to OPSS 911.

906.07.04 Quality Control

906.07.04.01 General

Quality control shall be according to CAN/CSA-S6, Clause 10.24.8. The acceptance standards of CSA W59 for dynamically loaded structures shall also apply.

In addition to quality control measures instituted by the Contractor, the Contractor shall be responsible for the quality control procedures specified herein.

906.07.04.02 Control of Material

A record for each component shall be kept to identify the material as to heat number, corresponding mill test certificate, and colour coding or other identifying markings.

906.07.04.03 Visual Inspection

The Contractor's inspector shall carry out full visual inspection.

906.07.04.04 Non-Destructive Testing

906.07.04.04.01 General

An independent testing organization shall carry out all non-destructive testing of the welds for bridge structures by using radiographic, ultrasonic, magnetic particle, and liquid penetrant test methods.

A non-destructive testing technician shall do the testing.

Neither the technician nor the independent testing organization shall be changed without the approval of the Contract Administrator.

906.07.04.04.02 Notification of Testing

The independent testing organization shall be given at least 5 Days notice of when the work is ready for testing. Such notice shall include the type and quantity of work to be tested.

906.07.04.04.03 Testing of Welds

Radiographic, ultrasonic, or magnetic particle testing shall be carried out using procedures according to CSA W59.

The amount and location of welding to be tested shall not be less than:

- a) Visual inspection of all welds.

- b) Radiographic or ultrasonic inspection of groove welds in flanges and webs of built-up girders:
 - i. Flange splices in tension or stress reversal zones: 100% of all welds.
 - ii. Flange splices in compression zones: 100% of the weld of 1 in 4 splices.
 - iii. Web splices for 1/2 the depth from the tension flange: 100% of the weld length for each weld.
 - iv. Web splices for 1/2 the depth from the compression flange: 100% of the weld length of 1 in 4 splices.

If defects are found during testing of compression zones, two additional zones shall be tested for each zone exhibiting defects.

- c) Magnetic particle inspection of web-to-flange fillet welds:
 - i. Submerged-arc welds - 25% of length of each weld.
 - ii. Semi-automatic welds - 50% of length of each weld.
 - iii. Manual welds - 100% of length of each weld.
- d) Magnetic particle inspection of fillet welds in connection plates and stiffeners to which diaphragms or cross bracing are attached:
 - i. For 1/2 the depth from the tension flange: 100% of weld length of each weld.
 - ii. Transverse welds on tension flanges: 100% of weld length of each weld.
- e) Arc strikes shall be lightly ground and checked for cracks by magnetic particle inspection.

Radiographic and ultrasonic testing shall be performed prior to the assembly of the flanges to the webs.

906.07.05 Repair of Welds

The section of weld that does not meet the acceptance standards shall be removed, re-welded, and re-examined.

906.07.06 Inspection Reports

Inspection reports shall bear the seal and signature of an Engineer.

Copies of all inspection reports shall be submitted to the Contract Administrator.

906.07.07 Erected Girder Elevations

The top of flange elevations and top of splice plate elevations specified in the Contract Documents shall be checked and the elevations recorded and submitted to the Contract Administrator.

906.07.08 Certificate of Conformance Upon Completion of the Work

Upon completion of erection, the Contractor shall submit to the Contract Administrator a Certificate of Conformance sealed and signed by a Quality Verification Engineer. The Certificate shall state that the Work has been carried out in general conformance with the signed and sealed shop details, welding procedures, erection diagrams, erection procedure drawings, and Contract Documents.

906.07.09 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

906.08 QUALITY ASSURANCE

906.08.01 General

Visual inspection, non-destructive testing, and sampling shall be done in the fabricating shop and in the field by an Owner's inspector to confirm the material supplied, fabrication, and erection has been done as specified in the Contract Documents.

The Contractor shall supply electric power, scaffolding, protection from the weather, and free access for inspection and testing of material, to all aspects of the fabrication, delivery, and erection of the structural steel.

906.10 BASIS OF PAYMENT

906.10.01 Fabrication of Structural Steel - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Structural steel that is stored at the fabricator's premises or some other location away from the Working Area shall be paid for when the Contractor obtains a lease from the property owner that names the Owner as the tenant. The Owner shall provide the form of lease for this purpose that specifies payment of \$10.00 for the term of the lease. The Contractor shall retain full responsibility for the members.

**906.10.02 Delivery of Structural Steel - Item
Erection of Structural Steel - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

906.10.03 Shop and Field Inspection and Testing

The supply of electric power, scaffolding, protection from the weather, and access for material testing and inspection shall be the Contractor's responsibility at no extra cost to the Owner.

906.10.04 Bearings

Payment for the supply and installation of bearings shall be according to OPSS 922.

When the Contract does not contain a separate item for bearings and bearings are not paid as part of any concrete tender item according to OPSS 904, the Contract price for the erection of structural steel shall include full compensation for all labour, Equipment, and Material to supply and install the bearings.

Appendix 906-A, November 2012
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Grade and category of structural steel. (906.05.01)
- Bridge alignment and elevation. (906.07.03.04)
- Girder top flange and top splice plate elevations. (906.07.07)

OPSS 906 contains information written for provincial contracts. To ensure completeness of municipal Contract Documents, the designer should invoke Appendix 906-B. The appendix contains supplemental requirements that modify OPSS 906 so it can be used by a municipality in its contracts.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 3311.100	Deck Girders, Steel, Method of Obtaining Screed Elevations
OPSD 3311.900	Deck Girders, Steel Box, Access Hatch

Appendix 906-B, November 2012

FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

Supplemental Requirements for Using OPSS 906 in Municipal Contracts

OPSS 906, Structural Steel for Bridges, is amended as follows:

906.03 Definitions

Section 906.03 is amended by the deletion of the definitions for Certificate of Conformance and for Quality Verification Engineer.

Section 906.03 is amended by the addition of the following:

Certificate of Fabrication and Installation means a document issued by the design Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

906.04.02.02 Shop Details and Welding Procedures

The first paragraph of clause 906.04.02.02 is deleted in its entirety and replaced by the following:

The Contractor shall submit 5 sets of shop details and welding procedures to the Contract Administrator at least 14 Days prior to commencement of fabrication, for review. Prior to making a submission, the seal and signature of an Engineer shall be affixed on the shop details and welding procedures verifying that the details and procedures are consistent with the Contract Documents.

The second to last paragraph of clause 906.04.02.02 is deleted in its entirety.

906.04.02.03 Erection Diagrams and Erection Procedure Drawings and Calculations

The first paragraph of clause 906.04.02.03 is deleted in its entirety and replaced by the following:

The Contractor shall submit 5 sets of the erection diagrams and erection procedure drawings and calculations to the Contract Administrator at least 14 Days prior to commencement of erection, for review. Prior to making a submission, the seal and signature of an Engineer shall be affixed on the erection diagrams and erection procedure drawings and calculations verifying that the erection diagrams and erection procedure drawings and calculations are consistent with the Contract Documents.

The second to last paragraph of clause 906.04.02.03 is deleted in its entirety.

Appendix 906-B

906.04.02 Submissions

Subsection 906.04.02 is amended by the addition of the following:

906.04.02.06 Return of Submissions

Two copies of each submission shall be returned as one of the following:

- a) Stamped with the wording that allows for permission to construct. In this case, work can commence on receipt of the drawings by the Contractor.
- b) Stamped with the wording that allows for permission to construct as noted. In this case, work can commence on receipt of the drawings by the Contractor. The drawings shall be updated as noted and shall be sealed and signed by an Engineer stating the drawings have been revised according to the noted comments.
- c) Showing only required changes. In this case, the drawings shall be updated as required and the submission process repeated.

906.04.03 Interim Inspection after Fabrication of Components

Clause 906.04.03 is deleted in its entirety and replaced by the following:

Upon completion of fabrication of the components, and prior to erection, an Engineer shall conduct an interim inspection of the work to verify that the fabrication of components has been carried out in general conformance with the shop details, welding procedures, and Contract Documents and issue the fabricator written permission to proceed with the work.

906.07.03.01 General

The second paragraph of clause 906.07.03.01 is deleted in its entirety and replaced by the following:

The Contract Administrator shall be notified in writing of the erection starting date at least 3 weeks prior to the commencement of field operations.

906.07.03.03 Connections

The second paragraph of clause 906.07.03.03 is deleted in its entirety and replaced by the following:

Fabrication errors that prevent the proper assembly and fitting of parts shall be reported immediately to the Contract Administrator. The proposed method of correction shall be submitted to the Contract Administrator for review. Corrective measures shall not commence until written approval to proceed is issued by the Contract Administrator.

Appendix 906-B

906.07.08 Certificate of Conformance

Clause 906.07.08 is deleted in its entirety and replaced by the following:

906.07.08 Certificate of Fabrication and Installation

A certificate shall be submitted for all fabrication and installation work for which Working Drawings are submitted.

A completed certificate of fabrication and installation shall be submitted to the Contract Administrator upon completion of the structure erection. An Engineer's seal and signature shall be affixed on the completed certificate of fabrication and installation confirming that the work has been carried out in general conformance with the shop details, welding procedures, erection diagrams, erection procedure drawings, and Contract Documents.



CONSTRUCTION SPECIFICATION FOR STRUCTURAL WOOD SYSTEMS

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907.01 SCOPE

This specification covers the requirements for structural wood systems.

907.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

907.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

907.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 501	Compacting
OPSS 902	Excavating and Backfilling - Structures
OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete
OPSS 910	Stressing Systems for Post-Tensioning

Ontario Provincial Standard Specifications, Material

OPSS 1010	Granular - Base, Subbase, Selected Subgrade and Backfill Material
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1601	Wood - Material, Preservative Treatment and Shop Fabrication
OPSS 1860	Geotextiles

Ontario Ministry of Transportation Publications

Structural Manual

CSA Standards

B111-1974 (R2003)	Wire Nails, Spikes and Staple
G40.20-04/G40.21-04 (R2009)	General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
O86-09	Consolidation, Engineering Design in Wood
S6-06	Canadian Highway Bridge Design Code

ASTM International

A 47/A 47M-99 (2009)	Ferritic Malleable Iron Castings
A 307-10	Carbon Steel Bolts and Studs, 60000 psi Tensile Strength
A 653/A 653M-10	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process
A 722/A 722M-07	Uncoated High-Strength Steel Bar for Prestressed Concrete

907.03 DEFINITIONS

For the purpose of this specification, definitions in OPSS 1601 and the following definitions apply:

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Fastener means hardware used to connect wood members or components.

Girders means generally very large size beams and stringers or glued-laminated member for use in bending with load applied to the narrow face.

Groove and Dap means the wood base of a wood-concrete composite deck using alternating height laminations where the higher laminate is grooved and dapped according to CAN/CSA-S6.

Laminated Wood Deck means dimension lumber placed side by side on its narrow face to form a wood slab.

Lamination means dimension lumber sizes when used in a laminated wood deck.

Longitudinally Laminated Deck means a deck where the wood laminations are placed on edge and oriented parallel to the longitudinal centreline of the deck.

Notch and Spike means the wood base of a wood-concrete composite deck using uniform height laminations, where all laminations have square notches reinforced with spikes according to CAN/CSA-S6.

Reinforcing Spike means a common nail used to reinforce the shear key in notch and spike wood-concrete composite decks.

Stress-Laminated Wood Deck means a laminated wood deck, which is held together by pressure applied perpendicular to the laminations using high-strength bars according to CAN/CSA-S6.

Stringers means sawn wood that has a minimum thickness of 114 mm and a width at least 51 mm greater than the thickness for use in bending with load applied to the narrow face.

Transversely Laminated Deck means a deck in which the wood laminations are placed on edge and oriented transversely to the longitudinal centre line of the deck.

Truss Plates means a sheet of steel that has been punched by a special die, where the displaced material forms sharp teeth, used to connect laminations at butt joints in wood-concrete composite decks.

Wood-Concrete Composite Deck means a deck that has a laminated wood base made composite with a reinforced concrete overlay.

907.04 DESIGN AND SUBMISSION REQUIREMENTS

907.04.01 Submission Requirements

907.04.01.01 General

All Working Drawings, stressing details, and calculations shall bear the seal and signature of an Engineer.

At least 14 Days prior to commencement of work, 5 copies of any proposal shall be submitted to the Contract Administrator.

When other authorities are involved in the approval of the design or construction of a highway structure, the submission shall be made at least 5 weeks prior to commencement of the work. One additional set is required to be submitted for each authority.

907.04.01.02 Submission of Working Drawings for Fabrication and Fastening Details

At least 4 weeks before the commencement of fabrication, the Contractor shall submit 5 complete sets of the Working Drawings to the Contract Administrator.

Fabrication details shall include the following:

- a) The grade and species of all wood components and all necessary specifications.
- b) The type of preservative treatments to be used for all wood components, including the penetration, and retention required.
- c) Details of shop fabrication.
- d) Details of all fabrication to be performed in the field.
- e) Details of all field cuts and field boring.
- f) Special handling or protection details required in the shop, during shipping, or in the field.
- g) The field installation details of any temporary attachments such as running planks, barricades, and railings.
- h) Protective treatment of heat-treated alloy components.
- i) Fastening details.

907.04.01.03 Submission of Erection Procedures

Erection procedures shall bear the seal and signature of an Engineer.

At least 4 weeks before commencement of erection, the Contractor shall submit to the Contract Administrator, 5 complete sets of the erection procedures, including lifting point locations, details of all temporary supports, and prestressing procedures.

907.04.01.04 Return of Submissions

Two copies of each submission to be returned shall be marked as one of the following:

- a) Stamped with wording that allows for permission to construct.

In this case, work can commence upon the Contractor's receipt of the Working Drawings. A copy of the Working Drawings shall be available at the site prior to and during construction.

- b) Stamped with wording that allows for permission to construct as noted.

In this case, work can start upon the Contractor's receipt of the Working Drawings. The Working Drawings shall be updated as noted and shall have a stamp affixed that is signed by an Engineer stating that the Working Drawings have been revised according to the noted comments. A copy of the stamped updated Working Drawings shall be available at the site prior to and during construction.

- c) Showing only required changes.

In this case, the Working Drawings shall be updated as required and the submission process repeated.

907.05 MATERIALS

907.05.01 Wood

Wood shall be according to OPSS 1601.

907.05.02 Preservatives

The preservatives shall be according to OPSS 1601.

For wood structural systems in bridges, preservatives shall also be according to the CAN/CSA-S6 and the Structural Manual.

907.05.03 Fasteners and Hardware

907.05.03.01 Bolts, Rods, and Lag Screws

Bolts, rods, and lag screws shall be according to ASTM A 307 or CSA G40.20/G40.21.

907.05.03.02 Truss Plates

Sheet steel for manufacturing truss plates shall be according to ASTM A 653, Type A or Type B.

907.05.03.03 Split Ring and Shear Plate Connectors

Split ring and shear plate connectors shall be according to CSA O86.

907.05.03.04 Glulam Rivets

Glulam rivets shall be according to CSA O86.

907.05.03.05 Nails and Spikes

Nails and spikes shall be according to CSA B111.

907.05.03.06 Drift Pins

Steel used for drift pins shall have minimum yield strength of 280 MPa and shall be according to CSA G40.20/G40.21.

907.05.03.07 Washers

Steel washers shall be according to CSA G40.20/G40.21. Malleable iron casting washers shall be according to ASTM A 47M.

907.05.03.08 High-Strength Bars

High-strength bars shall be according to ASTM A 722M.

907.05.03.09 Galvanizing

All fasteners and hardware shall be hot dip galvanized according to CSA G164, after manufacture.

Heat-treated alloy components shall be galvanized according to the manufacturers specifications.

907.05.04 Granular Materials

Granular materials shall be according to OPSS 1010.

907.05.05 Geotextile

Geotextile shall be non-woven, Class II according to OPSS 1860, Table 1, with an FOS of 75-150 µm.

907.05.06 Concrete

Concrete shall be according to OPSS 1350 with a minimum 28-Day specified compressive strength of 30 MPa.

907.05.07 Steel Reinforcement

Steel reinforcement for concrete shall be according to OPSS 1440.

907.06 EQUIPMENT

907.06.01 Hydraulic and Mechanical Press

Hydraulic or mechanical presses capable of applying uniform pressure over the whole area of truss plates shall be used for the installation of all truss plates.

907.06.02 Hydraulic Jack System Stress-Laminated Wood Decks

The stressing equipment shall be according to OPSS 910.

The hydraulic jack system shall be capable of stressing a minimum of six post-tensioning locations at a time. For longitudinally laminated decks, the number of jacks shall not be less than those required to stress a length of deck equal to one half the width of the deck at the same time.

907.07 CONSTRUCTION

907.07.01 Handling and Storage of Wood

All wood shall be handled, stacked, and protected according to OPSS 1601.

907.07.02 Shop Fabrication

Shop preparation and fabrication shall be according to OPSS 1601.

907.07.03 Field Fabrication

Field fabrication shall only be permitted when specified in the Contract Documents.

Field cut portions of treated wood members shall not be buried or placed in contact with the ground.

Cutting and boring shall not puncture the internal voids of bridge decks containing the post-tensioning bars.

Field cuts, abrasions, and boreholes made in fabricated wood after preservative treatment shall be trimmed and treated to be according to OPSS 1601.

907.07.04 Fasteners

907.07.04.01 Bolts, Rods, and Lag Screws

Holes shall be prebored as specified in the Contract Documents. Holes shall be aligned and the bolts and rods shall be driven, with a hammer not larger than 0.5 kg, in order to make the connection. Lag screws shall be turned into the wood, not driven.

Holes for smooth dowels and drift pins shall be 1.5 mm less in diameter than the dowels or pins. Holes for galvanized bolts shall be bored with a bit 1.5 mm larger in diameter than the bolt.

Holes for lag screws shall have the same diameter and depth as the shank of the screw, plus a lead hole for the threaded portion with the diameter approximately 75% of the shank diameter.

Washers shall be placed under all bolt heads and nuts. Excess bolt lengths of more than 50 mm shall be cut off to a level where at least 5 threads are still extending beyond the nut. The cut ends of galvanized bolts shall receive 2 coats of zinc rich paint. After final tightening, all nuts shall be checked and threads burred effectively with a pointing tool to prevent loosening. Field cuts or damaged surfaces shall be touched-up with a zinc rich paint within 10 hours of exposure.

907.07.04.02 Nailing for Laminated Decks

Gauge lines for horizontal nailing shall be followed. Nails in the upper gauge line shall be inclined slightly downward and those in the lower gauge line inclined slightly upward. The nailheads shall be flush and well set so that they do not protrude from the surface. Power nailing devices shall be permitted for stress-laminated wood decks according to the CAN/CSA-S6.

907.07.05 Wood in Cribs

Excavation shall be according to OPSS 902.

Cribs shall be erected to the dimensions shown in the Contract Documents with each layer horizontal before placing the next. Wood with the least surface oils shall be located in or nearest to the water. Wood, which appears to be more heavily treated, shall be placed at the back of the crib against the ground.

The cribs shall be filled to 1 m below the top of the crib with boulder or rock fragments having dimensions in the range 200 to 600 mm. The top metre of the cribs shall be filled with Granular A or B. The granular material shall be protected against migration into the rock layer by the placement of geotextile fabric between the rock and the granular layers. The geotextile shall be placed uniformly, free of tears and as specified in the Contract Documents. All seams shall have a minimum overlap of 500 mm and the geotextile shall be fixed to prevent movement. Filling of the cribs shall be such that distortion is avoided. Fill material shall be placed in even horizontal layers and shall be compacted according to the requirements of OPSS 501.

907.07.06 Placement of Members

907.07.06.01 Stringers and Girders

Stringers and girders shall be placed and adjusted when necessary so that full and accurate bearing is achieved on the supports. Sawn wood members shall be oriented so that elevation differences between adjacent members, due to natural curvatures along their lengths, are minimized.

907.07.06.02 Laminated Wood Deck

Each lamination shall be placed in the bridge so that initially, full and accurate bearing is achieved. Subsequently the alignment of predrilled holes in stress-laminated decks or slots in composite wood-concrete decks shall be achieved. Finally, the laminations shall be brought to position by nailing.

907.07.07 Stress-Laminated Wood Decks

907.07.07.01 Stressing

Hydraulic jacks shall be used for stressing the stress-laminated wood decks. For transversely laminated decks, all tendons shall be uniformly stressed at the same time.

High-strength bars shall be stressed to the forces shown in the Contract Documents. The tensioning shall be performed in the following sequence:

- a) Initial stressing - at time of construction of deck.

The initial stressing shall consist of two stressing operations not less than 12 hours apart.

- b) 1st restressing - not less than 2 weeks after completion of the initial stressing.
- c) 2nd Restressing - not less than 4 weeks after the 1st restressing.

The allowable variation of prestressing force in each bar shall be 5%.

The Contract Administrator may increase the time periods between restressings, when the ambient temperature is below 0 °C.

907.07.07.02 Securing of Deck

The deck shall not be secured to the supporting members, except as specified in the Segmental Construction clause, until after the 1st restressing. When a deck requires restraint against buckling during stressing, the restraint shall not inhibit free movement of the deck perpendicular to the laminates.

907.07.07.03 Segmental Construction

When a deck is to be constructed in segments, each segment shall undergo all restressings as specified in the Stressing clause before being installed. The method of installation of the segments shall be such that the final assembled deck is continuous.

When the method of installation requires the temporary release of stressing in a segment in order to facilitate installation, that segment shall then be stressed twice before any segments are attached to it. The first stressing shall be at the time of installation of that segment. The second stressing shall be performed no sooner than $4 \times T$ after the first stressing, where T equals the total time period the segment was not under stress.

907.07.08 Wood-Concrete Composite Decks

907.07.08.01 Wood Base Construction

Wood-concrete interface construction of the deck shall be according to CAN/CSA-S6.

907.07.08.02 Concrete

Concrete placement and testing shall be according to OPSS 904.

907.07.08.03 Steel Reinforcement

Steel reinforcement for concrete shall be placed according to OPSS 905 and CAN/CSA-S6.

907.07.08.04 Reinforcing Spikes

Reinforcing spikes, for notch and spike construction, shall be driven into the top of the laminations in every notch of alternate laminations. These spikes shall be inclined at about 30° from the vertical toward the nearest internal support or end support. If the notches in adjacent laminations are staggered by more than 50 mm, then all laminations involved shall contain reinforcing spikes. Reinforcing spikes shall be a minimum of 50 mm longer than the full vertical depth of the wood deck.

907.07.09 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

907.09 MEASUREMENT FOR PAYMENT

907.09.01 Actual Measurement

907.09.01.01 Wood in Cribs

Measurement of wood in cribs shall be by volume in cubic metres using dressed dimensions of the wood with no deductions for grooves, notches, and holes.

907.09.02 Plan Quantity Measurement

When measurement is by plan quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

907.10 BASIS OF PAYMENT

**907.10.01 Wood in Structure - Item
Wood in Cribs - Item**

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

When rock is available on the Contract, no deduction shall be made from the tender item "Rock Excavation, Grading," for the quantity of rock used in cribs.

907.10.02 Excavation for Wood Cribs

When excavation for wood cribs overlaps excavation for other work, measurement of the overlapping excavation shall be according to the specification for such other work.

Appendix 907-A, April 2011
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The following should be specified in the Contract Documents:

- Allowable field fabrication. (907.07.03)
- Prebored holes for bolts, rods, and lag screws. (907.07.04.01)
- Crib details. (907.07.05)
- Geotextile placement details. (907.07.05)
- Stressing forces for high-strength bars. (907.07.07.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



NOTICE TO USERS OF OPSS 908

CONSTRUCTION SPECIFICATION FOR METAL TRAFFIC BARRIERS AND METAL RAILINGS FOR STRUCTURES

OPSS 908 has been removed from this
OPS volume

The provincial version of OPSS 908 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 908

The municipal version of OPSS 908 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 908

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



**CONSTRUCTION SPECIFICATION FOR
PRESTRESSED CONCRETE - PRECAST MEMBERS**

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909.01 SCOPE

This specification covers the construction requirements for fabrication, delivery, and erection of concrete members with steel reinforcement.

909.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

909.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

909.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete
OPSS 910	Stressing Systems for Post Tensioning
OPSS 919	Formwork and Falsework
OPSS 929	Abrasive Blast Cleaning - Concrete Construction

Ontario Provincial Standard Specifications, Material

OPSS 1002	Aggregates - Concrete
OPSS 1213	Hot Applied Rubberized Asphalt Waterproofing Membrane
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1442	Epoxy Coated Steel Reinforcement for Concrete

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

- LS-407 Method of Test for Compressive Strength of Moulded Cylinders
- LS-426 Method of Test for Compressive Strength of High Performance Concrete Cylinders
- LS-432 Method of Test for Microscopical Determination of Air Void System Parameters in Hardened Concrete
- LS-433 Method of Test for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Structural Manual

MTO Form:

PH-CC-322 Concrete Construction Report

CSA Standards

- A23.2-3C Making and Curing Concrete Compression and Flexural Test Specimens *
 - A23.2-1D Moulds for Forming Concrete Test Cylinders Vertically *
 - A23.4-09 Precast Concrete Material and Construction
 - G40.20/G40.21-04 General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
 - G164-M92 (R2003) Hot Dip Galvanizing of Irregularly Shape Articles
 - G189-1966 (R2003) Sprayed Metal Coatings for Atmospheric Corrosion Protection
 - S6-06 Canadian Highway Bridge Design Code
 - W47.1-09 Certification of Companies for Fusion Welding of Steel Structures
 - W59-03 (R2008) Welded Steel Construction (Metal Arc Welding)
 - W186-03 (R2007) Welding of Reinforcing Bars in Reinforced Concrete Construction
- * [Part of A23.1-09/A23.2-09 - Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]

ASTM International

- B 633-07 Electrodeposited Coatings of Zinc on Iron and Steel
- C 171-07 Sheet Materials for Curing Concrete

American Association of State and Highway Transportation Officials (AASHTO)

- M182-05 (2009) Burlap Cloth made from Jute or Kenaf and Cotton Mats

909.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Bed means the assembly consisting of platform, forms and end blocks in which the members are cast.

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Design Proposal means a Contractor's submission of proposed changes, when engineering design is required.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Laitance means a layer of weak and nondurable material on the surface of the concrete containing cement and fines from aggregates, brought by bleeding water to the top surface concrete.

Lot means all the members of the same member type, cast during 7 consecutive Days.

Member means a precast concrete prestressed girder.

Member Type means a member differentiated by its cross-section shape such as Box, I, or T.

Post-Tensioning means a method of prestressing in which tendons are tensioned after the concrete has reached a predetermined strength.

Precaster means the party who produces the members.

Prestressed Concrete means reinforced concrete in which internal stresses have been initially introduced so that subsequent stresses resulting from dead load and superimposed loads are counteracted to a desired degree. This may be accomplished by pretensioning or post-tensioning.

Pretensioning means a method of prestressing in which tendons are tensioned before the concrete is placed.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Repair Proposal means a Contractor's submission when repairs to the members are required.

Strand means a group of wires laid helically over a central core-wire.

Sweep means the lateral deviation from straightness of a member with respect to its design centre line.

Tendon means a high strength steel element consisting of one or more wires, strands or bars; used to impart prestress to the concrete.

909.04 DESIGN AND SUBMISSION REQUIREMENTS

909.04.01 Design Requirements

909.04.01.01 General

The design shall be according to CAN/CSA S6 and the Structural Manual.

909.04.01.02 Permissible Changes from the Contract Drawings

909.04.01.02.01 General

Changes from the Contract Drawings are permitted and may be implemented by the precaster, without prior approval from the Owner, provided they meet the requirements of this specification.

909.04.01.02.02 Permissible Changes to Prestressing of Members

The prestressing strand pattern may be adjusted to suit production requirements provided all changes meet the original design strength without adversely affecting other components of the structure. If the centre of gravity of the strands at the interior hold down closest to mid-span is within ± 10 mm of the original design, then one or more of the following adjustments shall be permitted provided that both the serviceability and ultimate limit states capacities are not adversely affected:

- a) Provide additional strands with a lower jacking stress provided the total prestress force is within $\pm 2\%$ of the original design.
- b) Use of imperial strand spacing in lieu of metric, where 25 mm = 1" and 50 mm = 2".
- c) Addition of one hold-down per end is added towards the member end at the same spacing as the original design.
- d) One less hold-down per end when the hold-down closest to mid-span is deleted.
- e) Increase or decrease the number of strands in each hold-down group.
- f) Increase of vertical strand spacing between hold-down points from 25 mm up to 50 mm.

909.04.01.02.03 Permissible Changes to Reinforcing of Members

The stirrup projection may be adjusted from that shown on the original design, based on details such as the predicted camber, provided it meets the deck embedment range indicated elsewhere in the Contract Documents.

Spacing of stirrups around blockouts for diaphragms may be adjusted, as long as the minimum spacing requirements of CAN/CSA S6 are satisfied, and up to two stirrups may be added in order to maintain the total reinforcement requirements.

909.04.01.02.04 Other Design Details

Details limited to those below may be adjusted to suit production requirements, provided all changes meet the original design without adversely affecting other components of the structure:

- a) Dowel holes and inserts may be adjusted vertically within ± 75 mm from the location shown on the original design to avoid any conflict with tendons.
- b) Undercut dimensions may be adjusted to accommodate the predicted camber.
- c) Additional pockets and hardware for temporary bracing may be added.
- d) Additional temporary post-tensioning or pre-tensioning for shipping and handling may be added provided they do not adversely affect the girders at any stage.

The production length of the member may be adjusted to account for elastic shortening.

909.04.01.03 Temporary Bracing

Temporary bracing for members shall be designed according to CAN/CSA S6 using a wind load specific for the location and having a return period of 10 years if the members are to be permanently connected within the same construction season. If the members are not to be permanently connected within the same construction season, the return period to be used in the design shall be 25 years.

909.04.02 Submission Requirements

909.04.02.01 Working Drawings

The Contractor shall submit 3 sets of fabrication Working Drawings, including supporting documentation, to the Contract Administrator at least 7 Days prior to commencement of fabrication of the members, for information purposes only. Prior to making a submission, the design Engineer and the design-checking Engineer shall affix their seals and signatures on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

When other authorities are involved in the approval of the design or construction of a highway structure, submissions shall be made at least 5 weeks prior to commencement of work and one additional copy of the submission shall be provided for each authority. The requirements of each authority and the Owner, as stated elsewhere in the Contract Documents, shall be satisfied prior to commencement of the Work.

The Working Drawings shall include the following information:

- a) Member details.
- b) Prestressing reinforcing steel size, grade, location, and jacking force as required by the design.
- c) Hold-down locations and forces.
- d) Reinforcing steel schedules.
- e) Lifting point locations.
- f) Details and location of all temporary supports.
- g) All other applicable details.

The supporting documents shall include the following information:

- a) A letter signed and sealed by an Engineer listing all permitted changes made along with supporting calculations. The letter shall state that the changes have not adversely affected the member capacities.
- b) Handling and erection procedures, including calculations and lifting point locations.
- c) Details of bracing installed to provide adequate support and stability to the member during construction.

909.04.02.02 Concrete Mix Design

The Contractor shall be responsible for the concrete mix design and shall submit the concrete mix design to the Contract Administrator according to the mix design requirements of OPSS 1350.

909.04.02.03 Concrete Plant Certification

The precast concrete plant certificate verifying compliance with the certification requirements of the Canadian Standards Association (CSA) under the category Precast Concrete Products-Structural, Prestressed; or the Canadian Precast/Prestressed Concrete Institute (CPCI), Group B, Products and Group BA, Bridge Products with Architectural Finishes, Category B4, shall be submitted to the Contract Administrator as part of the concrete mix design submission.

Documentation verifying certification of the concrete production facility by the Ready-Mixed Concrete Association of Ontario shall be submitted when concrete is supplied by an external concrete supplier.

909.04.02.04 Control of Concrete Temperature

One week prior to the commencement of fabricating the members, a description of the method for monitoring and effectively controlling the temperature of the concrete shall be submitted to the Contract Administrator, for information purposes only. The description shall include the method of controlling the concrete temperature during the curing and protection period.

909.04.02.05 Precast Report

A precast report shall be submitted to the Contract Administrator for each shipment of members, prior to shipping the members. The report shall contain the following information:

- a) List of members in the shipment, including their ID number and description.
- b) The mill certificates for the strands, along with the elongation calculations based on the actual material properties specified in the mill certificate of the strands used in the work.
- c) Record of the jacking force, elongations, and corrections used for temperature variation.
- d) Temperature control records, including location of thermocouple wires.
- e) Summary of material test results for plastic concrete: air content, slump, and concrete temperature.
- f) Summary of material test results for hardened concrete: transfer strength, confirmation of the projected 28-Day compressive strength, and air void system parameters. If test results are not available at the time of shipping, they may be submitted within 4 Business Days following completion of testing.
- g) Summary of all measurements and inspections required herein, including the concrete cover, crack measurement summary, tolerances, and surveys for geometric control.
- h) Documentation that the Contractor identified, evaluated, and corrected all repairable defects, as detailed under the clause on Repair of Defects and Deficiencies Repairable by Standard Methods.
- i) A letter from the Quality Verification Engineer (QVE), giving the Contractor permission to proceed with the work. The letter shall state that the QVE has conducted an interim inspection and verified that the fabrication of members and required testing have been carried out in general conformance with the sealed and signed Working Drawings, supporting documents, and Contract Documents.

909.04.02.06 Design Proposals

Five copies of the design proposal shall be submitted to the Contract Administrator for acceptance. The design proposals shall bear the seal and signature of the design Engineer and the design checking Engineer. The Contractor shall not proceed with the proposed changes until the design proposal has been accepted by the Contract Administrator.

The Contract Administrator shall respond to the Contractor within 10 Business Days of receiving the proposal.

909.05 MATERIALS

909.05.01 Bearing Plate

The bearing plate shall meet the requirements of CSA G40.20/G40.21, Grade 300W or greater.

Anchor studs shall be a headed type and meet the requirements of CSA W59 M and shall be welded to the bearing plates prior to galvanizing.

All surfaces shall be hot dipped galvanized and meet the requirements of CAN/CSA G164 or shall be zinc metallised according to CSA G189.

909.05.02 Burlap

Burlap shall be according to AASHTO M182, Class 4, and shall be free from substances that are deleterious to concrete. The burlap shall have no tears or holes.

909.05.03 Concrete

Concrete materials and production shall be according to OPSS 1350 with the following exceptions and amendments:

- a) Compressive strength shall be as specified in the Contract Documents.
- b) The air void system in hardened concrete when tested according to LS-432 shall be:
 - i. Air Content: 3.0% minimum
 - ii. Spacing Factor: 0.200 mm maximum
- c) Rapid chloride permeability of concrete containing silica fume at 28 to 32 Days shall be equal to or less than 1,000 coulombs and rapid chloride permeability of all other concrete at 28 Days shall be equal to or less than 2,500 coulombs.
- d) Aggregates shall be according to OPSS 1002 with the exception that the maximum nominal size of coarse aggregate shall not exceed 19.0 mm.
- e) Slag aggregate shall not be used.
- f) Superplasticizer may be added to the mix at time of batching for all types of concrete.

909.05.04 Concrete Sealers

Concrete sealers shall be from the Owner's list of acceptable sealers.

909.05.05 Elastomeric Coating

Elastomeric Coating shall meet the requirements of OPSS 1213.

909.05.06 Formwork

All formwork shall be according to OPSS 919 and CAN/CSA A23.4. Forms shall be fabricated to meet the dimensional tolerances and finishes required herein.

909.05.07 Hardware

All hardware shall be non-corroding or be galvanized according to CAN/CSA G164.

The hold down device may be black steel, however, the surfaces of the hold down device located within 40 mm of the concrete surface shall be chromate coated over an electrodeposited coating of zinc according to ASTM B 633.

909.05.08 Moisture Vapour Barrier

The moisture vapour barrier shall be a white opaque polyethylene film according to ASTM C 171 and shall not be less than 100 µm thick.

909.05.09 Post-Tensioning Material

Post-tensioning material, including grout shall be according to OPSS 910.

909.05.10 Proprietary Patching Materials

Proprietary patching materials shall be from the Owner's pre-qualified list of concrete patching materials. The list of proprietary patching material shall be obtained from the Contract Administrator.

909.05.11 Steel Reinforcement

Steel reinforcement shall be according to OPSS 905, OPSS 1440, and OPSS 1442.

909.05.12 Strand Splices

Strands shall not be spliced.

909.06 EQUIPMENT

909.06.01 Chipping Hammers

Chipping hammers shall have a maximum weight of 9.0 kg and a maximum piston stroke of 102 mm. All hammers shall have the manufacturer's name and model number engraved on them by the manufacturer. All information must be legible.

909.06.02 Pretensioning and Post-Tensioning

Pretensioning equipment shall be according to CSA A23.4. Post-tensioning equipment shall be according to OPSS 910.

909.06.03 Thermocouples and Dataloggers

Thermocouples and associated instrumentation shall have an accuracy of ± 1.5 °C and shall be capable of recording temperature and instantaneously displaying the temperature.

909.07 CONSTRUCTION

909.07.01 General

The Contractor shall notify the Contract Administrator in writing at least 7 Days prior to commencement of fabrication.

Each member shall be identified with a unique number and the date of casting. The information shall be marked on the members and shall remain visible for the duration of construction. When the information is stencilled, indelible ink or paint shall be used.

909.07.02 Precast Plant Certification

Members shall be fabricated by a plant certified by the Canadian Standards Association (CSA) under the category Precast Concrete Products-Structural, Prestressed; or by the Canadian Precast/Prestressed Concrete Institute (CPCI), Group B, Products and Group BA, Bridge Products with Architectural Finishes, Category B4.

909.07.03 Pretensioning

Tendons shall not be tensioned in the deflected position, unless the hold-down device used permits free movement of the strand and the use of the device has been tested by its manufacturer to ensure that the final stress along the full length of the tendon is uniform.

909.07.04 Welding

Welding of steel hardware including shear studs shall be according to CSA W59 and shall be performed by a qualified welder working for a company certified by the Canadian Welding Bureau according to CSA W47.1.

Welding of reinforcing steel bars shall be according to CSA W186 and performed by a qualified welder working for a company certified by the Canadian Welding Bureau according to CSA W186.

909.07.05 Steel Reinforcement

The placement of steel reinforcement shall be according to OPSS 905, with the exception or addition or both of the placing tolerances listed below:

- a) Vertical position of prestressing tendons: + 5/-10 mm
- b) Length of debond on prestressing tendons: ± 50 mm
- c) Projection of positive moment connection reinforcing steel at girder ends: ± 25 mm
- d) Stirrup spacing: ± 15 mm when spacing is 100 mm or less
 ± 25 mm when spacing is greater than 100 mm
 ± 30 mm when spacing is 300 mm or greater

909.07.06 Formwork

Formwork shall be according to OPSS 919.

909.07.07 Placing of Sheaths and Anchorages

When members are to be post-tensioned, the sheaths and anchorages shall be placed according to OPSS 905 except that the placing tolerances shall be ± 5 mm at splice points and ± 10 mm elsewhere.

909.07.08 Placing Concrete

The temperature of formwork, steel reinforcement, or the material on which the concrete is to be placed shall not exceed 30 °C.

The placing of concrete shall be according to OPSS 904, with the exception that the temperature of the formwork, steel reinforcement, or the material on which the concrete is to be placed shall be at a minimum temperature of 5 °C, prior to the placing operation. After discharging of concrete has started, one addition of superplasticizer shall be allowed, provided there is sufficient remaining time for mixing and testing. The slump and air content shall be re-tested if the mix is re-dosed.

During the placing operation, all exposed concrete surfaces shall be covered with water saturated burlap, within 2 to 4 m of the concrete reaching the top of the forms.

909.07.09 Concrete Finishing

The top surface of prestressed members, against which new concrete is to be placed, shall be intentionally roughened while it is sufficiently plastic so that the depth of the indentations is at least 5 mm and the spacing is not greater than 15 mm.

All concrete surfaces against which new concrete is to be placed shall be clean, sound, and free from any loose particles and laitance.

The following surfaces shall be abrasive blast cleaned according to OPSS 929, prior to shipping the members:

- a) Top portion of members containing laitance.
- b) The portion of the sides and end of the member against which new concrete is to be placed.

909.07.10 Control of Temperature

During production and during moist curing, moisture retention, and protection periods, the following temperature requirements shall be met:

- a) The concrete temperature shall not exceed 70 °C.
- b) The concrete temperature shall not fall below 10 °C before the concrete has reached 75% of the specified 28-Day compressive strength.
- c) The temperature difference between the concrete temperature of the member, and the conditions to which it is to be exposed shall not exceed 20 °C along any part of the member.

909.07.10.01 Temperature Records

Thermocouples, data loggers, handhelds units, and associated hardware shall be used to monitor the temperature of the member and the ambient conditions to which the member is exposed.

A sufficient number of thermocouples and thermocouple wires shall be installed to ensure compliance with the standard. As a minimum, thermocouples shall be installed to measure the following:

- a) Air temperature that the member is exposed or is to be exposed to.
- b) Concrete temperatures at the following locations:

For I-members

- i. In the middle of the web, 1 m from each end of the member.
- ii. In the middle of the web at mid-span.
- iii. In the middle of the bottom flange at mid-span.

For Box-members

- i. In the middle of the solid section at each end of the member.
- ii. In the middle of the bottom slab at mid-span.

Recording of the concrete temperatures shall begin at the start of the placing operation and continue until the moist curing, moisture retention, and protection periods are complete. For each member, the listed temperatures shall be recorded at intervals of 30 minutes or less.

The Contract Administrator shall be provided with necessary access, instrumentation, and equipment to verify temperature readings instantaneously. The thermocouples and data loggers shall be left in place until the end of the monitoring period.

909.07.11 Curing and Protection

909.07.11.01 Curing - General

Moist curing shall be applied for 48 hours followed by a 48-hour moisture retention period.

Concrete containing silica fume shall be moist cured for 7 Days, regardless of the ambient conditions.

During the moist curing and moisture retention period, the members may be exposed to ambient conditions for no more than a cumulative total of 3 hours for the purposes of form removal, release of strands at transfer strength, filling of bug holes, inspection, removal from the bed, and storage.

909.07.11.02 Moist Curing

During the first 48 hours after concrete placement, exposed surfaces shall be moist cured by any of the methods described below.

- a) Saturated burlap.
- b) Water spray or misting.
- c) Steam.
- d) Other means of maintaining 100% relative humidity next to the concrete surface.

Surfaces covered by the forms are not considered exposed. If forms are removed within the first 48 hours, all concrete surfaces shall be immediately moist cured by the positive addition of moisture for the duration of the 48 hours, according to the methods noted above.

Spray or steam to raise the ambient temperature above 30 °C, shall not be applied until after the concrete has attained its initial set. Steam, heat, or forced air shall not be directed on the concrete, forms, reinforcing steel or tendons. There shall be free circulation of steam, heat, and forced air around the top, sides, and ends of the members. The members shall be heated evenly. Concrete surfaces shall not be exposed to combustion gases.

All water shall be removed from and precautions taken to prevent the re-entrance of water into, the sheaths or any internal voids.

909.07.11.03 Moisture Retention

After moist curing has been completed, member surfaces shall be completely covered by moisture vapour barrier to protect members from moisture loss for a period of 48 hours.

At the option of the Contractor, moist curing methods may be continued during this period.

909.07.11.04 Protection from Cold

Prior to full exposure and after the moist curing and moisture retention periods, members that are to be exposed to temperatures less than 5 °C shall be protected from moisture loss for a minimum of an additional 3 Days. The protection period shall be extended beyond 3 Days, if required to meet the Control of Temperature clause.

All members must be dry prior to exposing them to temperatures below 0 °C.

909.07.12 Transfer of Prestressing Force

The prestressing force shall not be transferred to the members until the transfer strength specified in the Contract Documents has been reached. The prestressing force shall be transferred gradually and in a sequence that ensures eccentricities are kept to a minimum.

909.07.13 Treatment at Ends of Members

The prestressing tendons at ends of members that are to be encased in concrete shall be cut off 25 mm beyond the ends of the beams. The prestressing tendons at the end of members that are not to be encased in concrete shall be cut back to recess the cable 25 mm from the end of member. The recess shall be cleaned, filled with a proprietary patching material, and the ends of the members coated with elastomeric coating.

909.07.14 Quality Control

909.07.14.01 General

The Contractor shall carry out sufficient quality control testing and inspection to ensure that the concrete meets the requirements of the Contract Documents.

909.07.14.02 Sampling and Testing of Plastic Concrete

The Contractor shall be responsible for all aspects of sampling and testing of the plastic concrete for slump, air content, and temperature according to OPSS 1350. The results of these tests shall be recorded. The minimum frequency of testing shall be at least once for each load of concrete delivered by a truck mixer, or once for every 7 m³ of concrete for non-truck mixers until satisfactory control is established.

Satisfactory control is established when three consecutive tests of concrete are within the specified requirements, without field adjustments. If any field adjustments are required, testing shall continue until three consecutive tests meet the requirements with no field adjustments.

After satisfactory control has been established, testing shall be carried out on every third load delivered by a truck mixer, or at a delivery frequency of 21 m³ of concrete for non-truck mixers.

Sampling and testing of slump, air content, and temperature of plastic concrete, and casting of cylinders for determination of hardened concrete properties shall be carried out by a person holding either of the following certifications:

- a) CCIL Certified Concrete Testing Technician
- b) ACI Concrete Field Testing Technician, Grade 1

The person shall have a valid original card issued by the certifying agency in his or her possession at all times.

909.07.14.03 Transfer Strength

The Contractor shall demonstrate that the transfer strength specified in the Contract Documents has been achieved prior to transfer of prestressing force.

The Contractor, when requested by the Owner, shall participate in standard cylinder correlation strength testing programs conducted by the Ministry of Transportation.

909.07.14.04 Concrete Cover Measurement

The Contractor shall carry out, at the precaster's facility, a cover meter survey on all members until satisfactory control is established. For each lot, satisfactory control shall be established when three consecutive members of the same design are within the specified tolerances. After satisfactory control has been established, testing shall be carried out on every fifth member. If testing indicates that cover measurements for a member do not meet the tolerances specified in Table 1, testing shall resume on each member until satisfactory control is re-established.

Readings shall be taken at locations 300 mm from both ends, at mid-span, and at intervals not exceeding 5 metres along the length of the member.

For I-members, readings shall be taken at each location, as detailed below:

- a) Top of web, both sides.
- b) Bottom of web, both sides.
- c) Mid-height of each side of bottom flange.
- d) Underside of member, located at 150 mm from both edges of flange.

For box members, readings shall be taken at each location, as detailed below:

- a) Top of web, exterior sides.
- b) Bottom of web, exterior sides.
- c) Underside of member, located at 400 mm from both edges of flange.

909.07.14.05 Dimensional Measurements

The Contractor shall carry out measurements on each member to determine compliance with tolerance requirements. Members shall meet the tolerances specified in Table 1.

909.07.15 Sampling for Quality Assurance

Concrete shall be sampled on a lot basis.

909.07.15.01 General

The Contractor shall be responsible for all aspects of preparation, storage, and transportation of cylinders to determine compressive strength, air void system parameters, and rapid chloride permeability. Cylinders shall be 100 mm in diameter and 200 mm long. Samples shall be taken after all field adjustments have been made to the load of concrete.

Concrete cylinders shall be cast, cured, handled and transported according to CSA A23.2-3C. The specimens shall be delivered to the ministry's regional quality assurance laboratory, as directed by the Contract Administrator.

Moulds shall be according to CSA A23.2-1D, with a lid. The lids shall be chemically and physically compatible with the concrete and shall provide a watertight seal for the moulds.

909.07.15.02 28-Day Compressive Strength

The Contractor shall cast one set of acceptance and at his discretion cast one set of referee cylinders for each lot. Both sets of cylinders shall be cast from the same batch of concrete.

One set shall consist of three cylinders.

Test information shall be recorded on MTO form PH-CC 322. The forms shall be submitted with the concrete cylinders.

909.07.15.03 Air Void System and Rapid Chloride Permeability

The Contractor shall cast 1 cylinder from each lot for determination of air void system parameters of hardened concrete and 2 cylinders from each lot for determination of rapid chloride permeability. Each cylinder shall be cast from concrete from a different member in the lot.

909.07.15.04 Sampling of Steel Reinforcement

The Contractor shall retain samples of steel reinforcement according to OPSS 905 for the duration of the Contract and deliver them to the Owner when requested. Samples shall be delivered by the Contractor to:

Head, Concrete Section
Ontario Ministry of Transportation
Room 15, Building C
1201 Wilson Avenue
Downsview, Ontario M3M 1J8

909.07.16 Access for Quality Assurance

The Contractor shall supply electrical power, scaffolding, protection from the weather, and unhindered access to Owner's representatives for inspection and testing of all fabrication, delivery, and erection of prestressed concrete precast members.

For the purposes of cover meter and dimensional measurements, the Contractor shall clear all debris and obstructions and provide the Owner's representative with access.

909.07.17 Delivery

The Contractor shall notify the Contract Administrator in writing, 3 Days prior to delivery of the members.

Delivery shall include transportation and storage of the members. Transportation and storage shall be according to CAN/CSA A23.4. The work shall consist of loading of the members, delivery, unloading, and storage at the storage site and shall include temporary works for access.

Members shall be loaded for shipping in such a manner that they can be transported and unloaded at their destination without being damaged or exposed to stresses for which they were not designed.

Members shall be handled and transported with their webs in a vertical plane, and the points of support during lifting, storing, and transporting shall be according to the Working Drawings.

Members, when stored shall be stored in such a manner to avoid excessive stress or other damage.

Advertising by means of removable signing is permitted on elements only while in transit to the storage site. Any permanent markings on a surface that would be visible after erection shall not be permitted.

909.07.18 Erection

The Contractor shall notify the Contract Administrator in writing of the erection date at least 3 Days prior to the commencement of field erection operations. Erection shall be according to CAN/CSA A23.4.

The work shall consist of erection and stabilization of the members during construction. Members shall be lifted and placed in a manner to ensure they are not overstressed, unstable, or unsafe at any time.

The Contractor shall keep a copy of the Working Drawings on the site and accessible to the Contract Administrator during erection of the members.

The erection tolerance of members shall be ± 15 mm on the bearing in both the longitudinal and transverse directions.

For box members placed side-by-side, accumulated tolerance differences shall be distributed equally along the width of the structure. The maximum accumulated increase or decrease in total width of the members shall not exceed 70 mm with 35 mm maximum on either side.

The forces resulting from the lifting devices acting on the members shall not be inclined to the vertical at an angle greater than 30 degrees. All lifting devices for members shall be removed prior to the deck being poured.

CPCI girders and other members that may experience stability problems during construction shall be braced individually by attaching each end to the respective substructure element, immediately upon erection.

909.07.19 Repair of Defects and Deficiencies Repairable by Standard Methods

The Contractor shall repair any individual member having one or more of the defects and deficiencies identified in Table 2, according to the repair method specified. Such repairs do not require proposals or owner approval. Where more than one of the defects or deficiencies listed in Table 2 are located in the same area in the member, the contractor needs to submit a repair proposal. All causes, preventative actions, and corrective actions, including repair methods and materials used shall be documented.

909.07.19.01 Assessment of Repair

When defects or deficiencies occur, at the discretion of the design Engineer, a visual inspection may be conducted or other measures required, such as cores to be taken to assess the effectiveness of the repairs.

The filling of core holes shall be according to OPSS 1350.

909.07.20 Certificate of Conformance

Within 5 Business Days of erecting all the members within a stage, the Contractor shall submit to the Contract Administrator a Certificate of Conformance sealed and signed by a Quality Verification Engineer. The Certificate shall identify the members and state that the Work has been carried out in general conformance with the signed and sealed documents, which include the Working Drawings, supporting documents, and Contract Documents.

909.07.21 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

909.08 QUALITY ASSURANCE

909.08.01 General

The acceptance of members shall be according to the requirements of this specification, including satisfactory completion of all repairs, if applicable. Members not meeting the requirements of the Contract Documents shall be deemed unacceptable and shall not be included in the Work.

909.08.02 Acceptance of Concrete Compressive Strength

A 28-Day concrete compressive strength of a lot shall be considered acceptable when it meets all of the following:

- a) The average of the three individual compressive strength tests shall be equal to or greater than the specified strength.
- b) No individual cylinder test shall be more than 4.0 MPa below the specified strength.

Unacceptable lots shall be removed and replaced.

Compressive strength shall be determined according LS-426 for concrete with silica fume and high strength concrete and according to LS-407 for all other concrete.

The compressive strength result of the lot shall be the average of the set of three acceptance cylinders rounded to one decimal place.

The individual test results shall be forwarded to the Contractor as they become available.

909.08.02.01 Referee Testing Compressive Strength

If the Contractor has submitted a set of referee cylinders, an individual test result may be questioned by the Contractor within 5 Business Days of receiving the test result. The Contractor shall notify the Owner of his intention to referee test.

The lot shall be re-evaluated as based on the test result from the referee compressive strength cylinders representing the lot and the referee test result shall replace the original test result. The referee test result shall be binding.

909.08.03 Acceptance of Air Void System in Hardened Concrete

One half of a cylinder shall be tested to determine the acceptability of the lot. The cylinder shall be tested according to LS-432. The other half of the cylinder shall be retained by the Owner for audit purposes.

Individual test results shall be forwarded to the Contractor, as they become available.

For a lot to be considered acceptable, the cylinder shall have an air content of 3.0% or more and a spacing factor of 0.200 mm or less. Acceptable lots shall be subject to full payment.

Lots with a spacing factor between 0.200 mm and 0.250 mm shall be repaired as identified in Table 2.

Lots with a spacing factor exceeding 0.250 mm shall be rejected and replaced at the Contractor's expense.

909.08.03.01 Referee Testing of Air Void System in Hardened Concrete

Referee testing of air void system parameters shall be according to OPSS 1350.

909.08.04 Acceptance of Rapid Chloride Permeability

Rapid chloride permeability testing shall be according to LS-433. Acceptance of rapid chloride permeability shall be based on the result obtained on the cylinders representing the lot. Lots with rapid chloride permeability less than 2,500 coulombs are considered acceptable. Lots with a rapid chloride permeability result greater than 2,500 coulombs and less than or equal to 3,500 coulombs shall be considered unacceptable and shall be repaired as identified in Table 2. Lots with rapid chloride permeability results exceeding 3,500 coulombs shall be rejected and replaced.

For concrete lots containing silica fume, rapid chloride permeability less than 1,000 coulombs are considered acceptable. Lots containing silica fume with a rapid chloride permeability result greater than 1,000 coulombs and less than or equal to 2,000 coulombs shall be considered unacceptable and shall be repaired as identified in Table 2. Lots containing silica fume with rapid chloride permeability results exceeding 2,000 coulombs shall be rejected and replaced.

909.08.04.01 Referee Testing of Rapid Chloride Permeability

Referee testing of rapid chloride permeability testing for all concrete shall be carried out according to the high performance concrete requirements of the OPSS 1350 Acceptance of Rapid Chloride Permeability for Silica Fume Overlays and High Performance Concrete clause. The reference to cores in OPSS 1350 shall be interpreted to mean cylinders.

909.08.04.02 Referee Testing Cost of Rapid Chloride Permeability

The cost of rapid chloride permeability testing for all concrete shall be according to OPSS 1350 Acceptance of Rapid Chloride Permeability for Silica Fume Overlays and High Performance Concrete clause.

909.08.05 Dimensional Verification and Concrete Cover Measurements

The Contract Administrator shall carry out measurements to confirm compliance with tolerance requirements of Table 1. Members exceeding the tolerances specified in Table 1 shall be rejected and not incorporated into the Work.

909.08.06 Defects and Deficiencies

909.08.06.01 General

Defects and deficiencies are classified as follows:

- a) Defects and deficiencies repairable by standard methods.
- b) Defects and deficiencies causing rejection.
- c) All other defects and deficiencies.

909.08.06.02**Defects and Deficiencies Repairable by Standard Methods**

Any individual member having one or more of the defects and deficiencies listed in Table 2 shall be deemed unacceptable and the member shall be repaired according to Table 2. When more than one of the defects or deficiencies listed in Table 2 is located in the same area in the member, the Contractor shall be required to submit a proposal for repair for acceptance according to the All Other Defects and Deficiencies clause.

909.08.06.03**Defects and Deficiencies Causing Rejection**

A member having any one of the following defects and deficiencies shall be rejected and shall not be incorporated into the Work:

- a) If concrete temperature exceeds 70 °C at any time during the curing period.
- b) For I-girders, if there is honeycombing, voids, cavities, spalls, delaminations, or cracks, in the concrete within a bearing surface area defined by the contact area of the bearing plus 30 mm on all sides, except when member ends are encased in concrete.
- c) For box girders, if there is honeycombing, voids, cavities, spalls or delaminations in the concrete within a bearing surface area defined by the contact area of the bearing plus 30 mm on all sides, except when member ends are encased in concrete.
- d) If there is a crack in the bottom flange that extends through to the opposite face.
- e) If breakage of strand wires exceeds the limit permitted in CAN/CSA A23.4.
- f) If the sweep of the girder on site and in position without any intermediate bracing is in excess of 1.5 mm/m length of girder.

909.08.06.04**All Other Defects and Deficiencies**

For members with defects or deficiencies that are not identified as rejectable or included in the list of defects and deficiencies repairable by standards methods in Table 2, or when more than one of the defects or deficiencies listed in Table 2 are located in the same area in the member, the Contractor shall submit a proposal for repair to the Contract Administrator for acceptance.

If the repair proposal is deemed acceptable, the members shall be repaired according to the proposal. The Contractor shall not carry out any repairs without the acceptance of the proposal. If the repair proposal is deemed unacceptable, the members shall be rejected and shall not be incorporated into the Work.

The repair proposal, signed and sealed by an Engineer, shall include as a minimum:

- a) Description of the member and identification of the defects or deficiencies.
- b) Detailed sketches, width, length, depths, location, and nature and frequency of any defects.
- c) Assessment of any impact of the repaired defects on durability, structural adequacy, and integrity of the member or on the structure.
- d) A detailed repair plan including material, method, and equipment to be used.
- e) Verification that the repair plan complies with the applicable standards for the type of work.

- f) All relevant supporting information, including material test results, field measurements and observations, production records, photographs, and structural analysis calculations used for determining that the performance and function originally expected from the member shall be met.
- g) Causes of the defect and corrective action to be taken to prevent recurrence of the defect in future production, delivery, or erection.

909.10 BASIS OF PAYMENT

909.10.01 Prestressed Concrete Members (Type) Fabrication - Item Prestressed Concrete Members Containing Silica Fume (Type) Fabrication - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Members stored at the precaster's premises or at some other location away from the Working Area shall be paid for when the Contractor obtains a lease from the property owner that names the Owner as the tenant. The Owner shall provide the form of lease for this purpose that specifies a payment of \$10.00 for the term of the lease. The Contractor shall retain full responsibility for the members.

909.10.02 Payment Adjustment for Rapid Chloride Permeability

For concrete members containing silica fume, lots of members with an average value of rapid chloride permeability exceeding 1,500 Coulombs and less than or equal to 2,000 Coulombs shall be accepted with a payment reduction in addition to the repair method required in Table 2. The payment reduction shall be calculated and applied as follows:

- a) The price for the fabrication items in the Contract shall be converted to an equivalent price per meter length for each member type in the lot.
- b) P_f , the percent payment reduction factor for each lot = 10%
- c) For each member type in the lot, the payment reduction = $(P_f) \times (\text{Equivalent price per meter length}) \times (\text{Length of Members})$.
- d) Total payment reduction for each lot is the sum of the individual payment reductions for each member type calculated in 'c'.

909.10.03 Prestressed Concrete Members (Type) Delivery - Item Prestressed Concrete Members Containing Silica Fume (Type) Delivery - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

909.10.04 Prestressed Concrete Members (Type) Erection - Item Prestressed Concrete Members Containing Silica Fume (Type) Erection - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

TABLE 1
Tolerances

Item	Tolerances
Length: Straight-line measurement taken horizontally at the mid-height of member	± 1.0 mm/m; not to exceed ± 25 mm maximum
Overall Depth	± 8 mm for depths up to 600 mm ± 12 mm for depths over 600 mm
Flange Depth and Web Width for Members Without Voids	Flange depth ± 5 mm Web width -5/+10 mm
Flange Depth and Web Width for Members With Voids	Flange depth ± 10 mm Web width ± 10 mm
Width: Flanges and Box Members	± 10 mm
Sweep: I-girders, spaced box girders and spaced hollow slab girders	1 mm/m length of girder.
Abutting box and hollow slab girders	± 10 mm
Squareness and Plumbness	1 in 200 maximum
Camber Difference: Between adjacent members spaced apart Between adjacent members placed side-by-side	25 mm 15 mm
Hold-Down Position Along Length	± 300 mm
Void and Diaphragm Position Along Length	± 25 mm
Concrete Cover Over Reinforcing Steel	Unless otherwise specified in the Contract Documents, the tolerance for concrete cover over reinforcing steel shall be -5/+15 mm
Stirrup Projection	-10/+15 mm

TABLE 2
Defects and Deficiencies Repairable by Standard Methods

Repairable Defects and Deficiencies	Condition	Repair Method
Honeycombing, Voids, Cavities, Spalls, and Delaminations	Any area less than an equivalent area of 300 x 300 mm with no reinforcing steel or strand exposed.	a) Square all sides of the repair area. b) Sawcut perimeter of removal area to a depth of 10 mm or to the depth of reinforcing steel or strands, whichever is less. c) Remove all loose concrete using a chipping hammer or hand tools. d) Insert corrosion resistant wire mesh and anchors. e) Abrasive blast-clean all concrete surfaces to be patched according to OPSS 929. f) Remove all dust and loose material from the prepared surface by using compressed air. g) Moisten area to be repaired. h) Fill repair area with concrete or a proprietary patching material. i) Cure concrete according to moist curing requirements of this specification. Cure proprietary patching material according to the manufacturer's recommendations.
Low Cover	Any cover readings less than 25 mm and greater than or equal to 20 mm	The entire surface of the member shall be sealed, except areas against which new concrete is to be placed or in contact with bearings.
Compressive Strength	Any lot with 28-Day compressive strength lower than specified, but not more than 4.0 MPa lower than specified.	The entire surface of the member shall be sealed, except areas against which new concrete is to be placed or in contact with bearings
Rapid Chloride Permeability	Any lot of concrete containing silica fume with rapid chloride permeability value exceeding 1,000 and less than or equal to 2,000 Coulombs and lots of all other concrete with rapid chloride permeability value exceeding 2,500 and less than or equal to 3,500 Coulombs.	The entire surface of the member shall be sealed, except areas against which new concrete is to be placed or in contact with bearings
Air Void System Parameters	Any lot with spacing factor greater than 0.200 mm, but less than or equal to 0.250mm.	The entire surface of the member shall be sealed, except areas against which new concrete is to be placed or in contact with bearings
Sweep	Sweep greater than 1.0 mm /m length but less than or equal to 1.5 mm/m length.	Push or pull the girders to within tolerance. Girders that can be brought into tolerance and maintained at that position without visible signs of distress shall be accepted. Girders greater than or equal to 1,900 mm in depth shall be pulled or pushed at both the top and bottom flange.

Appendix 909-A, April 2012
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

Several revisions have been made to the technical information of OPSS 909. It is recommended that the designer and the users read the specification in its entirety to become familiar with the differences and necessary requirements for municipal use.

The designer should specify the following in the Contract Documents:

- Concrete compressive strength. (909.05.03)
- Concrete strength at transfer. (909.07.12, 909.07.14.03)

Subsection 909.07.15, Sampling for Quality Assurance, requires concrete cylinders taken to determine compressive strength, air void system parameters, and rapid chloride permeability to be delivered to the ministry's quality assurance laboratory and samples of steel reinforcement to be delivered to the MTO Concrete Section. For municipal contracts, the designer should write a special provision to delete the delivery locations for samples currently in this specification, and identify the appropriate quality assurance laboratory locations for sample delivery.

Clause 909.07.15.02 requires the use of MTO form PH-CC-322 for reporting concrete test information. If a form other than MTO form PH-CC-322 is to be used for submission purposes, the alternate form should be invoked by reference in the Contract Documents and a special provision should be written to delete the MTO form from the specification.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



NOTICE TO USERS OF OPSS 910

CONSTRUCTION SPECIFICATION FOR STRESSING SYSTEMS FOR POST-TENSIONING

OPSS 910 has been removed from this
OPS volume

The provincial version of OPSS 910 is now in:

OPS Volume 5,
Provincial-Oriented
MTO General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.PROV 910

The municipal version of OPSS 910 is now in:

OPS Volume 7,
Municipal-Oriented
OPS General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.MUNI 910

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



NOTICE TO USERS OF OPSS 911

CONSTRUCTION SPECIFICATION FOR COATING STRUCTURAL STEEL SYSTEMS

OPSS 911 has been removed from this
OPS volume

The provincial version of OPSS 911 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 911

The municipal version of OPSS 911 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 911

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



CONSTRUCTION SPECIFICATION FOR EMBEDDED WORK IN STRUCTURES FOR ELECTRICAL SYSTEMS

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APPENDICES

913-A	Commentary

913.01 SCOPE

This specification covers the requirements for the installation of electrical and communication materials to be embedded in structures.

913.01.01 Significance and Use of Appendices

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

913.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

913.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 603	Installation of Ducts
OPSS 616	Footings and Pads for Electrical Equipment

CSA Standards

C22.2 No. 85-14	Rigid PVC Boxes and Fittings
C22.2 No. 40-M1989 (R2009)	Cutout, Junction, and Pull Boxes
C22.2 No. 211.2-06 (R2011)	Rigid PVC (Unplasticized) Conduit
C22.2 No. 227.1-06 (R2011)	Electrical Nonmetallic Tubing

913.05 MATERIALS

913.05.01 Junction Boxes and Fittings

Junction boxes and fittings shall be according to CSA C22.2 No. 85.

913.05.02 Rigid Ducts

Rigid ducts to be embedded shall be according to OPSS 603, Table 1.

Ducts less than 60 mm diameter shall be rigid PVC and according to CSA C22.2 No. 211.2. The associated cleaner and solvent cement shall be according to the duct manufacturer's recommendations.

913.05.03 Flexible Ducts and Fittings

Flexible ducts and fittings shall be according to CAN/CSA C22.2 No. 227.1.

913.05.04 Fish Line

Fish line shall be nylon or polypropylene materials with a minimum test strength of 400 N.

913.05.05 Anchorage Assemblies and Hardware

Anchorage assemblies and hardware shall be according to OPSS 616.

913.05.05.01 Anchor Assembly Struts

Anchor assembly struts shall be according to OPSS 616.

913.05.05.02 Studs, Nuts, and Washers

Studs, nuts, and washers shall be according to OPSS 616.

913.05.05.03 Ferrules

Ferrules shall be according to OPSS 616.

913.07 CONSTRUCTION

913.07.01 Embedded Work in Structure

All components shall be installed at locations specified in the Contract Documents. Components shall be secured and supported in place so that shifting or deflection of the components does not occur during the placing of concrete or under other such loads as may be encountered during construction.

913.07.01.01 Junction Boxes

Junction boxes shall be installed so that the outside faces of the covers are flush with the finished surface of the concrete, except for barrier walls. Junction boxes shall be recessed 50 mm in barrier walls and have grounded galvanized steel treaded covers according to CSA C22.2 No. 40 and the Contract Documents.

Junction boxes shall be drilled to accept conduit fittings as specified in the Contract Documents. Ducts and conduit fittings shall be connected to junction boxes using appropriate solvent cement.

913.07.01.02 Ducts

Ducts shall be installed using CSA approved fittings, couplings, and accessories for the type of duct used. Adapter couplings shall be installed between ducts of dissimilar materials. Expansion and deflection fitting assemblies or wobble joints shall be installed at structural expansion joints.

Expansion and deflection coupling joints shall be according to the Contract Documents and manufacturer's specifications. Duct to couplings and fittings connections shall be made with a cleaner and solvent cement suitable for the type of duct installed.

Ducts ending at vertical concrete faces shall be terminated with fittings as specified in the Contract Documents.

Ducts shall be free of debris, water, breakage, and distortion and verified by pulling a mandrel through the ducts.

All open ends in ducts shall be plugged with plastic plugs.

913.07.01.03 Fish Line

A fish line shall be installed in all duct systems. A 1.5 m length of fish line shall be left coiled in each junction box and at each duct termination at a concrete face by bringing the fish line out of the duct beside the plastic plug.

913.07.01.04 Anchorage Assemblies

Anchorage assemblies shall be installed according to OPSS 616.

913.07.02 Embedded Work in Structure for Other Than Owner

The work for embedded work in structure for other than the Owner shall be according to subsection Embedded Work in Structure and as specified in the Contract Documents.

When material supplied by others to the Contractor is specified in the Contract Documents, the Contractor shall notify the Contract Administrator in writing of the need for the material a minimum of 30 Days in advance of the date when the material is required.

913.10 BASIS OF PAYMENT

913.10.01 Embedded Work in Structure - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 913-A, Commentary for OPSS 913, November 2014 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Locations of components for embedded work in structures. (913.07.01)
- Drilling requirements for junction boxes. (913.07.01.01)
- Fittings for conduits ending at vertical concrete surfaces. (913.07.01.02)
- Additional requirements for embedded work in structures for other than the Owner. (913.07.02)

The designer should determine if there is material supplied by the Owner or by others to the Contractor. If so, this should be specified in the Contract Documents. (913.07.02)

The designer shall incorporate embedded work in structures according to CAN/CSA S6-00, Canadian Highway Bridge Design Code.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 2101.020	Extension of Existing Rigid Ducts Encased in Concrete
OPSD 2102.01	Underground Rigid Duct Connection at Concrete Structure
OPSD 2200.070	Pole Footing in Earth for Cast-In-Place Concrete Barrier
OPSD 2200.080	Pole Footing in Rock for Cast-In-Place Concrete Barrier
OPSD 2215.02	Anchorage Assembly
OPSD 2216.010	Anchorage Assembly for Pole Footing in Concrete Barrier
OPSD 2300.010	Rigid PVC Junction Box, Type P1
OPSD 2300.020	Rigid PVC Junction Box, Type P2
OPSD 2300.030	Rigid PVC Junction Box, Type P4
OPSD 2302.010	Embedded Work Detail for Rigid PVC Junction Box, Type P3-1, for Use in Concrete Barrier Wall
OPSD 2302.020	Expansion and Deflection Fitting Assembly for 50 and 75 mm Rigid Ducts
OPSD 2302.040	Embedded Work in Structure, New Jersey Type Concrete Barrier Wall
OPSD 2456.010	High Mast Lighting Pole Anchorage Assembly Details for Double Base Plate



NOTICE TO USERS OF OPSS 914

CONSTRUCTION SPECIFICATION FOR WATERPROOFING BRIDGE DECKS WITH HOT APPLIED ASPHALT MEMBRANE

OPSS 914 has been removed from this
OPS volume

The provincial version of OPSS 914 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 914

The municipal version of OPSS 914 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 914

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



NOTICE TO USERS OF OPSS 915

CONSTRUCTION SPECIFICATION FOR SIGN SUPPORT STRUCTURES

OPSS 915 has been removed from this
OPS volume

The provincial version of OPSS 915 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 915

The municipal version of OPSS 915 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 915

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



**CONSTRUCTION SPECIFICATION FOR
MODULAR BRIDGE STRUCTURES FOR TEMPORARY INSTALLATIONS**

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918.01 SCOPE

This specification covers the requirements for the supply, erection, maintenance and removal of standardized modular bridge structures, used for temporary installations including the ramps, bank seats, decking, sidewalks and railings.

918.02 REFERENCES

This specification refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction:

OPSS 501	Compacting
OPSS 907	Structural Wood Systems
OPSS 908	Metal Traffic Barriers and Metal Railings for Structures

Ontario Provincial Standard Specifications, Material:

OPSS 1601	Wood

Canadian Standard Association Standards:

CSA 47.1-92	Certification of Companies for Fusion Welding of Steel Structures
CSA W47.2-M1987	Certification of Companies for Fusion Welding of Aluminum
CSA W59-M1989	Welded Steel Construction, Metal Arc Welding
CSA W59.2 M1991	Welded Aluminum Construction

Others:

OHBDC - Ontario Highway Bridge Design Code, 3rd Ed.

918.03 DEFINITIONS

For the purpose of this specification the following definitions apply:

Bank Seats: means mud sills, timber matting and vertical post supports.

Modular Bridge: means a superstructure comprised of prefabricated components that can be assembled and disassembled on site.

Temporary Installation: means an installation that is erected to provide for maintenance of traffic at a construction site for a length of time not exceeding three years.

918.04 SUBMISSION AND DESIGN REQUIREMENTS

918.04.01 Submissions

918.04.01.01 Working Drawings & Fabricator Certification

At least one week prior to commencement of construction, the following information shall be submitted to the Contract Administrator.

- a. Certification of the welding fabricator as required in the Materials section.
- b. Working drawings showing the proposed modular bridge.
- c. Method and procedures for launching, erecting and removing as recommended by the modular bridge manufacturer and supplementary methods and procedures proposed by the Contractor.
- d. Design calculations indicating that the modular bridge conforms to the requirements of the Ontario Highway Bridge Design Code or;

Load test information, provided by the manufacturer of the modular bridge, indicating the superstructure conforms to the requirements for "Evaluation of Existing Bridges" section of the Ontario Highway Bridge Design Code.

The working drawings, design calculations and load test information shall bear the seals and signatures of the Design and Checking Engineers.

918.04.01.02 Notice of Erection

The Contract Administrator shall be given written notice at least one week in advance of the commencement of erection of the modular bridge.

918.04.01.03 Certificate of Conformance

A certificate of conformance bearing the seal and signature of an Engineer, stating that the modular bridge has been installed according to the stamped working drawings shall be submitted to the Contract Administrator.

918.04.02 Design Requirements

The modular bridge structure shall be designed according to the Ontario Highway Bridge Design Code except that:

1. The following requirements of the Ontario Highway Bridge Design Code are not mandatory:
 - a. Traffic lane widths, side clearance and sidewalks.
 - b. Deck crossfall and drain outlets.
 - c. Limitation of maximum deflection. Designing floor beam and diaphragms for jacking and provision of a protective coating.
 - d. Fatigue
 - e. Accessibility for inspection, cleaning and coating, the avoidance of pockets and the provision of drain holes in pockets and their filling with waterproofing.
 - f. Camber
 - g. Provision of two bolts at the end of bracing members.
 - h. Welding procedures approval when the components are manufactured outside Canada.

2. The following are additional requirements:

- a. The traffic lanes, side clearance and sidewalks shall be the same as those on the approaches unless specified otherwise.
- b. Welding design and practice shall conform to CSA W59M, CSA W59.2M or shall conform to an equivalent recognized national standard effective in the jurisdiction in which the modular bridge is fabricated.
- c. Unless otherwise specified, to ensure the requirements for a multiload path structure are satisfied, single trusses shall not be used.

3. The following modification is acceptable:

- a. Nuts with safety pins or snap rings may be used instead of hexagonal recessed nuts or hexagonal solid nuts with washers.

918.04.03 Return of Submissions

Two copies will be returned as follows:

- a. Stamped with the wording "Permission to Construct".

In this case work can start on receipt. A copy of the drawings shall be available at the site prior to and during construction.

or

- b. Stamped with the wording "Permission to Construct Approved As Noted".

Work can start on receipt of these drawings by the Contractor.

In this case the drawings shall be updated as noted, shall have a stamp affixed signed by an Engineer stating the drawings have been revised according to the approved as noted comments.

A copy of the updated drawings shall be available at the site prior to and during construction.

or

- c. Showing only required changes.

In this case the submission shall be updated as required and the submission process repeated.

918.05 MATERIALS

918.05.01 General

All material shall comply with the details specified and shown on the working drawings.

918.05.02 Modular Bridge

The modular bridge shall be a commercially available standardized proprietary product.

The fabricator shall be certified according to Division 2.1 of CSA W47.1 for steel fabrication or W47.2M for aluminum fabrication or certified according to an equivalent recognized National Standard effective in the jurisdiction in which the modular bridge is fabricated.

Used components shall be certified by an Engineer, within 6 months prior to use, to be equivalent to new.

918.05.03 Miscellaneous Hardware

The miscellaneous hardware and other structural steel used in the erection and assembly of the modular bridge shall be according to the modular bridge manufacturers requirements.

918.05.04 Wood

Wood shall be according to OPSS 1601. Wood for installations that are in use for less than three years need not be preservative treated.

918.05.05 Railings

Unless otherwise specified the railing shall be according to OPSS 908.

918.05.06 Fasteners and Hardware for Wood Construction

Fasteners and hardware for wood construction shall be according to OPSS 907.

918.07 CONSTRUCTION

918.07.01 General

Prior to erection of the modular bridge, documentation shall be submitted to the Contract Administrator indicating that the foreman who will be in charge of the erection of the modular bridge has successfully performed the duties of foreman on similar work.

918.07.02 Maintenance of Installation

During the working time of the Contract, excluding winter shutdown, the superstructure, bank seats, ramps, decking, sidewalks, railing and approaches shall be maintained in a safe and useable condition.

Except during winter shutdown the substructure and pile bents shall be kept clear of debris and ice during the working time of the contract.

918.07.03 Bank Seats

Fill under bank seats shall be compacted according to OPSS 501 to 95% of the maximum dry density.

918.07.04 Erection and Removal of Modular Bridge

The modular bridge including all appurtenances shall be erected, assembled and removed according to the manufacturers recommendations.

When not detailed otherwise the construction of the decking and sidewalks shall be according to the modular bridge manufacturers requirements. All wood components shall be placed tightly together and fixed firmly in place.

918.10

BASIS OF PAYMENT

918.10.01

Modular Bridge - Item

Payment at the contract price for the above item shall be full compensation for all labour, equipment and material to do the work of installing, maintaining and removing the modular bridge components including the associated decking, ramps, bank seats, sidewalks and railings.



CONSTRUCTION SPECIFICATION FOR FORMWORK AND FALSEWORK

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919.01 SCOPE

This specification covers the design and construction requirements for formwork, falsework, and temporary supports used in the construction and rehabilitation of structures.

919.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

919.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

919.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 501	Compacting
OPSS 903	Deep Foundations
OPSS 906	Structural Steel

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase, Selected Subgrade, and Backfill Material
OPSS 1350	Concrete - Materials and Production
OPSS 1801	Corrugated Steel Pipe Products

CSA Standards

A23.3-04	Design of Concrete Structures
G40.20-04/40.21-04	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
G164-M92	Hot Dip Galvanizing of Irregularly Shaped Articles
O86-M84 (R1992)	Engineering Design in Wood
O121-08	Douglas Fir Plywood
O122-06	Structural Glued-Laminated Timber
S16-1969	Steel Structures for Buildings
S157/S157.1-05	Strength Design in Aluminum/Commentary on CSA S157-05, Strength Design in Aluminum
S269.1-1975 (R2003)	Falsework for Construction Purposes
S269.3-M92 (R2008)	Concrete Formwork

National Research Council (NRC)

National Building Code of Canada-2005

919.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Bulkhead means the vertical form that supports the end width of a deck pour of concrete.

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Culvert means a structure that provides an opening through an embankment and in which roadway loads are distributed to the structure through fill or that is designated as a culvert in the Contract Documents.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Exposed Surface means all external formed surfaces not to be covered by backfill material.

Falsework means any temporary structural support, including bracing, used to support all or part of the formwork or of the structure during its construction or rehabilitation until it becomes self-supporting.

Formwork means the mould into which the fresh concrete is placed.

Foundation means the ground immediately below the mudsills that supports the falsework or that portion of ground supporting the falsework piles.

Grade means:

- a) For steel, the designation of the quality of the steel that can be determined by referring to the appropriate CSA standard or by specimen testing.
- b) For wood, the designation of the quality of a piece of wood that can be determined by referring to the appropriate CSA Standard.

Hardwood means wood with a degree of hardness at least equal to a species, such as hard maple, oak, or beech.

Joist means one of a series of horizontal members, usually with narrow face up, to which form material is fastened.

Ledger means a horizontal flexural member usually supporting joists and resting on vertical supports.

Mudsill means a mat of timbers or a small footing on the ground used as a base from which the remainder of the falsework structure is erected.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Shoring means a system of vertical or inclined supports for forms or structure components. Shoring may be wood or metal posts, scaffold-type frames, or various patented members or other system of falsework.

Stay-in-Place Forms means forms that are not removed.

Structure means any bridge, culvert, tunnel, retaining wall, wharf, dock, or guideway.

Stud means one of a series of usually vertical members used in framing to support the plywood or formwork fastened to it.

Timber means felled trees or logs suitable for conversion by sawing or otherwise or a piece of sawn lumber having a minimum nominal dimension greater than or equal to 125 mm.

Wood means lumber and timber.

919.04 DESIGN AND SUBMISSION REQUIREMENTS

919.04.01 Design Requirements

919.04.01.01 Formwork Design

Formwork design shall be according to CAN/CSA S269.3.

919.04.01.02 Falsework Design

Falsework design shall be according to CSA S269.1 and as specified herein.

The allowable stresses for wood design shall be according to CSA/CAN3-086.

The allowable stresses for structural steel design shall be according to CSA S16, except the stresses allowed may be increased by 15% for temporary loading.

Deflection of beams shall be limited to $L/270$, where L is the span. The loading for deflection shall be the weight of concrete and formwork.

When deflection of a beam is 10 mm or more, provision shall be made to compensate for deflection. When provision is made to compensate for deflection, the deflection of the beams shall be limited to $L/240$, where L is the span. The tolerance shall be ± 5 mm.

Aluminum components shall be designed according to CAN3-S157.

Concrete components shall be designed according to CSA A23.3.

Where scaffolding, fabricated shoring, or patented accessories are used, the design shall be according to the manufacturer's recommendations.

Where another authority is involved, any additional requirements specified by the authority shall also be satisfied.

919.04.01.03 Vertical Loadings

Vertical loading shall be:

- a) The weight of the concrete being supported or 2.50 kN/m^2 on the horizontal projected area of the formwork, whichever is the greater.
- b) The weight of normal concrete, as it is placed, shall be considered as a liquid having a weight of 24.00 kN/m^3 .
- c) The weight of the formwork supported by the falsework or 0.50 kN/m^2 of the horizontal projected area, whichever is greater.
- d) The weight of workers, equipment, and tools that is to be supported during the concrete placing and finishing operations or 2.00 kN/m^2 of horizontal projected area of formwork whichever is greater. When motorized placing equipment is used this minimum load shall be increased to 3.00 kN/m^2 .
- e) Load due to any special conditions of construction likely to occur.
- f) Loads for temporary supports as specified.

919.04.01.04 Horizontal Loading

The horizontal loadings shall include the effects of environmental factors, such as wind; the rate of placing of concrete; the temperature of the concrete; the effect of vibration of the concrete; the consistency of the mix; and other pertinent factors.

Wind pressures shall be based on those listed in the National Building Code of Canada using 1/30 probability for falsework and 1/10 probability for formwork with a gust factor of 2 and a minimum wind pressure of 0.8 kPa.

Notwithstanding the above, a minimum transverse and longitudinal force of 2% of vertical loading or 1.50 kN/m of deck edge applied at the mid-depth of the deck, whichever is greater, shall be used.

919.04.01.05 Tower Leg Loads

The vertical loads on the tower legs may be based on simple span assumptions. The loads supported by a tower leg may be assumed to be those loads applied to the area immediately above the tower leg that is bounded by lines located one half way between each of the bays adjacent to the tower leg being considered.

When locating towers, the following criteria shall apply:

The maximum design load on one leg of a frame shall not exceed four times the design load on the other leg under full or partial loading conditions.

The maximum design load on one of the two frames making up a tower shall not exceed four times the design load on the opposite frame under any loading condition.

The minimum bracing requirements are as follows:

a) Connections Between Joists and Ledgers

Every fourth joist shall be connected to a ledger.

Ledgers on top of frames shall be axially continuous across the shoring system to evenly distribute horizontal forces to individual scaffold towers below. Ledgers with a splice designed to take the axial load are considered axially continuous.

b) Bracing in the Transverse Direction

When the shoring height is composed of three frames or the shoring height is more than three times the tower width or the total shoring height is more than 5 m, one horizontal brace made continuous shall be installed on one face of each tower.

The brace shall be located at the mid-height of a two-frame tower and at the top of the second frame for a three-frame tower.

When shoring towers are adequately braced against transverse movement by tying to an adjacent structure or adjacent tower, the above height-to-width restriction applies only to the tower grouping.

When the shoring height is composed of more than three frames, at least one horizontal brace made continuous and one diagonal brace made continuous shall be attached to one transverse face of each tower for every three frames of shoring height. In addition, the maximum spacing of the horizontal brace shall be three times the tower width. The horizontal brace shall be located near the top of a frame. Diagonal braces on adjacent towers shall be installed in opposite directions.

When superelevation is 4% or greater, a horizontal transverse brace shall be attached to one tower face of the top frame in addition to the bracing required by the preceding paragraph.

When the shoring height is greater than 20 m, guy wires shall be installed. The spacing of the guy wires shall not be greater than 15 m horizontally.

c) Bracing in the Longitudinal Direction

When the shoring height is composed of three frames or the total height is more than 5 m, one horizontal brace made continuous shall be installed spaced horizontally not more than 6 m apart. The brace shall be located at the top of the first frame of a two-frame tower and the top of the second frame of a three-frame tower.

When the shoring height is composed of four frames or more, horizontal braces and diagonal braces made continuous shall be attached on a tower and spaced horizontally not more than 6 m apart. The lowest brace shall be located no higher than the third frame and additional braces shall be spaced vertically at the top of every third frame thereafter.

When the bridge is on a longitudinal grade of 4% or greater, braces parallel to the grade shall be attached to one tower face of the top frame and spaced not more than 6 m apart horizontally.

d) Tie Back Bracing - Falsework Opening Towers

The falsework opening towers shall be longitudinally braced to two rows of scaffold towers behind them according to the Bracing in the Longitudinal Direction requirements above, regardless of the height, and shall be continuously braced transversely.

919.04.01.07 Mudsills

The mudsills shall be designed such that the settlement of mudsills shall not exceed 12 mm.

919.04.02 Submission Requirements

919.04.02.01 Working Drawings

919.04.02.01.01 General

Working Drawings shall be submitted for all falsework used in the construction or rehabilitation of structures, except for culverts less than 3 m in span.

Working Drawings are required for the following formwork:

- a) Inside forms for post-tensioned decks;
- b) Bulkheads in post-tensioned decks 2.0 m or greater in height;
- c) All columns and walls, 2.4 m or greater in height, of abutments, piers, and retaining walls.

Working Drawings for other formwork shall only be submitted, when specified in the Contract Documents.

Formwork and falsework shall not be supported by, braced to, or come in contact with another structure unless written permission is received from the owner of the other structure. In order to obtain written permission, 3 copies of Working Drawings shall be submitted to the owner of the other structure showing the support locations and imposed loads as they are applied to that structure and certify that the structure can safely support all the imposed loads from the Contractor's method of construction. Prior to a submission, an Engineer's seal and signature shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

During formwork and falsework construction, the Contractor shall have a copy of the Working Drawings at the site.

919.04.02.01.02 Falsework

The Contractor shall submit 3 sets of falsework Working Drawings to the Contract Administrator at least 1 Day prior to commencement of erection of falsework, for information purposes only. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

Where multi-discipline engineering work is depicted on the same Working Drawing and the design or design-checking Engineer or both are unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be sealed and signed by as many additional design and design-checking Engineers as necessary.

When other authorities are involved, 1 set of Working Drawings shall be submitted for each authority at least 5 weeks prior to the commencement of falsework construction.

The Working Drawings for the falsework for each structure shall include all details of all falsework to be erected.

Falsework Working Drawings shall include at least the following:

- a) Longitudinal, lateral, vertical, live, impact, and anticipated construction loads used in the design.
- b) Allowable bearing capacity of the soil beneath the mudsills.
- c) Maximum column loads.
- d) Deflection diagrams for beams having a deflection of 10 mm or more.
- e) The grade and actual size of all structural materials.
- f) Posts, connections, bracing and welding sufficiently detailed to demonstrate compliance with the structural analysis and erection requirements.
- g) Fully detailed frame shoring.
- h) Type and mass of moving or stationary equipment to be supported by the falsework.
- i) Sequence, method, and rate of concrete placement.
- j) All proprietary equipment sufficiently identified to demonstrate compliance with the structural analysis and erection requirements.
- k) Full details and locations of all splices.
- l) Method of maintaining rotational and lateral stability of bridge girders.
- m) Vertical stiffening details and lateral restraint for ledgers and subledgers.
- n) Lateral restraint details for falsework supporting beams spanning openings.
- o) Fluid concrete loads, assumed for design purposes.
- p) Location of screed rail supports and design load.
- q) Anticipated settlement of falsework, including settlement of mudsill.

919.04.02.01.03 Formwork

The Contractor shall submit 3 sets of formwork Working Drawings to the Contract Administrator at least 1 Day prior to commencement of erection of formwork, for information purposes only. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents and sound engineering practices.

Where multi-discipline engineering work is depicted on the same Working Drawing and the design or design-checking Engineer or both are unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be sealed and signed by as many additional design and design-checking Engineers as necessary.

When other authorities are involved, 1 set of Working Drawings shall be submitted for each authority at least 5 weeks prior to the commencement of falsework construction.

The Working Drawings shall show all necessary design and construction details, including the grade and size of materials used and the pressure diagrams used in the design.

919.04.02.02 Foundation Information

919.04.02.02.01 Falsework Foundation Design Report

Three copies of a Falsework Foundation Design Report shall be submitted to the Contract Administrator. The report shall bear the seal and signature of an Engineer, shall include the rationale used to determine the soil bearing capacity, and shall include the following information:

- a) The soil bearing capacity.
- b) Site preparation details.

A Falsework Foundation Design Report is not required when the mudsill bears on mass concrete poured directly on bedrock or when the mudsill bears on compacted Granular A of depth 1.0 m or less placed directly on bedrock.

919.04.02.02.02 Interim Inspection after Construction of Falsework Foundation

Upon completion of the falsework foundation and prior to installation of falsework, the Quality Verification Engineer shall conduct an interim inspection of the work to verify that the falsework foundation has been constructed according to the Falsework Foundation Design Report and issue the Contractor written permission to proceed with the work.

919.04.02.03 Proprietary Shoring, Forms, and Accessories

When proprietary shoring, forms, and accessories are used, the manufacturers' allowable loads with supporting test data shall be submitted with the Working Drawings.

919.04.02.04 Splices for Stay-In-Place Forms

Details of the method of joining round stay-in-place forms shall be shown on the Working Drawings.

919.04.02.05 Revised Submissions

When falsework design considerations or field conditions necessitate amendments to the falsework, revisions shall be resubmitted according to the Working Drawings clause.

919.05 MATERIALS

919.05.01 General

Forms and falsework shall be constructed of wood, metal, or concrete.

919.05.02 Wood

Wood shall be according to CSA/CAN3-O86.

919.05.03 Plywood

Plywood for formwork shall be 7 ply, 17 mm minimum thickness exterior grade Douglas Fir Plywood according to CSA O121.

For exposed surfaces, the finish side shall be medium density overlay plywood; however, this finish is not required in the following locations:

- a) The underside of a deck between girders.
- b) The ends of decks.
- c) The face of ballast walls.
- d) The internal faces of a culvert.

919.05.04 Structural Glued-Laminated Timber

Structural glued-laminated timber shall be exterior grade according to CAN/CSA O122.

919.05.05 Metal

Structural steel shall be according to CAN/CSA G40.20/G40.21 and be of the grade shown on the Working Drawings.

Aluminum shall be according to CSA-S157 and be of the alloy and temper shown on the Working Drawings.

Used metal shall be in good condition. All previous fabrication, adversely affecting the required strength, shall be corrected.

919.05.06 Concrete

Concrete shall be according to OPSS 1350.

919.05.07 Accessories

All accessories used shall comply with the details shown on the Working Drawings or with the recommendations of the manufacturer of the specified accessory.

Deck hangers and hardware left in place, either exposed or embedded in concrete within 20 mm of its surface, shall be hot dip galvanized.

All form ties left in place in barrier and parapet walls shall be hot dip galvanized, coated with an approved material, or non-corrodible. Where stainless steel reinforcement is used within the form, all form ties left in place in barrier and parapet walls shall be of stainless steel type 304.

The maximum diameter of plastic cones for form ties shall be 30 mm.

Hot dip galvanizing shall be according to CAN/CSA G164-M.

919.05.08 Void Tubes

Corrugated steel pipe shall be according to OPSS 1801 and need not be coated.

The thickness of the plate in the corrugated pipe shall be as follows:

- a) Diameters equal to or less than 900 mm - 0.9 mm thick.
- b) Diameters over 900 mm to 1200 mm - 1.1 mm thick.

Steel void forms shall have an outside diameter, top of corrugation to top of corrugation, equal to the diameter of the voids shown on the Working Drawings.

Paper fibre tubes shall be coated, spiral wound, wood fibre paperboard manufactured with waterproof glue.

919.05.09 Granular A

Granular A shall be according to OPSS 1010.

919.07 CONSTRUCTION

919.07.01 Formwork

919.07.01.01 General

Forms shall be smooth; clean; free from warps, splits, holes, and bulges; and constructed and maintained to be mortar tight.

919.07.01.02 Exposed Surfaces

Forms for exposed surfaces shall be new, except that forms may be re-used for exposed surfaces providing their condition is such as to produce a surface equal to one that would be attained using new materials. Where possible, plywood used on exposed surfaces shall be in full sheets and, except when used to form the underside of deck slabs for slab-on-girder construction, shall be so arranged that the face grain is perpendicular to the studs or joists.

919.07.01.03 Studs, Joists, and Decking

Studs and joists shall be spaced not more than 400 mm on centres. Edges of abutting sheets shall be nailed to the same stud or joist with 50 mm nails at not more than 200 mm centres. When used to form the underside of deck slabs in post-tensioned slab and rigid frame bridges, the joints between sheets abutting over joists shall be staggered a minimum of 400 mm. When prefabricated form panels are used, adjacent panels shall be placed such that the joints are maintained flush.

919.07.01.04 Form Release Oil

Non-staining form release oil shall be applied to the faces of forms against which concrete is to be placed. The form release oil shall be applied before placing reinforcement.

919.07.01.05 Ties

When internal form ties are used, concrete cover to any metal left upon removal of the forms shall be 20 mm minimum.

All ties, securing stay-in-place forms in position and extending below the deck soffit shall be loosened before any stressing commences.

Holes left in the deck soffit after removal of hanger coil rods shall be left open.

919.07.01.06 Exposed Corners

All exposed corners on concrete work and the edges of the box void slabs on the soffit of the structure shall be chamfered. The chamfer shall have a vertical and horizontal dimension of 20 mm.

919.07.01.07 Stay-in-Place Forms

Stay-in-place forms shall only be used when specified in the Contract Documents or under the following conditions:

- a) Round void tubes of metal in cast-in-place hollow prestressed concrete decks and round void tubes of metal or paper fibre in precast prestressed hollow slab deck units.

Where round voids are used, individual lengths shall be joined by an inner or outer sleeve or other method. Details of the method of joining shall be submitted to the Contract Administrator, for information purposes only.

- b) Box voids in precast concrete box girder deck units less than 1.2 m in depth.

919.07.02 Falsework

919.07.02.01 General

Sound adjustable falsework shall be built such that the structure remains true to line and grade after anticipated settlement.

Mudsills shall not be placed until the Contractor has a set of falsework Working Drawings on site.

The use of tack welds for hangers or other attachments to structural steel is not allowed, except that tack welds may be used on shear studs where it is not detrimental to the connection between the stud and the structural steel.

All welding of structural steel shall be according to OPSS 906.

919.07.02.02 Foundation Work

The falsework structure shall be supported on mudsills, structure footings, or piles.

Where the existing ground is unable to take the applied loads, piles driven according to OPSS 903 shall be used to support the falsework.

Where a timber pile in a falsework bent is too short, the Contractor shall cut off all the piling in the bent to the same elevation and cap the bent. An extension bent shall then be constructed. A pile splice shall only be used with the approval of the Contract Administrator.

Where steel piles are used in a falsework bent, a splice designed and fabricated for 100% of the pile section may be used to make up the required length of any pile.

All caps shall be continuous for the entire length of the bent or sliced as approved by the Contract Administrator. When splices in caps are approved, they shall be located at the centreline of a pile.

For traffic openings, a minimum horizontal space of 1.0 m shall be provided between the back face of the concrete barrier and the front edge of the mudsill.

A levelling pad consisting of a minimum of 100 mm of Granular A, compacted according to OPSS 501, or of poured in place concrete shall be placed under mudsills on bedrock to provide a level surface.

Where the ground is sloped and the Contractor elects to excavate steps, the slopes between the horizontal steps shall not be steeper than 1H:1V. A minimum horizontal width of 300 mm shall be provided between the mudsill and the top edge of slope.

Reduction of the bearing capacity of existing ground or compacted fill, due to water or ice, shall be prevented by suitable drainage or protection.

919.07.02.03 Wooden Shoring

All wooden posts shall be solid, not built up. Where splicing is necessary, the posts shall be cut square and the two pieces shall be in full contact over the splice. Scabbing shall be provided on all four faces of a post to be spliced. Each post shall be braced in two directions both above and below the splice immediately adjacent to the scabbing. Splices on adjacent posts shall be staggered.

Splicing of round posts shall not be permitted.

Bracing material shall be at least 38 x 89 mm lumber except for cross bracing for side forms where 19 x 138 mm lumber may be used. Bracing shall be nailed to each post with at least two 100 mm nails for 38 x 89 mm lumber and two 75 mm nails for 19 x 138 mm lumber. Splicing of bracing shall not be permitted.

Wedges used for purposes of falsework adjustment or to facilitate removal shall be hardwood.

919.07.02.04 Metal Shoring

Erection of metal frame shoring shall be according to CSA S269.1.

The maximum extension of jacks shall not exceed the lesser of the manufacturer's recommendations or 600 mm.

Shims used for levelling mudsills shall be fir plywood or solid lumber.

Wedges used to provide full bearing in U-heads shall be hardwood.

919.07.03 Temporary Supports

The construction of temporary supports shall be as specified in the Contract Documents.

919.07.04 Screed Rail Supports in Slab on Girder Construction

In slab-on-girder construction, screed rail supports shall not be located outside the centreline of the web of the outside girders.

When screed rail supports are not located over the webs of girders, a system of support shall be installed such that the deflection of the system under the load of the screed machine shall not exceed 5 mm.

919.07.05 Certificate of Conformance

Certificates of Conformance shall be submitted for all formwork and falsework for which Working Drawings are submitted.

A completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of formwork and falsework installation and before any concreting takes place. The Qualification Verification Engineer's seal and signature shall be affixed on the completed Certificate of Conformance confirming that the formwork and falsework have been installed in general conformance with the Working Drawings and Contract Documents.

919.07.06 Removal of Formwork, Falsework, and Temporary Supports

All formwork and falsework shall be removed. When authorized by the Contract Administrator, piles used for falsework may be left in place provided the top is 1.2 m below the finished grade or ground level or is at least 0.6 m below a streambed.

The method and sequence of removal of the formwork and falsework shall be such that it permits the concrete to take up the stresses gradually.

Falsework shall not be removed from post-tensioned structures until the post-tensioning is completed.

When a component is not post-tensioned, falsework may be removed after the concrete has attained a minimum strength of 20 MPa.

Formwork shall not be removed until the concrete has attained a minimum strength of 20 MPa; however, formwork for cast-in-place barrier walls and parapet walls may be removed 24 hours after completion of the placement.

Where insulation is used, the side forms may be slackened off 24 hours after concrete placement to help control temperature.

Removal of temporary supports shall be as specified in the Contract Documents.

919.07.07 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

919.10 BASIS OF PAYMENT

919.10.01 Formwork and Falsework

The Contract price for the concrete tender item directly associated with formwork and falsework shall include full compensation for all labour, Equipment, and Material to do the work.

919.10.02 Temporary Support - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the Work.

Appendix 919-A, November 2011 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Stay-in-place forms. (919.07.01.07)
- Construction of temporary supports. (919.07.03)
- Removal of temporary supports. (919.07.06)

The design should determine if the following is required and, if so, it should be specified in the Contract Documents:

- Submissions of other formwork Working Drawings. (919.04.02.01.01)

OPSS 919 contains information written for provincial contracts. To ensure completeness of municipal Contract Documents, the designer should invoke Appendix 919-B. The appendix contains supplemental requirements that modify OPSS 919 so it can be used by a municipality in its contracts.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 3310.100	Deck, Girders, Concrete, Method of Obtaining Screed Elevations
OPSD 3311.100	Deck, Girders, Steel, Method of Obtaining Screed Elevations
OPSD 3332.100	Deck, Round Voids, Form Supports and Tie Downs
OPSD 3333.100	Deck, Round Voids, Drains
OPSD 3333.101	Deck, Trapezoid Voids, Drains
OPSD 3390.100	Deck, Drip Channel
OPSD 3390.150	Falsework Clearance to Traffic Lanes
OPSD 3940.150	Figures In Concrete, Warning Message, Layout
OPSD 3940.151	Figures In Concrete, Warning Message Letters
OPSD 3940.200	Figures In Concrete, Site Number and Date Layout

Appendix 919-B, November 2009

FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

Supplemental Requirements for Using OPSS 919 in Municipal Contracts

OPSS 919, Formwork and Falsework, is amended as follows:

919.03 Definitions

Section 919.03 is amended by the deletion of the definitions for Certificate of Conformance and for Quality Verification Engineer.

Section 919.03 is amended by the addition of the following:

Certificate of Installation means a document issued by the design Engineer or design-checking Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

919.04.02.01.02 Falsework

The first paragraph of clause 919.04.02.01.02 is deleted in its entirety and replaced by the following:

The Contractor shall submit 5 sets of Working Drawings to the Contract Administrator at least 14 Days prior to commencement of the erection of falsework. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

919.04.02.01.03 Formwork

The first paragraph of clause 919.04.02.01.03 is deleted in its entirety and replaced by the following:

The Contractor shall submit 5 sets of Working Drawings to the Contract Administrator at least 14 Days prior to commencement of the erection of formwork. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

919.04.02.02.02 Interim Inspection after Construction of Falsework

Clause 919.04.02.02.02 is deleted in its entirety and replaced by the following:

Upon completion of the falsework foundation and prior to installation of falsework, the design Engineer or the design-checking Engineer shall conduct an interim inspection of the work to verify that the falsework foundation has been constructed according to the Falsework Foundation Design Report and issue the Contractor written permission to proceed with the work.

Appendix 919-B

919.04.02 Submission Requirements

Subsection 919.04.02 is amended by the addition of the following:

919.04.02.06 Return of Submissions

Two copies of each submission shall be returned as one of the following:

- a) Stamped with the wording that allows for permission to construct. In this case, work can commence on receipt of the drawings by the Contractor.
- b) Stamped with the wording that allows for permission to construct as noted. In this case, work can start on receipt of the drawings by the Contractor. The drawings shall be updated as noted and shall be sealed and signed by the design Engineer and the design-checking Engineer stating the drawings have been revised according to the noted comments.
- c) Showing only required changes. In this case, the drawings shall be updated as required and the submission process repeated.

919.07.05 Certificate of Conformance

Clause 919.07.05 is deleted in its entirety and replaced by the following:

919.07.05 Certificate of Installation

Certificates of installation shall be submitted for all formwork and falsework for which Working Drawings are submitted.

A completed certificate of installation shall be submitted to the Contract Administrator upon completion of the formwork and falsework installation prior to the placement of concrete. The design Engineer or design-checking Engineer's seal and signature shall be affixed on the completed certificate of installation confirming that the formwork and falsework have been installed in general conformance with the Working Drawings and Contract Documents. The certificate of installation shall also certify that the interim milestone inspections have been completed as specified in the Contract Documents.



NOTICE TO USERS OF OPSS 920

CONSTRUCTION SPECIFICATION FOR DECK JOINT ASSEMBLIES, PREFORMED SEALS, JOINT FILLERS, JOINT SEALS, JOINT SEALING COMPOUNDS, AND WATERSTOPS - STRUCTURES

OPSS 920 has been removed from this
OPS volume

The provincial version of OPSS 920 is now in:

OPS Volume 5,
Provincial-Oriented
MTO General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.PROV 920

The municipal version of OPSS 920 is now in:

OPS Volume 7,
Municipal-Oriented
OPS General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.MUNI 920

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



CONSTRUCTION SPECIFICATION FOR INSTALLATION OF BEARINGS

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922.01 SCOPE

This specification covers the construction requirements for the installation of bearings.

922.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

922.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

922.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Material

OPSS 1202	Bearings - Elastomeric Plain and Steel Laminated
OPSS 1203	Bearings - Rotational and Sliding Surface

CSA Standards

A23.1-04/A23.2-04	Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete

ASTM International

C 928-05	Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs

922.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Anchor means a device employed to secure a bearing to the structure or to restrict movement of the structure or both.

Bearing means a structural device that transmits load while permitting translation or rotation or both.

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Engineer means a Professional Engineer licensed by the Professional Engineers Ontario to practice in the province of Ontario.

Product Drawings means drawings prepared by the manufacturer that have been approved by the Owner for use with the product.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Superstructure means all parts of a bridge above the bearings.

922.04

DESIGN AND SUBMISSION REQUIREMENTS

922.04.01

Submission Requirements

922.04.01.01

Layout and Installation Drawings

922.04.01.01.01

General

The Contractor shall submit 3 sets of bearing layout and installation drawings to the Contract Administrator at least 1 week prior to commencement of bearing installation, for information purposes only. An Engineer's seal and signature shall be affixed on the layout and installation drawings verifying that the drawings are consistent with the Contract Documents.

The Contractor shall have a copy of these drawings at the site prior to and during site installation of the bearings.

922.04.01.01.02

Elastomeric Bearings

The layout and installation drawings for elastomeric bearings shall clearly indicate the following:

- a) Bearing layout and orientation.
- b) Dimensions and details of the bearings.
- c) Details of the top or bottom plate, or both, including anchorages or dowels or both.
- d) Installation details.

- e) Load resistance at serviceability and ultimate limit states, including maximum compressive permanent and total loads.
- f) Individual alphanumeric identification of each bearing.

922.04.01.01.03 Rotational and Sliding Surface Bearings

The layout and installation drawings for rotational and sliding surface bearings shall clearly indicate the following:

- a) Bearing layout and orientation.
- b) Top and bottom plate details, including anchorages.
- c) Installation details.
- d) Method of attachment of bearings to the top and bottom plates.
- e) Bearing identification letter and numbers.

922.04.01.02 Jacking

When jacking of the superstructure is specified in the Contract Documents, the Contractor shall submit 3 sets of the jacking drawings to the Contract Administrator at least 1 week prior to commencement of jacking, for information purposes only. The submission shall include the method and location, type, and capacity of jacks to be used; the type and location of the gauges; and the calibration certificates for both the jacks and gauges. An Engineer shall affix his or her seal and signature on the jacking drawings verifying that the drawings are consistent with the Contract Documents and sound engineering practices.

When jacking is not specified in the Contract Documents, the Contractor shall submit 5 sets of the jacking proposal drawings to the Contract Administrator at least 3 weeks prior to the commencement of jacking, for approval. The submission shall include the method and location, type, and capacity of jacks to be used; the type and location of the gauges; and the calibration certificates for both the jacks and gauges and, where necessary, the details of support for the jacks. Proposals shall bear the seals and signatures of the design and checking Engineers.

A copy of each jacking proposal drawing shall be returned as one of the following:

- a) Stamped with the wording that allows for permission to construct. In this case, work can commence on receipt of the drawing by the Contractor.
- b) Stamped with the wording that allows for permission to construct as noted. In this case, work can start on receipt of the drawings by the Contractor. The drawings shall be updated as noted and shall be sealed and signed by an Engineer stating the drawings have been revised according to the noted comments.
- c) Showing only required changes. In this case, the drawings shall be updated as required and the submission process repeated.

When another authority is involved with the Contract, all submissions shall be made at least 5 weeks prior to the commencement of work.

The Contractor shall have a copy of the jacking drawings or the approved jacking proposal drawings at the site prior to and during the jacking operation.

922.05 MATERIALS

922.05.01 Bearings

Bearings shall be according to OPSS 1202 or OPSS 1203 and as specified in the Contract Documents.

922.05.02 Grout

Grout shall be cement based, non-shrink, non-staining, and approved by the Owner.

Grout shall have a minimum nominal 7-Day compressive strength of 35 MPa.

922.07 CONSTRUCTION

922.07.01 General

The bearings shall be protected from damage, distortion, excessive heat, and deleterious matter during the handling, transportation, storage, and installation.

The bearings shall not be disassembled by the Contractor without the permission of the bearing supplier. The bearing supplier's representative shall be present during disassembly and reassembly.

Upon completion of the structure, the top and bottom surfaces of the bearings shall be in full contact with the structure.

Grouting operations shall be according to the manufacturer's recommendations, except that the temperature of the air, concrete, and bearings shall not be less than 10 °C at the time of grouting and shall be maintained at not less than 10 °C for a minimum of 96 hours after grout is placed.

922.07.02 Bearing Seats

The bearing seats shall be finished level and to an elevation established by subtracting the thickness of the bearings supplied from the top of bearing elevations specified in the Contract Documents. For elastomeric bearings, the finish of the concrete surface shall be smooth and not vary more than 1 mm along a straightedge placed in any direction across an area that extends at least 25 mm beyond the outside limits of the bearing. For other types of bearings, deviation along the straightedge shall not vary more than 3 mm.

Any concrete surface area prepared by grinding shall not allow water to pond in the area. For elastomeric bearings, the bearing seat areas prepared by grinding shall be intentionally roughened such that the surface has an equivalent to trowel finish. All surface areas shall be inspected and deemed acceptable by the Contract Administrator prior to installation of bearings.

922.07.03 Alignment

The longitudinal and transverse centrelines of the bearings shall be installed within ± 3 mm of the position specified in the Contract Documents. The centreline of the bearing along the direction of movement shall be parallel to the direction of movement of the bridge at that bearing location.

922.07.04 Installation of Anchors

The diameter, length, and material of the anchor and the diameter and depth of the anchor hole shall be as specified in the Contract Documents.

Where coring of the bearing seats to receive anchors is permitted, care shall be taken to ensure that the coring is done without damaging or cutting the steel reinforcement. Where permitted, coring shall not commence earlier than 3 weeks prior to bearing installation. In lieu of coring, the holes may be formed.

The holes shall be protected against entry of moisture and shall be completely filled with grout, when the anchors are installed.

922.07.05 Grouting

Where the anchors for rotational and sliding surface bearings require core drilling or preformed holes, the bearings shall be bedded over their entire area on grout that does not contain any voids. The use of permanent shims to achieve the theoretical elevation at the top of the bearing shall not be allowed.

The thickness of the grout bedding for rotational and sliding surface bearings shall be $12 \text{ mm} \pm 3 \text{ mm}$. The substrate shall be roughened by bushhammering, cleaned, and prewetted prior to grouting. Transfer of superstructure load to the bearings shall not be allowed until the grout has reached a minimum strength of 30 MPa.

The grout material shall be mixed, handled, and cured according to the manufacturer's instructions.

Elastomeric bearings shall not be placed directly on grout.

922.07.06 Tolerances

Bearings shall be set level to within a 500H:1V slope in any direction. The top of the bearing shall be set at the theoretical elevation specified in the Contract Documents, within the following tolerances:

Concrete deck and precast I-type girders	$\pm 5 \text{ mm}$
Steel plate girders	0 to + 3.0 mm
Steel and precast concrete box girders	0 to + 2.0 mm

922.07.07 Temporary Attachments

Temporary clamping devices shall be used to maintain correct orientation and setting and to prevent movement or separation of the bearing components during the handling, transportation, and installation. The clamping devices shall not be used for lifting or suspending the bearings. Clamping devices shall be removed after each bearing is in its final position, with all permanent connections made, and after all grout and concrete in contact with the bearing have been placed.

922.07.08 Jacking

Jacking operations shall be carried out under the direct supervision of an Engineer.

The lifting or lowering of the structure shall be carried out in one uniform and synchronized jacking operation. At no time during jacking operations shall the difference between any of the jacking points be more than 3 mm at the same abutment or pier cap.

When jacking is required in order to adjust the bearings, the structure shall be jacked the minimum amount required to allow the bearings to come back to a vertical position.

922.07.09 Quality Control

922.07.09.01 Certificate of Conformance

A completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Qualification Verification Engineer's seal and signature shall be affixed on the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the layout and installation drawings, Working Drawings, product drawings, and Contract Documents for the bearings:

- a) Fabrication
- b) Installation
- c) Adjustments, when applicable

922.07.09.02 Sampling and Supplying of Bearings

After the bearings have been fabricated, the Contractor shall notify the Contract Administrator in writing of the identification and availability of the bearings.

Where strip bearings have been specified for precast boxes placed side-by-side, each bearing strip shall be supplied at least 600 mm longer than required. A sample, 600 mm in length, shall be cut in the field from one end of each strip bearing and supplied for testing.

Elastomeric bearings beyond the number of bearings specified for installation shall be supplied as specified in the Contract Documents.

All bearings shall be available for sampling either at the project site or at a location acceptable to the Contract Administrator. Sample bearings for testing purposes shall be selected by the Contract Administrator from all the bearings of each size and thickness fabricated for the Contract. The Contract Administrator shall advise the Contractor in writing which bearings have been selected for testing. The Contractor shall deliver these bearings to the location specified in the Contract Documents.

922.07.09.03 Grout Testing

Three 7-Day compressive strength cubes shall be made and tested according to ASTM C 928 for each day that grout is being placed.

For early strength testing, additional cubes shall be tested.

922.08 QUALITY ASSURANCE

922.08.01 Testing

The Contractor shall allow 60 Days from the time of submission of elastomeric bearings for the Owner's testing program.

The number, type, and size of elastomeric bearing samples to be selected for destructive testing shall be as specified in the Contract Documents.

922.08.02 Rejection

If a sample plain elastomeric bearing fails, all plain elastomeric bearings represented by that sample shall be rejected.

If the number of laminated elastomeric bearings specified is less than 10, failure of the sample bearing shall mean that all laminated elastomeric bearings are rejected.

If the number of laminated elastomeric bearings specified is 10 or more, failure of a sample bearing shall mean that all laminated elastomeric bearings of that size and thickness are rejected.

Rejected bearings, whether installed or not, shall be removed from the job site. Bearings supplied as replacements for rejected bearings shall be sampled, tested, and approved or rejected on the same basis as the original bearings.

922.09 MEASUREMENT FOR PAYMENT

922.09.01 Bearings

For measurement purposes, a count shall be made of the number of the bearings installed and of the bearings supplied for destructive testing. Alternatively, bearings may be a lump sum item.

922.10 BASIS OF PAYMENT

922.10.01 Bearings - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the Work.

When bearings are a lump sum item, payment at the Contract price for the tender item Bearings shall include full compensation for the bearings supplied for destructive testing.

**Appendix 922-A, November 2009
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- When jacking of a structure is required. (922.04.01.02)
- Type of bearing. (922.05.01)
- Top of bearing elevation. (922.07.02)
- Bearing location. (922.07.03)
- Bearing anchor dimensions and material. (922.07.04)
- Bearing anchor hole dimensions. (922.07.04)
- Number of sample bearings and delivery location of samples for testing. (922.07.09.02)
- Number, type, and size of elastomeric bearings for destructive testing. (922.08.01)

OPSS 922 contains information that is not used by municipalities in their Contracts. To ensure completeness of the municipal Contract Documents, the designer should invoke Appendix 922-B. The appendix contains information that modifies OPSS 922 so it can be used by a municipality in its Contracts.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.

Appendix 922-B, November 2009

FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

Supplementary Requirements for Using OPSS 922 in Municipal Contracts

OPSS 922, Installation of Bearings, is amended as follows:

922.03 DEFINITIONS

Section 922.03 is amended by the deletion of the definitions for Certificate of Conformance and Quality Verification Engineer.

922.04.01.01.01 General

Clause 922.04.01.01.01 is deleted in its entirety and replaced by the following:

The Contractor shall submit 5 sets of bearing layout and installation drawings to the Contract Administrator at least 3 weeks prior to commencement of bearing installation, for information purposes only. An Engineer shall affix his or her seal and signature on the layout and installation drawings verifying that the drawings are consistent with the Contract Documents and sound engineering practices.

The Contractor shall have a copy of these drawings at the site prior to and during site installation of the bearings.

922.04.01.02 Jacking

Clause 922.04.01.02 is deleted in its entirety and replaced by the following:

When jacking of the superstructure is specified in the Contract Documents or is required due to the Contractor's method of construction, the Contractor shall submit 5 sets of the jacking or jacking proposal drawings to the Contract Administrator at least 3 weeks prior to the commencement of jacking, for review. The submission shall include the method and location, type, and capacity of jacks to be used; the type and location of the gauges; and the calibration certificates for both the jacks and gauges and, where necessary, the details of support for the jacks.

All jacking drawings shall bear the seal and signature of an Engineer verifying that the drawings are consistent with the Contract Documents and sound engineering practices.

Proposals shall bear the seals and signatures of the design and checking Engineers.

Appendix 922-B

922.04.01 Design and Submission Requirements

Subsection 922.04.01 is amended by the addition of the following:

922.04.01.03 Return of Submissions

Two copies of each submission shall be returned as one of the following:

- a) Stamped with the wording that allows for permission to construct. In this case, work can commence on receipt of the drawings by the Contractor.
- b) Stamped with the wording that allows for permission to construct as noted. In this case, work can start on receipt of the drawings by the Contractor. The drawings shall be updated as noted and shall be sealed and signed by an Engineer stating the drawings have been revised according to the noted comments.
- c) Showing only required changes. In this case, the drawings shall be updated as required and the submission process repeated.

When another authority is involved with the Contract, all submissions shall be made at least 5 weeks prior to the commencement of work.

The Contractor shall have a copy of the stamped updated or accepted drawings at the site during any jacking operation.

922.07.09.01 Certificate of Conformance

Clause 922.07.09.01 is deleted in its entirety.



NOTICE TO USERS OF OPSS 928

CONSTRUCTION SPECIFICATION FOR STRUCTURE REHABILITATION - CONCRETE REMOVAL

OPSS 928 has been removed from this
OPS volume

The provincial version of OPSS 928 is now in:

OPS Volume 5,
Provincial-Oriented
MTO General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.PROV 928

The municipal version of OPSS 928 is now in:

OPS Volume 7,
Municipal-Oriented
OPS General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.MUNI 928

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



**CONSTRUCTION SPECIFICATION FOR
ABRASIVE BLAST CLEANING - CONCRETE CONSTRUCTION**

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929-A	Commentary

929.01	SCOPE

This specification covers the requirements for abrasive blast cleaning of concrete surfaces and reinforcing steel.

929.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

929.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

929.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

ASTM International

D 4285-83 (R2006) Standard Test Method for Indicating Oil or Water in Compressed Air

The Society for Protective Coatings (SSPC)

VIS 1-2002 Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

Joint Publications of the Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE)

SSPC-SP 6/NACE No. 3-2007 Commercial Blast Cleaning

929.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Abrasive means a solid substance capable of grinding or wearing down.

Fiber Reinforced Polymer (FRP) Reinforcement means a structural reinforcing bar made from glass fibers or carbon fibers held in a polymeric resin matrix binder. FRP includes dowels, reinforcing bars and grids.

Layer, Reinforcing Steel means two or more reinforcing bars placed in a plane parallel to a concrete face.

Mat, Reinforcing Steel means transverse and longitudinal layers of reinforcing steel tied together.

Structure means any bridge, culvert, tunnel, retaining wall, wharf, dock, guideway or any part thereof, or other reinforced concrete component designed to carry loads, including high mast pole footings and sign support footings.

929.06

EQUIPMENT

929.06.01

Air Compressor

The air compressor for abrasive blast cleaning shall be capable of delivering material at a pressure of 620 kPa. The air pressure shall be measured in the delivery system at a distance not greater than 3 m from the nozzle end.

The compressed air shall be clean, dry, and free of oil residue when tested according to ASTM D 4285.

Nozzles used for abrasive blast cleaning shall have a minimum diameter of 8 mm and the size shall be indicated on the nozzle.

Hoses used for abrasive blast cleaning shall have an internal diameter not less than 40 mm.

929.07

CONSTRUCTION

929.07.01

General

Abrasive blast cleaning shall only be permitted when the concrete and reinforcing steel are surface dry.

Areas and components not designated for abrasive blast cleaning shall be protected from adjacent abrasive blast cleaning operations.

All new epoxy coated reinforcing steel and any FRP reinforcement in the vicinity of the abrasive blast cleaning operations shall be protected from damage.

Adequate access to the work area shall be provided to facilitate the work and for any inspection or measurement required by the Contract Administrator.

929.07.02

Abrasive Blast Cleaning of Reinforcing Steel

Abrasive blast cleaning of existing reinforcing steel applies to both epoxy coated and uncoated reinforcing steel.

All existing epoxy coated reinforcing steel within a concrete removal area shall be abrasive blast cleaned to remove the epoxy coating. Reinstatement of the epoxy coating on the existing reinforcing steel is not required.

The full circumference of the existing exposed reinforcing steel shall be abrasive blast cleaned to a commercial blast cleaned finish according to SSPC-SP 6/NACE No. 3, and the blast cleaned steel surfaces shall be according to the applicable visual standards specified in SSPC-VIS 1.

When silica sand is used as the abrasive material, the subsequent placement of concrete or shotcrete shall be done within 72 hours or the reinforcing steel shall be reblasted. When other types of abrasive materials are used, the subsequent placement of concrete or shotcrete shall be done within 36 hours or the reinforcing steel shall be reblasted.

929.07.03 Abrasive Blast Cleaning of Structural Steel in Contact with Concrete

All surfaces of existing structural steel against which new concrete is to be placed for the rehabilitation of a concrete structure component shall be abrasive blast cleaned to a commercial blast cleaned finish according to SSPC-SP6/NACE No. 3, and the blast cleaned steel surfaces shall be according to the applicable visual standards specified in SSPC-VIS 1.

The abrasive blast cleaning of structural steel shall be done immediately prior to placing coated reinforcing steel or FRP reinforcement.

Enclosure shall be provided during abrasive blast cleaning of structural steel to prevent escape of dust from the immediate work area into the natural environment, live traffic, waterways, and beyond the right-of-way.

929.07.04 Abrasive Blast Cleaning of Concrete Surfaces

929.07.04.01 General

All new and existing concrete surfaces against which new concrete is to be placed shall be abrasive blast cleaned.

The abrasive blast cleaning shall be of an extent to expose and clean the coarse aggregate and remove all dirt, laitance, and hardened concrete slurry. Any oil or grease on the surface of the concrete shall be removed using hand tools.

The abrasive blast cleaning of concrete surfaces shall be carried out not more than 48 hours prior to the placement of concrete against them.

Immediately after abrasive blast cleaning is completed, the surface shall be checked by the Contract Administrator for fractured concrete or loose aggregate. This material shall be removed using hand tools.

929.07.04.02 Concrete Surfaces for Overlays

Abrasive blast cleaning shall proceed by delineating an area of the deck not exceeding 10 m² and completing abrasive blast cleaning within the delineated area prior to proceeding to the adjacent areas of the deck surface.

When the concrete overlay is to be placed over cathodic protection anode mesh, the abrasive blast cleaning shall be completed prior to installing the mesh in that area.

Except when anode mesh is used, areas of concrete that are abrasive blast cleaned for the subsequent treatment of concrete overlay, shall have the overlay applied within 36 hours or shall be reblasted.

929.07.05 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

929.08 QUALITY ASSURANCE

928.08.01 General

After abrasive blast cleaning is completed, the abrasive blast cleaned concrete surfaces, reinforcing steel, and structural steel shall be examined by the Contract Administrator to verify that the requirements of this specification have been met.

929.09 MEASUREMENT FOR PAYMENT

929.09.01 Actual Measurement

929.09.01.01 Abrasive Blast Cleaning of Reinforcing Steel

Measurement for payment shall be of the area of concrete removed in square metres where reinforcing steel bars are exposed. When the removal exposes more than one mat of reinforcing steel, the measured area shall be for each mat of exposed bars that are to remain in place. There shall be no measurement for abrasive blast cleaning of reinforcing steel in volume of concrete that was not designated for concrete removal by the Contract Administrator.

When only one reinforcing steel bar is exposed in the area of concrete removal, the area shall be calculated based on the width of 200 mm by the length of the exposed reinforcing steel bar.

The total area shall be calculated to the nearest 0.1 m².

929.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

929.10 BASIS OF PAYMENT

**929.10.01 Abrasive Blast Cleaning for Overlays - Item
Abrasive Blast Cleaning of Reinforcing Steel - Item
Abrasive Blast Cleaning of Structural Steel in Contact with Concrete - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the Work.

Abrasive blast cleaning of reinforcing steel applies to abrasive blast cleaning of existing reinforcing steel that is either epoxy coated or uncoated reinforcing steel.

When the Contract does not contain a separate tender item for providing access to the work, the Contract price for the abrasive blast cleaning items requiring the access shall include full compensation for all labour, Equipment, and Material to provide such access.

Appendix 929-A, April 2012
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



NOTICE TO USERS OF OPSS 930

CONSTRUCTION SPECIFICATION FOR STRUCTURE REHABILITATION - CONCRETE PATCHES AND OVERLAYS

OPSS 930 has been removed from this
OPS volume

The provincial version of OPSS 930 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 930

The municipal version of OPSS 930 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 930

USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS



CONSTRUCTION SPECIFICATION FOR STRUCTURE REHABILITATION - SHOTCRETE

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APPENDICES

931-A	Commentary

931.01	SCOPE

This specification covers the requirements for concrete structure rehabilitation using normal and silica fume shotcrete.

931.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

931.02**REFERENCES**

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications.

Ontario Provincial Standard Specifications, Construction

OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete
OPSS 919	Formwork and Falsework
OPSS 928	Structure Rehabilitation - Concrete Removal
OPSS 929	Abrasive Blast Cleaning - Concrete Construction
OPSS 932	Crack Repair - Concrete

Ontario Provincial Standard Specifications, Material:

OPSS 1002	Aggregates - Concrete
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1306	Burlap
OPSS 1315	White Pigmented Curing Compounds for Concrete

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:
LS-430 Method of Test for Bond Strength by Tensile Load

CSA Standards

A23.2-14C- 09 Obtaining and Testing Drilled Cores for Compressive Strength Testing*

* [Part of A23.1-09/A23.2-09 Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]

ASTM International

A 123/A 123M-12 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 153/A 153M-09 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 185/A 185M-07 Steel Welded Wire Reinforcement, Plain, for Concrete
C 1202-10 Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

931.03 DEFINITIONS

For the purpose of this specification the following definitions apply:

Cold Weather means those conditions when the air temperature is at or below 10° C. It is also considered to exist when the air temperature is at or is likely to fall below 10° C within 96 hours after concrete placement. Temperature refers to shade air temperature.

Dry-Mix Shotcrete means shotcrete in which the mixing water is added at the nozzle.

Hot Weather means those conditions when the air temperature is at or above 28 °C. It is also considered to exist when the air temperature is at or is likely to rise above 28 °C within 24 hours after concrete placement. Temperature refers to shade air temperature.

Nozzle Operator means the worker on the shotcrete crew who manipulates the nozzle, controls consistency with the dry process, and controls final placement of the material.

Rehabilitation means any modification, alteration, or improvement to a structure or its components that is designed to correct defects or deficiencies.

Structure means any bridge, culvert, tunnel, retaining wall, wharf, dock, guide way, or any part thereof.

Wet-Mix Shotcrete means shotcrete in which all of the ingredients, including water, are mixed before introduction into the delivery hose. Compressed air is introduced to the material flow at the nozzle.

931.04 DESIGN AND SUBMISSION REQUIREMENTS

931.04.01 Submission Requirements

931.04.01.01 Mix Design

The mix proportions and the name of the supplier of the prebagged shotcrete mix shall be forwarded to the Contract Administrator for review at least 14 Days prior to the application of shotcrete.

In addition, the Contractor shall submit with the mix design the following:

- a) A certificate from the cement supplier stating that the cement is certified to be free from early stiffening tendencies according to the requirements of OPSS 1301.
- b) Performance test data from the manufacturer of the prebagged material, or test data from another contract, verifying that the material meets the requirements of this specification.

All supporting test data shall not be more than 12 months old at the time the mix design was submitted to the Contract Administrator.

931.04.01.02 Shotcrete Equipment

A list of equipment and accessories to be used, including the following information, shall be submitted to the Contract Administrator at least 14 Days prior to the application of shotcrete:

- a) Equipment type and capacity.
- b) Nozzle type and size.
- c) Continuous feed predampener details, only when the dry mix process is used.

931.04.01.03 Nozzle Operator

The names of the nozzle operators and proof of their qualification shall be submitted to the Contract Administrator at least 14 Days prior to the commencement of the shotcreting operation.

931.04.01.04 Cold Weather Protection

Details of the method to be used in the production of the shotcrete to control the shotcrete temperature shall be submitted to the Contract Administrator at least 14 Days prior to the commencement of the shotcreting operation in cold weather. The submission shall be accompanied by samples of insulation, if requested by the Contract Administrator, and shall contain the following information:

- a) Weather conditions for which the description applies.
- b) Type of insulation, metric "R" value, and number of layers to be used.
- c) Description of housing and heating.
- d) Method of withdrawal of protection to avoid sudden temperature change in the shotcrete.
- e) Method of ensuring cold weather protection measures are maintained and effective when work requiring adjustment to the protective measure is being performed.

931.04.01.05 Hot Weather Shotcreting

A description of the method to be used in the production of the shotcrete to control the shotcrete temperature shall be submitted to the Contract Administrator 14 Days prior to the application of shotcrete in hot weather.

931.04.01.06 Curing

A description of the methods to be used for fog-misting and curing, including equipment and procedures, shall be submitted to the Contract Administrator 14 Days prior to the application of shotcrete.

931.04.01.07 Return of Submissions

Two copies of each submission shall be returned as one of the following:

- a) Stamped with the wording: Reviewed. In this case, work can commence on receipt of the drawings by the Contractor.
- b) Stamped with the wording: Reviewed as Noted. In this case, work can start on receipt of the reviewed submission by the Contractor. The submission shall be updated as noted and shall be sealed and signed by the design Engineer and the design-checking Engineer stating the submission has been revised according to the noted comments.
- c) Showing only required changes. In this case, the submission shall be updated as required and the submission process repeated.

931.05 MATERIALS

931.05.01 Anchors

Anchors for the attachment of the welded steel wire fabric to the concrete surface shall be galvanized according to ASTM A 153/A 153M and be of adequate length and strength to resist a pull-out force of 1.0 kN.

931.05.02 Burlap

Burlap shall be according to OPSS 1306.

931.05.03 Cementing Material

Cementing material shall be according to OPSS 1301.

931.05.04 Curing Compound

Curing compound shall be according to OPSS 1315.

931.05.05 Fine Aggregate

Fine aggregate shall be according to OPSS 1002.

931.05.06 Formwork

Formwork shall be according to OPSS 919.

931.05.07 Proprietary Patching Materials

Proprietary patching materials shall be as specified in the Contract Documents.

931.05.08 Shotcrete

931.05.08.01 General

The shotcrete mix shall be supplied prebagged. The prebagged mix shall contain cementing materials and fine aggregate. The bags shall be maintained in a dry condition up to the time of its use and shall be stored within a temperature range of 5 to 30 °C. Any bags that contain lumps of pre-hydrated shotcrete or appear to be frozen or otherwise damaged shall not be used in the Contract.

Each bag shall be stamped with the name of the manufacturer, mix identification, and date of packaging. The prebagged mix shall be used within 3 months of packaging.

931.05.08.02 Normal Shotcrete

The shotcrete shall have a minimum 28-Day compressive strength of 30 MPa. The water to cement ratio, by mass, shall not be greater than 0.35 when the wet mix process is used.

931.05.08.03 Silica Fume Shotcrete

The silica fume shotcrete shall have a minimum 28-Day compressive strength of 35 MPa and maximum rapid chloride permeability at 28 Days of 1,000 coulombs. The shotcrete mix shall contain 8% silica fume by mass of total cementing materials.

931.05.09 Tie Wire

Coated tie wire according to OPSS 905 shall be used.

931.05.10 Water

Water shall be according to OPSS 1302.

931.05.11 Welded Steel Wire Fabric

Welded steel wire fabric shall be welded galvanized steel of 51 x 51 mm, MW 5.5 x MW 5.5, and shall be according to ASTM A 185/A 185M. Galvanizing shall be according to ASTM A 123/A 123M.

931.06 EQUIPMENT

931.06.01 Compressor - Air Blasting

The compressor for air blasting shall have a minimum capacity of 3.5 m³/min. The compressed air shall be free from oil and other contaminants.

931.06.02 Fog Misting Equipment

The Contractor shall provide fog misting equipment for curing of the shotcrete. Fog misting equipment shall include at least one hand held portable unit.

931.06.03 Hand Finishing Equipment

Where hand finishing is required, only magnesium, wood, or sponge rubber floats shall be used.

931.06.04 Mixers

931.06.04.01 Dry Mix Process

A continuous feed predampener shall be used. The predampening equipment shall be capable of bringing the dry bagged material to consistent and suitable moisture content and shall operate at sufficient capacity to allow work to proceed without delays.

The delivery equipment shall be capable of discharging the mixture into the delivery hose at a rate sufficient to ensure a continuous smooth stream of uniformly mixed shotcrete mixture being delivered to the nozzle, at the velocity required.

The discharge nozzle shall be equipped with a manually operated water injection system, for directing an even distribution of liquid through the mixture. The liquid valve shall be capable of ready adjustment to vary the quantity of liquid and shall be convenient for the nozzle operator. The nozzle shall be capable of delivering a conical discharge stream with uniform appearance throughout. The liquid pressure at the discharge nozzle shall be sufficiently greater than the operating air pressure to assure that the liquid is thoroughly mixed with the other materials. The liquid pressure shall be uniform.

931.06.04.02 Wet Mix Process

The mixing equipment shall be capable of thoroughly mixing the specified materials in sufficient quantity to maintain continuous placing. The delivery equipment shall be capable of delivering the pre-mixed materials accurately, uniformly, and continuously through the delivery hose.

The wet mix process shall not be used for silica fume shotcrete.

931.06.05 Straight Edge

The straight edge shall be 1.0 m long, commercially made, and metal.

931.07 CONSTRUCTION

931.07.01 General

Typical locations and areas of repair are as specified in the Contract Documents; however, the actual locations and extent of repair shall be as determined during the layout of the repair areas according to OPSS 928 and as directed by the Contract Administrator.

931.07.02 Operational Constraints

The Contract Administrator shall be notified of the intent to apply shotcrete 3 Business Days prior to the commencement of the shotcreting operation. The application of shotcrete shall not proceed until the concrete surface preparation has been completed according to this specification and verified by the Contract Administrator.

Prior to shotcreting, the Contractor shall demonstrate to the Contract Administrator that the substrate temperatures meet the requirements specified in the Contract Documents by measuring and recording the substrate temperatures using a contact thermometer or infrared thermometer.

Shotcreting shall not be carried out when the air temperature or existing concrete surface temperature is below 10 °C or is likely to fall below 10 °C, or is above 28 °C or likely to rise above 28 °C throughout the duration of the shotcreting operation, unless protection is provided in accordance with the Contractor's submitted plan.

The air in contact with the repaired surfaces shall be maintained at temperatures above 10 °C for at least 96 hours after the application of shotcrete. The use of unvented heaters shall be prohibited.

Shotcreting operations shall be suspended during adverse weather conditions, unless protection is provided.

Prior to seasonal shutdown, operations shall be scheduled in such a manner to ensure that the shotcreting operations are completed in all areas where concrete removal has commenced. No steel reinforcement shall be left exposed during seasonal shutdown.

931.07.03 Access to Work Areas, Work Platform, and Scaffolding

Adequate access shall be provided to facilitate inspection and measurement by the Contract Administrator.

931.07.04 Surface Preparation

All concrete surfaces against which shotcrete is to be placed shall be clean, solid, and free from loose or unsound fragments, coatings, and any other foreign substances or debris, and shall be sufficiently rough to ensure that a full bond is developed with the new shotcrete.

All existing concrete surfaces to be covered by shotcrete shall be uniformly roughened by means of scabbling, chipping, or bush hammering. A surface profile of 5 ± 2 mm shall be achieved by exposing the aggregates across the entire surface.

All concrete surfaces, including areas 50 mm beyond the perimeter of the removal area and existing steel reinforcement to receive shotcrete, shall be abrasive blast cleaned according to OPSS 929 prior to installation of welded steel wire fabric.

Abrasive blast cleaned areas shall have shotcrete applied within 36 hours or shall be reblasted. In areas requiring reblasting, the Contractor shall remove the welded steel wire fabric prior to abrasive blast cleaning and reinstall the wire fabric.

Immediately prior to wetting the concrete, all dust and loose material shall be removed from the prepared surface of the repair area by using compressed air.

The area to be shotcreted shall be maintained in a wet condition for a period of 2 hours prior to the application of the shotcrete. Prior to the shotcreting operation, excess water shall be removed from the surface using compressed air.

931.07.05 Placement of Welded Steel Wire Fabric

When welded steel wire fabric is specified in the Contract Documents, it shall not be installed until after the concrete surface and exposed steel reinforcement in the repair area have been abrasive blast cleaned. The wire fabric shall not be abrasive blast cleaned at any time.

The Contractor shall install wire fabric in all repair areas greater than 0.1 m^2 that have a minimum dimension of 200 mm. The wire fabric shall be securely fastened to the exposed steel reinforcement by ties placed no further than 300 mm apart in a grid pattern. When the exposed steel reinforcement is not capable of providing rigid support for the wire fabric, anchors shall be used to support the wire fabric.

When there is no exposed steel reinforcement, the wire fabric shall be fastened to the concrete with anchors placed no further than 300 mm apart in a grid pattern. The minimum clearance between the wire fabric and the existing concrete shall be 20 mm.

The wire fabric shall be installed flat, tight, and at locations shown in the Contract Documents using spacers and anchors. The edges of adjoining wire fabric sheets shall be overlapped by one wire spacing plus 50 mm. The wire fabric shall be kept clean of any substance that may reduce the bond of the shotcrete to the wire surface.

931.07.06 Approval of Nozzle Operator

Shotcreting shall be carried out by a nozzle operator who has been certified by participation in the MTO Shotcrete Nozzlemen Certification Program.

931.07.07**Placing**

Prior to the application of shotcrete, the Contractor shall protect all structural components not receiving shotcrete and appurtenances from the shotcreting operation. Repair areas being prepared to receive shotcrete shall also be protected.

When practical, shotcrete shall be placed without the use of formwork. When the requirements of this specification cannot otherwise be met, formwork may be used and shall be according to OPSS 919. Formwork shall be adequately braced against excessive vibration and constructed to permit the escape of air and rebound during the shotcreting operation.

During the application of shotcrete, a steady continuous flow of shotcrete shall be maintained. Any predampened mixture that is not used within one half hour, shall not be incorporated into the work.

Shotcrete shall be applied so that there is no sagging or separation of the material in place. All rebound material shall be removed from the repair area as the work proceeds. Rebound or waste material shall not be worked back into construction or salvaged and re-used.

The concrete surface surrounding the repair area shall be cleaned immediately after the application of shotcrete using suitable hand tools.

When shotcrete in a repair area cannot be applied in a single operation or delays are experienced, moist curing by means of continuous fog mist shall be applied according to the curing requirements of this specification. If the previous layer has hardened, the surface of the shotcrete shall be thoroughly cleaned of any laitance by wire brushing and wetted prior to application of an additional layer of shotcrete.

The shotcrete shall be placed level or slightly above the level of the original concrete surface to provide a minimum of 50 mm cover to the welded steel wire fabric or reinforcing steel, unless otherwise specified in the Contract Documents.

At the end of the shotcreting operation, the shotcrete shall be terminated at a 1H:1V slope. Before placing an adjacent section, this sloped portion shall be thoroughly cleaned by wire brushing any laitance and wetted.

The total required depth of shotcrete shall be placed within the same working day.

931.07.08**Finishing**

Unless otherwise specified in the Contract Documents, when the final layer of shotcrete has attained its initial set, the surface of the shotcrete shall be finished with hand finishing equipment.

When tested with a straight edge, the maximum gap between the straight edge and any point on the surface shall be 6 mm.

931.07.09**Curing**

Shotcrete shall be initially moist cured by continuous fog mist for a minimum period of 24 hours. The curing shall commence as soon as the fog mist can be applied without deforming the surface of the shotcrete. When an area of fresh shotcrete is exposed to direct sunlight or to wind, the curing shall be applied immediately after the final application of shotcrete in that area.

After the initial 24 hour fog misting period, moist curing shall continue for an additional period of 72 hours by means of fog mist or wet burlap.

When wet burlap is used, the burlap shall be placed in a manner to ensure that it is in full contact with the surface of the shotcrete for the full duration of the curing period. The curing with burlap and water shall be according to OPSS 904.

Immediately after removal of moist curing, the shotcrete surface shall be coated with a curing compound according to OPSS 904.

931.07.10 Cold Weather Protection

931.07.10.01 General

The Contractor shall protect the shotcrete during cold weather. The protection system shall be designed for the worst conditions that can be reasonably anticipated from local weather records, forecasts, site conditions and past experience for the time period during which the protection is required.

931.07.10.02 Control of Temperature

During cold weather, the Contractor shall for a minimum period of seven days following the shotcrete operation, monitor and control the temperature of the shotcrete to ensure that the temperature does not fall below 10 °C. The Contractor shall take measures to ensure that the shotcrete temperature remains within the acceptable limits.

The Contractor shall supply thermocouples, wires, and digital temperature indicators with an accuracy of $\pm 0.5^{\circ}\text{C}$ to monitor the shade air temperature and shotcrete temperature. The digital temperature indicators shall be left in place or provided upon request to the Contract Administrator to facilitate additional readings for verification purposes.

Thermocouples shall be embedded near the shotcrete surface at a minimum of two locations for each day of shotcreting, as directed by the Contract Administrator.

For cold weather conditions, protection of concrete shall at least be according to Table 1.

931.07.10.03 Temperature Records

The Contractor shall record the shade air temperature and shotcrete temperature at a minimum frequency of once every four hours for the first 24 hours after the shotcreting operation and then once every eight hours for the remainder of the curing and protection period and during the removal of the cold weather protection.

The Contractor shall provide the Contract Administrator with the necessary access to the location and equipment to verify temperature readings.

Temperature records shall be forwarded to the Contract Administrator at the end of every day. At the end of the cold weather protection period, the Contractor shall submit to the Contract Administrator a complete temperature record consisting of a summary of the recorded temperatures and a graphical plot of temperature vs. time.

931.07.11 Coring and Testing

931.07.11.01 General

The cores shall be obtained according to CSA A23.2-14C at random locations specified by the Contract Administrator. The Contractor shall locate all steel reinforcement in the area, prior to taking any cores, to avoid cutting steel reinforcement.

Testing shall not be required on a structure when the total measured vertical area of shotcrete on a structure is less than 20 m² or the total measured horizontal area of shotcrete on a structure is less than 20 m².

931.07.11.02 Lot and Sublot Size

A lot shall consist of the total quantity of normal shotcrete or silica fume shotcrete in the Contract Documents. Each lot shall be divided into sublots of approximately equal size and not greater than 100 m². Separate sublots are required for vertical and horizontal repairs. Separate sublots are required for individual structures.

The Contract Administrator shall determine the sublot size after discussion with the Contractor and prior to the commencement of the shotcreting operation.

931.07.11.03 Compressive Strength

The Contractor shall be responsible for all aspects of coring, storage, and transportation of cores to determine compressive strength.

For evaluation of compressive strength testing, the Contractor shall remove four cores from the hardened shotcrete when the shotcrete is between 7 to 10 Days of age, for each sublot. The cores shall be 75 mm in diameter and at least 100 mm long. Cores may contain wire fabric but shall not contain reinforcing steel.

The Contractor shall deliver the cores to the designated quality assurance laboratory as specified in the Contract Documents. The cores shall be tested according to CSA A23.2-14C at 28 Days of age. The forms on which the field data for the cores is recorded shall be submitted to the laboratory with the shotcrete cores. Test results shall be recorded on forms acceptable to the Owner and forwarded to the Contract Administrator within 4 Days from the date of testing.

931.07.11.04 Tensile Bond Strength

The minimum tensile bond strength of the shotcrete shall be 1.0 MPa.

The tensile bond strength testing shall be carried out by the Contractor, in the presence of the Contract Administrator, on 3 in-situ cores taken within one metre of each other for each sublot. The testing shall be carried out by technicians employed by a laboratory acceptable to the Owner.

The cores shall be 100 mm in diameter and extend into the parent concrete to the depth specified in MTO LS-430. The testing shall be according to MTO LS-430 and shall be carried out when the shotcrete is 7 to 10 Days of age. The equipment used to measure the tensile bond strength shall be equipped with a maximum load indicator.

The Contractor shall ensure that the epoxy adhesive is cured according to the manufacturer's recommendations prior to carrying out the test. If failure occurs in the epoxy adhesive and the specified strength of 1.0 MPa has not been reached, the test shall be repeated within 300 mm of the original core location. Retesting is not required when the specified strength of 1.0 MPa has been achieved.

After the tensile bond strength testing is completed, the cores shall be extracted for the full depth of the coring to demonstrate to the Contract Administrator that the depth of coring was adequate.

All individual tensile bond strength results obtained by the Contractor and average shall be recorded on forms acceptable to the Owner and forwarded to the Contract Administrator within 4 Business Days of the date of testing.

931.07.11.05**Rapid Chloride Permeability - Silica Fume Shotcrete**

For evaluation of rapid chloride permeability, the Contractor shall remove cores from the hardened silica fume-shotcrete and test cores according to ASTM C 1202. Testing shall be carried out by a laboratory that is acceptable to the Owner.

Two cores, 100 mm in diameter and at least 75 mm long, shall be removed from each subplot, when the silica fume shotcrete is 7 to 10 Days of age. The portion of the core to be tested shall contain no reinforcing steel, welded wire steel fabric, or other embedments.

Cores shall be delivered in a plastic bag sealed to avoid loss of moisture, to a laboratory acceptable to the Owner, within 24 hours of coring. The cores shall be stored at a temperature of 23 ± 2 °C in a moist condition until time of testing. A 10 mm thick slice shall be cut from the top of each core before testing. Testing shall be carried out according to ASTM C 1202 when the shotcrete is 28 to 32 Days of age.

Rapid chloride permeability results obtained by the Contractor shall be recorded and forwarded to the Contract Administrator within 37 Days of application of shotcrete. Rapid chloride permeability core samples and original test record shall be retained by the Contractor until final completion of the Contract and shall be provided to the Contract Administrator, upon request.

931.07.11.06**Filling of Core Holes**

All remnants of cores, including ones that remain in place, shall be completely removed and core holes filled immediately after coring. Prior to filling, the inside surfaces of each core hole shall be cleaned of laitance and other debris from the coring operation by wire brushing. The core holes shall be cleaned using compressed air, pre-wetted, and filled with a proprietary patching material. The patching material shall be comparable to the surrounding concrete in terms of strength and permeability. The patching material shall be mixed and cured according to the manufacturer's recommendations. The patch shall be finished flush with the surface of the concrete and all excess material removed.

931.07.12**Remedial Work**

If plastic shotcrete is rejected by the Contract Administrator, the Contractor shall stop the work and take all necessary measures to correct deficiencies while the shotcrete is in the plastic state.

The Contractor shall notify the Contract Administrator in writing immediately if any of the defects or conditions listed in the Quality Assurance section are present in the Work with an explanation of the cause and extent of the deficiencies. These areas shall be repaired by the Contractor.

A proposal for the remedial work for the above defects and conditions shall be submitted to the Contract Administrator for review. The Contractor shall not proceed with repairs until approval of the proposal has been received.

The Contractor shall repair all cracks greater than or equal to 0.3 mm after the curing period has elapsed. Repair of cracks shall be according to OPSS 932. If the linear measurement of cracks greater than or equal to 0.3 mm in width per square metre is 2 m or greater, the entire shotcrete in the repair area shall be removed and replaced.

931.07.13**Management of Excess Material**

Management of excess material shall be according to the Contract Documents.

931.08 QUALITY ASSURANCE

931.08.01 Inspection

931.08.01.01 During Shotcrete Application

The Contract Administrator shall inspect the plastic shotcrete during the application process and shall reject all or a portion of the work based on the presence of one or more of the defects identified below:

- a) Failure to properly control and remove build-up of overspray and rebound.
- b) Incomplete consolidation around steel reinforcement and anchors.
- c) Excessive shotcrete rebound.
- d) Incorporation of sand lenses, excessive voids, delaminations, sags, and sloughing.
- e) Failure to apply shotcrete to the required line, grade, and tolerance.

931.08.01.02 Completed Work

The Contract Administrator shall inspect the completed work to determine if the work contains any of the following:

- a) Debonding or hollow-sounding areas.
- b) Porous or rebound material visible in cores.
- c) Areas that have visibly sagged in cores.
- d) Cracks.

931.08.02 Acceptance or Rejection

The Contract Administrator shall have the authority to accept or reject shotcrete that does not conform to the Contract requirements, either during the shotcrete application process or on the basis of the completed work, or if any of the defects identified in the Inspection subsection are identified in any of the cores extracted.

931.08.02.01 Normal Shotcrete

For normal shotcrete, the Contract Administrator shall reject all or a portion of the lot based on the presence of one or more of the defects identified in the Inspection subsection or one or more of the following conditions:

- a) Average compressive strength less than 30 MPa.
- b) An individual compressive strength result more than 3.5 MPa below the specified strength.
- c) Average tensile bond strength less than 0.6 MPa.
- d) Any work that does not conform to the requirements of this specification.

931.08.02.02**Silica Fume Shotcrete**

For silica fume shotcrete, the Contract Administrator shall reject all or a portion of the lot based on the presence of one or more of the defects identified in the Inspection subsection or one or more of the following conditions:

- a) Average compressive strength less than 35 MPa.
- b) An individual compressive strength result more than 3.5 MPa below the specified strength.
- c) Average tensile bond strength less than 0.6 MPa.
- d) Average rapid chloride permeability greater than 2,500 coulombs.
- e) Any work that is not according to the requirements of this specification.

931.09**MEASUREMENT FOR PAYMENT****931.09.01****Actual Measurement****931.09.01.01****Normal Shotcrete
Silica Fume Shotcrete**

Measurement shall be by volume in cubic metres of the concrete removed according to the Measurement for Payment section of OPSS 928, except when the existing cover to steel reinforcement is less than 50 mm, the depth used in calculating the volume shall be adjusted by adding the difference between the 50 mm required and the existing cover.

No measurement shall be made for areas of shotcrete that were removed according to the Remedial Work subsection.

No measurement shall be made for shotcrete required to patch areas of concrete removal when the removal was not approved by the Contract Administrator.

931.10**BASIS OF PAYMENT****931.10.01****Normal Shotcrete - Item
Silica Fume Shotcrete - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour Equipment, and Material to do the work, including abrasive blast cleaning of the concrete surfaces.

Payment for the work of abrasive blast cleaning of steel reinforcement shall be according to OPSS 929.

When the Contract does not contain a separate tender item for providing access to the work, the Contract price for the shotcrete items requiring the access shall include full compensation for all labour, Equipment, and Material to do the work.

TABLE 1
Minimum Cold Weather Protective Measures

Anticipated Minimum Air Temperature °C	Protective Measure Thickness of New Shotcrete < 0.25 m
+10 to 0	PM2
-1 to -10	PM4
-11 to - 20	PM5
Less than - 20	PM5
Maximum Allowable Drop in Concrete Temperature/24 hours	15 °C

Notes:

A. Protective Measures:

PM2 - Cover concrete with insulation having an R-Value of 0.67.

PM3 - Cover concrete with insulation having an R-Value of 1.33.

PM4 - Cover concrete with insulation having an R-Value of 2.00.

PM5 - House and heat as specified in the Housing and Heating clause of OPSS 904.

B. All R-Values are metric.

C. The conversion factor from metric to imperial units is:

Metric R-Value x 5.678 = Imperial R-Value.

Appendix 931-A, November 2013
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Proprietary patching materials. (931.05.07)
- Location of the quality assurance laboratory. (931.07.11.03)

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- Welded steel wire fabric. (931.07.05)

The wire fabric shall not be used in repair areas on which a cathodic protection system is to be installed.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR CRACK REPAIR - CONCRETE

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APPENDICES

932-A	Commentary

932.01	SCOPE

This specification covers the requirements for the pressure injection, routing, and sealing of cracks in concrete for the purpose of structural rehabilitation and water seepage control.

932.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

932.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

932.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

- OPSS 920 Deck Joint Assemblies, Preformed Seals, Joint Fillers, Joint Seals, Joint Sealing Compounds, and Waterstops - Structures
- OPSS 929 Abrasive Blast Cleaning - Concrete Construction

Ontario Provincial Standard Specifications, Material

- OPSS 1212 Hot Poured Rubberized Asphalt Joint Sealing Compound
- OPSS 1302 Water

ASTM International

- C 920-08 Elastomeric Joint Sealants
- D 4285-83 (2006) Test Method for Indicating Oil or Water in Compressed Air

932.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Active Crack means a crack in concrete with plane surfaces that are in a state of movement relative to each other.

Crack Depth means the distance that the crack extends from the injection surface into the concrete to the point where the crack is 0.10 mm wide.

Effective Pressure means the fluid grout pressure at point of entry at the injection port. This shall be calculated as gauge pressure minus head losses in injection system.

Engineer means a Professional Engineer licensed by the Professional Engineers Ontario to practice in the province of Ontario.

Flushing means removing debris from the crack section by means of air or a liquid under pressure.

Gauge Pressure means the actual fluid grout pressure reading on the pump gauge.

Injection Port means a mechanical device that is firmly connected into the crack section for the purpose of providing access into a crack for the grouting material.

Passive Crack means a concrete crack in concrete with plane surfaces that are not moving relative to each other.

Payment Adjustment Factor means a multiplier applied to the unit Contract price to determine the actual unit payment price.

Plural Component Pump means a grout pump that separately delivers the grout material components separately to a common static mixer.

Pot Life means the period of time during which the polyurethane or epoxy resin remains pumpable.

Refusal Criteria means zero flow of grout at the proposed effective pressure for a duration of 5 minutes.

Regulated Operating Pressure means the maximum pressure, measured at the pump discharge, that the pump is capable of producing.

932.04

DESIGN AND SUBMISSION REQUIREMENTS

932.04.01

Submissions

932.04.01.01

Crack Repair Work Plan

Four copies of the crack repair work plan shall be submitted to the Contract Administrator at least 3 weeks prior to the commencement of the work.

The crack repair work plan shall bear the seal and signature of an Engineer and include at least the following information.

a) A description of the method of repair, including the following minimum information:

- i. Basis of selection.
- ii. Proposed effective pressure.

- iii. Surface finishing.
 - iv. Location and size of injection ports.
 - v. Surface treatment of the concrete prior to surface sealing.
 - vi. Method of storing and handling grouts, cleaning solvents, and waste materials.
- b) A list of the materials to be used for crack preparation and repair, including the following minimum information:
- i. Material specifications.
 - ii. Product data sheets with test data.
 - iii. Material safety data sheets.
 - iv. Pot life of the components to be used based on a sample size of 200 ml at 5 °C and 20 °C.
- c) A certificate from the material supplier shall be submitted stating the material is suitable for the intended use in this Contract.
- d) A list of the equipment and accessories to be used including the following minimum information:
- i. The operating pressure of each component.
 - ii. The type of injection port and means of closure.

932.04.02 Return of Submissions

Two copies of each submission shall be returned marked as one of the following:

- a) Stamped with the wording that allows for permission to construct.

In this case, work can commence upon receipt of the submission by the Contractor. A copy of the submission shall be available at the site prior to and during construction.

- b) Stamped with the wording that allows for permission to construct as noted.

In this case, work can start upon receipt of the submission by the Contractor. The submission shall be updated as noted and shall have a stamp affixed that is signed by an Engineer stating the submission has been revised according to the noted comments. A copy of the stamped updated submission shall be available at the site prior to and during construction.

- c) Showing only required changes.

In this case, the submission shall be updated as required and the submission process repeated.

932.05 MATERIALS

932.05.01 Grout

932.05.01.01 General

Material used for crack injection shall be polyurethane resins for active cracks and epoxy resins for passive cracks.

Polyurethane and epoxy grout shall prevent the penetration of water and shall have sufficient flowability to fill the crack at least 80% of the depth of the crack using the proposed equipment and method of repair at the ambient and substrate temperatures existing at the time of grouting.

932.05.01.02 Epoxy Resin

Epoxy resin shall be moisture insensitive and 100% solids.

932.05.01.03 Polyurethane Resin

Polyurethane resin shall be 100% solids.

932.05.02 Joint Sealing Compounds

932.05.02.01 Hot-Poured Rubberized Joint Sealing Compound

The hot-poured rubberized joint sealing compound shall be according to OPSS 1212.

932.05.02.02 Cold-Applied Joint Sealing Compound

Cold-applied joint sealing compound shall be according to ASTM C 920, Type S, Grade NS, Class 25, Use TM. Type M sealant shall be used where the depth of a chase exceeds 15 mm or the manufacturer's recommended depth for Type S sealant, whichever is less. Where the cold sealing compound is visible after completion of the work a grey colour material shall be used.

932.05.03 Water

Water shall be according to OPSS 1302.

932.06 EQUIPMENT

932.06.01 Gauges

In addition to the calibrated gauges required for use with the pumps and with the injection hose, additional gauges shall be available on site to replace those that malfunction.

Certificates of calibration, from an organization accredited by the Standards Council of Canada shall be supplied for each gauge certifying that the gauges are capable of measuring the pressure within a tolerance of ± 5 kPa.

932.06.02 Pumps

Equipment used for pressure injection shall be suitable for the intended use and compatible with the grout.

Pumps shall be positive displacement type and shall be capable of delivering a minimum of two litres of grout per minute.

Pumps shall be capable of developing a maximum regulated operating pressure at least equal to twice the effective pressure.

Pumps shall be equipped with a calibrated gauge and shall be capable of accurately maintaining an effective operating pressure of 50 kPa or less.

Plural component pumps shall be used when multicomponent solution grouts are used.

Hand cartridge pumps shall not be used unless the volume of crack repair is less than one litre of resin for 100 m² of gross repair area.

932.06.03 Mixers

932.06.03.01 Static In-Line Mixers

Static in-line mixers shall produce a homogeneous grout and shall be sized to accommodate the minimum and maximum anticipated flow rates.

Static mixers shall have the manufacturer's plate attached showing the following mixer information:

- a) Size.
- b) Type.
- c) Maximum operating pressure.

932.06.03.02 Agitating Mixer

Agitating mixers shall have a power driven paddle mixing head and produce a homogeneous component.

The speed of the mixers shall be variable to a maximum of 500 rpm.

932.06.04 Injection Hoses

Injection hoses shall have a rated working pressure equal to or greater than the maximum pump operating pressure and shall be equipped with a calibrated gauge at the injection port end.

932.06.05 Injection Ports

Injection ports shall be removable or non-metallic insert type units. The pressure capacity of the injection ports shall be at least equal to the maximum operating pressure of the pump. All injection ports shall be equipped with a shut-off valve or other mechanical means of closure under pressure.

Surface mounted injection ports shall not be used.

932.06.06 Air Compressor

Compressed air shall be free from oil and water when tested according to ASTM D 4285.

932.06.07 Drills

Drilling of the injection holes shall be performed using a rotary percussion or rotary diamond type drill.

Percussion drilling equipment shall not be used for drilling holes greater than 26 mm diameter and holes within 150 mm of any edge of concrete.

Only holes 26 mm or less in diameter shall be drilled within 50 mm of any free edge of concrete.

932.06.08 Routing Equipment

Routing equipment shall be any of the following:

- a) Concrete router.
- b) Hand-held grinding wheel or a multi-bladed cut-off saw equipped with abrasive or diamond blades.
- c) Multi-bladed floor saw cutting equipment equipped with diamond blades.

932.07 CONSTRUCTION

932.07.01 General

Installation of all accessories and material shall be according to the manufacturer's recommendations and as specified in the submitted work plan.

Work shall only proceed when the temperature of the concrete is 5 °C or greater.

932.07.02 Access

Adequate access shall be provided to facilitate:

- a) Performance of work.
- b) Inspection and measurement of the work by the Contract Administrator.

932.07.03 Crack Identification

Prior to commencement of the work, the cracks requiring repair, as identified by the Contract Administrator, shall be numbered, physically marked as to their extent, and measured in the presence of the Contract Administrator.

This information shall be recorded and a copy submitted to the Contract Administrator.

932.07.04 Crack Injection

932.07.04.01 Drilling for Injection Ports

Injection holes shall be drilled, on each side of the crack, at a 45° angle to the surface of the concrete. The holes shall be located such that they intersect the crack section at approximately the midpoint and they shall extend through the crack section. The holes shall be sized to accommodate the injection ports. The spacing of the holes shall not exceed the depth of the crack or 200 mm, and the holes shall be alternated from one side of the crack to the other.

Prior to installation of the injection ports each hole shall be individually cleaned of all deleterious material by an air-water blast to completely remove all drill cuttings from the hole.

Injection ports shall be inserted into the holes and sealed. The inserted end of the injection port shall not extend beyond the point at which the drilled hole intersects the crack.

932.07.04.02 Cleaning and Flushing

After the injection ports have been inserted, cracks shall be flushed with an air-water mixture or an alternating water and air flush to remove all deleterious material prior to the injection of grout. The flushing material shall be injected through the injection port and continued until it exudes from the adjacent injection port and the crack is thoroughly cleaned. This flushing shall proceed from one end of the crack to the other.

A final flush shall be made with air only to remove all of the free water.

932.07.04.03 Surface Preparation and Sealing

Surface opening of the cracks shall be sealed prior to injection.

The surface of the concrete shall be mechanically cleaned for a distance of 25 mm each side of the crack sections to prepare a clean substrate for bonding of the surface sealing compound. The surface preparation and sealing shall be as recommended by the manufacturer of the surface sealing material.

The surface sealing material shall completely confine the injection grout to the crack section with only the injection ports providing access. The surface sealing material shall withstand the maximum injection pressure without developing leakage along the crack section.

Surface sealing of passive cracks shall not commence until at least one hour after the final air flush.

932.07.04.04 Injection of Grout

932.07.04.04.01 General

Injection of grout shall proceed from the injection port at the lowest elevation of the crack and continue upwards along the crack on an injection port to injection port basis without interruption to the other end of the crack. The injection nozzle shall not be moved to the adjacent injection port until grout is showing at the next higher adjacent injection port or refusal criteria is developed.

While under pressure, each injection port shall be sealed immediately after completion of injection at that injection port.

When a maximum operating pressure greater than 3 MPa is required to inject the grout, the injection operation shall cease until the Contractor determines why this operating pressure is required.

932.07.04.04.02 Monitoring

The volume of grout used within each five metres of crack length shall be recorded. The pump gauge pressure shall be recorded every 10 minutes. The volume of grout and pump pressure shall be related to the crack location.

The records shall indicate crack location and number, injection port spacing and confirmation of grout showing or refusal. A copy of the recorded information shall be submitted to the Contract Administrator at the end of each Day.

932.07.04.04.03 Effective Pressure

When calculating the effective pressure, the head losses shall be determined prior to commencement of injection.

Head losses shall be determined in the presence of the Contract Administrator by performing a pressure flow test, through the equipment, for each equipment configuration used.

932.07.04.04.04 Ratio Test

Plural component injection equipment proportioning shall be verified in the presence of the Contract Administrator by measuring the volume output of material in the pressure lines at least once for each two hours of operation.

When deviation from the manufacturer's specified proportioning ratio exceeds 5%, immediate adjustment or replacement of the equipment is required.

932.07.04.04.05 Pot Life Determination

Prior to commencing the grouting operation, a sample shall be taken from the material containers on site and manually proportioned to the specified component ratio in the presence of the Contract Administrator. The total sample size shall be 200 ml, and the same size container shall be used for each sample taken.

The temperature of the material at the time of mixing and the pot life of the mixed material shall be recorded.

The proportions of materials and pot life shall conform to those specified in the original submissions.

An additional sample shall be taken from the end of the injection hose and a further pot life determination performed.

During grouting material samples shall be taken on a frequency of at least one per hour of operation and the pot life recorded.

Deviation from the proportions and pot life specified shall result in immediate discontinuance of use of the material.

All records shall be submitted to the Contract Administrator at the end of each working day.

932.07.04.05 Surface Finishing

Surface finishing shall not proceed until the curing period, as specified by the material supplier, has elapsed. Surface finishing shall consist of removal of the injection ports and the surface sealant flush with the original concrete surface. Core holes and holes left after the removal of injection ports shall be filled with a cement-based non-shrink grout after the surface sealant has been removed.

Where the crack is not completely filled to the injection surface, the crack shall be filled with a compatible material acceptable to the Contract Administrator. The material shall be applied according to the manufacturer's recommendations.

932.07.04.06 Coring

A 75 mm diameter test core shall be taken for each completed ten-metre increment of injected crack for the full depth of the crack, within 1½ to 2 hours after injection, at locations specified by the Contract Administrator. The ten-metre increment is the length of a continuous crack or a cumulative measurement of cracks of lesser length. The cores shall be submitted to the Contract Administrator. Similar coring shall be done to check remedial work.

932.07.04.07 Filling of Core Holes

Following the extraction of cores all slurry and other debris shall be removed from the core holes. The holes shall be blasted with compressed air and filled with non-shrink grout flush with the surface of the concrete.

Surface preparation, mixing, installation, and curing shall be according to the manufacturer's recommendations.

932.07.05 Routing and Sealing Cracks

Cracks shall be routed to create a chase and then filled with a sealant.

The depth to width ratio of the chase shall be 1H:1V with the crack located within the middle third of the chase. The width of the chase shall be 15 mm ± 5 mm.

The chase shall be abrasive blast cleaned according to OPSS 929. Abrasive blast cleaned areas shall have the subsequent treatment applied within 36 hours or shall be reblasted.

Immediately prior to placing the bond breaker, the chase shall be blasted with compressed air to remove all dust, dirt, and loose material.

A bond breaker compatible with the joint sealing compound and concrete shall be placed at the bottom of the chase.

Joint sealing compound shall be placed in the chase flush with the adjacent concrete surface unless it is subjected to vehicular traffic, in which case, it shall be recessed $2 \text{ mm} \pm 1 \text{ mm}$.

Hot-poured rubberized joint sealing compounds shall only be used on horizontal surfaces. Cold-applied joint sealing compounds shall only be used on vertical surfaces or on horizontal surfaces that are not to be waterproofed. Cold-applied joint sealing compound shall be installed according to the manufacturer's recommendations. Hot-poured rubberized joint sealing compound shall be installed according to OPSS 920.

932.07.06 Remedial Action

The failure of the test cores to meet the requirements specified in the Quality Assurance section shall be sufficient cause for immediate review and adjustment of the method of injection. The ten-metre increments represented by the failed test cores shall be repaired such that at least 80% of the crack depth is filled. The method of repair shall be submitted to the Contract Administrator prior to the commencement of the work.

932.07.07 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

932.08 QUALITY ASSURANCE

932.08.01 General

When the repair operation is complete, the Contract Administrator shall inspect the work to determine if the completed work contains defects.

932.08.02 Crack Injection

The 75 mm diameter test cores shall be examined for the percentage of the crack depth filled.

932.08.03 Ratio Test

The proportioning ratio of the injection material shall not deviate more than 5% from the manufacturer's specified proportioning ratio stated in the work plan.

932.08.04 Pot Life

The proportion of material and pot life shall not deviate from that specified by the manufacturer in the work plan.

932.08.05 Acceptance or Rejection

The Contract Administrator shall accept or reject material on the basis of the ratio testing and pot life determination results.

Crack injection shall be accepted or rejected on the basis of the percentage of crack depth filled as determined by evaluating the test core taken in each ten-metre increment of length.

Rejection of the ten-metre increment of crack shall be applied during the entire grouting operation.

Where 90% or more of the crack depth is filled in the test core, the ten-metre increment of crack length represented by the core shall be accepted.

Where 80 to 89% of the crack depth is filled in the test core, the work shall be accepted and a payment adjustment shall be applied to the ten-metre increment length of crack represented by that core.

Where less than 80% of the crack depth is filled in the test core, the ten-metre increment of crack length represented by the core shall be rejected.

932.09 MEASUREMENT FOR PAYMENT

932.09.01 Actual Measurement

932.09.01.01 Crack Injection

Measurement of crack injection shall be by length in metres of the accepted injected cracks. The total length shall be the sum of individual increments represented by the accepted test cores taken within each increment. Cracks filled to less than 80% of the crack depth shall not be measured for payment.

932.09.01.02 Routing and Sealing

Measurement of routing and sealing shall be by length in metres.

932.10 BASIS OF PAYMENT

932.10.01 Crack Injection - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

There shall be 100% payment of the Contract price where 90% or more of the crack depth is filled.

There shall be no payment where less than 80% of the crack depth is filled.

There shall be a payment adjustment of the unit Contract price for each ten-metre increment of crack filled to between 80% and 89% of the crack depth.

$$Pa = [100 - (89 - D) \times 2] \div 100$$

Where: Pa = payment adjustment factor

D = percentage of the crack depth filled, rounded to the nearest 0.1%.

and: 89 ≥ D ≥ 80

932.10.02

**Routing and Sealing-Hot-Poured Rubberized Joint Sealing Compound-Item
Routing and Sealing-Cold-Applied Joint Sealing Compound-Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 932-A, November 2009
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR PRESTRESSED SOIL AND ROCK ANCHORS

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942.01 SCOPE

This specification covers the requirements for the design, installation, and testing of prestressed anchors in soil and rock.

942.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

942.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

942.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following specifications, standards, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 903	Deep Foundations
OPSS 904	Concrete Structures
OPSS 906	Structural Steel for Bridges

Ontario Provincial Standard Specifications, Material

OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete

CSA Standards

A23.1-04/A23.2-04	Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete
A283-06	Qualification Code for Concrete Testing Laboratories
G40.20-04/G40.21-04	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels

ASTM International

A 53/A 53M-07	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
A 416/A 416M-06	Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
A 500/A 500M-07	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
A 722/A 722M-07	Uncoated High-Strength Steel Bars for Prestressing Concrete
D 1143/D 1143M-07	Standard Test Method for Deep Foundations Under Static Axial Compressive Load
D 1248-05	Polyethylene Plastics Extrusion Materials for Wire and Cable
D 1784-08	Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
D 3350-08	Polyethylene Plastics Pipe and Fittings Materials
D 4101-08	Polypropylene Injection and Extrusion Materials

International Organization for Standardization/International Electrotechnical Commission (ISO/IEC)

17025 General Requirements for the Competence of the Testing and Calibration Laboratories

American Petroleum Institute (API)

13A Drilling Fluid Materials, 18th Edition, 01.10.06
RP 13B-1 Standard Procedure for Field Testing Water Based Drilling Fluids, 4th Edition

Post Tensioning Institute (PTI)

Recommendations for Prestressed Rock and Soil Anchors

942.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Alignment Load means a nominal minimum load applied to an anchor during testing to keep the testing equipment positioned correctly.

Anchor means a system used to transfer tensile loads to soil or rock that includes the prestressing steel, anchorage, corrosion protection, sheathings, spacers, centralizers, and grout.

Anchorage means the combined system of anchor head, bearing plate, trumpet, and anchorage corrosion protection that is used to transmit the prestressing force from the prestressing steel to the surface of the ground or the supported structure.

Anchor Head means the device by which the prestressing force is permanently transmitted from the prestressing steel to the bearing plate.

Apparent Free Length means the length of tendon or bar that is apparently not bonded to the surrounding ground or grout, as calculated from the elastic movement measured during the load test.

Bond Length means the length of the tendon that is bonded to the primary grout and capable of transmitting the applied tensile load to the surrounding soil or rock.

Centralizer means a device to support and position the tendon and sleeves in the drill hole throughout the bond length of the tendon so that a minimum grout cover is achieved.

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in General Conformance with the requirements of the Contract Documents.

Coupler means the method by which the prestressing force can be transmitted from one partial length of prestressing tendon to another.

Design Load means the anticipated final maximum effective load in the anchor after allowance for time-dependent losses or gains. The design load includes appropriate load factors to ensure that the overall structure has adequate capacity for its intended use.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Free Stressing Length means the designed length of the tendon that is not bonded to the surrounding ground or grout during stressing.

Lift-Off means checking the load in the tendon at any specified time with the use of a hydraulic jack at the moment of lifting of the anchor head off the bearing plate.

Lock-Off Load means the prestressing force in an anchor immediately after transferring the load from the jack to the stressing anchorage.

Log Time Cycle means one rotation of a log cycle of a semilogarithmic plot for the purpose of recording the measurement of movement and time.

Permanent Anchor means a prestressed anchor intended for permanent use.

Performance Test means cyclic and incremental loading and unloading of an anchor, while recording the total movement of the pulling head in each cycle at each increment, including the residual movement at alignment load.

Post-Grouting means regrouting an anchor after the primary grout has set.

Pre-Production Test Anchor means an anchor installed and then loaded to verify the design parameters, prior to the installation of the production anchors.

Prestressing Steel means strands, a group of strands combined to form a tendon, or a high strength steel bar.

Primary Grout means Portland cement based grout that is injected into the anchor hole prior to or after the installation of the anchor tendon to provide for the force transfer to the surrounding ground along the bond length of the tendon.

Production Anchor means an anchor installed and loaded that forms part of the final foundation support system.

Production Test Anchor means an anchor installed and then loaded to verify the design parameters, prior to the installation of the production anchors.

Proof Test means incremental loading of an anchor and recording the total movement of the anchor at each increment.

Quality Verification Engineer means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Residual Movement means the non-recoverable movement of the pulling head measured at alignment load.

Temporary Anchor means a prestressed anchor intended for temporary use.

Test Load (TL) means the maximum load that the anchor is subjected during testing.

Total Movement means the total movement of the pulling head measured at maximum load in each cycle.

942.04 DESIGN AND SUBMISSION REQUIREMENTS

942.04.01 Design Requirements

942.04.01.01 General

Except for Owner designed anchors, the Contractor shall be responsible for the detailed design of the anchor, including the determination of the applied loads, design assumptions, and installation procedures. The Contractor shall also be responsible for the design of the anchor testing equipment and reaction system.

The anchors shall be designed to safely withstand the applied loads specified in the Pre-Production Test Anchor clause and fulfill the acceptance criteria specified in the Production Anchor clause and perform satisfactorily at the design load through the required service life.

The design assumptions shall accurately represent the subsurface conditions prevalent at the site.

Temporary anchors in a corrosive environment shall be designed as permanent anchors.

Except as specified in this specification, the anchors shall be designed according to the design recommendation of the Recommendations for Prestressed Rock and Soil Anchors publication.

942.04.02 Submission Requirements

942.04.02.01 Working Drawings

The Contractor shall submit 5 sets of Working Drawings to the Contract Administrator at least 3 weeks prior to the commencement of the work of prestressed rock and soil anchors, for information purposes only. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

Where multi-discipline engineering work is depicted on the same Working Drawing and the design or design-checking Engineer or both are unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be sealed and signed by as many additional design and design-checking Engineers as necessary.

Information to be shown on the Working Drawings shall describe and illustrate the complete details of the anchor system, anchor testing equipment, and reaction system for the production anchors and, when specified in the Contract Documents, pre-production test anchors. This information shall include as a minimum:

a) Plans, Elevations, and Sections

- i. Anchor spacing.
- ii. Orientation.
- iii. Minimum total anchor length.
- iv. Free stressing length.
- v. Design load.

- vi. A unique identification number for each anchor.
- vii. Anchor components and details.

b) Installation

- i. Construction methods.
- ii. Work restrictions.
- iii. Schedule.
- iv. Sequence and coordination of work.
- v. Monitoring.
- vi. Type and number of tests
- vii. Evaluation of test results.

c) Materials

- i. Physical properties of monobar and multistrand anchors.
- ii. Primary grout materials and mix proportions.
- iii. Post grouting materials and mix proportions.
- iv. Free stressing length materials and mix proportions.
- v. Corrosion protection material physical and mechanical properties.

d) Anchor Hole Construction

- i. Method of constructing the anchor holes and maintaining the stability of the holes during the anchor installation. The drilling equipment and materials including drill bit or auger diameter and lengths, casing diameter and lengths, and slurry material used to facilitate the construction of the anchor hole. The method of verifying the hole length shall also be identified.
- ii. Details for assembling the anchor in the anchor hole.
- iii. Method of placing and centring the anchor tendons, including the method used to maintain them in the centre of the hole over the design bond length.
- iv. Bond zone primary grout placement. Grout mixing procedure and the method of installation, including grout pressures. The method to determine the surface of the hardened bond length grout shall be identified.
- v. Bond zone post grout placement. Grout mixing procedure and the method of installation, including grout pressures.
- vi. Free stressing zone grout placement. Grout mixing procedure and the method of installation, including grout pressures.
- vii. Waterproofing of holes drilled in rock for permanent anchors. Details of water tightness tests, including setup, water pressure, method of applying pressure, details of consolidation, grouting, redrilling, and retesting.

e) Stressing Information

- i. Anchor stressing schedule that includes the working loads and test loads.
- ii. Anchor stressing equipment, and the method for testing the stressing of pre-production and production test anchors and production anchors. Details of the reaction system used to support the applied loads.
- iii. Equipment, including the calibration records of the gauges and jacks, and procedure to monitor the applied loads and movements during anchor testing.
- iv. Details of the reference system and equipment to monitor the movement.

f) All design assumptions, loads, parameters, and bond stresses used for pre-production and production test anchors and production anchors.

g) Testing records when testing has been done to determine bond stress.

h) Details of destressing and removal of temporary anchors.

942.04.02.02**Slurry**

At least 14 Days prior to commencement of the work, the following information for the slurry shall be submitted to the Contract Administrator, for information purposes only:

- a) The type, source, and physical and chemical properties of the bentonite or polymer.
- b) The source of water.
- c) Method of mixing slurry.
- d) The water solids ratio and the mass and volumes of the constituent parts, including any chemical admixtures or physical treatment employed to produce slurry with the required physical properties.
- e) Details of procedure to be used for monitoring the quality of the slurry.
- f) A test report showing the properties of the slurry and certifying that the slurry meets the requirements of API 13A.
- g) Method of disposal of the slurry.

942.04.02.03**Couplers**

At least 14 Days prior to commencement of the work, a copy of the following shall be submitted to the Contract Administrator:

- a) Manufacturer's catalogue giving the complete data on the coupler material and installation procedures.
- b) Test reports from the manufacturer certifying strength and fatigue requirements.

942.04.02.04**Prestressing Steel****942.04.02.04.01****Mill Certificates**

One copy of the mill test certificates, indicating that the steel meets the requirements of the Contract Documents, shall be submitted to the Contract Administrator at the time the prestressing steel is delivered to the job site.

Identification on the anchor tendon shall allow tracing of the prestressing steel to its heat or reel number.

Where mill test certificates originate from a mill outside Canada or the United States of America the Contractor shall have the information on the mill certificate verified by testing by a Canadian testing laboratory. The laboratory shall be accredited by the Standards Council of Canada as complying with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian testing laboratory and appropriate wording stating that the material is according to the Contract Documents. The stamp shall include the appropriate material specification number, testing date (i.e., yyyy-mm-dd), and signature of an authorized officer of the testing laboratory.

One copy of the stress-strain curves that are representative of the lots to be used shall be submitted to the Contract Administrator together with the mill certificates specified detailed in OPSS 1440.

942.04.02.04.02 Prestressing Steel Bond Capacity

If not available from the prestressing steel manufacturer, a prestressing strand bond capacity test shall be conducted on the strand according to Appendix A of the Recommendations for Prestressed Rock and Soil Anchors publication. The test information shall be submitted to the Contract Administrator prior to commencement of work.

942.04.02.05 Milestone Inspections

The Quality Verification Engineer shall witness the following interim inspections of the work:

- a) Construction of anchor holes.
- b) Anchor installation.
- c) Primary grouting.
- d) Post grouting.
- e) Placement of slurry in free stressing length.
- f) Anchorage installation.
- g) Pre-production anchor testing.
- h) Production anchor testing.

A written request for permission to proceed shall be submitted to the Contract Administrator prior to commencement of the successive operation.

942.05 MATERIALS

942.05.01 Permanent Anchors

942.05.01.01 General

Tendons shall be manufactured from steel bars or strand either in single or multiple element tendons.

The permanent anchors shall be Dywidag Threadbar Anchors, BBR Cona Multi-Strand Anchors, VSL Multi-Strand Anchors, or other approved equivalent anchors.

942.05.01.02 Anchorages

The components of the anchorage shall be capable of developing at least 100% of the guaranteed minimum ultimate capacity of the tendon or bar.

The anchor head shall be wedges for prestressing strands and anchor nuts for prestressing bars. The wedges shall be designed to uniformly engage the strand with no notch or pinching effects.

The bearing plate shall be fabricated from steel according to CSA G40.20/G40.21.

The trumpet shall be fabricated from steel pipe according to ASTM A 53M or tubing according to ASTM A 500M. The trumpet shall have a minimum wall thickness of 3 mm for diameters up to and including 100 mm and 5 mm for larger diameters. The joint between the trumpet and the bearing plate and the joint between the trumpet and sheath shall be watertight. The trumpet shall overlap the free stressing length corrosion protection by at least 100 mm. The trumpet shall be long enough to accommodate movements of the structure and the tendon during stressing and testing.

The anchorage covers shall completely encapsulate the anchor head with a watertight seal between the cover and the bearing plate.

942.05.01.03 Prestressing Steel

Prestressing steel shall be according to ASTM A 416M and ASTM A 722M.

Bars shall be high-tensile strength bars grade 1,030 MPa, 1,100 MPa, or 1,230 MPa.

Strand shall be seven-wire, uncoated, stress relieved and low relaxation strand grade 1,720 MPa, 1,760 MPa, or 1,860 MPa.

The strand and bar shall meet the bond capacity test specified in the Prestressing Steel Bond Capacity subsection.

942.05.01.04 Couplers

Couplers for bars shall be as specified by the supplier of the anchor and shall develop at least 100% of the guaranteed minimum ultimate strength of the tendon. Strand tendons shall not be coupled.

942.05.01.05 Cement

Cement shall be according to OPSS 1301 and shall be certified free of false set.

942.05.01.06 Water

Water shall be according to OPSS 1302.

942.05.01.07 Sheathing

Plastic sheathing shall be high density polyethylene according to ASTM D 1248, Type III, or polyvinyl chloride (PVC) according to ASTM D 1784, Class 13464-B or equal. The plastic sheathing shall be such that a bond of 5 MPa is developed when grout with a compressive strength of 30 MPa is used.

Hot melt extruded plastic tubing made from polyethylene according to ASTM D 3350 and ASTM D 1248 shall have an average minimum wall thickness of 1.5 mm. Hot melt extruded plastic tubing from polypropylene according to ASTM D 4101 shall have an average minimum wall thickness of 1.5 mm. Steel tubing or pipe shall have an average minimum wall thickness of 5.0 mm.

The materials for the sheathing accessories such as end caps, grouting caps, grout tubes, and sealing caps shall have properties equal to the plastic sheathing.

942.05.01.08 Heat Shrinkable Sleeves

Heat shrinkable sleeves shall be fabricated from a radiation cross-linked polyolefin tube internally coated with an adhesive sealant.

942.05.01.09 Grout Tubes

Grout tubes shall have an adequate inside diameter to enable the grout to be pumped to the bottom of the drill hole. They shall be able to withstand 1 MPa pressure.

Post-grout tubes shall be strong enough to withstand the post-grouting pressure.

942.05.01.10 Bond Breaker

The bond breaker shall be fabricated from plastic tube or pipe made from medium to high density polyethylene according to ASTM D 1248 or from polyvinyl chloride according to ASTM D 1784, Class 13464-B or equivalent, with a minimum wall thickness of 1 mm.

942.05.01.11 Centralizers and Spacers

Centralizers and spacers shall be steel or plastic.

942.05.01.12 Grout

The grout cube for high early strength grout shall be at least 20 MPa at 7 Days and 30 MPa at 28 Days. The type of cement used shall be suitable for the required use of the grout. Accelerators shall not be used. The grout shall bleed less than 2% when allowed to stand for 1 hour.

942.05.01.13 Corrosion Inhibiting Compound

The corrosion inhibiting compound placed in either the free stressing length or the anchorage area shall be an organic compound, grease, or wax with appropriate polar moisture displacing and self-healing properties and corrosion inhibiting additives. The compound shall permanently stay viscous and be chemically stable and non-reactive with the prestressing steel, sheathing material, and anchor grout.

942.05.01.14 Corrosion Protection

The anchor shall be provided with Class I, encapsulated tendon, double corrosion protection according to the Recommendation for Prestressed Rock and Soil Anchors publication.

The tendon shall be fully encased within a corrugated PVC sheathing that is, in turn, encased within a smooth PVC sheathing over the length of the free stressing zone and protected with grout having the 7- and 28-Day compressive strengths.

942.05.02 Temporary Anchors

The material for temporary anchors shall be the same as specified for the permanent anchors except the double protection system is not required.

942.05.03 Pre-Production Test Anchors

The material for the pre-production test anchors shall be the same as specified for the production anchor being evaluated.

942.05.04 Bentonite Cement Slurry

Bentonite and polymers shall meet the requirements of API 13A.

The bentonite cement slurry shall consist of a stable mixture of cement and a colloidal suspension of pulverized solids or polymers thoroughly mixed with water. The density, viscosity, sand content, and pH of the slurry while being used during excavation shall be according to API RP13B-1.

942.05.05 Concrete

Concrete shall be according to OPSS 1350 with a nominal 28-Day compressive strength of 30 MPa.

The slump shall be 150 to 180 mm.

942.06 EQUIPMENT

942.06.01 General

All equipment for the installation of the anchor, anchor stressing, anchor testing, and monitoring of the anchor test shall be suitable for the intended purposes and capable of working on the site under the prevailing access and clearance conditions.

The equipment used shall not cause damage to the anchor tendon, corrosion protection, or retained structural members.

The equipment used shall be in according to those listed in the required submissions.

942.06.02 Grouting Equipment

Mixers and pumps shall be of an adequate capacity and hoses shall be sized to allow continuous grouting of an individual anchor within one hour. A colloidal mixer with a gauge to measure the water shall be used.

942.06.03 Temporary Anchor Concrete Placement Equipment

Continuous flight augers shall be used for the placement of concrete for temporary anchors up to a maximum ratio of hole diameter to length of 1:35. Open hole concrete placement shall be limited to a minimum hole diameter of 600 mm and a maximum ratio of hole diameter to length of 1:15.

942.06.04 Anchor Testing Equipment

The rated capacity of the equipment shall not be exceeded when stressing the tendon to the maximum specified test load. The pump shall be capable of applying each load increment in less than 60 seconds.

The equipment shall permit the tendon to be stressed in increments so that the load in the tendon can be increased or decreased according to the test specifications and to allow the anchor to be lift-off tested to confirm the lock-off load.

Dial gauges shall have at least a 75 mm travel. Longer gauge stems or sufficient gauge blocks shall be provided to allow for greater travel where required. Gauges shall have precision of at least 0.02 mm.

Dial gauges shall permit the measurement of total tendon movement to the nearest 0.02 mm at every load increment. The gauge shall have sufficient travel to record the total anchor movement at test load without the need to reset at an interim point.

Jacks used for stressing tendons shall have a minimum ram extension of 150 mm.

Stressing equipment shall be calibrated within an accuracy of $\pm 2\%$ immediately prior to use.

Current calibration curves bearing the seal and signature of an Engineer shall be provided for all gauges and jacks.

942.07 CONSTRUCTION

942.07.01 General

The Contractor shall be responsible for the material, fabrication, installation, testing, and monitoring of pre-production and production test anchors and production anchors.

In addition, for non-Owner designed anchors, the Contractor shall be responsible for the preparation of a soils report, the determination of design parameters, and the design of the anchors.

The anchor system shall be according to this specification and the Working Drawings.

Concrete placement according to the Concrete clause of the Caisson Piles subsection of OPSS 903 may be used for temporary anchors inclined a minimum of 30 degrees below the horizontal and having a minimum hole diameter of 450 mm.

942.07.02 Structural Steel

Structural steel components shall be fabricated according to OPSS 906.

942.07.03 Anchor Fabrication

Anchors shall be either shop or field fabricated according to the Working Drawings and schedules by personnel trained and qualified for this work.

Prestressing steel shall be cut with an abrasive saw or, when approved by the prestressing steel supplier, an oxyacetylene torch may be used.

All of the bond length shall be free of dirt, manufacturers' lubricants, corrosion-inhibiting coatings, or other deleterious substances that may significantly affect the grout-to-tendon bond or the service life of the anchor.

When encapsulated anchors are pregouted, they shall be done on an inclined, rigid frame or bed by injecting the grout from the low end of the tendon.

Joints in the protection system shall be made watertight by use of an epoxy bonding agent.

942.07.04 Storage and Handling

Upon delivery, the fabricated anchors and the prestressing steel for fabrication of the tendons and all hardware shall be stored and handled in a manner that avoids mechanical damage, corrosion, and contamination with dirt or deleterious substances.

Handling of the tendons shall not cause mechanical damage or contamination to the prestressing steel, the corrosion protection, or the epoxy coating.

Rope or nylon slings shall be used.

Cement and additives for grout shall be stored under cover and protected against moisture.

Lifting of any pregouted tendons shall not cause excessive bending that may debond the prestressing steel from the surrounding grout.

942.07.05 Corrosion Protection

942.07.05.01 Anchorage Protection

The corrosion protection of the tendon in the vicinity of the anchorage shall ensure proper protection.

All stressing anchorages permanently exposed to the atmosphere or that has a concrete cover less than 50 mm shall be covered with a corrosion inhibiting compound-filled or grout-filled cover.

On strand tendons, the trumpet shall be long enough to enable the tendon to make a transition from the diameter of the tendon along the free stressing length to the diameter of the tendon at the wedge plate without damaging the encapsulation.

The trumpet shall be completely filled with a corrosion inhibiting compound or grout. Compounds may be placed any time during construction. Grout shall be placed after the anchor has been tested and stressed to the lock-off load.

Corrosion inhibiting compound-filled trumpets shall have a permanent seal between the trumpet and the free stressing length corrosion protection.

Trumpets filled with grout shall have either a temporary seal between the trumpet and the free stressing length corrosion protection or the trumpet shall fit tightly over the free stressing length corrosion protection for a minimum of 0.3 m.

942.07.05.02 Free Stressing Length Protection

The tendon shall be fully encased within a corrugated PVC sheathing that is in turn encased within a smooth PVC sheathing over the length of the free stressing zone and protected with grout.

Corrosion protection of the free stressing length shall be provided by a sheath filled with a corrosion inhibiting compound or grout or a heat shrinkable tube internally coated with a mastic compound. The corrosion inhibiting compound shall completely coat the tendon elements, fill the void between them and the sheath, and fill the interstices between the wires of 7-wire strands. Provisions shall be made to retain the compound within the sheath.

The corrosion protective sheath surrounding the free stressing length of the tendon shall be long enough to extend into the trumpet but shall not come into contact with the stressing anchorage during testing.

For pregrouted encapsulations, a separate bond breaker shall be provided to prevent the tendon from bonding to the grout surrounding the free stressing length.

Fusion bonded epoxy may be used to provide an additional layer of protection to the prestressing steel.

942.07.05.03 Free Stressing Length and Bond Length Transition

The transition between the corrosion protection for the bonded and free stressing lengths shall be designed and fabricated to ensure continuous protection from corrosion.

The corrosion protection surrounding the free stressing length of the tendon shall not contact the bearing plate or anchor head.

942.07.05.04 Coupler Protection

On encapsulated bar tendons, the coupler and any exposed bar section next to it shall be covered with a corrosion proof compound or wax impregnated cloth tape. The coupler area shall be covered by a smooth plastic tube overlapping the adjacent sheathed tendon by at least 25 mm. The two joints shall be sealed each by a coated heat shrink sleeve of at least 150 mm length or approved equivalent. The corrosion proof compound shall completely fill the space inside the cover tube.

942.07.06 Construction of Anchor Holes

942.07.06.01 General

The anchor holes shall be constructed to the diameter, orientation, and length specified in the Contract Documents and detailed on the Working Drawings. A drilling method that establishes a stable anchor hole within the tolerances specified in the Contract Documents shall be used.

The sides and end of the completed anchor holes shall be maintained in a stable condition.

The anchor hole entry shall be located within 300 mm of its plan location. The deviation of the anchor hole entry angle from its inclination as specified the Contract Documents shall be no greater than ± 3 degrees.

Open anchor holes and drilled casings shall be cleaned upon completion of drilling.

Anchor holes open for longer than eight hours shall be recleaned prior to insertion of the tendon and primary grouting.

The following information shall be recorded for each anchor hole and submitted to the Contract Administrator:

- a) Identification number.
- b) Anchor hole diameter.
- c) Anchor hole length.
- d) Drilling procedure.
- e) Soil, rock, and ground water conditions encountered.
- f) Time required to drill the anchor hole.
- g) Problems encountered.

942.07.06.02 Waterproofing Anchor Holes

Waterproofing of anchor holes shall be done when specified in the Contract Documents and according to the Working Drawings, procedures, and equipment.

If during the water tightness test, the leakage from an anchor hole over a ten-minute period exceeds 9.5 L, the anchor hole shall be consolidation grouted, redrilled, and retested.

Redrilling shall be done when the grout strength is considerably less than the strength of the surrounding rock.

942.07.07 Anchor Installation

The anchors shall be installed as specified in this specification and detailed on the Working Drawings.

Care shall be taken to ensure the sheathing, corrosion protection, and grout tubes are not damaged during installation of the anchors.

Damaged anchors that cannot be repaired to the satisfaction of the Contract Administrator shall be replaced.

Method of repair shall be submitted to the Contract Administrator for approval.

The prestressing steel in the tendon bond length shall be protected with a grout filled corrugated plastic encapsulation. Centralizers shall be used to ensure a grout cover of at least 12 mm over the encapsulation.

The centralizers shall be maintained in position during installation.

The centralizer shall support the tendon in the drill hole and position the tendon so a minimum grout cover of 12 mm is achieved. Centralizers used inside a sheath shall provide a nominal grout cover of 5 mm over the prestressing steel. All centralizers shall be designed to permit grout to flow freely around the tendon and up the drill hole.

The Contractor shall determine the number of centralizers required; however, one unit shall be placed within 1 m of the bottom of the hole and another at the bond length and free stressing length interface. The centralizers shall not interfere with the placement of grout.

Spacers shall be used in multiple element tendons to separate the strands or bars individually or into small groups.

942.07.08 Primary Grouting of Anchors

The grout shall be placed as specified in this specification and as detailed on the Working Drawings.

The grout shall entirely fill the annular space between the anchor and the borehole wall in the bond length.

Anchors shall be grouted as soon as practical after installation. The stressing tails of prestressing steel strands shall be aligned prior to initial set of the grout.

After grouting, the anchor shall remain undisturbed until the grout has reached the strength specified in the Contract Documents.

The following information shall be recorded for each anchor and submitted to the Contract Administrator:

- a) Identification number.
- b) Type of grout.
- c) Grout pressure.
- d) Volume of grout used.
- e) Location of the top of the bond length grout.

942.07.09 Post-Grouting of Bond Length

When specified in the Contract Documents, post-grouting of the bond length shall be done according to the submitted procedures and equipment.

The information required to be recorded for primary grouting shall be recorded for post grouting.

Ground movement shall be monitored and, if excess movement is observed, the grouting shall be terminated and the situation reported to the Contract Administrator.

The Contract Administrator shall be notified prior to the commencement of post-grouting of both permanent and temporary anchors.

942.07.10 Placing of the Cement Bentonite Slurry in the Free-Stressing Length

The method of placing the cement bentonite slurry shall be as specified in this specification and as detailed on the Working Drawings.

The cement bentonite slurry for the free stressing length shall completely fill the annular space between the prestressing steel and the borehole wall and shall prevent any transfer of the anchor load to the free stressing zone.

942.07.11 Installation of Anchorage

The anchor bearing plate and the anchor head or nut shall be installed perpendicular to the tendon within ± 3 degrees and centred on the bearing plate, without bending or kinking of the prestressing steel elements. Wedge holes and wedges shall be free of rust, grout, and dirt. Special care shall be exercised to obtain the continuity of corrosion protection in the vicinity of the anchorage as described in the Corrosion Protection subsection. The stressing tail shall be cleaned and protected from damage until final testing and lock-off.

The tendon stressing tail shall be cut to its final length according to the tendon manufacturer's recommendations after the anchor is accepted by the Contract Administrator.

Anchorage permanently exposed to the atmosphere shall be covered with a corrosion inhibiting compound filled or grout filled cover

942.07.12 Testing

942.07.12.01 General

Testing shall be carried out as detailed on the Working Drawings and as specified in this specification.

The maximum anchor load shall not exceed 80% of the guaranteed minimum ultimate strength of the tendon.

Stressing shall not commence until the grout has reached its 28-Day strength.

Anchor tests shall be conducted at a time mutually acceptable to the Contractor and Contract Administrator. The Quality Verification Engineer shall witness the testing.

942.07.12.02 Reaction System

The reaction system shall be installed as detailed on the Working Drawings.

942.07.12.03 Reference System and Testing Equipment

The layout of the reference systems and testing equipment required for testing shall be as detailed on the Working Drawings and as specified in this specification.

All reference beams shall be independently supported with the support firmly embedded in the ground at a distance of not less than 2.5 m from the anchor. Reference beams and their supports shall be sufficiently rigid to support instrumentation and to prevent movement relative to the test anchor as a result of stressing or other construction activity during testing.

Dial gauges shall bear on the pulling head of the jack and their stems shall be co-axial with the tendon direction.

The jacks shall be secured with chains to provide adequate protection to personnel in the event of breakage of the anchor or stressing system.

942.07.12.04 Reference System Enclosures

Suitable enclosures shall be constructed to provide complete protection for personnel, equipment, and instruments from variations in the weather conditions and disturbances during the test program.

These provisions shall meet the approval of the Contract Administrator and include the following specific requirements:

- a) The test enclosures shall be weatherproof and adequately lighted and have consistent and controllable heat in order to eliminate temperature variations.
- b) The test enclosure shall be provided with a level dry floor.
- c) A field office equipped with tables, chairs, heating, and lighting shall be provided adjacent to the test anchors.

942.07.12.05 Pre-Production Test Anchors

942.07.12.05.01 General

Pre-production tests shall be conducted to determine the bond stress when:

- a) A bond stress is not specified in the Contract Documents.
- b) A higher bond stress than specified in the Contract Documents is used in the design.
- c) To establish the adequacy of other components of the anchor in advance of the production anchors.

For Contractor designed anchors, at least one pre-production test anchor shall be installed and tested in each significantly different ground condition.

For Owner designed anchors, the number of pre-production test anchors shall be as specified in the Contract Documents. The test anchor shall be constructed using the materials, methods, and procedures specified in this specification and as detailed on the Working Drawings.

Pre-production test anchors shall not be incorporated into the permanent or temporary work unless approved by the Contract Administrator.

942.07.12.05.02 Pre-Production Test Procedures and Measurements

The pre-production anchor test shall be carried out generally in accordance with the prevailing requirements of ASTM D 1143M superseded where applicable by the procedure specified in this specification.

When the pre-production test anchor is to be incorporated into the work, the load in the anchor shall be adjusted to lock-off load in the final cycle.

The pre-production test shall be conducted by cyclically and incrementally loading and unloading the anchor according to the schedule below or until the anchor fails.

AL, 0.25 DL, AL
AL, 0.25 DL, 0.50 DL, AL,
AL, 0.25 DL, 0.50 DL, 0.75 DL, AL
AL, 0.25 DL, 0.50 DL, 0.75 DL, 1.00 DL, AL,
AL, 0.25 DL, 0.50 DL, 0.75 DL, 1.00 DL, 1.25 DL, AL,
AL, 0.25 DL, 0.50 DL, 0.75 DL, 1.00 DL, 1.25 DL, 1.50 DL, AL
AL, 0.25 DL, 0.50 DL, 0.75 DL, 1.00 DL, 1.25 DL, 1.50 DL, 1.75 DL, AL,
AL, 0.25 DL, 0.50 DL, 0.75 DL, 1.00 DL, 1.25 DL, 1.50 DL, 1.75 DL, 2.00 DL*, AL
AL, 0.00 DL

Where:

AL = alignment load
DL = design load of anchor

* At 2.00 DL, the load shall be maintained for 24 hours.

Each load shall be maintained for a minimum of 15 minutes or until the rate of displacement is not greater than 0.25 mm per hour.

Vertical and horizontal movement of the reaction system and tendon elongation shall be recorded with respect to an independent fixed reference point. A record of the test enclosure temperature is also required.

During the load hold periods, the anchor load shall not be allowed to deviate from the test pressure by more than 0.35 MPa.

When required, repumping back to test load shall be done to compensate for small movements, hydraulic oil seepage, and changes in temperature of the hydraulic oil.

The load shall always be returned to the specified test load prior to taking the movement reading at the specified interval. The test load shall not be exceeded during the period of observation.

942.07.12.05.03 Removal of Pre-Production Test Anchors

The test anchors not approved to be incorporated into the work shall be removed flush with the surrounding ground and the test site restored to its pretest conditions.

The test anchorages shall not be removed until the Contract Administrator has given permission in writing to remove them.

942.07.12.06 Production Anchors

942.07.12.06.01 General

Every temporary and permanent anchor shall be tested according to the Proof Test - Permanent Anchors or Proof Test - Temporary Anchors clause, as appropriate.

942.07.12.06.02 Proof Test - Permanent Anchors

The following proof test shall be applied to the anchorages:

After preloading the anchor to 1.5 DL for 30 minutes, the proof test shall be conducted by incrementally loading and unloading the anchor according to the following schedule or until the anchorage fails, as determined by the Contract Administrator. The acceptance criteria apply to only the peak loading.

Loads shall be applied as follows:

0.25 DL, 1.00 DL, 1.50 DL, 1.00 DL, 0.25 DL

Where:

DL = specified working load of anchorage

At 1.50 DL, the load shall be maintained for a minimum of 30 minutes. Measurement shall be recorded according to the following time increment schedule.

0 min, 1 min, 2 min, 3 min, 6 min, 9 min, 12 min, 15 min, 18 min, 30 min.

If the acceptance criteria as specified herein are met, the anchorage shall be prestressed to 1.50 DL, then shall be locked-off at the transfer load of 1.10 DL.

If the acceptance criteria as specified herein are not met in the 30-minute period the test shall be extended as required, with readings at 30-minute increments, up to 180 minutes.

If the acceptance criteria as specified herein are not met, the provisions of the Unacceptable Stressing Results clause shall apply.

942.07.12.06.03 Proof Test - Temporary Anchors

The proof test shall be conducted by incrementally loading the anchor according to the following schedule:

AL, 0.25 DL, 0.50 DL, 0.75 DL, 1.00 DL, 1.20 DL, 1.33 DL, AL, and adjust to lock-off load

Where:

AL = alignment load

DL = specified working load of anchorage

At the test load of 1.33 DL, the load shall remain constant for 10 minutes and the total movement shall be recorded at 1, 2, 3, 4, 5, 6, and 10 minutes. If the difference between the total movements at 1 minute and 10 minutes exceeds 1 mm, the test load shall be maintained for an additional 50 minutes, and the movements readings shall be recorded at 20, 30, 40, 50, and 60 minutes. The anchor shall be returned to AL after holding the load at test load for 50 minutes and the residual movement recorded.

The hydraulic pressure during the load hold period shall not deviate by more than 0.35 MPa and the load shall be returned to the test load prior to taking the movement reading. The total movements at each load increment shall be recorded.

942.07.12.06.04 Lock-Off Procedure

After testing has been completed, the load in the tendon shall be such that, after seating losses (wedge seating), the specified lock-off load has been applied to the anchor tendon.

The magnitude of the lock-off load shall be 1.10 DL or as specified by the Contract Administrator and shall not exceed 70% of the ultimate load of the tendon or bar (F_{pu}).

The wedges shall be seated at a minimum load of 50% of F_{pu} . If the lock-off load is less than 50%, shims shall be used under the wedge plate and the wedges seated at 50% of F_{pu} . The shims shall then be removed to reduce the load in the tendon to the desired lock-off load. Bar tendons may be locked off at any load less than 70% of F_{pu} .

942.07.12.06.05 Lift-Off Tests

A minimum of three lift-off tests shall be conducted at each site. The location of the anchor to be tested and the time of test shall be as determined by the Quality Verification Engineer. The lift-off test shall not be performed until 48 hours has elapsed after transferring the lock-off load. The method of testing shall be as detailed on the Working Drawings.

The lift-off test shall be performed after transferring the load to the anchor and prior to removing the jack from its location. The lift-off load shall be determined by re-applying the load to the tendon or bar to lift off the wedge plate or anchor nut without unseating the wedges or turning the anchor nut.

942.07.12.07 Acceptance Criteria

An anchor shall be considered acceptable when all three of the following acceptance test criteria are satisfied:

- a) The total creep movement at test load during the last log time cycle is less than 1.5 mm.
- b) The apparent free stressing length based on the elastic movement at the test load is not less than 80% of the designed free stressing length.
- c) The load measured during the lift-off test is within 10% of the designed lock-off load.

942.07.12.08 Unacceptable Stressing Results

For the anchorages that do not meet the acceptance criteria for the performance test or the proof test, the Contractor shall submit one of the following alternatives as a proposal to the Contract Administrator for approval:

- a) Abandon the deficient anchor and install a new anchor.
- b) Lock-off the anchors at no more than 50% of the accepted test load sustained during test or as determined by the Contract Administrator and install an additional anchor to compensate for the deficiency.
- c) Post grout the anchor at a grouting pressure not exceeding 3.6 MPa or as recommended by the Contract Administrator and then conduct a proof test and apply the acceptance criteria to the test results. The post grouting shall be terminated immediately if any distress on the ground surface is observed during grouting.
- d) Readjust the transfer load to 1.10 DL for an anchor that does not meet the lift-off criteria and repeat the test after a minimum of 48 hours. If the anchor does not meet the lift-off test criteria after completing this procedure, it shall be considered unacceptable.

942.07.13 Quality Control

942.07.13.01 General

In addition to the quality control procedures initiated by the Contractor, the following work shall also be done.

942.07.13.02 Quality of Grout Mixture

942.07.13.02.01 General

The Contractor shall be responsible for testing of bleeding, preparation and initial storage of grout cubes for determination of compressive strength, and delivery of the grout cubes to a testing laboratory designated by the Owner.

The Contractor shall employ staff from a testing company certified according to CSA A283, Certification for Additional Tests 1B, by an organization accredited by the Standards Council of Canada to carry out testing for bleeding, making, and curing of grout cubes and early strength determination.

Grout cubes for compressive strength test and testing of bleeding shall be made on a level, vibration free surface.

942.07.13.02.02 Testing for Bleeding

The testing for bleeding of the grout shall be according to CSA A23.2-1B.

Prior to the grouting operation, in the presence of the Contract Administrator, a trial batch shall be mixed and the grout tested for bleeding to ensure that the grout meets the requirements of this specification. The trial batch of grout shall not be used in the actual grouting operation.

During the grouting operation, bleeding measurements shall be performed on the grout sampled at the mixer. The measurements shall be performed at least once a day and as requested by the Contract Administrator.

The bleeding test results shall be submitted to the Contract Administrator in writing. The test results that indicate the grout is not meeting the requirements of the Contract Documents shall be reported immediately to the Contract Administrator and the grouting operation halted until the cause of the problem is identified and corrected.

942.07.13.02.03 Making, Curing, and Transportation of Cubes for Compressive Strength Tests

Grout cubes shall be prepared as follows on site from the grout pumped into the anchor body:

- a) One set of grout cubes, consisting of three cubes, shall be made each day the grouting operations are carried out.
- b) The grout cubes shall be prepared according to CSA A23.2-1B and stored at a temperature between 15 and 25 °C and shall not be moved prior to demoulding.
- c) The grout cubes shall be demoulded and transported to the laboratory designated by the Owner within 24 hours.
- d) The grout cubes shall be transported in a sealed white opaque plastic bag containing at least 250 mL of water and maintained at a temperature between 15 and 25 °C.

942.07.13.02.04 Early Strength Determination

The Contractor shall prepare and test additional grout cubes to determine when the grout has attained a strength of 20 MPa.

The laboratory conducting the test shall be certified as specified in this specification.

942.07.13.03 Certificate of Conformance

A completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the anchor installation and stressing operations. The Qualification Verification Engineer's seal and signature shall be affixed on the completed Certificate of Conformance confirming that the anchors have been supplied, installed, and stressed in general conformance with the Working Drawings. The Certificate of Conformance shall also certify that the interim milestone inspections have been completed as specified.

942.07.14 Management of Excess Materials

Management of excess material shall be as specified in the Contract Documents.

942.09 MEASUREMENT FOR PAYMENT

942.09.01 Actual Measurement

942.09.01.01 Pre-Production Test Anchors and Production Anchors

Measurement of pre-production test anchors and production anchors shall be by length in metres along the actual length of the anchor from the anchor plate to the tip.

942.09.01.02 Post-Grouting of Bond Length

Measurement of post-grouting of bond length shall be by mass in kilograms of mixed grout used.

942.10 BASIS OF PAYMENT

**942.10.01 Pre-Production Test Anchors - Item
Production Anchor - Item
Post-Grouting of Bond Length - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

**Appendix 942-A, November 2009
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Anchor hole diameter, orientation, and length tolerances and inclination. (942.07.06.01)
- Grout strength. (942.07.08)
- Number of pre-production test anchors for Owner designed systems. (942.07.12.05.01)
- Grout testing laboratory. (942.07.13.02.01)

The designer should determine if the following are required and, if so, they should be specify in the Contract Documents:

- Waterproofing anchor holes. (942.07.06.02)
- Post-grouting of bond length of anchors. (942.07.09)
- Bond stress. (942.07.12.05.01)

OPSS 942 contains information written for provincial contracts. To ensure completeness of municipal Contract Documents, the designer should invoke Appendix 942-B. The appendix contains supplemental requirements that modify OPSS 942 so it can be used by a municipality in its contracts.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.

Appendix 942-B, November 2009

FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

Supplemental Requirements for Using OPSS 942 in Municipal Contracts

OPSS 942, Prestressed Soil and Rock Anchors, is amended as follows:

942.03 Definitions

Section 942.03 is amended by the deletion of the definitions for Certificate of Conformance and for Quality Verification Engineer.

Section 942.03 is amended by the addition of the following:

Certificate of Installation means a document issued by the design Engineer or design-checking Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

942.04.02.01 Working Drawings

The first paragraph of clause 942.04.02.01 is deleted in its entirety and replaced by the following:

The Contractor shall submit 5 sets of Working Drawings to the Contract Administrator at least 3 weeks prior to commencement of the work for the prestressed soil and rock anchor installation. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

Clause 942.04.02.01 is amended by the addition of the following:

942.04.02.01.01 Return of Submissions

Two copies of each submission shall be returned as one of the following:

- a) Stamped with the wording that allows for permission to construct. In this case, work can commence on receipt of the drawings by the Contractor.
- b) Stamped with the wording that allows for permission to construct as noted. In this case, work can start on receipt of the drawings by the Contractor. The drawings shall be updated as noted and shall be sealed and signed by the design Engineer and the design-checking Engineer stating the drawings have been revised according to the noted comments.
- c) Showing only required changes. In this case, the drawings shall be updated as required and the submission process repeated.

The Contractor shall have a copy of the stamped updated or accepted drawings at the site prior to the commencement of the work of the prestressed soil and rock anchors.

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942.04.02.02 Slurry

The first sentence of clause 942.04.02.02 is deleted in its entirety and replaced by the following:

At least 14 Days prior to the commencement of the work, the following information for the slurry shall be submitted to the Contract Administrator.

942.04.02.05 Milestone Inspections

The first sentence of clause 942.04.02.05 is deleted in its entirety and replaced by the following:

The design Engineer or the design-checking Engineer shall witness interim inspections of the following work:

942.07.12.01 General

The last paragraph of clause 942.07.12.01 is deleted in its entirety and replaced by the following:

Anchor tests shall be conducted at a time mutually acceptable to the Contractor and Contract Administrator. The design Engineer or the design-checking Engineer shall witness the testing.

942.07.12.06.05 Lift-Off Tests

The first paragraph of clause 942.07.12.06.05 is deleted in its entirety and replaced by the following:

A minimum of three lift-off tests shall be conducted at each site. The location of the anchor to be tested and the time of test shall be as determined by the design Engineer or design-checking Engineer. The lift-off test shall not be performed until 48 hours has elapsed after transferring the lock-off load. The method of testing shall be as detailed on the Working Drawings.

942.07.13.03 Certificate of Conformance

Clause 942.07.13.03 is deleted in its entirety and replaced by the following:

942.07.13.03 Certificate of Installation

A completed certificate of installation shall be submitted to the Contract Administrator upon completion of the anchor installation and stressing operations. The design Engineer or design-checking Engineer's seal and signature shall be affixed on the completed certificate of installation confirming that the anchors have been supplied, installed, and stressed in general conformance with the Working Drawings. The certificate of installation shall also certify that the interim milestone inspections have been completed as specified.

942.07 Construction

Section 942.07 is amended by the addition of the following:

942.07.15 As Built Drawings

As built drawings shall be prepared by the Contractor for the soil and rock anchor installations as follows:

Appendix 942-B

a) For all work incorporated in the completed structure that required the submission of Working Drawings.

For all changes to the original Contract Document requirements.

The as built drawings shall be submitted to the Contract Administrator, prior to the final acceptance of the work, in a reproducible format specified by the Owner.

The submission of as built drawings shall be accompanied by a letter bearing the seal and signature of an Engineer stating the as built drawings contain all the changes to the work.

The as built drawings shall bear the seal and signature of an Engineer.