



Ontario Provincial Standards Unit
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REVISION INFORMATION SHEET

ONTARIO PROVINCIAL STANDARDS FOR ROADS AND PUBLIC WORKS

VOLUME 7 MUNICIPAL-ORIENTED OPS GENERAL CONDITIONS OF CONTRACT AND GENERAL AND CONSTRUCTION SPECIFICATIONS

MANUAL REVISION #13

APRIL 2017

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for use of Ontario Provincial Standards; therefore, manual holders are cautioned about immediately discarding superseded and cancelled standards.

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.raqs.mto.gov.on.ca/techpubs/ops.nsf/OPSHomepage>)
- The eight OPS manuals of standards are also available for free as well in a single PDF format on the website.

A link to the Ontario Provincial Standards on the MTO Library website is 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

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 7

Remove the entire index and replace with the revised index.

Standard Specifications Volume 7

Superseded/Cancelled (Remove)		Revised/New (Insert)		Remarks
OPSS.MUNI	Dated	OPSS.MUNI	Dated	
		106	Apr 2017	“GENERAL SPECIFICATION FOR ELECTRICAL WORK” See Summary of Revisions.
		127	Apr 2017	“SCHEDULE OF RENTAL RATES FOR CONSTRUCTION EQUIPMENT, INCLUDING MODEL AND SPECIFICATION REFERENCE” New Prov Specification that replaces OPSS Common 127 April 2016. Rental rates and machinery details updated.
		360	Apr 2017	“CONSTRUCTION SPECIFICATION FOR FULL DEPTH REPAIR OF CONCRETE PAVEMENT OR CONCRETE BASE” The MUNI implemented in April 2017 replaces OPSS 360 COMMON, November 2015 with no technical content changes.
		362	Apr 2017	“CONSTRUCTION SPECIFICATION FOR FAST TRACK FULL DEPTH REPAIRS TO CONCRETE PAVEMENT” The MUNI implemented in April 2017 replaces OPSS 362 COMMON, November 2015 with no technical content changes.

		364	Apr 2017	“CONSTRUCTION SPECIFICATION FOR PARTIAL DEPTH REPAIRS IN CONCRETE PAVEMENT” The MUNI implemented in April 2017 replaces OPSS 364 COMMON, November 2015 with no technical content changes.
517	Nov 2016	517	Apr 2017	“CONSTRUCTION SPECIFICATION FOR DEWATERING OF PIPELINE, UTILITY, AND ASSOCIATED STRUCTURE EXCAVATION” Formatting update with no technical content changes.
518	Nov 2016	518	Apr 2017	“CONSTRUCTION SPECIFICATION FOR CONTROL OF WATER FROM DEWATERING OPERATIONS” Formatting update with no technical content changes.
610	Nov 2016	610	Apr 2017	“CONSTRUCTION SPECIFICATION FOR REMOVAL OF ELECTRICAL EQUIPMENT AND MATERIALS” Formatting update with no technical content changes.
		615	Apr 2017	“CONSTRUCTION SPECIFICATION FOR ERECTION OF POLES” The MUNI implemented in April 2017 replaces OPSS 615 COMMON, November 2010 with no technical content changes.
		620	Apr 2017	“CONSTRUCTION SPECIFICATION FOR TRAFFIC SIGNAL EQUIPMENT” The MUNI implemented in April 2017 replaces OPSS 620 COMMON, November 2014 with no technical content changes.

706	Nov 2016	706	Apr 2017	“CONSTRUCTION SPECIFICATION FOR TEMPORARY TRAFFIC CONTROL DEVICES” Formatting update with no technical content changes.
721	Nov 2016	721	Apr 2017	“CONSTRUCTION SPECIFICATION FOR STEEL BEAM GUIDE RAIL AND CABLE GUIDE RAIL” See Summary of Revisions.
723	Nov 2016	723	Apr 2017	“CONSTRUCTION SPECIFICATION FOR ENERGY ATTENUATORS” See Summary of Revisions.
732	Apr 2016	732	Apr 2017	“CONSTRUCTION SPECIFICATION FOR GUIDE RAIL END TREATMENT - STEEL BEAM ENERGY ATTENUATING TERMINAL SYSTEM” See Summary of Revisions.
		810	Apr 2017	“CONSTRUCTION SPECIFICATION FOR ROOTWAD STRUCTURES” The MUNI implemented in April 2017 replaces OPSS 810 COMMON, November 2013 with no technical content changes.
		811	Apr 2017	“CONSTRUCTION SPECIFICATION FOR LARGE WOODY DEBRIS” The MUNI implemented in April 2017 replaces OPSS 811 COMMON, November 2013 with no technical content changes.
		812	Apr 2017	“CONSTRUCTION SPECIFICATION FOR LUNKERS” The MUNI implemented in April 2017 replaces OPSS 812 COMMON, November 2013 with no technical content changes.

		820	Apr 2017	“CONSTRUCTION SPECIFICATION FOR RIFFLES ON STREAMBEDS” The MUNI implemented in April 2017 replaces OPSS 820 COMMON, November 2014 with no technical content changes.
		821	Apr 2017	“CONSTRUCTION SPECIFICATION FOR POOLS IN STREAMBEDS” The MUNI implemented in April 2017 replaces OPSS 821 COMMON, November 2014 with no technical content changes.
		822	Apr 2017	“CONSTRUCTION SPECIFICATION FOR ROCKY RAMPS ON STREAMBEDS” The MUNI implemented in April 2017 replaces OPSS 822 COMMON, November 2014 with no technical content changes.
		823	Apr 2017	“CONSTRUCTION SPECIFICATION FOR LOW FLOW CHANNELS” The MUNI implemented in April 2017 replaces OPSS 823 COMMON, November 2014 with no technical content changes.
		824	Apr 2017	“CONSTRUCTION SPECIFICATION FOR BAFFLES IN A CULVERT” The MUNI implemented in April 2017 replaces OPSS 824 COMMON, November 2014 with no technical content changes.
		830	Apr 2017	“CONSTRUCTION SPECIFICATION FOR LOCAL SEED BANK” The MUNI implemented in April 2017 replaces OPSS 830 COMMON, November 2015 with no technical content changes.

909	Nov 2016	909	Apr 2017	“CONSTRUCTION SPECIFICATION FOR PRESTRESSED CONCRETE-PRECAST GIRDERS” Formatting update with no technical content changes.
		918	Apr 2017	“CONSTRUCTION SPECIFICATION FOR MODULAR BRIDGE STRUCTURES FOR TEMPORARY INSTALLATIONS” The MUNI implemented in April 2017 replaces OPSS 918 COMMON, March 1998 with no technical content changes.
922	Nov 2016	922	Apr 2017	“CONSTRUCTION SPECIFICATION FOR INSTALLATION OF BEARINGS” Formatting update with no technical content changes.

SUMMARY OF REVISIONS TO OPSS.MUNI 106

GENERAL SPECIFICATION FOR ELECTRICAL WORK

- The specification was reviewed as a result of OPSS 624 being cancelled.
- Section 106.02 References, OPSS 624 deleted.
- Existing Appendix 106 B was incorporated into the specification to convert OPSS 106 into OPSS.MUNI 106.

SUMMARY OF REVISIONS TO OPSS.MUNI 721

CONSTRUCTION SPECIFICATION FOR STEEL BEAM GUIDE RAIL AND CABLE GUIDE RAIL

- Clause 721.07.03.01, Type M steel beam guide rail mounting heights added.
- Appendix, specify that Type M steel beam guide rail should use MASH Terminal Systems.

SUMMARY OF REVISIONS TO OPSS.MUNI 723

CONSTRUCTION SPECIFICATION FOR ENERGY ATTENUATORS

- Section 723.02 References, ASTM A 123 and ASTM D 4956 updated.
- New clauses 723.07.03.09 and 723.07.03.10 added.

SUMMARY OF REVISIONS TO OPSS.MUNI 732

CONSTRUCTION SPECIFICATION FOR GUIDE RAIL END TREATMENT – STEEL BEAM ENERGY ATTENUATING TERMINAL SYSTEMS

- Section 732.02 References, ASTM A 123 updated.
- MASH SoftStop Terminal System and MASH Sequential Kinking Terminal System added throughout specification.

MANUAL REVISION RECORD

Municipal-Oriented

Volume 7 – OPS General Conditions of Contract and General & 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
1	APRIL 2008	Included in new manuals	27		
2	NOV 2008	Included in new manuals	28		
3	APR 2010	Included in new manuals	29		
4	NOV 2010	Included in new manuals	30		
5	APR 2012	Included in new manuals	31		
6	NOV 2012	Included in new manuals	32		
7	NOV 2013	Included in new manuals	33		
8	NOV 2014	Included in new manuals	34		
9	APR 2015	Included in new manuals	35		
10	NOV 2015	Included in new manuals	36		
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NOV 2006	100	OPS General Conditions of Contract
DIVISION 1 - GENERAL SPECIFICATIONS		
APR 2017	106	Electrical Work
NOV 2014	120	The Use of Explosives
APR 2017	127	Schedule of Rental Rates for Construction Equipment, Including Model and Specification Reference
NOV 2016	180	General Specification for the management of Excess Materials
NOV 2012	182	Environmental Protection for Construction in Waterbodies and on Waterbody Banks
DIVISION 2 - GENERAL GRADING		
NOV 2016	202	Rock Scaling by Manual Scaling, Machine Scaling, Trim Blasting or Controlled Blasting
NOV 2013	206	Grading
NOV 2015	209	Embankments Over Swamps and Compressible Soils
NOV 2013	212	Borrow
NOV 2014	220	Wick Drain Installation
DIVISION 3 - PAVEMENT (FLEXIBLE AND RIGID)		
NOV 2016	302	Primer Granular Base
NOV 2016	304	Single and Double Surface Treatment
NOV 2016	305	Granular Sealing
NOV 2016	314	Untreated Sub base, Base, Surface, Shoulder, Selected Subgrade, and Stockpiling
NOV 2014	320	Open Graded Drainage Layer
NOV 2014	330	In-Place Full Depth Reclamation of Bituminous Pavement and Underlying Granular
NOV 2016	331	Full Depth Reclamation with Expanded Asphalt Stabilization
NOV 2016	332	Hot In-Place recycling and Hot In-Place recycling With Integral Overlay



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NOV 2015	333	Cold In-Place Recycling
NOV 2016	334	Cold recycled Mix
NOV 2016	335	Cold In-Place Recycling with Expanded Asphalt
NOV 2016	353	Concrete Curb and Gutter Systems
NOV 2014	355	Installation of interlocking Concrete Pavers
APR 2017	360	Full Depth Repair of Concrete Pavement or Concrete Base
APR 2017	362	Fast Track Full Depth Repairs to Concrete Pavement
NOV 2014	363	Repairing Rigid Pavement with Precast Concrete Slabs
APR 2017	364	Partial Depth Repairs in Concrete Pavement
NOV 2014	365	Cross-Stitching Longitudinal Cracks in Concrete Pavement and Concrete Base

DIVISION 4 - DRAINAGE, WATERMAINS, AND UTILITY

NOV 2015	401	Trenching, Backfilling, and Compacting
NOV 2016	402	Excavating, Backfilling and Compacting for Maintenance Holes, Catch Basins, Ditch Inlets and valve chambers
NOV 2016	403	Rock Excavation For Pipelines, Utilities and Associated Structures in Open Cut
NOV 2015	410	Pipe Sewer Installation in Open Cut
NOV 2015	421	Pipe Culvert Installation in Open Cut
NOV 2016	441	Watermain Installation in Open Cut
NOV 2016	442	Corrosion Protection of New and Existing Watermains

DIVISION 5 – MISCELLANEOUS

NOV 2014	501	Compacting
NOV 2014	510	Removal
NOV 2014	512	Installation of Gabions
APR 2017	517	Dewatering
APR 2017	518	Control of Water from Dewatering Operations



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NOV 2014	539	Temporary Protection Systems
DIVISION 6 – ELECTRICAL		
APR 2017	610	Removal of Electrical Equipment and Materials
APR 2017	615	Erection of Poles
APR 2017	620	Traffic Signal Equipment
NOV 2016	630	Installation of Sectional Steel High Mast Lighting Poles
DIVISION 7 - TRAFFIC SAFETY		
APR 2017	706	Temporary Traffic Control Devices
APR 2017	721	Steel Beam Guide Rail and Cable Guide Rail
APR 2017	723	Energy Attenuators
APR 2017	732	Guide Rail End Treatment - Steel Beam Energy Attenuating Terminal System
NOV 2016	771	Standard Highway Fence
DIVISION 8 - ENVIRONMENTAL AND LANDSCAPE		
NOV 2014	804	Seed and Cover
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APR 2017	909	Pre-stressed Concrete – Precast Girders
NOV 2005	910	Stressing Systems for Post-Tensioning
NOV 2014	911	Coating Structural Steel Systems
NOV 2014	914	Waterproofing Bridge Decks with Hot Applied Asphalt Membrane
NOV 2014	915	Sign Support Structures
APR 2017	918	Modular Bridge Structures For Temporary Installations
NOV 2012	920	Deck Joint Assemblies, Preformed Seals, Joint Fillers, Joint Seals, Joint Sealing Compounds, and Waterstops – Structures
APR 2017	922	Installation of Bearings
APR 2012	928	Structure Rehabilitation - Concrete Removal
NOV 2014	930	Structure Rehabilitation - Concrete Patches and Overlays



GENERAL SPECIFICATION FOR ELECTRICAL WORK

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APPENDICES

106-A	Commentary

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 is written as a municipal-oriented specification. Municipal-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of many municipalities in Ontario.

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 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 630	Installation of Sectional Steel High Mast Lighting Poles

Ontario Ministry of Transportation Publications

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

Electrical Safety Authority (ESA)

Ontario Electrical Safety Code

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 a representative of the Owner 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.

106.04.01.02 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.

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 manufacturers.

- 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 providers.
- 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 manufacturer's recommendations and the Owner's maintenance standards.

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 Owner's maintenance standards.

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) 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, April 2017
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.



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

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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, m³/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	44.85
4,000	60.25
7,000	103.50
9,000	225.75
14,000	271.90
17,000	315.25
20,000	356.60

127.02.02.02 Asphalt Paver Attachment

Mechanical Floating Beam	7.30
Mechanical Grade and Slope Control	16.75
Screed Extension, Bolt On	4.70
Sonic Averaging Ski	8.15
Sonic Grade and Slope Control	16.25

127.02.02.03 Asphalt Distributor With Truck

Tank Volume, litre	
7,000	127.25
11,000	150.55

127.02.02.04 Asphalt Pavement Profiler

Power, kW	
32	107.85
90	176.30
135	295.50
340 *	486.50
590 *	520.30
700 *	660.35

* Excluding teeth

127.02.02.05 Asphalt Pavement Repair Equipment

Equipment Type	
4 kW Pavement Line Grinder	2.80
8 kW Pavement Line Grinder	7.25
Pavement Router	10.95
Hot Air Lance	9.85
Mastic Kettle	32.50

127.02.02.06	Asphalt Material Transfer Vehicle	
Without Surge Bin		269.30
With Surge Bin		343.05

127.02.02.07	Profilograph	
Equipment Type		
California Profilograph, including trailer		27.40
High Speed, including truck		66.30

127.02.02.08	Linestripper	
Equipment Type		
Walk Behind		4.25
Walk Behind Ride-On Attachment		3.60
Skid Mounted		13.85
Ride-On		14.80
400 litre Truck Mounted		98.50
1,000 litre Truck Mounted		115.50
2,000 litre Truck Mounted		138.55
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-LoadingMinimum Struck Capacity, m³

6	141.40
11	273.40

127.02.06.04 Scraper, Pull TypeVolume, 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		70.20
127.02.08.07	Rear Dump, Tandem Rear Axle, Diesel or Gas	
AGW, kg		
24,000		93.80
127.02.08.08	Rear Dump, Tri-Axle, Diesel	
AGW, kg		
32,000		113.75
32,000 kg Stone Spreader		126.50
127.02.08.09	Tractor, On Highway, Diesel	
Tandem Axle		106.45
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		49.25
Tri		56.35
Quad		59.75
Quint		64.25

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		251.00
38,000		277.70
50,000		353.00
75,000		483.45
127.02.08.15	Dump Trucks, Off Highway, Articulated Frame	
Payload, kg		
20,000		164.65
26,000		195.45
30,000		233.90
35,000		256.65
40,000		316.55
127.02.09	HOISTING EQUIPMENT	
127.02.09.01	Boom Truck	
Lift Capacity, kg		
7,000		145.40
11,000		204.55
19,000		228.00
25,000		252.35
127.02.09.02	Hydraulic Crane, Rough Terrain	
Lift Capacity, kg		
13,000		85.55
20,000		148.50
40,000		190.85
65,000		259.25
100,000		370.95
127.02.09.03	Hydraulic Crane, Carrier Mounted	
Lift Capacity, kg		
25,000		213.50
45,000		286.15
60,000		304.35
90,000		457.80
135,000		612.65
200,000		714.40
300,000		1,057.80

127.02.09.04 Lattice Boom Crane, Crawler Mounted

Lift Capacity, kg	
50,000	223.60
70,000	292.85
90,000	359.70
130,000	480.40
200,000	663.50
250,000	763.50

127.02.09.05 Lattice Boom Crane, Carrier Mounted

Lift Capacity, kg	
110,000	505.10
270,000	688.70

127.02.09.06 Aerial Bucket Lift, Truck Mounted, Including Truck

Platform Height, m	
7.0	85.20
10.0	102.90
15.0	127.30
20.0	154.85

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

Platform Height, m	
9.0	40.85
12.0	57.00
18.0	66.45
22.0	104.35
30.0	144.70
41.0	260.95

127.02.09.08 Scissor Lift, Self-Propelled

Platform Height, m	
4.0	10.65
7.0	27.10
9.0	40.95

127.02.09.09 Tool Carrier

Power Rating, kW	
40	50.85
75	64.20
100	80.20
125	102.30

127.02.09.10 Telescopic Handlers

Lifting Height, m	
5	53.95
10	78.85

127.02.10 PILE DRIVING EQUIPMENT**127.02.10.01 Hammer, Open End, Diesel**

Rated Energy, joules

50,000	47.15
80,000	67.10
120,000	89.15
220,000	150.00

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

Driving Force, kN

245	69.05
392	94.40
637	120.05
980	171.60
1,471	210.45

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	25.50
30, Fixed/Vertical	77.85
30, Hanging	31.20

127.02.10.04 Hydraulic Post Driver

Track Mounted	59.95
Truck Mounted	150.55

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	184.80
120	353.15

127.02.11.02 Mechanical Drilling Equipment, Crawler Mounted, Including Auger

Power, kW	
95	179.55
113	254.20
130	314.60

127.02.11.03 Hydraulic Drill Rig

Power, kW	
185	452.90
250	645.55
350	710.60
430	873.65
570	1157.60

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	98.80
200	140.30

127.02.11.05 Horizontal Earth Boring Equipment

Power Rating, kW	
20	42.50
50	79.35
100	126.50
200	239.20

Note: Base rate includes 20 m auger and cutting head.

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

Note: 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	192.60
Tandem Axle	212.00
Tri Axle	245.25

127.03**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 2 - Schedule of Rental Rates for Construction Equipment.

127.03.01**AIR EQUIPMENT****Air Compressor, Silenced (127.02.01.01)**

CLASSIFIER	MAKE AND MODEL						
Flow Rate m ³ /min	Atlas Copco	Chicago Pneumatics	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 AP355F AP300F	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 P7170B P7110B	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 * BC-501/CRC2	Shooter 1665 Centennial 2000	
11,000	BC-501/CRC * BC-501/CRC3	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 BM 1000/35 BM 1200/35 BM 1300/35	PM102	RX-400e			1000F 1000 W100Fi W130Fi W150i W100i W60i
340	BM 2000/60 BM2200/75 BM2200/75	PM 200 PM 201 * PM 620 PM 622	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 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			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 Pneumatics	Dynapac	Ingersoll- Rand	Mikasa	Multi-Quip	Vibromax 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	102 252 255 265	RD 11A RD 11V RD12A-90 RD16-90 RD 25 WHK 90L 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-14 ton	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 422HF CC 522HF 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	DV213	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	Supercap	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)						

127.03.06**EARTH MOVING, GRADING EQUIPMENT****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 5045D 4005 5103 4044M 5105 4044R 5203 4052R 5205 4510 5220 4610 5225 5045		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 5320 5055D 5325 5065E 5403 5065M 5420 5210 5425 5303 6120 5310		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 6210 5075E 6215 5075M 6220 5085M 6320 5410 6403 5510 6405 5520 6415 5525 6420 6110 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 6430 5100M 6603 6100D 6605 6105D 6615 6105M 6715 6115D 7210 6115M 7220 6230 7405 6310 7410 6330 7420 6410			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 7330 6730 7520 7130 7610 7230 7710 7320 7810			5613 6290-2	TM-155 TM-175 TM-190 TS6.125 TS6.140
120			7210R 8120 7530 8130 7630 8220 7730				
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 Boomer50 Boomer3040 Boomer3045 Boomer3050
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 Powerstar STD U80B
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

CLASSIFIER	MAKE AND MODEL									
Power kW	AGCO	Case	Ditch Witch	Fendt	JCB	John Deere		Kubota	Massey Ferguson	New Holland
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
22,000		16H 14M 16M 140M 160M						G990

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	Bob-cat	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					

CLASSIFIER		MAKE AND MODEL													
Min. Oper. Weight kg	Nominal Bucket Size m ³	Bob-cat	Case	Caterpillar	Daewoo	Fiat-Allis	Hitachi	John Deere	Kobelco	Komatsu	Kubota	Liebherr	Linkbelt	Samsung	Volvo
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	938-II 938H 939 950F 950G 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	Bob-cat	Case	Caterpillar	Clean-sweep	Gehl	John Deere	New Holland	Tele-dyne	Thomas	Volvo	Bore Pig	ETerra	Bradco	Quick Attach	Arrow-head	FFC	Sweep-ster
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 725C2	AH250-D	250D 250D Series II		D25		2566C 2766C TA25	A25B A25C A25D A325F A25G	
26,000	D30D D300D D350E 730 730C 730C Ejector 730C2 730C2EJ	AH300-D	300D 300D Series II	HM300-1 HM300-2	D300	MT30X	3066C TA30	A30C A30D A30F A30G	
30,000	735 735B	350D	350D	HM350-1		MT36	TA35	A35C A35D A35F A35FFS A35G A35GFS	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 A40G A40FFS	B40D
40,000								A60H	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	Altec	Tadano
7,000	300C 400B	BT 2047				TM-1052
11,000	300 C * 400 B * 500D 500E 600D 600E	3063B 3470 3874	1703 C 1704 C	1770 C 1781 C	AC 18-70B AC 18-70B HL AC 18-70R HL	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 BT 3870 S	2601 C 2801 C	26101 C 22101 S 2892 S	AC 23-95B AC 26-103B AC 23-95R AC 26-103R	
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	AC 38-103S AC 30-103S AC 28-130B AC 38-127S AC 40-152S AC 45-127S	

* 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	Liebherr	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	LRT 1090-2.1	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 100 RT C 80150-SII			RT100	LRT 1100-2.1	RT 130 RT 1000 RT 1100 Quadstar 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 GMK 3050-1	LTM 1045-3.1 LTM 1050-3.1 LTM 1055-3.1 LTM 1045-1 LTM 1055-1 LTM 1055-3.2	HTC 8660 HTC 8650 HTC 11100	TT 600XL	T 490 T 500-1 T 560
60,000	TMS 800E TMS 900E * GMK 3060	LTM 1060-1 LTM 1070-4.1 LTM 1080-1 LTM 1070-4.2	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 GMK 5465-2	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 LTM 1095-5.1	HTTO 86100	TT 800XXL *	Roadmaster 9000
135,000		LTM 1150-1 LTM 1160-2 LTM 1200-1 LTM 1160-5.1 LTM 1160-5.2			
200,000		LTM 1250-1 LTM 1300-1 LTM 1500 LTM 1800 LTM 1200-5.1 LTM 1220-5.2 LTM 1250-5.1			
250,000		LTM 1250-6.1	ATC 3275		
300,000		LTM 1300-6.1 LTM 1350-6.1 LTM 1300-6.2			

* 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 10000 A1	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		HS 895 HD LR 1200	248 HSL	Model 888	HC 230
250,000		LR 1200 SX LR 1250 LR 1300 SX LR 1280 LR 1300 CK 2500 II	LR 1250	348 HYLAB 5 * 298 HSL	Model 999	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	Elliot	Mobile Tool International	Terex	Versalift
7.0	AT200AV		P3	T292	TEL-29-N Vantel 29N/1
10.0	AO442 AT248F AT35G AT37G L42A TA36 TA37 TA40 TA41	M43R	83G-36 U3	HR37 HR46 L13i LT38 LT40 LTM40 SC40 T292 TL36P TL37 TL41 TL45	SST37E1H SST-37-EIH VO431 VST-40-I VST-47-I
15.0	AA55E AM50 AM55 AM650 AM855 AT37G CLASS A 50 LRV52 LRV55 TA50 TA55S TA60	G50F H60F H70R	83G-42 829-45 829-50 U5-50 805B-50 805B-55	HRX60 OM50 SCM55 TC55 TC65 TCX55 TL 45 TL50 TL55 TL60 XT PRO 56 XT PRO 60	LT56 VO255/260 VO-270E VO350/355 VST-47-MHI VST5000-6000
20.0	A77TE93 AN67-E100 CLASS A 70 CLASS A 77T	G85F G85R H70F I70F I85F		TCX65/100 TM100 TM125 XT PRO 60/70	VO-270-I VST7500 VXD 50

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

CLASSIFIER	MAKE AND MODEL					
Platform Height m	Genie	Grove	JLG	Skyjack	Snorkel	Terex
9.0	A-30/20 Z-30/20N Z33/18 Z34/22 DC Z-34/22N Z34/24 IC		340AJ E300AJ H340AJ	SJ30 AJE SJ30 ARJE	A38E TB 37	TA 33 TA 34
12.0	S40 S45 S60X Z34/22N Z40/23N Z40/23N RJ Z-45/25 Z-45/25DC Z45/25J DC Z45/25J RT		400S 400SJ 450A 450AJ 460SJ E400AJP E400AJP-N E400A-N E450A E450AJ M450A M450AJ	SJ40 T SJ45 T SJ46 AJ SJ61 T	400S 460SJ 660SJ A46JE A46JRT AB 50J T 46J TB 42 TB 42J TB 47J TB 50 UNO41	TA 40E TA 50E TA 50RT TB 42 TB 50
18.0	S60X S60 S65 Z-60/34 Z60/37 DC Z62/40	A60J Type I A60J Type II T60 T60 Type II T65T	600A 600AJ 600AJN 600AN 600S 600SC 660SJ 660SJC E600J E600JP M600J M600JP	SJ63 AJ SJ66 T	600S AB 60J TB 60 TB 66J	TB 60 TB 66
22.0	S80 S80X S85 Z80/60	A80J T80 T86J	740AJ 800A 800A 800AJ 800HX 800HX6 800S 860SJ	SJ82 T SJ85 AJ	AB80J AB85J TB 80 TB 85J TB86J	TB 85
30.0	S100 S105 S120 S125		1200SJP 1250AJP		TB100J TB120 TB126J	TB100 TB110
41.0	SX-135XC SX-150 SX-180 ZX-135/70		1350SJP 150 HAX 1500SJ 1850SJ			

Scissor Lift, Self-Propelled (127.02.09.08)

CLASSIFIER	MAKE AND MODEL				
Platform Height m	Genie	JLG	Skyjack	Snorkel	Terex
4.0	GS-1530 GS-1930 GS-2032 GS-2046	1532E3 1930ES 1932E2 1932R 2030ES 2032E2 2032ES 2033E3	SJIII 3015 SJIII 3215 SJIII 3219 SJIII 3220 SJIII 4620	S3219E	TSM 20
7.0	GS-2632 GS-2646 GS-2668 GS-2668 RT GS-2669 BE GS-2669 DC GS-2669 RT	260MRT 2630ES 2632E2 2632ES 2643E2 2646E3 2646ES 2658	2409 SJ 4626 SJ 6826RT SJ 7127 SJIII 3226 SJIII 4626 SJIII 6826	S3226E S4726E S2770RT	TSM 25RT TSM 26
9.0	GS-3232 GS-3246 GS-3268DC GS-3268RT GS-3369 GS-3369 BE GS-3369 DC GS-3369 RT GS-3384RT GS-3390RT GS-4047 GS-4069 BE GS-4069 DC GS-4069 RT GS-4390 GS-4390RT GS-5390 GS-5390 RT	3246E2 3246ES 3369LE 3394RT 339RT 3669ES 4069LE 4394RT 439RT 500RTS 530LRT	4832 6832 8831 8841E 9250RT SJ 6832 RTE SJ 6832RT SJ 7135 SJ 8243 SJ 8831 SJ 8831 RT SJ 8841 SJ 8841 RT SJ 9250 SJ 9250 RT SJIII 4632 SJIII 4740 SJIII 6832	S4732E S3370RT S3970RT	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 570N EP 570 NXT	IT 14G * 907M 906M 908M 910K 914K 910M	411-HT*	310SJ TMC	
75		IT 14G 914M 918M	411-HT 416-HT 417-HT	410SJ TMC 410SK TMC 444K	WA200PT-5
100	521G XT T4	924 K 926M 930 K 930M	426-HT	544J 544K 544K-II 624J	
125	621G XT T4F 721G XT T4F	IT 38G 938K 938M	427-HT 436-HT 437-HT 456-HT 457-HT	624K 624K-II 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	Genie	JCB	JLG	Skyjack
5 - 10	V 518 V 723		TH210 TH215 TH220 TH255 TH330B TH406 TH407	GTH-5519	520 531-70 531-70T 541-70T	G5-18A	
> 10		TX742 TX842 TX945	TH350B TH460B TL1055 TL1055C TL1255 TL1255C TL1255D TL642 TL642C TL642D TL943 TL943C TL943D	GTH-636 GTH-844 GTH-1544 GTH-1256 GTH-1056	506-36 506-C 506-C HL 507-42 508-C 509-42 510-56 512-56 514-56 535-140 540 TURBO 550 550-140 550-170	642 943 1043 1055 1255	SJ883 TH SJ643 TH SJ1044 TH ZB2044 SJ1056 TH SJ1256 TH

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	D8-22 D12-42 D16-32 D19-32 D19-42 D112-32	42S I-19	DE-42 DE-50 DE-50C	D6-42 D19-42
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	D25-32 D36-32
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 D100-13

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 MODEL 150L	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	MODEL 500	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	Reeddrill	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	Reedrill	Steven M. Hain	Watson
110	Mark IV BDH-30/30 BDH 60/60 BHD-40	125 CH 155 CH	CM 100	165 K 8V71 450 K (2005)	5000 CA 200 K
200	BHD-80				

Horizontal Earth Boring Equipment (127.02.11.05)

CLASSIFIER	MAKE AND MODEL			
Power Rating kW	American Augers	Barbco Inc.	Bor-it Mfg.	McLaughlin Mfg.
20	24/30-150 30/225	24-150 30-200	24 Brute 30 Power Plus Model 24 Model 30 Model 36	MCL-24B MCL-30/36B
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	MCL 36/42C
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	MCL 54/60
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

127.03.12

BROOM AND SWEEPER EQUIPMENT

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

127.03.13 FORESTRY EQUIPMENT

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	

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	Multiquip	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				
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 Whisper-watt 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

CLASSIFIER	MAKE AND MODEL										
Power kW	Caterpillar	Detroit Diesel Spectrum	Honda	MTU Onsite Energy	Yamaha	Wacker-Neuson	Multiquip	Subaru	Magnum	Pramac	Doo-san
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							

127.03.15 PUMPING EQUIPMENT

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							

127.03.16
WELDING EQUIPMENT
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 250GFI 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	Reeddrill	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	



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.MUNI 360
APRIL 2017**

(Formerly OPSS 360 November 2015)

Note: The MUNI implemented in April 2017 replaces OPSS 360 COMMON, November 2015 with no technical content changes.

**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 municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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, April 2017
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.



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(Formerly OPSS 362 November 2015)

Note: The MUNI implemented in April 2017 replaces OPSS 362 COMMON, November 2015 with no technical content changes.

**CONSTRUCTION SPECIFICATION FOR
FAST TRACK FULL DEPTH REPAIRS TO CONCRETE PAVEMENT**

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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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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, April 2017
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



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.MUNI 364
APRIL 2017**

(Formerly OPSS 364 November 2015)

Note: The MUNI implemented in April 2017 replaces OPSS 364 COMMON, November 2015 with no technical content changes.

**CONSTRUCTION SPECIFICATION FOR
PARTIAL DEPTH REPAIRS IN CONCRETE PAVEMENT**

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364.09	MEASUREMENT OF PAYMENT
364.10	BASIS OF PAYMENT

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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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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.MUNI 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, April 2017
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



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.MUNI 517
APRIL 2017**

(Formerly OPSS 517 November 2010)

Note: The MUNI implemented in April 2017 replaces OPSS 517 COMMON, November 2010 with no technical content changes.

**CONSTRUCTION SPECIFICATION FOR
DEWATERING OF PIPELINE, UTILITY, AND
ASSOCIATED STRUCTURE EXCAVATION**

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517.08	QUALITY ASSURANCE - Not Used
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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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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518.06	EQUIPMENT - Not Used
518.07	CONSTRUCTION
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 water from dewatering operations prior to discharge to the environment and sewer systems. This specification does not apply to the management of contaminated water.

518.01.01 Specification Significance and Use

This specification is written as a municipal-oriented specification. Municipal-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of many municipalities in Ontario.

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 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

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, stormwater, surface run-off, water pipe leakage from excavations and trenches or within sheeted cofferdams to improve the soil stability or for other construction purposes.

Vegetated Discharge Area means a sloped, open area of land with existing vegetation suitable to prevent erosion.

Sediment means soil particles detached from an earth surface by erosion.

Sediment Control Measure means a measure to remove sediment from water prior to discharge to the environment and sewer systems.

518.07 CONSTRUCTION

518.07.01 Discharge of Water

Water from dewatering operations shall be directed to a sediment control measure and/or a vegetated discharge area according to OPSS 805 prior to discharge to the environment.

When water is discharged from a sediment control measure or a vegetated discharge area to the environment, it shall be done in a manner that does not cause erosion or other damage to adjacent lands.

Owner approval shall be obtained prior to discharge of water to a sewer system.

All other required approvals for dewatering operations shall be obtained and/or complied with prior to and during discharge of water.

518.07.02 Discharge to 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.

518.07.03 Discharge to Vegetated Discharge Areas

Equipment and materials not related to dewatering shall not be used or stored in vegetated discharge areas.

518.07.04 Discharge to the Environment

The discharge of water to the natural environment shall not be directed across pavements, sidewalks, curb and gutter or similar hard surfaces except through appurtenances as specified in the Contract Documents.

518.07.05 Management of Excess Material

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

518.07.06 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks 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 2016 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 does not apply to contaminated water sources.

The designer should specify the following in the Contract Documents:

- Construction requirements for sediment control measures. (518.07.02)
- Types of erosion and sediment control measures. (518.07.03)

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 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



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.MUNI 610
APRIL 2017
(formerly OPSS 610, Nov 2008
Reissued Nov 2010)**

Note: The MUNI implemented in April 2017 replaces OPSS 610 COMMON, November 2008 reissued in Nov 2010 with no technical content changes.

**CONSTRUCTION SPECIFICATION FOR
REMOVAL OF ELECTRICAL EQUIPMENT AND MATERIALS**

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610.09	MEASUREMENT FOR PAYMENT - Not Used
610.10	BASIS OF PAYMENT

APPENDICES

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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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.

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610.02 REFERENCES

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) Environment Compliance 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.

Electrical concrete structures shall be removed to a minimum of 1.0 m below finished grade.

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 2016
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.



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.MUNI 615
APRIL 2017**

(Formerly OPSS Common 615 November 2010)

Note: The MUNI implemented in April 2017 replaces OPSS 615 COMMON, November 2010 with no technical content changes.

**CONSTRUCTION SPECIFICATION FOR
ERECTION OF POLES**

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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 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.

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 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



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.MUNI 620
APRIL 2017**

(formerly OPSS 620 Common, November 2014)

Note: The MUNI implemented in April 2017 replaces OPSS 620 COMMON, November 2014 with no technical content changes.

**CONSTRUCTION SPECIFICATION FOR
TRAFFIC SIGNAL EQUIPMENT AND
ELECTRICAL TRAFFIC CONTROL DEVICES**

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APPENDICES

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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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**
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 Traffic Signal Controllers - Item
 Pedestal Mounted Traffic Signal Controllers - Item
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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)
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- Traffic signal pre-emption equipment specifications. (620.05.24)
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- Size and type of LED modules or incandescent lamps to be installed in the signal heads. (620.07.02.04)
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- Internally illuminated sign installation specifications. (620.07.03.04)
- Location and orientation of pole mounted controller cabinets. (620.07.04.01.01)
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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)
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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	



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.MUNI 706
APRIL 2017**

(Formerly OPSS 706 2010)
(Formerly OPSS 543, December 1990)

Note: The MUNI implemented in April 2017 replaces OPSS 706 COMMON, November 2010 with no technical content changes.

**CONSTRUCTION SPECIFICATION
FOR TRAFFIC CONTROL SIGNING**

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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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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 STEEL BEAM GUIDE RAIL AND CABLE GUIDE RAIL

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721.01	SCOPE
721.02	REFERENCES
721.03	DEFINITIONS - Not Used
721.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
721.05	MATERIALS
721.06	EQUIPMENT - Not Used
721.07	CONSTRUCTION
721.08	QUALITY ASSURANCE - Not Used
721.09	MEASUREMENT FOR PAYMENT
721.10	BASIS OF PAYMENT

APPENDICES

721-A	Commentary

721.01	SCOPE

This specification covers the requirements for the installation of steel beam guide rail and cable guide rail systems.

721.01.01 Specification Significance and Use

This specification is written as a municipal-oriented specification. Municipal-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of many municipalities in Ontario.

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

721.01.02 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.

721.02 REFERENCES

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 1350 Concrete - Materials and Production
OPSS 1503 Cable Guide Rail
OPSS 1504 Steel Beam Guide Rail
OPSS 1505 Channel Components for Steel Beam Guide Rail
OPSS 1601 Wood, Preservative Treatment, and Shop Fabrication

Ontario Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 11 - Pavement, Hazard and Delineation Markings

CSA Standards

G164-M92 (R2003) Hot Dip Galvanizing of Irregularly Shaped Articles
O56-10 (R2015) Round Wood Piles

ASTM International

A 36/A 36M-14	Carbon Structural Steel
A 780/A 780M-09 (2015)	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
D 4956-16a	Retroreflective Sheeting for Traffic Control

721.05 MATERIALS

721.05.01 Cable Guide Rail

Guide rail cable, fittings, cable clamps and nails, and steel sections for anchor blocks shall be according to OPSS 1503.

Guide rail posts shall be clean peeled according to CAN/CSA O56, and according to OPSS 1601.

Precast concrete anchor blocks shall be according to OPSS 1503.

Reflectorized strips on 0.5 mm thick aluminum sheet shall be according to OTM Book 11 and as specified in the Contract Documents.

721.05.02 Steel Beam Guide Rail

Steel beam guide rail shall be according to OPSS 1504.

Channel components shall be according to OPSS 1505.

Wooden posts and blocks shall be according to OPSS 1601.

Plastic blocks shall be as specified in the Contract Documents.

Steel sleeves and spacer tubes used in transition treatments to concrete structures shall be fabricated from Schedule 40 galvanized steel pipe.

Steel posts, sleeves, and spacer tubes shall be hot dip galvanized after fabrication according to CSA G164.

Steel posts shall be according to ASTM A 36.

Reflectors shall have a minimum reflective surface of 100 x 100 mm; high intensity retroreflective sheeting according to ASTM D 4956, Type VII; colour according to OTM Book 11; and flexibility to bend 90 degrees from vertical and self restore.

721.05.03 Fabricated Steel Bases

Fabricated steel bases shall be according to OPSS 1503.

721.05.04 Concrete

Concrete shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 30 MPa.

721.07 CONSTRUCTION

721.07.01 General

Guide rail systems shall be installed plumb and to the alignment and grade as specified in the Contract Documents, regardless of the material encountered.

Tops of wooden posts shall be cut as specified in the Contract Documents and treated with two coats of 2% copper naphthenate wood preservative. Field applied wood preservative that comes in contact with any galvanized components shall be removed immediately.

Acceptable material from posthole or anchor block excavation shall be used as backfill around posts and compacted according to OPSS 501.

When required, fabricated steel bases shall be installed level and square to the centreline of the roadway.

Cut ends, field drilled holes, and damaged areas of hot dip galvanized coatings on any galvanized component shall be repaired according to ASTM A 780.

Flame cutting shall not be permitted.

721.07.02 Cable Guide Rail

721.07.02.01 Installation

Cable guide rail shall be installed as specified in the Contract Documents.

Wooden posts shall be installed to the specified depth with the larger end of the post in the ground.

Cable shall be attached to guide rail posts using cable clamps and nail fasteners.

Cable mounting height shall be measured from the top of final shoulder grade at the post face. Cable height shall be adjusted to provide a smooth installation.

Cables shall be tensioned so that the sag between posts shall be a maximum of 6 mm.

Cable splices occurring on the same cable shall be spaced a minimum length of 15 m apart.

There shall be only one cable splice per panel, regardless of the number of cables in the system.

721.07.02.02 Anchor Blocks

Precast or cast-in-place cubical or cylindrical anchor blocks shall be installed as specified in the Contract Documents, regardless of the material encountered.

In porous or crumbly soil, forms for cast-in-place anchors shall be used to prevent contamination of the concrete. Forms may be left in place or removed.

Earth backfill and granular materials shall be compacted according to OPSS 501.

721.07.02.03 Reflectorized Strips

Reflectorized strips shall be installed:

- a) starting at the second post from the approach end.
- b) at a maximum interval of every fifth post on tangent.
- c) at a maximum interval of every third post on curves.
- d) ending on the second to last post.

The reflectorized strip shall be fastened on posts as specified in the Contract Documents using two 50 mm aluminum nails.

721.07.02.04 Adjust Cable Guide Rail

Cable guide rail shall be adjusted at locations as specified in the Contract Documents.

Cable guide rail adjustment shall be as specified in the Contract Documents and include:

- a) the removal of the following:
 - i. staples and spacers or cable clamps and nails
 - ii. reflectorized strips
 - iii. cables as salvage
- b) the installation of the following:
 - i. salvaged cables
 - ii. new cable clamps and nails
 - iii. new reflectorized strips

To facilitate cable tensioning, one new turnbuckle assembly shall be installed on each cable between each set of adjacent anchor blocks. Cables shall be tensioned so that the sag between posts shall be a maximum of 6 mm.

721.07.02.05 Cable Guide Rail Post Replacement

Existing cable guide rail posts shall be removed and replaced with new cable guide rail posts at locations as specified in the Contract Documents and installed as specified in the Cable Guide Rail Installation clause. The Contractor shall confirm the locations with the Contractor Administrator prior to commencing the removal of existing posts.

721.07.03 Steel Beam Guide Rail

721.07.03.01 Installation

Steel beam guide rail shall be installed as specified in the Contract Documents.

Each steel beam guide rail installation may incorporate either steel posts with either plastic or routed wooden blocks or wooden posts with wooden blocks, but not both. Wooden posts shall only be permitted within steel post installations when wooden posts are specified for treatments. Extension of an existing wooden post installation using steel posts shall only be permitted when the extension length is greater than 100 m.

Different types of plastic and wooden blocks shall not be used together within a steel beam guide rail installation.

When a transition to a rigid obstacle is required, the offset block for the channel may be either wood or a pipe sleeve over the connecting bolt. The pipe sleeve shall be 89 mm OD galvanized steel pipe cut to the required length.

Backup plates, steel spacer tubes, and pipe sleeves shall be installed as specified in the Contract Documents.

All joints shall be lapped in the direction of traffic.

Bolts shall be tightened to 100 N·m. Bolts for wooden post installations shall be field cut as required to maintain a maximum protrusion of 10 mm beyond the nut. The cut end of the bolt shall be ground smooth with all sharp edges and burrs removed.

Steel beam guide rail mounting heights shall be measured vertically from the top of the steel beam guide rail.

Steel beam guide rail without channel mounting heights shall be within the following ranges:

- a) 685 to 760 mm during construction and seasonal shutdown.
- b) 685 to 735 mm upon completion of the work.

Steel beam guide rail with channel mounting heights shall be within the following ranges:

- a) 685 to 785 mm during construction and seasonal shutdown.
- b) 735 to 785 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.

Type M steel beam guide rail mounting heights shall be within the following ranges:

- a) 710 to 810 mm during construction and seasonal shutdown.
- b) 760 to 810 mm upon completion of the work.

Where curb with gutter is required with Type M steel beam guide rail, mounting heights shall be measured vertically at the inside edge of the concrete gutter.

Where sidewalk is required with Type M steel beam guide rail, mounting heights shall be measured vertically at the face of Type M steel beam guide rail.

721.07.03.02 Reflectors

Reflectors shall be installed:

- a) starting at the fifth post from the approach end of a steel beam guide rail end treatment.
- b) at a maximum interval of every tenth post on tangent.
- c) as specified in OTM Book 11, Table 4, on curves.
- d) ending on the last post of the steel beam guide rail installation.
- e) on the posts at the four adjacent steel beam guide rail splices at the approach and leaving end of structures.

The reflector shall be fastened to the post using adhesives, bolts and nuts, or screws with reflective surfaces clear above the top of the posts. One-sided reflectors shall be installed on divided highways and two-sided reflectors shall be installed on undivided highways.

721.07.03.03 Steel Beam Guide Rail Structure Connections

Steel beam guide rail shall be connected to new or existing structure walls as specified in the Contract Documents.

721.07.03.04 Adjust Steel Beam Guide Rail

Steel beam guide rail shall be adjusted at locations as specified in the Contract Documents.

Steel beam rail elements, channel elements, and offset blocks shall be disassembled from the posts. Post bolts, washers, nuts and existing steel offset blocks shall be removed and disposed of as specified in the Contract Documents.

Steel beam rail elements, channel elements, wooden offset blocks, and plastic offset blocks, shall be salvaged for reinstallation. Washers from the front face of the existing steel beam guide rail shall not be reinstalled.

Salvaged steel beam rail elements, channel elements, and wooden or plastic offset blocks shall be reinstalled within the mounting height ranges as specified in the Steel Beam Guide Rail Installation clause using new post bolts, washers, and nuts.

For steel post adjustment, the post shall be raised a minimum of 50 mm above the specified height and then driven down to the required depth before the salvaged steel beam guide rail components are reinstalled. When existing steel offset blocks have been removed, new wooden or plastic offset blocks shall be installed. A new hole shall be field punched through the existing post as specified in the Contract Documents.

For wooden post adjustment, a new hole shall be field drilled through the existing post as specified in the Contract Documents. The top of the offset block shall not extend beyond the top of the existing post. When channel elements are being reinstalled, an additional hole shall be field drilled through the existing post as specified in the Contract Documents.

New reflectors shall be supplied and installed as specified in the Reflectors clause. When new reflectors are installed on a wooden post system, the reflector shall be installed on the approach transverse face of the wooden offset block with one edge 12 mm from edge of post.

721.07.04 Management of Excess Material

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

721.09 MEASUREMENT FOR PAYMENT

721.09.01 Actual Measurement

721.09.01.01 Cable Guide Rail

Measurement of cable guide rail shall be by length in metres along the centreline of the system from centre of anchor block to centre of anchor block at each end of an installation. No additions shall be made for the overlapping length of cable at intermediate anchor blocks.

721.09.01.02 Adjust Cable Guide Rail

Measurement of adjust cable guide rail shall be by length in metres along the centreline of the system from centre of anchor block to centre of anchor block at each end of an installation. No additions shall be made for the overlapping length of cable at intermediate anchor blocks.

721.09.01.03 Cable Guide Rail Post Replacement

For measurement purposes, a count shall be made of the number of cable guide rail post replacement installed.

721.09.01.04 Anchor Blocks

For measurement purposes, a count shall be made of the number of anchor blocks installed.

721.09.01.05 Single Rail Steel Beam Guide Rail Single Rail Steel Beam Guide Rail with Channel Double Rail Steel Beam Guide Rail Steel Beam Barricade

Measurement of steel beam guide rail shall be by length in metres along the centreline of the system from end to end of each steel beam guide rail installation and does not include the terminal systems.

721.09.01.06 Adjust Steel Beam Guide Rail, Wooden Posts Adjust Steel Beam Guide Rail, Steel Posts Adjust Steel Beam Guide Rail, Steel Posts with Steel Offset Blocks

Measurement of adjust steel beam guide rail shall be by length in metres along the centreline of the adjusted system from end to end of each steel beam guide rail installation and includes the end treatments and terminal systems.

721.09.01.07 Steel Beam Guide Rail Structure Connections

For measurement purposes, a count shall be made of the number of steel beam guide rail structure connections installed.

721.09.02 Plan Quantity Measurement

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

721.10

BASIS OF PAYMENT

721.10.01

Cable Guide Rail - Item
Adjust Cable Guide Rail - Item
Cable Guide Rail Post Replacement - Item
Anchor Blocks - Item
Single Rail Steel Beam Guide Rail - Item
Single Rail Steel Beam Guide Rail with Channel - Item
Double Rail Steel Beam Guide Rail - Item
Adjust Steel Beam Guide Rail, Wooden Posts - Item
Adjust Steel Beam Guide Rail, Steel Posts - Item
Adjust Steel Beam Guide Rail, Steel Posts with Steel Offset Blocks - Item
Steel Beam Guide Rail Structure Connections – Item
Steel Beam Barricade - 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 steel beam guide rail structure connections, payment at the Contract price for single rail steel beam guide rail with channel shall include full compensation for all labour, Equipment, and Material to do the work of connecting steel beam guide rail to a structure.

Costs associated with any required repairs or removal and replacement of defective materials shall be the Contractor's responsibility at no additional cost to the Owner.

Appendix 721-A, April 2017
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 OPSD 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:

- Guide rail system type (include OPSD number) and locations. (721.07.01)
- Cable guide rail to be adjusted. (721.07.02.04)
- Cable guide rail post to be replaced. (721.07.02.05)
- Steel beam guide rail to be adjusted. (721.07.03.04)

For Type M steel beam guide rail, use only MASH Terminal Systems.

Leaving end treatments should only be used on divided highways and ramps, when the leaving end of the installation is located beyond the clear zone for opposing traffic.

Height adjustments for steel beam guide rail with wooden post shall be a minimum of 50 mm.

Cable Guide Rail Adjustment:

Mounting height tolerances for cable guide rail (CGR) are provided in the MTO Roadside Safety Manual. The purpose of the Adjust Cable Guide Rail item is to allow for the adjustment of the mounting height of an existing CGR installation. Generally, adjustment is necessary at locations where the pavement rehabilitation strategy will raise the existing ground elevation adjacent to an existing guide rail installation. An evaluation of existing guide rail will provide the designer with an inventory of the type of existing guide rail systems as well as the existing mounting height.

When adjusting CGR systems, the posts remain in their current location and the cables are reinstalled at the new mounting height. If the CGR was installed according to OPSD 913.130, there should be approximately 150 mm of space available for adjustment assuming that this is the first adjustment. Cables are not to be installed within 200 mm of the top of the posts. This ensures that the cables do not interfere with the reflectorized strip.

The Adjust Cable Guide Rail tender item also includes the removal and replacement of cable clamps and nails, the installation of one new turnbuckle per cable between anchor blocks, and the installation of new reflectorized strips.

When the evaluation of the existing CGR indicates that the posts are in unsound condition, out of plumb, or cannot meet the mounting height tolerance, it may be necessary to replace some or all of the posts. The Cable Guide Rail Post Replacement tender item can be used to replace existing cable guide rail posts when the remainder of the components (i.e., cables and anchor blocks) are in satisfactory condition.

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Steel Beam Guide Rail Adjustment:

Mounting height tolerances for steel beam guide rail (SBGR) are specified in OPSS 721. There are three tender items available for adjustment of SBGR. The purpose of these items is to allow for the adjustment of the mounting height of an existing SBGR installation on wooden or steel posts. Generally, adjustment is necessary at locations where the pavement rehabilitation strategy will raise the existing ground elevation adjacent to an existing guide rail installation. An evaluation of the existing guide rail will provide the designer with an inventory of the type of existing guide rail systems as well as existing mounting height. Existing SBGR installations may consist of the following configurations:

a) Wooden posts with wooden offset blocks:

Although still installed today, these systems were used primarily in the years prior to implementation of SBGR on steel posts in 1995. When adjusting these systems, the posts remain in their current location, but the offset block and rail (and channel, where necessary) are reinstalled at the new mounting height. If the guide rail was installed according to OPSD 912.140, there should be approximately 150 mm of space available for adjustment assuming this is the first adjustment. The evaluation of existing guide rail should determine whether the existing installation can accommodate the proposed change in height.

b) Steel post with steel offset blocks:

Steel post systems have been the most common since they were first implemented in 1995 mainly due to their relative ease of handling and installation. Steel offset blocks were used exclusively with steel post systems from 1995 through 2002 when the standard was revised to specify routed wooden blocks. When they are adjusted, existing steel post systems with steel offset blocks will be retrofitted with routed wooden or plastic offset blocks. This requires the punching of a new hole to accommodate the wooden or plastic offset block.

c) Steel posts with wooden or plastic offset blocks:

From 2003 through the early 2008, steel post systems were installed exclusively with routed wooden offset blocks. In 2008, plastic offset blocks were implemented as an alternative to the routed wooden offset blocks. Since that time, steel post systems with plastic offset blocks have been the most common steel beam system.

Selection of the appropriate tender item for each installation will ensure that the Contractor will address the unique adjustment requirements of each system configuration.

Tender items for adjustment include the removal and replacement of existing hardware including bolts, washers, and nuts as well as the installation of new reflectors. For SBGR with steel offset blocks, replacement of steel offset blocks with plastic or wooden offset blocks is included.

Existing end terminals and treatments should be reviewed when SBGR is being considered for adjustment.

Existing end terminals may consist of eccentric loader terminal (ELT) systems, extruder terminal (ET) systems, or sequential kinking terminal (SKT) systems:

a) ELT Systems:

- Consider replacement of ELT installations that are greater than or equal to 5 years in age with a new steel beam energy attenuating terminal (SBEAT) system. If the ELT system is located on a horizontal curve with a radius of less than 190m, a new ELT should be installed.

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b) SBEATs:

- Existing ET and SKT systems consist of several different variations on wooden and steel posts.
- Consider replacement of ET and SKT system installations on wooden posts with a new SBEAT System.
- ET and SKT systems on steel posts that are in good condition may be adjusted.

Existing leaving end treatments consisting of buried leaving end treatments (formerly OPSD 912.233) or upright fishtail ends:

- a) Buried leaving end treatments are a challenge to adjust and could be replaced with a standard leaving end treatment according to OPSD 912.235. This would require the removal of 16 m of existing SBGR and subsequent installation of 4 m of new SBGR according to OPSD 912.235.
- b) Existing upright fishtail type end treatments typically have been installed based on the extension requirements for unanchored guide rail in accordance with Table 3.4.2 in the MTO Roadside Safety Manual. When replacing an upright fishtail end treatment with a standard leaving end treatment, ensure that after removal of the unanchored end beyond the hazard that the 4 m of new SBGR in accordance with OPSD 912.235 extends beyond the hazard by 4 m.
- c) Where an existing buried end treatment or upright fishtail end treatment is on the leaving end of a SBGR installation located on an undivided highway or at a location on a divided highway where the end of the SBGR is located within the clear zone for opposing traffic, the treatment should be considered for replacement with an end terminal.

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 OPSD 912.530	Steel Beam Guide Rail System
OPSD 913.101 to OPSD 913.135	Cable Guide Rail System



CONSTRUCTION SPECIFICATION FOR ENERGY ATTENUATORS

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723-A	Commentary

723.01 SCOPE

This specification covers the requirements for the installation of permanent and temporary energy attenuators and relocation of temporary energy attenuators.

723.01.01 Specification Significance and Use

This specification is written as a municipal-oriented specification. Municipal-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of many municipalities in Ontario.

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

723.01.02 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.

723.02 REFERENCES

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 510	Removal
OPSS 705	Flexible Delineator Posts
OPSS 740	Concrete Barriers
OPSS 904	Concrete Structures

Ontario Provincial Standard Specifications, Material

OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete

Ontario Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 6 - Warning Signs

ASTM International

A 123/A 123M-15	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 325-14	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
A 780/A 780M-09(2015)	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
D 4956-16a	Retroreflective Sheeting for Traffic Control

723.03 DEFINITIONS

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

Dual Duty means a new high exposure energy attenuator that is supplied and installed in a temporary configuration during construction, temporarily relocated as required, and then relocated to its permanent location prior to the end of the Work.

High Exposure means an energy attenuator that is installed in a location where the risk of impact is expected to be high such as in gore areas at exit ramps and express - collector transfers.

Reduced Exposure means a temporary energy attenuator that is installed in a location where the risk of impact is expected to be low. These energy attenuators should be specified in a location where they will be required for short duration of less than four months, are frequently relocated, and where they are not required during seasonal shutdown.

723.04 DESIGN AND SUBMISSION REQUIREMENTS

723.04.01 Design Requirements

The energy attenuator manufacturer shall complete the design of any non-standard details (e.g., a connection or transition to a rigid object other than a concrete barrier or temporary concrete barrier) at locations specified in the Contract Documents.

723.04.02 Submission Requirements

One copy of the manufacturer's installation instructions and Working Drawings shall be submitted to the Contract Administrator.

Installation of the energy attenuator shall not commence until the Contract Administrator has received the copy of the instructions and Working Drawings.

723.04.02.01 Submission Requirements for Non-Standard Details

Three copies of Working Drawings, prepared by the manufacturer, for any non-standard details shall be submitted to the Contract Administrator prior to the commencement of construction. The Working Drawings shall show full details of the materials and installation procedures. An Engineer's seal and signature shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents. The submission of Working Drawings shall be accompanied by 3 copies of a letter that has been signed by the manufacturer, on company letterhead, summarizing the details of the proposed design.

Installation of the energy attenuator shall not commence until the Contract Administrator has received and accepted the copy of the letters and Working Drawings.

723.05 MATERIALS

723.05.01 General

All supplied system components shall be according to the manufacturer's specifications.

723.05.02 Energy Attenuator Systems

The names of systems acceptable for the Energy Attenuator - Permanent items are shown in Table 1.

The names of systems acceptable for the Energy Attenuator - Temporary items are shown in Table 2.

The Contractor shall have the option of supplying and installing any of these approved systems shown for the appropriate tender item.

When a specific energy attenuator system is specified in the Contract Documents, there shall not be an option of substitution for the energy attenuator system.

723.05.03 Concrete

Concrete for pads and anchor blocks shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 30 MPa.

723.05.04 Steel Reinforcement

Steel reinforcement shall be according to OPSS 1440.

723.05.05 Anchor Bolts

Anchor bolts shall be supplied and installed according to energy attenuator manufacturer recommendations.

723.05.06 Bolts for Connection of BB-BEAT System to Concrete Barrier

Bolts used to connect the BB-BEAT system to the concrete barrier shall be according to ASTM A 325 and shall be hot dip galvanized according to ASTM A 123.

723.05.07 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.

723.05.08 Flexible Delineator Posts

Flexible delineator posts shall be according to OPSS 705. The post colour shall be orange.

723.05.09 Reflective Sheeting

Flexible delineator posts shall be outfitted with high intensity retroreflective sheeting according to ASTM D 4956, Type IV; white colour; and to the dimensions specified in the Contract Documents.

723.05.10 Reuse of Materials

Notwithstanding subsection GC 5.02, Quality of Material, paragraph 01 of the General Conditions of Contract, the reuse of materials is permitted for temporary energy attenuator installations and relocations, provided the components have not been damaged to affect the safety performance of the system.

723.07 CONSTRUCTION

723.07.01 General

Permanent and temporary energy attenuators shall be installed according to manufacturer's instructions at locations specified in the Contract Documents. A reference for energy attenuator Contract Drawing Notation is shown in Table 3.

Energy attenuators shall not be placed on surfaces with a crossfall greater than 6%.

723.07.02 Permanent Installation

723.07.02.01 New Concrete Pads

Levelling and site preparation required for the existing granular base shall be performed prior to placing the concrete pad. The concrete pad shall be constructed as specified in the Contract Documents. Concrete shall be placed, cured, and finished according to OPSS 904.

The granular base below new concrete pads shall be a minimum depth of 150 mm of existing or new Granular A and shall be according to OPSS 314.

723.07.02.02 Existing Concrete Surfaces and Pads

When specified in the Contract Documents, existing 200 mm thick concrete surfaces, pads, or precast pads may be used to support the energy attenuator.

723.07.02.03 Connection of BB-BEAT and QuadTrend Systems to Concrete Barrier

When the BB-BEAT or QuadTrend system is connected to new concrete barrier, the adjacent 4.0 m of concrete barrier shall be according to OPSS 740 and the Contract Documents.

When the BB-BEAT or QuadTrend system is connected to existing concrete barrier, the adjacent 4.0 m of existing concrete barrier shall be removed according to OPSS 510 and a new 4.0 m section of concrete barrier shall be installed according to OPSS 740 and the Contract Documents.

723.07.02.04 Rear Cable Anchor Blocks for QuadTrend Systems

Rear cable anchor blocks shall be as specified in the Contract Documents. In both earth and rock fills, rear cable anchor blocks shall be placed on slopes 3H:1V or flatter. The cable supplied with the unit shall be used to determine the proper location of the rear cable anchor block.

In porous or crumbly soils, forms for cast-in-place anchor blocks shall be used to prevent contamination of the concrete. Forms may be left in place or removed.

The top of the concrete block shall be flush with the embankment slope and the rear cable anchor assembly shall not protrude more than 100 mm above ground.

723.07.02.05 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.

723.07.02.06 Posts for BB-BEAT Systems

All posts shall be set to the alignment specified in the Contract Documents, regardless of the material encountered. Permissible tolerance for plumb shall be 20 mm maximum over the post length above the ground. The driving of posts shall be accomplished with methods and equipment that leave the posts free of distortion, burring, and any other damage.

All lower end posts shall be installed so that not more than 100 mm is exposed above finished grade.

723.07.03 Temporary Installation

723.07.03.01 New Concrete Pads

The concrete pad shall be as specified by the manufacturer.

723.07.03.02 Existing Concrete Surface

Existing 200 mm minimum thick concrete surfaces, pads, or precast pads may be used to support the energy attenuator.

723.07.03.03 Asphalt Over Concrete

Existing or new 75 mm minimum thick asphalt over 75 mm minimum thick concrete pavement may be used to support the energy attenuator.

723.07.03.04 Asphalt Over Compacted Granular

Existing or new 150 mm minimum thick asphalt over 150 mm minimum thick compacted granular base may be used to support the energy attenuator. The asphalt shall extend a minimum of 500 mm beyond the anchor bolts.

723.07.03.05 Reduced Exposure

When water filled energy attenuator systems are in use, the temperature shall be monitored on a daily basis. When the temperature is predicted to fall below freezing, antifreeze agents according to manufacturer recommendations shall be added to the water. The use of a water filled energy attenuator system when frozen is not permissible.

Water filled energy attenuator systems shall not be left in place during a seasonal shutdown period without approval from the Contract Administrator. When approval from the Contract Administrator is not granted, water filled energy attenuator systems shall be replaced with another approved energy attenuator listed for the reduced exposure tender item for the duration of the seasonal shutdown period.

Disposal of liquid materials shall be managed according to the Contract Documents.

723.07.03.06 Dual Duty

A new high exposure energy attenuator shall be supplied and installed in a temporary configuration during construction at the locations specified in the Contract Documents.

723.07.03.07 Relocation

Temporary energy attenuators, object markers, oversize snowplow markers, object marker posts, and flexible delineator posts shall be relocated as specified in the Contract Documents, including the removal of existing and installation of new anchor bolts and mounting hardware.

Prior to completion of the Contract, dual duty energy attenuators and associated object markers, oversize snowplow markers, and object marker posts including the replacement of anchor bolts and mounting hardware, shall be relocated to their permanent locations as specified in the Contract Documents and in accordance with the General and Permanent Installation subsections.

723.07.03.08 Permanent and Temporary Concrete Barriers

Temporary concrete barriers shall be modified and installed as specified in the Contract Documents and the modified surfaces shall be smooth. Temporary concrete barriers shall be anchored as specified in the Contract Documents.

Permanent existing concrete barriers shall be modified as specified in the Contract Documents and the modified surfaces shall be smooth.

723.07.03.09 Compact Backstop Adapter for TAU-II Systems

The applicable compact backstop adapter matching the temporary concrete barrier connection type shall be installed according to the manufacturer's specifications.

723.07.03.10 Front Anchor Backup Plate for TAU-II Systems

When the TAU-II system is installed on asphalt surface, a front anchor backup plate shall be installed according to manufacturer's specifications.

723.07.04 Delineation

723.07.04.01 Object Markers and Oversize Snowplow Markers

A Wa-33 object marker according to OTM Book 6, a Wz-2 oversize snowplow marker, and galvanized mounting hardware shall be installed at each energy attenuator.

When installed on a paved surface, the object marker and oversize snowplow 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 snowplow 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.

723.07.04.02 Flexible Delineator Posts

Flexible delineator posts shall be installed according to OPSS 705 at locations specified in the Contract Documents.

723.07.05 Management of Excess Material

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

723.09 MEASUREMENT FOR PAYMENT

723.09.01 Actual Measurement

**723.09.01.01 Energy Attenuator - Permanent, Narrow
Energy Attenuator - Permanent, Wide
Energy Attenuator - Permanent, Extra Wide
Energy Attenuator - Permanent, Super Wide
Energy Attenuator - Permanent, High Exposure
Energy Attenuator - Permanent, Single-Sided
Box Beam Bursting Energy Absorbing Terminal System - Permanent
Quadguard System - Permanent
Quadguard Wide System - Permanent
Quadguard Extra Wide System - Permanent
Quadguard Super Wide System - Permanent
QuadTrend System - Permanent
Smart System - Permanent
TRACC System - Permanent
TAU-II System - Permanent
TAU-II Wide System - Permanent
TAU-II Extra Wide System - Permanent**

For measurement purposes, a count shall be made of the number of complete energy attenuator systems installed.

**723.09.01.02 Energy Attenuator - Temporary, Narrow
Energy Attenuator - Temporary, Wide
Energy Attenuator - Temporary, Extra Wide
Energy Attenuator - Temporary, Super Wide
Energy Attenuator - Temporary, Reduced Exposure
Energy Attenuator - Temporary, Dual Duty
ABSORB 350 System - Temporary
ACZ-350 System - Temporary
Quadguard System - Temporary
Quadguard Wide System - Temporary
Quadguard Extra Wide System - Temporary
Quadguard Super Wide System - Temporary
SLED System - Temporary
Smart System - Temporary
TAU-II System - Temporary
TAU-II Wide System - Temporary
TAU-II Extra Wide System - Temporary
TRACC System - Temporary**

For measurement purposes, a count shall be made of the number of complete energy attenuator systems installed and removed, up to the maximum number of systems required to be in place at any one time during the Contract.

723.09.01.03

- Energy Attenuator - Relocation, Narrow
- Energy Attenuator - Relocation, Wide
- Energy Attenuator - Relocation, Extra Wide
- Energy Attenuator - Relocation, Super Wide
- Energy Attenuator - Relocation, Reduced Exposure
- Energy Attenuator - Relocation, Dual Duty
- ABSORB 350 System - Relocation
- ACZ-350 System - Relocation
- Quadguard System - Relocation
- Quadguard Wide System - Relocation
- Quadguard Extra Wide System - Relocation
- Quadguard Super Wide System - Relocation
- SLED System - Relocation
- Smart System - Relocation
- TAU-II System - Relocation
- TAU-II Wide System - Relocation
- TAU-II Extra Wide System - Relocation
- TRACC System - Relocation

For measurement purposes, a count shall be made of the number of complete energy attenuator systems relocated. Systems 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.

723.09.02 Plan Quantity Measurement

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

723.10 BASIS OF PAYMENT

723.10.01

- Energy Attenuator - Permanent, Narrow - Item
- Energy Attenuator - Permanent, Wide - Item
- Energy Attenuator - Permanent, Extra Wide – Item
- Energy Attenuator - Permanent, Super Wide – Item
- Energy Attenuator - Permanent, High Exposure - Item
- Energy Attenuator - Permanent, Single-Sided - Item
- Box Beam Bursting Energy Absorbing Terminal System - Permanent - Item
- Quadguard System - Permanent - Item
- Quadguard Wide System - Permanent - Item
- Quadguard Extra Wide System - Permanent - Item
- Quadguard Super Wide System - Permanent - Item
- QuadTrend System - Permanent - Item
- Smart System - Permanent - Item
- TAU-II System - Permanent - Item
- TAU-II Wide System - Permanent - Item
- TAU-II Extra Wide System - Permanent - Item
- TRACC System - Permanent - Item
- Energy Attenuator - Temporary, Narrow - Item
- Energy Attenuator - Temporary, Wide - Item
- Energy Attenuator - Temporary, Extra Wide - Item
- Energy Attenuator - Temporary, Super Wide - Item
- Energy Attenuator - Temporary, Reduced Exposure - Item
- Energy Attenuator - Temporary, Dual Duty - Item
- ABSORB 350 System - Temporary - Item

ACZ-350 System - Temporary - Item
 Quadguard System - Temporary - Item
 Quadguard Wide System - Temporary - Item
 Quadguard Extra Wide System - Temporary - Item
 Quadguard Super Wide System - Temporary - Item
 SLED System – Temporary - Item
 Smart System - Temporary - Item
 TAU-II System - Temporary - Item
 TAU-II Wide System - Temporary - Item
 TAU-II Extra Wide System - Temporary - Item
 TRACC System - Temporary - Item
 Energy Attenuator - Relocation, Narrow - Item
 Energy Attenuator - Relocation, Wide - Item
 Energy Attenuator - Relocation, Extra Wide - Item
 Energy Attenuator - Relocation, Super Wide - Item
 Energy Attenuator - Relocation, Reduced Exposure - Item
 Energy Attenuator - Relocation, Dual Duty - Item
 ABSORB 350 System - Relocation - Item
 ACZ-350 System - Relocation - Item
 Quadguard System - Relocation - Item
 Quadguard Wide System - Relocation - Item
 Quadguard Extra Wide System - Relocation - Item
 Quadguard Super Wide System - Relocation - Item
 SLED System - Relocation - Item
 Smart System - Relocation - Item
 TAU-II System - Relocation - Item
 TAU-II Wide System - Relocation - Item
 TAU-II Extra Wide System - Relocation - Item
 TRACC System - 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.

TABLE 1
Energy Attenuator, Permanent

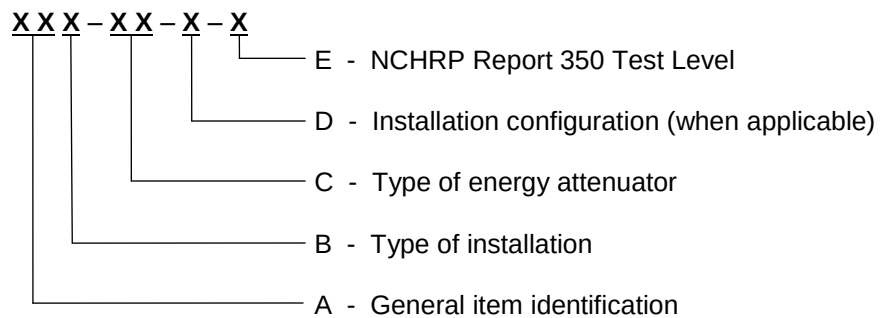
Energy Attenuator	NCHRP Report 350 Test Level		Permanent Installation					
	TL-2	TL-3	Narrow (NA)	Wide (WI)	Extra Wide (EW)	Super Wide (SW)	High Exposure (HE)	Single- Sided (SS)
BB-BEAT	No	Yes	No	No	No	No	No	Yes
Quadguard System	Yes	Yes	Yes	No	No	No	No	No
Quadguard Wide System	Yes	Yes	No	Yes	No	No	No	No
Quadguard Extra Wide System	Yes	Yes	No	No	Yes	No	No	No
Quadguard Super Wide System	No	Yes	No	No	No	Yes	No	No
QuadTrend	No	Yes	No	No	No	No	No	Yes
Smart System	Yes	Yes	Yes	No	No	No	Yes	No
TAU-II System	Yes	Yes	Yes	No	No	No	No	No
TAU-II Wide System	Yes	Yes	No	Yes	No	No	No	No
TAU-II Extra Wide System	Yes	Yes	No	No	Yes	No	No	No

TABLE 2
Energy Attenuator, Temporary

Energy Attenuator	NCHRP Report 350 Test Level		Temporary Installation					
	TL-2	TL-3	Reduced Exposure (RE)	Narrow (NA)	Wide (WI)	Extra Wide (EW)	Super Wide (SW)	Dual Duty (DD)
ABSORB 350 System	Yes	Yes	Yes	No	No	No	No	No
ACZ 350 System	Yes	Yes	Yes	No	No	No	No	No
Quadguard System	Yes	Yes	Yes	Yes	No	No	No	No
Quadguard Wide System	Yes	Yes	No	No	Yes	No	No	No
Quadguard Extra Wide System	Yes	Yes	No	No	No	Yes	No	No
Quadguard Super Wide System	No	Yes	No	No	No	No	Yes	No
SLED System	Yes	Yes	Yes	No	No	No	No	No
Smart System	Yes	Yes	Yes	Yes	No	No	No	Yes
TAU-II System	Yes	Yes	Yes	Yes	No	No	No	No
TAU-II Wide System	Yes	Yes	No	No	Yes	No	No	No
TAU-II Extra Wide System	Yes	Yes	No	No	No	Yes	No	No
TRACC System	Yes	Yes	Yes	Yes	No	No	No	No

TABLE 3
Contract Drawing Notation

A	EA - Energy Attenuator
B	P - Permanent T - Temporary R - Relocation
C	NA - Narrow WI - Wide EW - Extra Wide SW - Super Wide HE - High Exposure SS - Single-Sided RE - Reduced Exposure DD - Dual Duty
D	U - Unidirectional B - Bidirectional N - Not applicable
E	2 - NCHRP Report 350 TL-2 3 - NCHRP Report 350 TL-3



Appendix 723-A, April 2017 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:

- Energy attenuator system locations using the notation shown in Table 3. (723.07.01)
- Relocation of energy attenuators using the notation shown in Table 3. (723.07.01 and 723.07.03.06)

The designer should specify whether each system is TL-2 or TL-3 configuration. TL-2 configurations are required for low-speed installations with posted speeds of less than 70 km/h. TL-3 configurations are required for high-speed installations with posted speeds of 70 km/h and greater. Single-sided systems are only available in a TL-3 configuration. (723.07.01)

A permanent energy attenuator installation should include a new concrete pad (723.07.02.01). If an existing concrete surface or pad can be used to support the system, it should be specified in the Contract Documents (723.07.02.02). The designer should confirm that the existing concrete surface or pad is in good condition and will provide a smooth operating surface for the system.

The designer should confirm that one of the following foundation options is available for each temporary energy attenuator installation (723.07.03):

- a) Existing concrete surface:
 - minimum 200 mm deep, 28 MPa minimum compressive strength
- b) Asphalt over compacted granular:
 - minimum 150 mm asphalt over 150 mm minimum compacted granular
 - the asphalt must extend a minimum of 500 mm beyond the anchor bolts
- c) Asphalt over concrete
 - minimum 75 mm asphalt over 75 mm minimum concrete, 28 MPa minimum compressive strength

The designer should confirm that the existing surface is in good condition and will provide a smooth operating surface for the system.

When a single-sided system is connected to existing concrete barrier as specified in the Contract Documents, the designer should include payment in the Contract Documents for the removal of the 4.0 m section of existing concrete barrier and placement of a new 4.0 m section adjacent to each system. (723.07.02.03)

Single-sided systems shall be installed with grading according to OPSD 202.033. Single-sided systems should not be installed in a location where backside hits towards the concrete barrier are possible (e.g., in gore areas), or in a narrow median where backside opposite direction hits are possible. The area behind and beyond the end terminal should be traversable and free of fixed objects. The minimum recommended rectangular area should be 6 m wide, measured behind and perpendicular to the back of the rail, by 22 m long, measured from the front face of the system and parallel to the system. (723.07.02.03)

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When the reduced exposure tender item is selected, the designer should confirm that the following requirements for water filled energy attenuator systems are satisfied (723.07.03.04):

- a) Water filled energy attenuator systems shall be installed at an offset of not less than 1.0 m from the edge of the travelled way.
- b) When installed adjacent to an existing guide rail system, the clearance shall be less than or equal to 0.3 m or greater than or equal to 3.0 m. Otherwise, the area behind and beyond the water filled energy attenuator system shall be traversable and free of fixed objects. The minimum recommended rectangular area shall be 6 m wide, measured behind and perpendicular to the back of the system, by 22 m long, measured from the front face of the system and parallel to the system.
- c) At a minimum, the first 16 m of temporary concrete barrier shall be placed tangential to the water filled energy attenuator system.

When the item for payment is Energy Attenuator, the designer should not include any drawings for specific energy attenuators in the Contract Documents.

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 202.033	Roadway Widening, Single Sided Energy Attenuating Terminals, Approach End
OPSD 922.131	Energy Attenuator, Crash Cushion, QuadTrend System, Installation - Concrete Barrier
OPSD 922.133	Energy Attenuator, Crash Cushion, QuadTrend System, Installation - Concrete Pad and Rear Cable Anchor Block
OPSD 923.001	Energy Attenuator, Crash Cushion, Narrow Systems, Component - Reinforced Concrete Pad
OPSD 923.002	Energy Attenuator, Crash Cushion, Component - Anchor Assembly
OPSD 923.004	Energy Attenuator, Crash Cushion, Wide Systems, Component - Reinforced Concrete Pad
OPSD 923.005	Energy Attenuator, Crash Cushion, Extra Wide Systems, Component - Reinforced Concrete Pad
OPSD 923.006	Energy Attenuator, Crash Cushion, Quadguard Super Wide System, Component - Reinforced Concrete Pad
OPSD 923.010	Energy Attenuator, Crash Cushion, Narrow Systems, Component – Reinforced Precast Concrete Pad for Permanent Installation
OPSD 923.011	Energy Attenuator, Crash Cushion, Component – Reinforced Precast Concrete Pad for Modified Temporary Concrete Barrier
OPSD 923.180	Energy Attenuator, Crash Cushion, Quadguard System, Installation - Temporary, Unidirectional
OPSD 923.181	Energy Attenuator, Crash Cushion, Quadguard System, Installation - Temporary, Bidirectional
OPSD 923.182	Energy Attenuator, Crash Cushion, Quadguard System, Installation - Permanent, Unidirectional
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OPSD 923.184	Energy Attenuator, Crash Cushion, Quadguard Wide System, Installation - Temporary, Unidirectional
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OPSD 923.194	Energy Attenuator, Crash Cushion, Quadguard Super Wide System, Installation - Permanent, Unidirectional
OPSD 923.195	Energy Attenuator, Crash Cushion, Quadguard Super Wide System, Installation - Permanent, Bidirectional
OPSD 923.280	Energy Attenuator, Crash Cushion, TRACC System, Installation - Temporary, Unidirectional
OPSD 923.281	Energy Attenuator, Crash Cushion, TRACC System, Installation - Temporary, Bidirectional
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OPSD 923.283	Energy Attenuator, Crash Cushion, TRACC System, Installation - Permanent, Bidirectional
OPSD 923.380	Energy Attenuator, Crash Cushion, TAU-II System, Installation - Temporary, Unidirectional
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OPSD 923.390	Energy Attenuator, Crash Cushion, TAU-II Extra Wide System - TL-3, Installation - Temporary, Unidirectional

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OPSD 923.391	Energy Attenuator, Crash Cushion, TAU-II Extra Wide System - TL-3, Installation - Temporary, Bidirectional
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OPSD 923.480	Energy Attenuator, Crash Cushion, Smart System, Installation - Temporary, Unidirectional
OPSD 923.481	Energy Attenuator, Crash Cushion, Smart System, Installation - Temporary, Bidirectional
OPSD 923.482	Energy Attenuator, Crash Cushion, Smart System, Installation - Permanent, Unidirectional
OPSD 923.483	Energy Attenuator, Crash Cushion, Smart System, Installation - Permanent, Bidirectional
OPSD 923.530	Energy Attenuator, Crash Cushion, Box Beam Bursting Energy Absorbing Terminal, Installation - Layout
OPSD 923.531	Energy Attenuator, Crash Cushion, Box Beam Bursting Energy Absorbing Terminal, Installation - Impact Head and Post
OPSD 924.131	Energy Attenuator, Crash Cushion, ABSORB 350 System, Installation - Temporary Concrete Barrier
OPSD 924.135	Energy Attenuator, Crash Cushion, ACZ-350 System, Installation - Temporary Concrete Barrier
OPSD 924.141	Energy Attenuator, Crash Cushion, SLED System, Installation – Temporary Concrete Barrier
OPSD 984.203	Energy Attenuator, Crash Cushion, Delineation, Installation - Temporary
OPSD 984.204	Energy Attenuator, Crash Cushion, Delineation, Installation - Permanent



**CONSTRUCTION SPECIFICATION FOR
GUIDE RAIL END TREATMENT - STEEL BEAM
ENERGY ATTENUATING TERMINAL SYSTEMS**

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732.01	SCOPE

This specification covers the requirements for the installation of steel beam energy attenuating terminal (SBEAT) systems.

732.01.01 Specification Significance and Use

This specification is written as a municipal-oriented specification. Municipal-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of many municipalities in Ontario.

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

732.01.02 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.

732.02 REFERENCES

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-15 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 780/A 780M-09(R2015) Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings

732.04 DESIGN AND SUBMISSION REQUIREMENTS

732.04.01 Submission Requirements

One copy of the manufacturer's installation instructions and Working Drawings for each type of SBEAT system to be installed shall be submitted to the Contract Administrator.

Installation of the SBEAT system shall not commence until the Contract Administrator has received the copy of the installation instructions and Working Drawings.

732.05 MATERIALS

732.05.01 General

All supplied system components shall be according to the manufacturer's specifications.

732.05.02 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.

732.07 CONSTRUCTION

732.07.01 General

SBEAT systems shall be installed according to manufacturer's instructions at locations specified in the Contract Documents.

When a SBEAT system is specified in the Contract Documents that is connected to steel beam guide rail, the Contractor has the option of using one of the following systems:

- a) Extruder Terminal system
- b) Sequential Kinking Terminal system
- c) X-Lite Tangent Terminal system
- d) SoftStop Terminal system

When a SBEAT system is specified in the Contract Documents that is connected to Type M steel beam guide rail, the Contractor has the option of using one of the following systems:

- a) MASH SoftStop Terminal System
- b) MASH Sequential Kinking Terminal System

When a specific SBEAT system is specified in the Contract Documents, there shall be no option of substitution for the SBEAT system.

SBEAT systems with steel posts shall be installed to steel beam guide rail systems with steel posts.

SBEAT systems with wooden posts shall be installed to steel beam guide rail systems with wooden or steel posts.

SBEAT systems shall be installed according to the manufacturer's instructions at locations specified in the Contract Documents using only the components supplied for a particular SBEAT system unit.

A minimum 2 m wide area behind the posts, measured from the back of the posts shall be clear of all obstacles for the entire length of the SBEAT system.

732.07.02 Posts and Steel Foundation Tubes

All posts and steel foundation tubes shall be set to the depth and alignment at locations specified in the Contract Documents, regardless of the material encountered.

Wooden post tops shall be cut to the height and to the chamfer as specified in the Contract Documents.

All holes shall be drilled in the wooden posts prior to installation and in the steel posts prior to galvanizing.

The predrilled holes and the cut tops of the wooden posts shall be treated with two coats of an approved wood preservative according to OPSS 1601.

All lower hinge break away posts, steel foundation tubes, and soil plates shall be installed so that no more than 100 mm is exposed above finished grade.

732.07.03 Steel Beam Guide Rails

SBEAT systems shall be connected to new or existing steel beam guide rail as specified in the Contract Documents.

SBEAT system mounting heights shall be measured vertically from the top of the steel beam guide rail to the ground or gutter line. SBEAT system mounting heights shall be within the ranges in Table 1.

Where curb with gutter is required, steel beam guide rail mounting height 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 gutter line.
- b) Vertically at gutter line, when face of steel beam guide rail is 300 mm or less beyond the gutter line.

Channel shall not be used within the SBEAT system.

732.07.04 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.

732.07.05 Object Markers and Oversize 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 degrees 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 the 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 as specified in the Contract Documents.

732.07.06 Management of Excess Material

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

732.09 MEASUREMENT FOR PAYMENT

732.09.01 Actual Measurement

**732.09.01.01 Steel Beam Energy Attenuating Terminal System
Extruder Terminal-System
Sequential Kinking Terminal System
X-Lite Tangent Terminal System
SoftStop Terminal System
MASH SoftStop Terminal System
MASH Sequential Kinking Terminal System**

For measurement purposes, a count shall be made of each complete steel beam energy attenuating terminal system installed, regardless of the type of steel beam energy attenuating terminal system placed.

732.09.02 Plan Quantity Measurement

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

732.10 BASIS OF PAYMENT

**732.10.01 Steel Beam Energy Attenuating Terminal System - Item
Extruder Terminal System - Item
Sequential Kinking Terminal System – Item
X-Lite Tangent Terminal System – Item
SoftStop Terminal System – Item
MASH SoftStop Terminal System – Item
MASH Sequential Kinking Terminal System – 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 replacement or repairs of defective work and materials shall be the Contractor's responsibility at no additional cost to the Owner.

TABLE 1
SBEAT System Mounting Heights

System	Height During Construction and Seasonal Shutdown mm	Height for Completion of the Work mm
Extruder Terminal	685 to 760	685 to 735
Sequential Kinking Terminal	685 to 760	685 to 735
X-Lite Tangent Terminal	685 to 760	685 to 735
SoftStop Terminal	760 to 810	760 to 810
MASH SoftStop Terminal	760 to 810	760 to 810
MASH Sequential Kinking Terminal	760 to 810	760 to 810

Appendix 732-A, April 2017 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:

- Steel beam energy attenuating terminal system locations. (732.07.01)
- Depth and alignment of system. (732.07.02)

For Type M steel beam guide rail, use only MASH Terminal Systems.

The steel beam energy attenuating terminal system should be installed flared; however, the system may be installed tangent to the roadway, if grading requirements cannot be met.

The steel beam energy attenuating terminal system should not be installed on roadway with centreline curves less than 250 m radius.

Each steel beam energy attenuating terminal system unit comes from the supplier with all components required for its installation, including posts and steel beam guide rail elements for the length of the system.

Reflective sheeting is normally supplied with each steel beam energy attenuating terminal system. The designer should determine if the sheeting is not required and, if so, specify it in the Contract Documents.

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 202.031	Roadway Widening For Steel Beam Energy Attenuating Terminal, Approach End
OPSD 202.032	Roadway Widening For Steel Beam Energy Attenuating Terminal, Leaving End And Constrained Approach End
OPSD 912.124	Guide Rail System, Steel Beam, Type M Transition Rail, Component
OPSD 912.125	Guide Rail System, Steel Beam, Type M Rail, Component
OPSD 912.127	Guide Rail System, Steel Beam, M20 Steel Post With Offset Block, Component
OPSD 912.130	Guide Rail System, Steel Beam, Steel Post With Offset Block Assembly, Installation - Single Rail
OPSD 912.140	Guide Rail System, Wooden Post Assembly, Installation - Single Rail
OPSD 922.161	Energy Attenuator, End Treatment, Steel Beam Energy Attenuating Terminal, SoftStop Terminal System, Installation
OPSD 922.165	Energy Attenuator, End Treatment, Steel Beam Energy Attenuating Terminal, MASH SoftStop Terminal System, Installation
OPSD 922.170	Energy Attenuator, End Treatment, Steel Beam Energy Attenuating Terminal, X-Lite Tangent Terminal System With Steel Posts, Installation

OPSD 922.180	Energy Attenuator, End Treatment, Steel Beam Energy Attenuating Terminal, Sequential Kinking Terminal System With Wooden Posts, Installation
OPSD 922.181	Energy Attenuator, End Treatment, Steel Beam Energy Attenuating Terminal, Sequential Kinking Terminal System With Steel Posts, Installation
OPSD 922.186	Energy Attenuator, End Treatment, Steel Beam Energy Attenuating Terminal, MASH SoftStop Terminal System, Installation
OPSD 922.530	Energy Attenuator, End Treatment, Steel Beam Energy Attenuating Terminal, ET Plus System With Wooden Posts, Installation
OPSD 922.532	Energy Attenuator, End Treatment, Steel Beam Energy Attenuating Terminal, ET Plus System With Steel Posts, Installation
OPSD 984.201	Energy Attenuator, End Treatment, Delineation, Installation - Approach End
OPSD 984.202	Energy Attenuator, End Treatment, Delineation, Installation - Leaving End



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.MUNI 810
APRIL 2017**

(Formerly OPSS 810, November 2013)

Note: The MUNI implemented in April 2017 replaces OPSS 810 COMMON, November 2013 with no technical content changes.

**CONSTRUCTION SPECIFICATION FOR
ROOTWAD STRUCTURES FOR WATERBODY BANKS**

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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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS 811
APRIL 2017**

(Formerly OPSS 811, November 2013)

Note: The MUNI implemented in April 2017 replaces OPSS 811 COMMON, November 2013 with no technical content changes.

**CONSTRUCTION SPECIFICATION FOR
LARGE WOODY DEBRIS FOR WATERBODY BANKS**

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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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS 812
APRIL 2017**

(Formerly OPSS 812, November 2013)

Note: The MUNI implemented in April 2017 replaces OPSS 812 COMMON, November 2013 with no technical content changes.

**CONSTRUCTION SPECIFICATION FOR
LUNKERS**

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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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS 820
APRIL 2017**

(Formerly OPSS 820, November 2014)

Note: The MUNI implemented in April 2017 replaces OPSS 820 COMMON, November 2014 with no technical content changes.

**CONSTRUCTION SPECIFICATION FOR
RIFFLES ON STREAMBEDS**

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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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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 Riffls - 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



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS 821
APRIL 2017**

(Formerly OPSS 821, November 2014)

Note: The MUNI implemented in April 2017 replaces OPSS 821 COMMON, November 2014 with no technical content changes.

**CONSTRUCTION SPECIFICATION
FOR POOLS IN STREAMBEDS**

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821.10	BASIS OF PAYMENT

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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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



ONTARIO PROVINCIAL STANDARD SPECIFICATION

**METRIC
OPSS 822
APRIL 2017**

(Formerly OPSS 822, November 2014)

Note: The MUNI implemented in April 2017 replaces OPSS 822 COMMON, November 2014 with no technical content changes.

CONSTRUCTION SPECIFICATION FOR ROCKY RAMPS ON STREAMBEDS

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822.08	QUALITY ASSURANCE - Not Used
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822.10	BASIS OF PAYMENT

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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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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



Note: The MUNI implemented in April 2017 replaces OPSS 823 COMMON, November 2014 with no technical content changes.

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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS 824
APRIL 2017**
(Formerly OPSS 824, November 2014)

Note: The MUNI implemented in April 2017 replaces OPSS 824 COMMON, November 2014 with no technical content changes.

**CONSTRUCTION SPECIFICATION FOR
BAFFLES IN A CULVERT**

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APPENDICES

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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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

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



Note: The MUNI implemented in April 2017 replaces OPSS 830 COMMON, November 2015 with no technical content changes.

CONSTRUCTION SPECIFICATION FOR LOCAL SEED BANK

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830.10	BASIS OF PAYMENT

APPENDICES

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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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.



Note: The MUNI implemented in April 2017 replaces OPSS 909 COMMON, April 2012 with no technical content changes.

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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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_r , the percent payment reduction factor for each lot = 10%
- c) For each member type in the lot, the payment reduction = $(P_r) \times (\text{Equivalent price per meter length}) \times (\text{Length of Members})$.
- 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.



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.MUNI 918
APRIL 2017**

(formerly OPSS 918 Common, March 1998)

Note: The MUNI implemented in April 2017 replaces OPSS 918 COMMON, March 1998 with no technical content changes.

**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:

OHBD - 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.



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.MUNI 922
APRIL 2017**

(Formerly OPSS 922, November 2009)

Note: The MUNI implemented in April 2017 replaces OPSS 922 COMMON, November 2009 with no technical content changes.

**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 municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

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 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.

