Ontario Provincial Standards for Roads and Public Works



- Volume 1 -

MUNICIPAL AND PROVINCIAL COMMON

GENERAL AND
CONSTRUCTION SPECIFICATIONS

Ontario

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MANUAL REVISION RECORD

Municipal and Provincial Common

Volume 1 – General and Construction Specifications

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

REVISION NUMBER	REVISION DATE	ENTERED BY	REVISION NUMBER	DATE	ENTERED BY
74	April 2005	Included in new manuals	99	April 2017	Included in new manuals
75	Nov 2005	Included in new manuals	100	Nov 2017	Included in new manuals
76	April 2006	Included in new manuals	101	April 2018	Included in new manuals
77	Nov 2006	Included in new manuals	102	Nov 2018	Included in new manuals
78	April 2007	Included in new manuals	103	April 2019	Included in new manuals
79	Nov 2007	Included in new manuals	104	Nov 2019	Included in new manuals
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81	Nov 2008	Included in new manuals	106		
82	April 2009	Included in new manuals	107		
83	Nov 2009	Included in new manuals	108		
84	April 2010	Included in new manuals	109		
85	July 2010	Included in new manuals	110		
86	Nov 2010	Included in new manuals	111		
87	April 2011	Included in new manuals	112		
88	Nov 2011	Included in new manuals	113		
89	April 2012	Included in new manuals	114		
90	Nov 2012	Included in new manuals	115		
91	April 2013	Included in new manuals	116		
92	Nov 2013	Included in new manuals	117		
93	April 2014	Included in new manuals	118		
94	Nov 2014	Included in new manuals	119		
95	April 2015	Included in new manuals	120		
96	Nov 2015	Included in new manuals	121		
97	April 2016	Included in new manuals	122		
98	Nov 2016	Included in new manuals	123		

DATE	OPSS	TITLE
DIVISION 1 - GENERAL SPECIFICATIONS		
Nov 2018	102	Notice to Users of OPSS 102 (Weighing of Materials)
Apr 2017	106	Notice to Users of OPSS 106 (Electrical Work)
Nov 2017	127	Notice to Users of OPSS 127 (Schedule of Rental Rates for Construction Equipment, Including Model and Specification Reference)
Apr 2006	128	Supply of Pre-Qualified Material and Products
DIVISION 2 - GENERAL GRADING		
Apr 2019	201	Notice to Users of OPSS 201 (Clearing, Close Cut Clearing, Grubbing, and Removal of Surface and Piled Boulders)
DIVISION 3 - PAVEMENT (FLEXIBLE AND RIGID)		
Nov 2018	301	Notice to Users of OPSS 301 (Restoring Unpaved Roadway Surface)
Nov 2018	303	Notice to Users of OPSS 303 (Double Chip Seal)
Nov 2017	307	Notice to Users of OPSS 307 (Stockpiling of Patching Materials and Patching of Asphalt Pavement)
Nov 2013	309	Cold Mixed, Cold Laid, Open and Dense Graded Bituminous Mix
Nov 2017	310	Notice to Users of OPSS 310 (Hot Mix Asphalt)
Nov 2018	311	Notice to Users of OPSS 311 (Asphalt Sidewalk, Driveway, and Boulevard and for Sidewalk Resurfacing)
Apr 2018	312	Notice to Users of OPSS 312 (Asphalt Curb and Gutter Systems)
Nov 2018	316	Notice to Users of OPSS 316 (Extruded Expanded Polystyrene Frost Heave Treatment)
Nov 2018	336	Notice to Users of OPSS 336 (Micro-Surfacing)
Nov 2017	337	Notice to Users of OPSS 337 (Slurry Seal)
Apr 2018	341	Notice to Users of OPSS 341 (Routing and Sealing Cracks in Hot Mix Asphalt Pavement)
Mar 1998	350	Concrete Pavement and Concrete Base

DATE	OPSS	TITLE
Nov 2019	351	Notice to Users of OPSS 351 (Concrete Sidewalk)
Nov 2018	356	Notice to Users of OPSS 356 (Pervious Concrete Pavement for Low-Volume Traffic Applications)
Apr 2017	360	Notice to Users of OPSS 360 (Full Depth Repair of Concrete Pavement or Concrete Base)
Nov 2019	361	Notice to Users of OPSS 361 (Rubblizing Concrete Pavement and Concrete Base)
Apr 2017	362	Notice to Users of OPSS 362 (Fast Track Full Depth Repairs to Concrete Pavement)
Apr 2017	364	Notice to Users of OPSS 364 (Partial Depth Repairs in Concrete Pavement)
Nov 2018	369	Notice to Users of OPSS 369 (Sealing or Resealing of Joints and Cracks in Concrete Pavement and Concrete Base)
DIVISION 4 - DRAINAGE, WATERMAINS, AND UTILITY		
Nov 2017	404	Notice to Users of OPSS 404 (Support Systems) (Formerly OPSS 538)
Nov 2017	405	Notice to Users of OPSS 405 (Pipe Subdrains)
Nov 2020	407	Notice to Users of OPSS 407 (Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber Installation)
Nov 2015	408	Adjusting or Rebuilding Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
Nov 2017	409	Notice to Users of OPSS 409 (Closed-Circuit Television (CCTV) Inspection of Pipelines)
Nov 2020	411	Notice to Users of OPSS 411 (Cleaning and Flushing of Pipe Sewers, Catch Basins, Maintenance Holes, Ditch Inlets, and Oil-Grit Separators)
Nov 2018	412	Notice to Users of OPSS 412 (Sewage Forcemain Installation in Open Cut)
Nov 2019	413	Notice to Users of OPSS 413 (Manure Pipeline Installation in Open Cut)
Nov 2018	415	Notice to Users of OPSS 415 (Pipeline and Utility Installation by Tunnelling)
Nov 2018	416	Notice to Users of OPSS 416 (Pipeline and Utility Installation by Jacking and Boring)
Nov 2015	422	Precast Reinforced Concrete Box Culverts in Open Cut

DATE	OPSS	TITLE
Nov 2018	450	Notice to Users of OPSS 450 (Pipeline and Utility Installation in Soil by Horizontal Directional Drilling)
Nov 2018	460	Notice to Users of OPSS 460 (Pipeline Rehabilitation by Cured-in-Place Pipe)
Nov 2019	462	Notice to Users of OPSS 462 (Cement Mortar Lining of Watermains)
Nov 2015	463	Pipeline and Conduit Installation by Pipe Bursting
Nov 2018	490	Notice to Users of OPSS 490 (Site Preparation for Pipelines, Utilities, and Associated Structures) (Formerly OPSS 503)
Nov 2017	491	Notice to Users of OPSS 491 (Preservation, Protection, and Reconstruction of Existing Facilities) (Formerly OPSS 504)
Nov 2018	492	Notice to Users of OPSS 492 (Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures)
Nov 2019	493	Notice to Users of OPSS 493 (Temporary Potable Water Supply Services)
DIVISION 5 - MISCELLANEOUS		
Nov 2017	506	Notice to Users of OPSS 506 (Dust Suppressants)
Nov 2018	511	Notice to Users of OPSS 511 (Rip-Rap, Rock Protection, and Granular Sheeting)
DIVISION 6 - ELECTRICAL		
Nov 2017	602	Notice to Users of OPSS 602 (Installation of Electrical Chambers)
Nov 2017	603	Notice to Users of OPSS 603 (Installation of Ducts)
Nov 2017	604	Notice to Users of OPSS 604 (Installation of Cable)
Nov 2019	609	Notice to Users of OPSS 609 (Grounding)
Nov 2019	611	Notice to Users of OPSS 611 (Installation of Underpass Luminaires)
Nov 2019	614	(Notice to Users of OPSS 614) Installation of Power Supply Equipment
Apr 2017	615	Notice to Users of OPSS 615 (Erection of Poles)

DATE	OPSS	TITLE
Apr 2018	616	Notice to Users of OPSS 616 (Footings and Pads for Electrical Equipment)
Nov 2019	617	Notice to Users of OPSS 617 (Installation of Roadway Luminaires)
Apr 2017	620	Notice to Users of OPSS 620 (Traffic Signal Equipment)
Nov 2019	631	Notice to Users of OPSS 631 (Concrete Footings and Maintenance Platforms for High Mast Lighting Poles)
DIVISION 7 - TRAFFIC SAFETY		
Nov 2019	703	Notice to Users of OPSS 703 (Permanent Small Signs and Support Systems)
Nov 2014	704	Post Mounted Delineators
Nov 2014	705	Flexible Delineator Posts
Nov 2015	707	Modified Overhead Signboards
Nov 2010	710	Pavement Marking (Formerly OPSS 532)
Nov 2010	740	Concrete Barriers (Formerly OPSS 553)
Nov 2014	741	Temporary Concrete Barriers
Nov 2013	753	Connecticut Impact Attenuation System
Apr 2019	760	Notice to Users of OPSS 760 (Noise Barrier Systems)
Nov 2017	772	Notice to Users of OPSS 772 (Chain-Link Fence)
Nov 2014	791	Expanded Metal Anti-Glare Screen
DIVISION 8 - ENVIRONMENTAL AND LANDSCAPE		
Apr 2018	801	Notice to Users of OPSS 801 (The Protection of Trees)
Nov 2019	802	Notice to Users of OPSS 802 (Topsoil)
Apr 2018	803	Notice to Users of OPSS 803 (Sodding)
Nov 2018	805	Notice to Users of OPSS 805 (Temporary Erosion and Sediment Control Measures)
Apr 2017	810	Notice to Users of OPSS 810 (Rootwad Structures for Waterbody Banks)

DATE	OPSS	TITLE
Apr 2017	811	Notice to Users of OPSS 811 (Large Woody Debris for Waterbody Banks)
Apr 2017	812	Notice to Users of OPSS 812 (Lunkers)
Apr 2017	820	Notice to Users of OPSS 820 (Riffles of Streambeds)
Apr 2017	821	Notice to Users of OPSS 821 (Pools in Streambeds)
Apr 2017	822	Notice to Users of OPSS 822 (Rocky Ramps on Streambeds)
Apr 2017	823	Notice to Users of OPSS 823 (Low Flow Channels)
Apr 2017	824	Notice to Users of OPSS 824 (Baffles in a Culvert)
Apr 2017	830	Notice to Users of OPSS 830 (Local Seed Bank)
DIVISION 9 - STRUCTURAL		
Nov 2019	902	Notice to Users of OPSS 902 (Excavating and Backfilling – Structures)
Apr 2010	904	Notice to Users of OPSS 904 (Concrete Structures)
Nov 2020	906	Notice to Users of OPSS 906 (Structural Steel for Bridges)
Apr 2011	907	Structural Wood Systems
Nov 2017	913	Notice to Users of OPSS 913 (Embedded Work in Structures for Electrical Systems)
Apr 2017	918	Notice to Users of OPSS 915 (Modular Bridge Structures for Temporary Installations)
Nov 2011	919	Formwork and Falsework
Nov 2017	929	Notice to Users of OPSS 929 (Abrasive Blast Cleaning - Concrete Construction)
Nov 2020	931	Notice to Users of OPSS 931 (Structure Rehabilitation – Shotcrete)
Nov 2020	932	Notice to Users of OPSS 932 (Crack Repair - Concrete)
Nov 2019	942	Notice to Users of OPSS 942 (Prestressed Soil and Rock Anchors)

NOTICE TO USERS OF OPSS 102

GENERAL SPECIFICATION FOR WEIGHING OF MATERIALS

OPSS 102 has been removed from this
OPS volume

The municipal version of OPSS 102 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 102

There is no PROV version.

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

NOTICE TO USERS OF OPSS 106

GENERAL SPECIFICATION FOR ELECTRICAL WORK

OPSS 106 has been removed from this
OPS volume

The provincial version of OPSS 106 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 106

The municipal version of OPSS 106 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 106

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

NOTICE TO USERS OF OPSS 127

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

OPSS 127 has been removed from this OPS volume

The provincial version of OPSS 127 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 127

There is no longer be a municipal version of OPSS 127

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

GENERAL SPECIFICATION FOR SUPPLY OF PRE-QUALIFIED MATERIAL AND PRODUCTS

TABLE OF CONTENTS

128.01 SCOPE

128.02 REFERENCES

128.03 DEFINITIONS

128.04 PRE-QUALIFIED MATERIAL AND PRODUCTS INFORMATION

128.05 SUPPLY OF MATERIAL AND PRODUCTS

128.06 QUALITY ASSURANCE

APPENDICES

128-A Commentary

128.01 SCOPE

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

a) Ontario Ministry of Transportation (MINISTRY)

b) Ontario Municipalities and local authorities (MUNICIPALITY)

c) Agencies in the transportation and related business (AGENCY)

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

128.01.01 Significance and Use of Appendices

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

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

128.02 REFERENCES

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

MINISTRY Publication:

Designated Sources for Materials (DSM)

MUNICIPALITY Listing:

Municipal Product Listing (MPL)

AGENCY Listing:

Agency Product Listing (APL)

Information Resource:

The Road Authority (TRA)

128.03 DEFINITIONS

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

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

Product means the same as Material.

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

128.04 PRE-QUALIFIED MATERIAL AND PRODUCTS INFORMATION

128.04.01 Submission

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

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

128.04.02 Pre-Qualified Material and Products

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

128.04.03 Material and Product Endorsement

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

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

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

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

128.05 SUPPLY OF MATERIAL AND PRODUCTS

128.05.01 General

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

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

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

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

128.05.02 Queries

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

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

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

128.05.03 Product Listings

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

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

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

128.06 QUALITY ASSURANCE

128.06.01 Material and Product Quality and Quantity

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

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

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

Designer Action/Considerations

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

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

Related Ontario Provincial Standards Drawings

None.

NOTICE TO USERS OF OPSS 201

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

OPSS 201 has been removed from this
OPS volume

The provincial version of OPSS 201 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 201

The municipal version of OPSS 201 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 201

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

NOTICE TO USERS OF OPSS 301

CONSTRUCTION SPECIFICATION

FOR RESTORING UNPAVED ROADWAY SURFACES

OPSS 301 has been removed from this
OPS volume

The provincial version of OPSS 301 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 301

The municipal version of OPSS 301 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 301

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

NOTICE TO USERS OF OPSS 303

CONSTRUCTION SPECIFICATION

FOR DOUBLE CHIP SEAL

OPSS 303 has been removed from this
OPS volume

The municipal version of OPSS 303 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 303

There is no PROV version.

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

NOTICE TO USERS OF OPSS 307

CONSTRUCTION SPECIFICATION FOR STOCKPILING OF PATCHING MATERIALS AND PATCHING OF ASPHALT PAVEMENT

OPSS 307 has been removed from this OPS volume

The provincial version of OPSS 307 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 307

The municipal version of OPSS 307 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 307

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

CONSTRUCTION SPECIFICATION FOR COLD MIXED, COLD LAID, OPEN AND DENSE GRADED BITUMINOUS MIX

TABLE OF CONTENTS

309.01 **SCOPE**

309.02 **REFERENCES**

309.03 **DEFINITIONS**

309.04 **SUBMISSION AND DESIGN REQUIREMENTS**

309.05 **MATERIALS**

309.06 **EQUIPMENT**

309.07 **CONSTRUCTION**

309.08 **QUALITY ASSURANCE**

309.09 **MEASUREMENT FOR PAYMENT**

309.10 **BASIS OF PAYMENT**

APPENDICES

309-A **Commentary**

309.01 SCOPE

This specification covers the requirements for production and placement of cold mixed, cold laid, open and dense graded bituminous mix and cover aggregate.

309.01.01 Specification Significance and Use

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

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

309.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

309.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 304	Single and Double Surface Treatment
OPSS 310	Hot Mix Asphalt

Ontario Provincial Standard Specifications, Material

OPSS 1003	Aggregates - Hot Mix Asphalt
OPSS 1006	Aggregates - Surface Treatment
OPSS 1103	Emulsified Asphalt

Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-263	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
LS-265	Percent Air Voids in Compacted Dense Bituminous Pavement Mixtures
LS-266	V.M.A. in Compacted Bituminous Mixtures
LS-281	Percent Compaction of Compacted Bituminous Pavement Mixtures
LS-282	Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
LS-301	Mix Design for Cold Mixed Dense Graded Bituminous Mixtures
LS-302	Coating Dense Graded Aggregates

LS-303 Percent Moisture Pickup in Compacted Dense Graded Bituminous Mixtures
LS-304 Coating Open Graded Aggregates
LS-305 Run Off for Open Graded Mixtures
LS-602 Sieve Analysis of Aggregates

309.03 DEFINITIONS

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

CL mix means cold mixed, cold laid, open or dense graded bituminous mix.

Fat Spot means an area of pavement substantially blacker than the surrounding pavement.

Segregation means a condition of the pavement characterized by areas with comparatively coarser or finer texture than that of the surrounding pavement.

309.04 SUBMISSION AND DESIGN REQUIREMENTS

309.04.01 Mix Design

The CL mix design shall be the responsibility of the Contractor. The proposed mix proportions corroborated by submission of the design proposed by the Contractor as determined by the supplier of the asphalt emulsion shall be forwarded to the Contract Administrator 5 Business Days before the start of production.

Mix proportions shall be determined using MTO test methods LS-301, LS-302, LS-304, and LS-305.

Aggregate samples shall be representative of the materials to be used and have proven compatibility, workability, and acceptable curing time with the emulsified asphalt selected.

309.05 MATERIALS

309.05.01 Emulsified Asphalt

The emulsified asphalt shall be according to OPSS 1103. The emulsified asphalt content shall be determined by laboratory testing and shall be within the limits set out in Table 1.

309.05.02 Aggregates

Aggregates shall meet the requirements of OPSS 1003 except that the gradations of open graded aggregates shall be according to Table 2 and dense graded aggregates shall be according to Table 3.

Sufficient aggregate to complete the work shall be stockpiled at least one week prior to use.

The cover aggregate shall be Class 4 aggregate according to OPSS 1006.

309.05.03 Cold Mixed, Cold Laid, Open and Dense Graded Bituminous Mix

309.05.03.01 General

The CL mix shall show good asphalt dispersion, uniform coating, and cohesion.

309.05.03.02 Open Graded Mix

The cure time for open graded mix shall be such that the asphalt cement residue in the emulsion will not wash off the aggregate, if water is applied one hour after compaction of the mix.

309.05.03.03 Dense Graded Mix

Dense graded mix shall be according to Table 4.

309.06 EQUIPMENT

309.06.01 Production and Placement

Mobile or stationary mixing plants shall be capable of producing a uniform thoroughly blended CL mix consisting of aggregate and emulsified asphalt. The aggregate feed system to the mixing unit shall be equipped with a means of determining the mass of material being deposited into the mixing unit prior to the addition of the emulsified asphalt. The mixing unit shall be capable of continuously maintaining the amount of emulsified asphalt added within $\pm$ 0.2% of the aggregate by weight. All measuring devices shall be calibrated according to the manufacturer's specifications at the start of the Contract and whenever deemed necessary by the Contract Administrator. The emulsified asphalt supply system shall be equipped with a flow meter and a total delivery meter.

A Midland Mix Paver or a central mixing plant, according to the Cold Mix Plants subsection, will be considered acceptable equivalents for the production of CL mixes.

Production equipment shall be properly equipped and adjusted to provide a CL mix according to this specification.

Mechanical pavers may be used to place CL mixes produced in a central mix plant and shall be according to the Paving Equipment clause of OPSS 310.

309.06.02 Cold Mix Plants

309.06.02.01 General Requirements

The equipment shall be such that the CL mix produced meets this specification and shall demonstrate adequate control and documentation of the CL mix materials for monitoring and production purposes.

309.06.02.02 Emulsified Asphalt Storage

A suitable holding tank, which has been thoroughly cleaned of any other material, shall be used.

309.06.02.03 Aggregate Feed System

A separate tapered cold feed bin with a minimum capacity of 6.0 m^3 shall be provided for each size, type, or gradation of aggregate. Partitions of sufficient height to eliminate intermingling of the aggregate shall be provided between adjoining bins. Bins shall be a minimum of 0.5 m wider than the width of the loading buckets.

A permanent scalping screen shall cover the top of each bin to remove any oversize aggregate.

Vibratory pan feeders shall not be acceptable for proportioning aggregates.

A calibrated and manually adjustable feed gate shall regulate the flow of aggregate from each bin to a conveyor feeding the pugmill. The conveyor shall be equipped with a scale indicating tonnes per minute of production and total tonnes.

309.06.02.04 Pugmill

The pugmill shall be an approved twin shaft type with a minimum capacity of 0.6 m^3 and capable of producing a uniform mix. The clearance of the blades from the inner surfaces of the pugmill shall not exceed 20 mm.

The paddles shall be of a type adjustable for angular position and reversible to retard the flow of the mix if required.

The mixing time or cycle shall be adjustable.

309.06.02.05 Emulsified Asphalt Pump

The pump shall be a variable speed positive displacement pump that feeds an adjustable spray bar located at the charging end of the pugmill. The pump may also be a positive displacement pump mechanically interlocked to the aggregate feed rate mechanism, in which case, the pump must be equipped with a variable speed control.

The pump shall be equipped with a totalizing type meter with manual reset and shall indicate the flow of emulsion being pumped in litres per minute.

There shall be a satisfactory means of positive control between the flow of aggregate from the hopper and emulsion from the pump. The pump shall be interlocked, either mechanically, electrically, or hydraulically, to the aggregate feed rate control mechanism so that a constant volumetric ratio of emulsion to aggregate is fed to the pugmill.

The system shall be interlocked through a master control switch.

309.06.02.06 Discharge Holding Hopper

The plant shall be equipped with a discharge holding hopper with a minimum capacity of 1.0 tonne. It shall be operated by a control switch on the control station panel.

309.06.03 Rollers

Rollers shall be according to OPSS 310, except that three wheel rollers will not be allowed.

309.06.04 Cover Aggregate Spreaders

Spreaders shall be according to OPSS 304 or shall be an acceptable tailgate type spreader capable of uniform application without displacement of the CL mix.

Spinner type spreaders are not allowed.

309.07 CONSTRUCTION

309.07.01 Emulsified Asphalt

Emulsified asphalt shall be thoroughly mixed with the aggregate.

309.07.02 Cold Mixed, Cold Laid, Open and Dense Graded Bituminous Mixes

309.07.02.01 Operational Constraints

Traffic shall not be permitted on the CL mix until final rolling is completed and the mix can support traffic loading without deformation.

CL mixes shall not be produced prior to May 15th or when rain is imminent. Except by special permission from the Contract Administrator, dense graded mix shall not be produced after September 15th, and open graded mix shall not be produced after September 30th. In no case shall CL mixes be produced unless the ambient temperature is at least 10 °C and rising.

309.07.02.02 Preparation of the Foundation

309.07.02.02.01 Granular Base

The granular base on which the CL mix is to be placed shall be smooth, true to grade, and free of surface float.

309.07.02.02.02 Pavement

Paved surfaces on which the CL mix is to be placed shall be free of dirt, sand, foreign matter, and loose material.

309.07.02.03 Production and Placement

CL mix of the type specified in the Contract Documents shall be produced and placed in accordance with the requirements of this specification.

When a second course is specified in the Contract Documents, any loose cover aggregate shall be swept from the surface. The previously laid course shall be adequately cured prior to placing the second or surface course.

309.07.02.04 Compaction

309.07.02.04.01 General

Initial rolling shall commence once initial breaking of the asphalt emulsion has occurred and the mix can support the roller without shoving.

Final rolling shall be done using a steel tandem roller after the cover aggregate has been applied.

309.07.02.04.02 Open Graded Mix

Each completed course of open graded mix shall have the following percent air voids in the compacted CL mix as determined by LS-265:

CL2 and CL3 - 15-20% Air Voids
CL4 and CL8 - 20-30% Air Voids

309.07.02.04.03 Dense Graded Mix

Each completed course of dense graded mix shall be compacted to at least 94% of laboratory density as determined LS-281.

309.07.02.05 Trial Application

At the start of the Contract, a trial area, 200 m in length and one traffic lane wide, shall be constructed to demonstrate that equipment, personnel, and methods of operation to be used are capable of producing an acceptable CL mix.

If deficiencies are evident during construction of the trial area, work shall be stopped until the deficiencies are corrected.

309.07.02.06 Surface Tolerance

Each course, after final compaction, shall be smooth and true to the established crown and grade and the surface of each course shall be free from deviations exceeding 6 mm as measured in any direction with a 3 m straight edge.

309.07.02.07 Surface Appearance

Each course, after final compaction, shall be of uniform texture and shall be free of segregation, fat spots, oil spills, or any other defect. Defective areas shall be removed and replaced with acceptable mix of the same type and compacted to the satisfaction of the Contract Administrator.

309.07.02.08 Sampling

Samples of the actual CL mix shall be taken by the Contractor at least twice a day and provided to the Contract Administrator. Each sample shall fill a four-litre pail.

Additional samples shall be provided when requested by the Contract Administrator.

309.07.02.09 Tolerances

The mix samples shall be according to the following tolerances:

Residual asphalt content: ± 0.3%

Aggregate retained on the 4.75 mm sieve:

For open graded mix ± 2.0%
For dense graded mix ± 6.0%

309.07.03 Cover Aggregate

After the initial rolling has taken place, cover aggregate shall be spread uniformly at a rate of 5 ± 1.5 kg/m^2 over the surface of all open graded mixes and then rolled into the CL mix.

309.07.04 Management of Excess Material

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

309.08 QUALITY ASSURANCE

309.08.01 Testing

The Owner may test any samples required by this specification for conformance to specified requirements.

309.09 MEASUREMENT FOR PAYMENT

309.01.01 Actual Measurement

309.09.01.01 Emulsified Asphalt

Measurement shall be by mass in kilograms according to the requirements of the Contract Documents, except that portable and conveyor scales will not be acceptable for use.

309.09.01.02 Open Graded CL 2
Open Graded CL 3
Open Graded CL 4
Open Graded CL 8
Dense Graded CL
Cover Aggregate

Measurement shall be by mass in tonnes according to the requirements of the Contract Documents.

309.10 BASIS OF PAYMENT

309.10.01 Emulsified Asphalt - Item
Open Graded CL 2 - Item
Open Graded CL 3 - Item
Open Graded CL 4 - Item
Open Graded CL 8 - Item
Dense Graded CL - Item
Cover Aggregate - Item

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

Defective areas shall be removed, replaced with acceptable mix of the same type, and compacted to the satisfaction of the Contract Administrator at no extra cost to the Owner.

TABLE 1
Emulsified Asphalt and Residual Asphalt Content

Type of Mix	Emulsified Asphalt Content kg/t	Residual Asphalt Content by Mass (Note 1)
CL 2 Open Graded, Surface or Levelling Course	69-122	4.5 - 8.0%
CL3 Open Graded, Surface or Levelling Course	65-115	4.2 - 7.5%
CL4 Open Graded, Binder or Levelling Course	61-107	4.0 - 7.0%
CL8 Open Graded, Binder or Levelling Course	55-77	3.5 - 5.0%
Dense Graded	61-107	4.0 - 7.0%

Note:

1. As determined by test LS-282.

TABLE 2
Gradation Requirements for Open Graded Aggregates, LS-602

Sieve Designation	% Passing			
	CL 2	CL 3	CL 4	CL 8
26.5 mm				100
19.0 mm			100	95-100
16.0 mm		100	96-100	65-90
13.2 mm	100	96-100	67-86	-
9.5 mm	75-100	50-73	29-52	20-55
6.7 mm	0-40	-	-	-
4.75 mm	0-10	0-10	0-10	0-10
2.36 mm	0-5	0-5	0-5	0-5
75 µm (Note 1)	0-2	0-2	0-2	0-2

Note:

1. Open graded mix aggregates with more than 2.0% passing the 75 µm sieve will be rejected.

TABLE 3
Gradation Requirements for Dense Graded Aggregates, LS-602

Sieve Designation	% Passing
16.0 mm	100
13.2 mm	75-95
9.5 mm	50-80
4.75 mm	25-50
1.18 mm	10-40
300 µm	2-20
150 µm	0-10
75 µm (Note 1)	0-5

Note:

1. Dense graded mix aggregates can have a maximum variability of 2.0% for material passing the 75 µm sieve.

TABLE 4
Physical Requirements for Cold Mixed Dense Graded Bituminous Mix

Property of Laboratory Compacted Mixtures	Air Cured	Water Cured	MTO Test Method
Marshall Stability, N	4500 Min.	3300 Min.	LS-263
Marshall Flow Units of 0.25 mm	10 Min.	8 Min.	LS-263
% Air Voids	4-12	-	LS-265
% VMA Pass 4.75 mm by Mass			LS-266
25%	12.0	-	
37.5%	13.25	-	
50%	14.5	-	
% by Mass Moisture Pick-up	-	2 Max.	LS-303

Appendix 309-A, November 2013
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Type of CL mix. (309.07.02.03)

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

- Second course of CL mix. (309.07.02.03)

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

Related Ontario Provincial Standard Drawings

No information provided here.

NOTICE TO USERS OF OPSS 310

CONSTRUCTION SPECIFICATION FOR
HOT MIX ASPHALT

OPSS 310 has been removed from this
OPS volume

There is no provincial version of OPSS 310

The municipal version of OPSS 310 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 310

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

NOTICE TO USERS OF OPSS 311

CONSTRUCTION SPECIFICATION

FOR ASPHALT SIDEWALK, DRIVEWAY, AND BOULEVARD AND FOR SIDEWALK RESURFACING

OPSS 311 has been removed from this
OPS volume

The municipal version of OPSS 311 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 311

There is no PROV version.

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

NOTICE TO USERS OF OPSS 312

CONSTRUCTION SPECIFICATION
FOR ASPHALT CURB AND GUTTER AND GUTTER SYSTEMS
AND ASPHALT SURFACING OF GUTTERS

OPSS 312 has been removed from this
OPS volume

The provincial version of OPSS 312 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 312

The municipal version of OPSS 312 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 312

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

NOTICE TO USERS OF OPSS 316

CONSTRUCTION SPECIFICATION

FOR EXTRUDED EXPANDED POLYSTYRENE FROST HEAVE TREATMENT

OPSS 316 has been removed from this
OPS volume

The provincial version of OPSS 316 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 316

The municipal version of OPSS 316 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 316

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

NOTICE TO USERS OF OPSS 336

CONSTRUCTION SPECIFICATION

FOR MICRO-SURFACING

OPSS 336 has been removed from this
OPS volume

The provincial version of OPSS 336 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 336

The municipal version of OPSS 336 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 336

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

NOTICE TO USERS OF OPSS 337

CONSTRUCTION SPECIFICATION FOR
SLURRY SEAL

OPSS 337 has been removed from this
OPS volume

The provincial version of OPSS 337 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 337

The municipal version of OPSS 337 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 337

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

NOTICE TO USERS OF OPSS 341

CONSTRUCTION SPECIFICATION FOR ROUTING AND SEALING CRACKS IN ASPHALT PAVEMENT

OPSS 341 has been removed from this OPS volume

The provincial version of OPSS 341 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 341

The municipal version of OPSS 341 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 341

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

CONSTRUCTION SPECIFICATION FOR CONCRETE PAVEMENT AND CONCRETE BASE

TABLE OF CONTENTS

350.01	SCOPE
350.02	REFERENCES
350.03	DEFINITIONS
350.04	SUBMISSION AND DESIGN REQUIREMENTS
350.05	MATERIALS
350.05.01	Concrete
.02	Burlap
.03	Moisture Vapour Barrier for Curing
.04	Curing Compound
.05	Water for Curing
.06	Tie Bars and Load Transfer Devices
.07	Joint Materials
350.06	EQUIPMENT
350.06.01	Compacting
.02	Hot Poured Rubberized Asphalt Joint Sealing
.03	Forms
.04	Automatic Dowel Bar Inserter
.05	Diamond Grinder
350.07	CONSTRUCTION
350.07.01	Preparation Work
350.07.01.01	General
350.07.02	Joints
350.07.02.01	General
.02	Load Transfer Devices
.03	Transverse Construction Joints
.04	Position and Alignment Tolerances
350.07.02.04.01	Dowel Bars
.02	Joints

350.07.02.05	Tie Bars
.06	Dowel Bars at Transverse Joints
.07	Protection of Tie Bars and Dowel Bars
350.07.03	Concreting
350.07.03.01	Consolidating
.02	Finishing
.03	Texturing of Surface
.04	Surface Tolerance
350.07.04	Curing
350.07.04.01	General
350.07.05	Joint Sealing
.06	Miscellaneous Protection
350.07.06.01	Rain
.02	Traffic
.03	Shoulders
.04	Cold Weather
350.07.06.04.01	Insulation Removal for Sawcutting
350.07.07	Concrete Base
350.07.07.01	General
.02	Joints
.03	Texturing of Surface
.04	Joint Sealing
.05	Surface Tolerance
350.07.08	Sampling and Testing
350.07.08.01	Slump and Air Content
.02	Coring
.03	Filling of Core Holes
.04	Identification
.05	Transportation of Cores
350.08	QUALITY ASSURANCE
350.08.01	Acceptance Criteria for Strength and Thickness
350.08.01.01	General
.02	Core Compressive Strength and Slab Thickness
350.08.01.03.01	Compressive Strength and Thickness
350.08.01.05	Removal of Unacceptable Concrete
.06	Cracking in Concrete Pavement

350.09 MEASUREMENT FOR PAYMENT

350.09.01 Actual Measurement

350.09.01.01 Concrete Pavement Concrete Base

350.09.02 Plan Quantity Measurement

350.09.02.01 Concrete Pavement Concrete Base

350.10 BASIS OF PAYMENT

350.10.01 Concrete Pavement - Item
Concrete Base - Item

350.10.01.01 Compressive Strength and Slab Thickness
.02 Additional Coring and Testing

350.01 SCOPE

This specification covers the requirements for the construction of concrete pavement and concrete base.

350.02 REFERENCES

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

Ontario Provincial Standard Specifications, Construction:

OPSS 314 Untreated Granular Subbase, Base, Surface, Shoulder and Stockpiling
OPSS 360 Full Depth Repair of Concrete Pavement and Concrete Base
OPSS 364 Partial Depth Repairs in Concrete Pavement
OPSS 369 Sealing or Resealing of Joints and Cracks in Concrete Pavement
OPSS 904 Concrete Structures
OPSS 905 Steel Reinforcement for Concrete
OPSS 914 Waterproofing Bridge Decks with Hot Applied Asphalt Membrane
OPSS 919 Formwork and Falsework

Ontario Provincial Standard Specifications, Material:

OPSS 1002 Aggregates - Concrete
OPSS 1302 Water
OPSS 1305 Moisture Vapour Barriers
OPSS 1306 Burlap
OPSS 1308 Joint Filler (Concrete)
OPSS 1315 White Pigmented Curing Compounds for Concrete
OPSS 1350 Concrete - Materials and Production
OPSS 1441 Load Transfer Assemblies
OPSS 1442 Epoxy Coated Steel Reinforcement for Concrete

Canadian Standards Association:

CSA A23.1-94/A23.2-94 Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete

Ministry of Transportation Publication:

MTO Laboratory Testing Manual:

LS-101 Procedures for Calculating Percent Within Limits

350.03 DEFINITIONS

For the purposes of this specification the following definitions shall apply:

Concrete Pavement: means a rigid pavement structure with an exposed concrete surface which may include concrete shoulders.

Concrete Base: means a rigid pavement structure which is overlaid with asphaltic concrete, on the same contract, and may include concrete shoulders.

Percent Within Limits (PWL): means an estimate of the percentage of the lot population that is within specification limits, determined by using the mean and standard deviation of the lot.

Standard Deviation: means the square root of the value found by summing the squares of the difference between each test result and the mean of the test results divided by the number of test results minus one.

350.04 SUBMISSION AND DESIGN REQUIREMENTS

Where concrete pavement or concrete base is to be placed from October 1 to April 1, the Contractor must submit a plan detailing curing and protection plans. The plan shall describe the method by which in-place minimum concrete temperatures shall be maintained. No concrete shall be placed unless the plan is approved by the Contract Administrator.

350.05 MATERIALS

350.05.01 Concrete

Concrete and concrete materials shall be according to OPSS 1350 with the following amendments:

a. The coarse aggregate for concrete pavement and concrete base shall have a combined gradation of nominal maximum size 37.5 mm and 19.0 mm aggregate and shall be according to the requirements of OPSS 1002.

b. The class of concrete shall be 30 MPa according to OPSS 1350. The Cementing Materials Content subsection and the Strength Tests and Requirements subsection of OPSS 1350 do not apply.

c. For all concrete pavement and concrete base, the air content shall be 6.0% $\pm$ 1.5%.

d. If the concrete is formed, the slump shall be 70 mm $\pm$ 20 mm.

e. Concrete shall be placed with a mix temperature within the range of 10°C and 28°C.

350.05.02 Burlap

Burlap shall be according to OPSS 1306.

350.05.03 Moisture Vapour Barrier for Curing

Moisture vapour barrier for curing shall be according to OPSS 1305.

350.05.04 Curing Compound

White pigmented membrane curing compound for concrete shall be according to OPSS 1315.

350.05.05 Water for Curing

Water for curing shall be according to OPSS 1302.

350.05.06 Tie Bars and Load Transfer Devices

Tie bars shall be according to OPSS 1442 and load transfer devices shall be according to OPSS 1441.

350.05.07 Joint Materials

Expansion joint filler shall be according to OPSS 1308.

Joint sealant material shall be according to OPSS 369.

350.06 EQUIPMENT

350.06.01 Compacting

Concrete shall be consolidated by means of surface vibrators, internal vibrators, or a combination of both that provide full depth consolidation without segregation.

350.06.02 Hot Poured Rubberized Asphalt Joint Sealing

Hot poured rubberized asphalt joint sealing equipment shall be according to OPSS 914.

350.06.03 Forms

Forms shall be according to OPSS 919.

350.06.04 Automatic Dowel Bar Inserter

Where an automatic dowel bar inserter is used, it must be capable of placing dowel bars as specified. The dowel bars shall be inserted to mid-depth of the slab and centred on the transverse joint locations and spaced as shown on the plans. The equipment shall be capable of consolidating the concrete around the dowel bars.

350.06.05 Diamond Grinder

Where a diamond grinder is used, it shall be power-driven, self-propelled equipment specifically designed to grind and texture concrete pavement and concrete base. It shall be equipped with a grinding head with at least 50 diamond blades per 300 mm of shaft. The grinding head shall be at least 0.9 m wide. The grinder shall be equipped with the capability to adjust the depth, slope and crossfall to ensure that concrete is removed to the desired dimensions and uniformly feathered and textured across the width and length of the required area. The equipment shall also include a slurry pick-up system.

350.07 CONSTRUCTION

350.07.01 Preparation Work

350.07.01.01 General

Before placing concrete on granular base, the granular immediately ahead of the concrete placing operation shall be wetted down thoroughly. The wetting down shall be carried out without leaving standing water.

350.07.02 Joints

350.07.02.01 General

Joints shall be of the type and at the location shown in the Contract.

The initial sawcut, for longitudinal and transverse contraction joints, shall be sawn as soon as possible, normally within 12 hours of paving operations. Sawcutting operations shall not result in ravelling or other damage to the concrete. The initial cut shall be for one third the depth of the concrete slab.

The joints shall be cleaned and sealed according to OPSS 369.

Dowel bars at the transverse contraction joints shall be placed using load transfer devices or an automatic dowel bar inserter.

350.07.02.02 Load Transfer Devices

Load transfer devices shall be as shown in the Contract.

350.07.02.03 Transverse Construction Joints

Transverse construction joints shall be made at the end of each day's run or when interruptions occur in the concreting operation. Transverse construction joints shall be formed at a contraction or expansion joint, except in exceptional cases of plant breakdown or adverse weather conditions. In these exceptional cases, a construction joint may be formed in the mid slab area subject to the provision that the portion of the slab placed, and the portion of the slab to be placed, is not less than 2 m in length. Construction joints in adjacent lanes of pavement shall align with joints in the previously placed lane.

350.07.02.04 Position and Alignment Tolerances

350.07.02.04.01 Dowel Bars

The dowel bars shall be placed within a tolerance of $\pm$ 6 mm in the vertical and horizontal planes of the pavement.

350.07.02.04.02 Joints

All joints shall be placed within a tolerance of $\pm$ 15 mm from the position and alignment of the centre of the dowel bars.

350.07.02.05 Tie Bars

At longitudinal joints, epoxy coated tie bars shall be installed where specified and as detailed in the Contract. Tie bars shall be inserted so that voids are not created around the bar. Tie bars shall not be placed within 600 mm of a transverse joint.

350.07.02.06 Dowel Bars at Transverse Joints

At all expansion and contraction joints, dowel bars shall be installed according to the details in the Contract. The location of dowel bars shall be marked to permit precise joint forming or cutting operations directly over the centre of the dowel bars.

When an automatic dowel bar inserter is used, the Contractor shall be required to remove a 2 m x full paver width section of concrete pavement or concrete base within the first days paving. Additional sections will be required until the Contractor's operations conform to the specification. The joint to be removed will be selected by the Contract Administrator. The section will be inspected by the Contract Administrator to ensure that the placement and alignment of the dowel bars meet requirements. The section removed shall be repaired according to OPSS 360.

350.07.02.07 Protection of Tie Bars and Dowel Bars

Protection of dowel bars shall be according to OPSS 905.

Bars with coating damage greater than 5% of the surface area of each bar shall not be used.

For bars with coating damage of 1% or less of their surface area, all damaged areas of the bar coating shall be repaired.

350.07.03 Concreting

Concrete shall be placed at or near its permanent location in such a manner so as to avoid segregation of the materials. Any excess concrete beyond the pavement edge shall be removed immediately.

Transverse joint load transfer devices shall be placed a minimum of 100 m in advance of the paving operations.

When an interruption in placing concrete of more than 45 minutes occurs, a transverse construction joint shall be formed. Concrete shall not be placed against any material which is at a temperature above 35°C or against any material whose temperature is below 5°C.

The maximum ambient air temperature for placing concrete is 32°C.

350.07.03.01 Consolidating

Concrete shall be thoroughly consolidated against and along the face of all forms and into the face of previously placed concrete.

For fixed-form placement, hand-held vibrators shall be used to supplement consolidation adjacent and along the full length of the form. They shall also be inserted at regularly spaced intervals along both sides of dowel assemblies. Vibrators shall never be operated longer than 15 seconds in any one location.

For slip-form pavers, the concrete shall be consolidated by vibrators of sufficient number, spacing and frequency to provide uniform consolidation to the entire pavement width and depth. The vibrators shall not operate while the paver is stopped.

The vibrators shall not come in contact with the subgrade, subbase, forms, tie bars or dowel assemblies.

350.07.03.02 Finishing

No water or other chemical agents shall be applied to the concrete surface for finishing purposes.

For concrete pavements where fixed forms are being used or where concrete is being placed against an existing pavement and before surface texturing, the edge of the pavement shall be finished with an edging tool having a radius of not more than 6 mm. The finished pavement edge shall be left smooth, true to line and grade.

350.07.03.03 Texturing of Surface

After all finishing operations are completed on concrete pavements and before initial curing and protection of the concrete, the plastic surface of the concrete shall receive an initial and final texturing. Initial texturing shall be performed with a longitudinal burlap drag to produce a uniform textured surface. Burlap shall be kept in a clean and damp condition, free from encrusted mortar. Final texturing shall be achieved using equipment manufactured to produce transverse grooves 3 mm $\pm$ 1 mm wide on 16 mm $\pm$ 3 mm centres with a groove depth of 4 mm $\pm$ 1 mm.

Grooving shall extend to within 75 mm $\pm$ 15 mm of the pavement edge. Grooving for small or irregular areas may be done by hand methods.

The surface shall be free in all cases from displaced aggregate particles and local projections.

350.07.03.04 Surface Tolerance

The surface of the concrete is to be such that when tested with a 3 m long straightedge placed in any location and direction, including the edge of pavement, except across the crown or drainage gutters, there shall not be a gap greater than 3 mm between the bottom of the straightedge and the surface of the pavement.

Diamond grinding will be required to ensure the concrete surface meets these requirements.

350.07.04 Curing

350.07.04.01 General

Curing shall be according to OPSS 904 with the following exceptions:

Curing shall be applied to all exposed surfaces as soon after the texturizing operation as can be achieved without damaging the surface.

As soon as forms are removed, the sides of the exposed concrete faces shall be sprayed with the white pigmented curing compound at the specified rate of application. Curing compound shall not be applied to joint faces receiving sealant or to concrete surfaces to which concrete or mortar is to be bonded.

350.07.05 Joint Sealing

Joint sealing shall be according to OPSS 369.

350.07.06 Miscellaneous Protection

350.07.06.01 Rain

Concrete shall not be placed in the rain. The Contractor shall take all necessary precautions to protect plastic concrete from rain.

350.07.06.02 Traffic

Traffic, other than foot traffic, rubber-tired sawing equipment, and rubber-tired side wheels of form mounted placing and finishing equipment necessary to construct adjacent lanes, shall not be permitted on the concrete until it has attained 20 MPa.

Samples required for early strength determination shall be taken and tested by the Contractor. A minimum of 1 set of two cylinders per 500 m length of paving shall be required for early opening determination. Samples shall remain on site as specified until time of testing.

The concrete pavement shall be protected from damage to the surface at all times when steel-tracked equipment is used.

350.07.06.03 Shoulders

Shouldering operations may commence once the adjacent concrete has attained 20 MPa. Completion of the shoulders shall be according to OPSS 314.

350.07.06.04 Cold Weather

Concrete shall not be placed when the ambient air temperature is below 0°C and shall not be placed against any material whose temperature is below 5°C.

The Contractor shall provide protection to ensure the minimum in-place temperature of the concrete pavement or concrete base is 15°C for the first three days of curing, and at 10°C for the subsequent 4 days.

350.07.06.04.01 Insulation Removal for Sawcutting

When the concrete pavement or concrete base requires protection by insulation, no more than 25 linear metres of concrete pavement or concrete base shall be exposed for sawcutting operations at any one time. In no case shall any concrete pavement or concrete base be exposed for more than one hour during sawcutting.

350.07.07 Concrete Base

350.07.07.01 General

The work required for concrete base includes the work required for concrete pavement except as modified by this subsection.

350.07.07.02 Joints

A final reservoir cut is not required at the joints.

350.07.07.03 Texturing of Surface

Texturing of the surface is not required.

350.07.07.04 Joint Sealing

The sealing of joints in concrete base is not required.

350.07.07.05 Surface Tolerance

The provisions of subsection 350.07.03.04 apply except that the tolerance is increased to 6 mm.

350.07.08 Sampling and Testing

350.07.08.01 Slump and Air Content

Field sampling and testing of plastic concrete for conformance to slump and air content requirements shall be the Contractors responsibility as detailed below.

Slump and air content shall be tested according to OPSS 904 with the following exceptions:

The frequency of slump and air content testing shall be according to Table 1.

Table 1
Sampling and Testing - Minimum Frequencies

Tests	Frequency
Air Content	Each load until satisfactory control is established. Then 1 random test per 5 truck loads
Slump for Fixed Form Paving	Each load until satisfactory control is established. Then 1 random test per 5 truck loads
Notes: Test Procedures shall be according to CSA A23.2-94. Satisfactory control is considered to have been established when tests on five consecutive truck loads or batches of concrete are within specification requirements.	

350.07.08.02 Coring

Coring shall be carried out when the concrete is 28 to 35 days old. The Contractor may elect to core for compressive strength testing prior to 28 days provided the strength testing is performed within two days of coring.

The location of the core in each sublot will be selected by the Owner using a table of random numbers. No core shall be taken within 250 mm of any joint or edge of slab.

The Contractor shall cut one core in each sublot. The cores shall be 100 mm in diameter and shall be drilled through the complete depth of concrete pavement or concrete base perpendicular to the surface of the slab.

350.07.08.03 Filling of Core Holes

Each core hole shall be filled immediately after coring with an approved non-shrink grout. The patch shall be finished flush with the surface of the concrete slab.

Immediately before filling, the vertical surface of each core hole shall be cleaned of the paste left from the coring operation by wire brushing, and all free water shall be removed. After filling each hole, all excess material shall be removed from the surface of the slab.

350.07.08.04 Identification of Cores

Each core shall be legibly marked with durable ink immediately after its removal from the core hole. The core identification numbers will be specified by the Owner.

350.07.08.05 Transportation of Cores

The concrete cores shall be delivered to a laboratory designated by the Owner. The cores shall be delivered on the same day they were obtained.

The Contractor is responsible for transporting these cores in a safe manner to avoid damage to the cores.

350.08 QUALITY ASSURANCE

350.08.01 Acceptance Criteria for Strength and Thickness

350.08.01.01 General

Acceptance of the concrete pavement or concrete base for each lot will be based on the mean and standard deviation of the lot measurements for core compressive strength and slab thickness. The Contract Administrator will calculate the Percent Within Limits for each criteria as described in LS-101.

350.08.01.02 Core Compressive Strength and Slab Thickness

The slab thickness will be determined based on core length for each sublot, each core shall be measured for length prior to trimming. Four measurements rounded to the nearest millimetre shall be made around the perimeter of the core to determine the actual concrete thickness. These measurements shall be taken at the ends of two perpendicular diameters.

Cores will be tested for compressive strength when the concrete is 30 to 42 days old. If the contractor elects to core prior to 28 days, the compressive strength tests will be performed within two days of coring. The cores shall be stored in the laboratory at an ambient air temperature of $\geq$ 15°C and $\leq$ 25°C and moisture conditioned for 40 - 48 hours prior to testing. The testing shall be according to CSA A23.2-9C.

If the lot PWL is greater than or equal to 90%, the lot is acceptable for the criteria. If the lot PWL is greater than 90%, the lot will be accepted with a bonus for the criteria. If the lot PWL is less than 90% and greater than or equal to 50%, the lot is accepted for the criteria with a price adjustment. If the lot PWL is less than 50%, the lot is rejectable and shall be subject to repair and reassessment.

Notwithstanding the overall PWL, if any individual core compressive strength or if any individual length is less than 60% of the specified compressive strength or specified slab thickness, the Contractor shall repair the sublot.

For calculation of PWL, the lower limit is 30 MPa for compressive strength. The lower limit for thickness shall be specified as the design thickness minus 5 mm.

350.08.01.03 Lot Size

350.08.01.03.01 Compressive Strength and Thickness

A lot shall consist of the total quantity of concrete pavement or concrete base on the contract of the same specified thickness.

Each lot will be divided into 1000 m^2 sublots or a minimum of three sublots for compressive strength and thickness. The Owner will test one core from each sublot to determine the core compressive strength and slab thickness.

350.08.01.04 Re-testing

350.08.01.04.01 Compressive Strength and Thickness

The Contractor or the Contract Administrator may question an individual test result within three working days of receiving the test result for that sublot. The Contractor shall notify the Owner of his intention to re-core. A new core shall be obtained from locations adjacent to the location of the original set of cores. The new core shall be obtained at a maximum age of 56 days and tested not later than 7 days after the coring. The lot will be re-evaluated as specified under basis of payment.

350.08.01.05 Removal of Unacceptable Concrete

If individual sublot results for core compressive strength or thickness of concrete pavement or concrete base dictates removal and replacement of a sublot, additional cores shall be taken by the Contractor to establish the extent of the deficient area.

The cores shall be taken at 3 m intervals along the length of the pavement in both directions starting 3 m from the location of the original core.

The area to be removed shall be bounded by the nearest contraction joint and longitudinal joint or concrete pavement or concrete base edge outside the deficient area so that there shall be no additional joints.

Where the overall sublot results dictate removal and replacement, the Contractor shall remove and replace the entire sublot.

350.08.01.06 Cracking in Concrete Pavement

All cracking, in excess of one third the depth of the slab thickness shall be repaired as a full depth repair according to OPSS 360.

Cracks less than one-third the thickness of the slab shall be repaired according to OPSS 364.

350.09 MEASUREMENT FOR PAYMENT

350.09.01 Actual Measurement

350.09.01.01 Concrete Pavement
Concrete Base

Measurement will be the surface area of concrete pavement or concrete base placed in square metres.

350.09.02 Plan Quantity Measurement

350.09.02.01 Concrete Pavement
Concrete Base

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

350.10 BASIS OF PAYMENT

350.10.01 Concrete Pavement - Item
Concrete Base - Item

Payment at the contract price for the above items shall be full compensation for all labour, equipment and material required to do the work except that, where work does not conform to the quality requirements, adjustment for each lot will be made according to the following. The price adjustment will be based on the average of the Pay Factors (PF) for strength and thickness.

When retesting is completed, the test results used to determine the price adjustment shall be as detailed in Table 2. Payment for retesting will be made only when the retest results in an increased payment.

350.10.01.01 Compressive Strength and Slab Thickness

Adjustment of the contract price for compressive strength and slab thickness shall be based on the following formulae and Table 2.

For concrete pavement and concrete base:

$$PF_{strength} = 55 + 0.5\ PWL$$

$$PF_{thickness} = 55 + 0.5\ PWL$$

Table 2

CRITERIA for PAYMENT when RETESTING		
	Difference Between New and Old Core	Test Core Used for Payment Adjustment
Thickness	$\leq$ 5 mm	Original Core
	> 5 mm	New Core
Strength	$\leq$ 5%	Original Core
	> 5%	New Core

350.10.01.02 Additional Coring and Testing

Payment will not be made for additional coring and testing to determine the limits of slab removal. The Owner will pay for reboring and testing for strength and thickness only when the retests result in an increase in payment.

NOTICE TO USERS OF OPSS 351

CONSTRUCTION SPECIFICATION

FOR CONCRETE SIDEWALK

OPSS 351 has been removed from this
OPS volume

The municipal version of OPSS 351 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 351

There is no PROV version.

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

NOTICE TO USERS OF OPSS 356

CONSTRUCTION SPECIFICATION

FOR PERVIOUS CONCRETE PAVEMENT FOR LOW-VOLUME TRAFFIC APPLICATIONS

OPSS 356 has been removed from this
OPS volume

The municipal version of OPSS 356 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 356

There is no PROV version.

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

NOTICE TO USERS OF OPSS 360

CONSTRUCTION SPECIFICATION FOR FULL DEPTH REPAIR OF CONCRETE PAVEMENT OR CONCRETE BASE

OPSS 360 has been removed from this OPS volume

The provincial version of OPSS 360 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 366

The municipal version of OPSS 360 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 360

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

NOTICE TO USERS OF OPSS 361

CONSTRUCTION SPECIFICATION

FOR RUBBLIZING CONCRETE PAVEMENT AND CONCRETE BASE

OPSS 361 has been removed from this
OPS volume

The municipal version of OPSS 361 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 361

There is no PROV version.

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

NOTICE TO USERS OF OPSS 362

CONSTRUCTION SPECIFICATION FOR
FAST TRACK FULL DEPTH REPAIRS TO CONCRETE PAVEMENT

OPSS 362 has been removed from this
OPS volume

The provincial version of OPSS 362 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 366

The municipal version of OPSS 362 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 362

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

NOTICE TO USERS OF OPSS 364

CONSTRUCTION SPECIFICATION FOR PARTIAL DEPTH REPAIRS IN CONCRETE PAVEMENT

OPSS 364 has been removed from this OPS volume

The provincial version of OPSS 364 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 366

The municipal version of OPSS 364 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 364

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

NOTICE TO USERS OF OPSS 369

CONSTRUCTION SPECIFICATION

FOR SEALING OR RESEALING OF JOINTS AND CRACKS IN CONCRETE PAVEMENT AND CONCRETE BASE

OPSS 369 has been removed from this
OPS volume

The municipal version of OPSS 369 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 369

There is no PROV version.

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

NOTICE TO USERS OF OPSS 404

CONSTRUCTION SPECIFICATION FOR
SUPPORT SYSTEMS

OPSS 404 has been removed from this
OPS volume

The provincial version of OPSS 404 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 404

The municipal version of OPSS 404 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 404

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

NOTICE TO USERS OF OPSS 405

CONSTRUCTION SPECIFICATION FOR
PIPE SUBDRAINS

OPSS 405 has been removed from this
OPS volume

The provincial version of OPSS 405 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 405

The municipal version of OPSS 405 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 405

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

NOTICE TO USERS OF OPSS 407

CONSTRUCTION SPECIFICATION
FOR NEW MAINTENANCE HOLE, CATCH BASIN, DITCH INLET, AND VALVE CHAMBER INSTALLATION

OPSS 407 has been removed from this
OPS volume

The municipal version of OPSS 407 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 407

There is no PROV version.

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

ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION

METRIC
OPSS 408
NOVEMBER 2015

CONSTRUCTION SPECIFICATION FOR ADJUSTING OR REBUILDING MAINTENANCE HOLES, CATCH BASINS, DITCH INLETS, AND VALVE CHAMBERS

TABLE OF CONTENTS

408.01 SCOPE

408.02 REFERENCES

408.03 DEFINITIONS

408.04 DESIGN AND SUBMISSION REQUIREMENTS - Not Used

408.05 MATERIALS

408.06 EQUIPMENT - Not Used

408.07 CONSTRUCTION

408.08 QUALITY ASSURANCE - Not Used

408.09 MEASUREMENT FOR PAYMENT

408.10 BASIS OF PAYMENT

APPENDICES

408-A Commentary

408.01 SCOPE

This specification covers the requirements for adjusting or rebuilding maintenance holes, catch basins, ditch inlets, and valve chambers and the installation of safety platforms.

408.01.01 Specification Significance and Use

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

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

408.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

408.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 402	Excavating, Backfilling, and Compacting for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 404	Support Systems
OPSS 407	Maintenance Hole, Catch Basis, Ditch Inlet, and Valve Chamber Installation
OPSS 490	Site Preparation for Pipelines, Utilities, and Associated Structures
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 904	Concrete Structures

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production

OPSS 1351 Precast Reinforced Concrete Components for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 1440 Steel Reinforcement for Concrete
OPSS 1850 Frames, Grates, Covers, and Gratings
OPSS 1853 Rubber Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers
OPSS 1854 High Density Polyethylene (HDPE) and Expanded Polystyrene (EPS) Adjustment Units for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

Canadian General Standards Board (CGSB)

1.181-99 Ready-Mixed Organic Zinc-Rich Coating

408.03 DEFINITIONS

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

Adjusting means changing the final grade of the frame with cover or grate on an existing structure,

a) upwards by the addition of adjustment units, or

b) downwards by removal of existing adjustment units or bricks and mortar, regardless of the size or type of structure.

Adjustment Units means circular and rectangular units used between the structure and the frame to adjust the elevation of the frame for grates and covers.

Lift Rings means circular and rectangular pre-fabricated metal or high density polyethylene units used to adjust the elevation of the grates and covers only. They are inserted between the frame and the grate or cover.

Rebuilding means changing the final grade of the frame with grate or cover on an existing structure,

a) upwards by the addition of precast concrete sections, concrete, and adjustment units; or

b) downwards by the removal of precast concrete sections, concrete, and adjustment units or bricks and mortar, regardless of the size or type of structure.

Structure means cast-in-place and precast maintenance holes, catch basins, ditch inlets, and valve chambers.

408.05 MATERIALS

408.05.01 Concrete

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

408.05.02 Steel Reinforcement

Steel bar reinforcement, bar mats, and wire fabric for cast-in-place structures shall be according to OPSS 1440.

408.05.03 Precast Concrete Components for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

Precast units shall be according to OPSS 1351 and as specified in the Contract Documents.

408.05.04 Steps and Ladders

Steps shall be according to OPSS 1351 and as specified in the Contract Documents.

Ladders shall be as specified in the Contract Documents.

408.05.05 Adjustment Units

Precast concrete adjustment units shall be according to OPSS 1351.

Rubber adjustment units shall be according to OPSS 1853.

High density polyethylene (HDPE) and expanded polystyrene (EPS) adjustment units shall be according to OPSS 1854.

408.05.06 Mortar

Mortar shall consist of a mixture of one part Portland cement according to OPSS 1301 and three parts mortar sand according to OPSS 1004, wetted with sufficient water to make the mixture plastic. Water shall be according to OPSS 1302.

408.05.07 Frames With Covers or Grates, and Lift Rings

Frames with covers or grates, and lift rings shall be according to OPSS 1850.

408.05.08 Aluminum Safety Platforms

Aluminum safety platforms shall be according to OPSS 1351 and as specified in the Contract Documents.

408.05.09 Joint Seal Systems

Joint seal systems for precast concrete structures shall be according to OPSS 1351.

408.05.10 Zinc Rich Paint

Zinc rich paint shall be according to CAN/CGSB 1.181.

408.07 CONSTRUCTION

408.07.01 General

The work of adjusting or rebuilding structures shall include the removal and subsequent replacement of the frame with grate or cover.

All structures shall be adjusted or rebuilt plumb, true to alignment and grade, and as specified in the Contract Documents.

During the progress of the work and until the final acceptance, all structures in service shall be kept clean and free of all extraneous material.

Prior to adjusting or rebuilding a structure, the existing frame with cover or grate shall be carefully removed and salvaged. Suitability of the salvaged frame with cover or grate for reuse shall be determined by the Contract Administrator.

The installation of adjustment units, frames, covers, grates, lift rings, precast concrete components, and cast-in-place aprons shall be according to OPSS 407 and of the type as specified in the Contract Documents.

Additional steps or ladder extensions are required when the distance from the adjusted cover or grate reference elevation to the first step exceeds 450 mm. Additional steps shall be placed according to OPSS 1351.

Alterations to ladders, valve extension stems and boxes, and frost straps shall be as specified in the Contract Documents.

After having been raised, any structure that has a total height of 5.0 m or more shall have a safety platform installed in it. The aluminum safety platforms shall be installed as specified in the Contract Documents.

After adjusting or rebuilding a valve chamber, insulation shall be installed according to the manufacturer's recommendations on the roof, wall, or access way of the valve chamber, when specified in the Contract Documents.

408.07.02 Site Preparation

Site preparation shall be according to OPSS 490.

408.07.03 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

408.07.04 Cold Weather Work

All work shall be protected from freezing.

408.07.05 Transporting, Unloading, and Storing and Handling

Transporting, unloading, storing, and handling shall be according to manufacturer's recommendations.

Materials that are unsound or damaged shall be rejected.

408.07.06 Excavating, Backfilling, and Compacting

Excavating, backfilling, and compacting for the adjustment or rebuilding of structures shall be according to OPSS 402.

408.07.07 Support Systems

Support systems shall be according to OPSS 404.

408.07.08 Adjusting

All existing brickwork and mortar shall be removed from the top of the existing structure.

When there are adjustment units on an existing structure, adjustment units shall be added or removed as required so when the adjustment is completed there is a minimum of one to a maximum of three adjustment units on the top of the structure prior to placing the frame with grate or cover.

408.07.08.01 Precast Concrete Adjustment Units

Precast concrete adjustment units shall be used to set the frame with grate or cover at the required position and elevation.

A minimum of one adjustment unit, but not more than three adjustment units are required at each structure to a maximum height of 300 mm.

The first adjustment unit shall be laid in a full bed of mortar and aligned with the opening in the structure. Successive adjustment units shall be laid plumb to the first adjustment unit and sealed according to manufacturer's recommendations.

408.07.08.02 High Density Polyethylene (HDPE) and Expanded Polystyrene (EPS) Adjustment Units

When specified in the Contract Documents, HDPE or EPS adjustment units shall be used to set the frame with grate or cover at the required position and elevation.

A minimum of one adjustment unit is required at each structure up to a maximum height of 100 mm.

HDPE or EPS adjustment units shall be installed and sealed according to manufacturer's recommendations.

Rubber adjustment units shall not be used in conjunction with HDPE or EPS adjustment units.

408.07.08.03 Rubber Adjustment Units

Rubber adjustment units shall be used when specified in the Contract Documents. One rubber adjustment unit is used to replace the top precast concrete adjustment unit per structure and shall be used in conjunction with one or two precast concrete adjustment units. More than one rubber adjustment unit may be placed when wedge shaped rubber units are used to provide slope to the frame with grate or cover. In either instance, the total height of the rubber units shall be greater than 25 mm and less than 75 mm. The rubber unit is to be placed on the precast concrete adjustment unit so it provides the surface on which the frame rests.

The rubber adjustment unit shall be bonded firmly in place on the precast concrete adjustment unit by laying a continuous strip of butyl tape on the top surface of the precast concrete unit. If more than one rubber unit is used, a continuous strip of butyl tape is to be laid between each rubber adjustment unit.

408.07.09 Rebuilding

408.07.09.01 General

All existing brickwork and mortar or adjustment units shall be removed from the top of the existing structure.

The completed rebuilt structure shall have a minimum of one to a maximum of three adjustment units on the top of the structure prior to placing the frame with grate or cover.

408.07.09.02 Cast-In-Place Structures

When the top of the structure is to be lowered, the concrete shall be carefully removed to the required elevation and exposed steel reinforcement shall be cut off as specified in the Contract Documents. The upper section of the structure shall then be rebuilt to its original configuration using cast-in-place concrete and steel reinforcement as specified in the Contract Documents.

To raise the top of structures with a tapered upper section, the concrete in the structure shall be removed for the entire depth of the taper. The upper section, including straight walls and taper shall then be rebuilt to the original configuration using cast-in-place concrete and steel reinforcement as specified in the Contract Documents.

To raise the top of straight walled structures, the existing roof section, if any, shall be removed. The existing walls shall then be extended upward and the roof section rebuilt to the original configuration using cast-in-place concrete and steel reinforcement as specified in the Contract Documents.

When cast-in-place units are to be raised or lowered with cast-in-place concrete, the top surface of all existing walls shall be roughened and a bonding agent shall be applied to the joint before the walls are extended upwards.

Concrete shall be placed according to OPSS 904.

All inside wall protuberances shall be removed once the forms are stripped.

408.07.09.03 Precast Concrete Structures

Where precast concrete structures having either a tapered or flat slab top section are to be raised or lowered, the top section shall be carefully removed and salvaged and riser sections of suitable height shall be carefully removed from, substituted for, or added to the existing riser sections. The top section shall then be replaced. All of the above work shall be performed according to OPSS 407.

The procedure described for lowering a cast-in-place structure shall be followed as an alternative to the method described above for lowering a precast structure.

408.07.10 Restoration

Restoration shall be according to OPSS 492.

408.07.11 Leakage Test

Sanitary sewer maintenance holes and storm sewer maintenance holes shall be tested for leakage according to OPSS 407.

408.07.12 Management of Excess Material

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

408.09 MEASUREMENT FOR PAYMENT

408.09.01 Actual Measurement

408.09.01.01 Adjusting or Rebuilding Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

For measurement purposes, a count shall be made of the number of structures adjusted or rebuilt. When more than one adjustment or rebuild is specified for a structure, each adjustment or rebuild shall be counted separately.

408.09.01.02 Installation of Safety Platforms

For measurement purposes, a count shall be made of the number of safety grates installed.

408.09.02 Plan Quantity Measurement

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

408.10 BASIS OF PAYMENT

408.10.01 Adjusting Maintenance Holes - Item
Rebuilding Maintenance Holes - Item
Adjusting Catch Basins - Item
Rebuilding Catch Basins - Item
Adjusting Ditch Inlets - Item
Rebuilding Ditch Inlets - Item
Installation of Lift Rings - Item
Adjusting Valve Chambers - Item
Rebuilding Valve Chambers - Item
Installation of Safety Platforms - Item
Rebuilding Catch Basin Apron - Item

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

Appendix 408-A, November 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Material requirements for:
  - Precast units. (408.05.03)
  - Steps and ladders. (408.05.04)
  - Aluminum safety platforms. (408.05.08)

- Adjustment and rebuilding requirements. (408.07.01)

- Use of HDPE or EPS adjustment units. (407.07.08.02)

- Rubber adjustment units. (407.07.08.03)

- Alterations to ladders, valve extension stems and boxes, and frost straps. (408.07.01)

- Installation of:
  - Aluminium safety platforms. (408.07.01)
  - Valve chamber insulation. (408.07.01)

- Additional adjustments required. (408.09.01.01)

- Cut-off of exposed steel reinforcement. (408.07.09.02)

- Concrete and steel placement requirements. (408.07.09.02)

The designer should consider determining the number of salvageable frames with covers or grates. If there are frames with covers or grates that are not suitable for salvage, then an item should be added to the Contract Documents to ensure there are a sufficient number of new frames with covers or grates to fill the Contract needs.

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

Related Ontario Provincial Standard Drawings

OPSD 400.001	Hoisting Hook Rib for Cast Iron Frames for Catch Basins, Maintenance Holes, and Valve Chambers
OPSD 400.010 to 400.120	Cast Iron Catch Basin Frames With Grates
OPSD 401.010 to 401.060	Cast Iron Maintenance Hole Frames With Covers
OPSD 402.010 to 402.021	Cast Iron Valve Chamber Frames With Covers
OPSD 403.010	Galvanized Steel Honey Comb Grating for Ditch Inlets
OPSD 404.020 to 404.022	Aluminum Safety Platforms
OPSD 405.010 to 405.020	Maintenance Hole Steps
OPSD 406.010	Aluminum Ladder for maintenance Holes
OPSD 610.010 to 610.030	Catch Basin Frame With Grate Installation

OPSD 701.010 to 701.015	Precast Concrete Maintenance Holes, 1,200 to 3,600 mm in Diameter
OPSD 701.030 to 701.081	Precast Concrete Maintenance Hole Components, 1,200 to 3,600 mm in Diameter
OPSD 701.100	Frost Strap Installation
OPSD 702.040 to 702.050	Precast Concrete Ditch Inlet Maintenance Hole
OPSD 703.011 to 703.015	Precast Concrete Single Inlet Flat Cap, 1,500 to 3,600 mm in Diameter
OPSD 703.021 to 703.024	Precast Concrete Twin Inlet Flat Cap, 1,500 to 3,000 mm in Diameter
OPSD 704.010 to 704.012	Maintenance Hole, Catch Basin, and Valve Chamber Adjustment Units
OPSD 705.001 to 705.002	Concrete Catch Basin Apron
OPSD 705.010 to 705.020	Precast Concrete Catch Basins
OPSD 705.030 to 705.040	Precast Concrete Ditch Inlets
OPSD 706.010 to 706.041	Precast Concrete Ditch Inlets Types A and B with 1,500 to 3,000 mm Diameter Flat Cap
OPSD 1100.010	Cast-In-Place Chamber for Valves Up to 350 mm Diameter
OPSD 1101.010	Precast Valve Chamber 1,200 mm and 1,500 mm Diameter
OPSD 1101.020	Valve Operator

NOTICE TO USERS OF OPSS 409

CONSTRUCTION SPECIFICATION FOR CLOSED-CIRCUIT TELEVISION (CCTV) INSPECTION OF PIPELINES

OPSS 409 has been removed from this OPS volume

The provincial version of OPSS 409 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 409

The municipal version of OPSS 409 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 409

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

NOTICE TO USERS OF OPSS 411

CONSTRUCTION SPECIFICATION FOR
THE CLEANING AND FLUSHING OF PIPE SEWERS, CATCHBASINS, MAINTENANCE HOLES, DITCH INLETS, AND OIL-GRIT SEPARATORS

OPSS 411 has been removed from this
OPS volume

The provincial version of OPSS 411 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 411

The municipal version of OPSS 411 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 411

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

NOTICE TO USERS OF OPSS 412

CONSTRUCTION SPECIFICATION

FOR FORCEMAIN INSTALLATION IN OPEN CUT

OPSS 412 has been removed from this
OPS volume

The municipal version of OPSS 412 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 412

There is no PROV version.

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

NOTICE TO USERS OF OPSS 413

CONSTRUCTION SPECIFICATION

FOR MANURE PIPELINE INSTALLATION IN OPEN CUT

OPSS 413 has been removed from this
OPS volume

The municipal version of OPSS 413 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 413

There is no PROV version.

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

NOTICE TO USERS OF OPSS 415

CONSTRUCTION SPECIFICATION

FOR PIPELINE INSTALLATION BY TUNNELLING

OPSS 415 has been removed from this
OPS volume

The municipal version of OPSS 415 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 415

There is no PROV version.

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

NOTICE TO USERS OF OPSS 416

CONSTRUCTION SPECIFICATION

FOR PIPELINE AND UTILITY INSTALLATION BY JACKING AND BORING

OPSS 416 has been removed from this
OPS volume

The municipal version of OPSS 416 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 416

There is no PROV version.

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

CONSTRUCTION SPECIFICATION FOR PRECAST REINFORCED CONCRETE BOX CULVERTS IN OPEN CUT

TABLE OF CONTENTS

422.01 **SCOPE**

422.02 **REFERENCES**

422.03 **DEFINITIONS**

422.04 **DESIGN AND SUBMISSION REQUIREMENTS**

422.05 **MATERIALS**

422.06 **EQUIPMENT - Not Used**

422.07 **CONSTRUCTION**

422.08 **QUALITY ASSURANCE - Not Used**

422.09 **MEASUREMENT FOR PAYMENT**

422.10 **BASIS OF PAYMENT**

APPENDICES

422-A **Commentary**

422.01 SCOPE

This specification covers the requirements for the installation of precast reinforced concrete box culverts and box in open cut, and includes the requirements for excavation, bedding, backfilling, and cover material.

422.01.01 Specification Significance and Use

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

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

422.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

422.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, General

OPSS 180 Management and Disposal of Excess Material

Ontario Provincial Standard Specifications, Construction

OPSS 209 Embankments Over Swamps
OPSS 404 Support Systems
OPSS 501 Compacting
OPSS 517 Dewatering of Pipeline, Utility and Associated Structure Excavation
OPSS 539 Temporary Protection Systems
OPSS 902 Excavating and Backfilling - Structures
OPSS 904 Concrete Structures
OPSS 905 Steel Reinforcement for Concrete

Ontario Provincial Standard Specifications, Material

OPSS 1002	Aggregates - Concrete
OPSS 1004	Aggregates - Miscellaneous
OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1205	Clay Seal
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1821	Precast Reinforced Concrete Box Culverts
OPSS 1860	Geotextiles

MTO Laboratory Testing Manual

LS-706	Moisture - Density Relationship of Soils Using 2.5 kg Rammer and a 305 mm Drop

ASTM International

D 2487-00	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
D 2488-00	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
D 2922-01	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D 3017-01	Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

422.03 DEFINITIONS

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

Backfill means earth, rock, or granular material used as fill within the excavation placed beyond the limits of bedding and cover below the subgrade elevation, including frost tapers.

Bedding means the material used to support the bottom of the box unit.

Box Culvert means a culvert constructed of precast reinforced concrete box units rectangular in cross-section.

Box Unit means a single precast reinforced concrete box unit of a box culvert.

Concrete Appurtenances means head walls, cut-off walls, aprons, collars, and any other concrete fixtures associated with the box culverts , excluding concrete bedding or concrete structures covered elsewhere in the Contract Documents and specified as such.

Cover means the material placed as a protective layer around the box unit to prevent damage to the box unit.

Distribution Slab means a reinforced concrete slab placed directly on the top slab of a box culvert to distribute loading.

Excavation, Earth and Rock means the excavation material classified as earth and rock according to OPSS 902.

Excavation, Swamp means swamp excavation as defined in OPSS 209.

Geotechnical Engineer means a professional engineer licensed by the Professional Engineers of Ontario to practice in the Province of Ontario who is responsible for the work related to earth and rock, including site investigation, foundation recommendations, inspection, and quality control with respect to the design and installation of box culverts.

Native Material means the original material removed to form an excavation and which is acceptable to the Contract Administrator for return to the same or other excavation as backfill or cover.

Soil means soil as defined in OPSS 902.

422.04 DESIGN AND SUBMISSION REQUIREMENTS

Six copies of the fabrication and assembly drawings, including handling details, shall be submitted to the Contract Administrator two weeks prior to delivery of the box units.

422.05 MATERIALS

422.05.01 Concrete

Concrete for appurtenances and distribution slab shall be according to OPSS 1350.

422.05.02 Granulars

Granulars shall be according to OPSS 1010.

422.05.03 Fine Aggregates for Levelling Course

Fine aggregate for levelling courses shall be according to OPSS 1002.

422.05.04 Precast Reinforced Concrete Box Units

Precast reinforced concrete box units for spans not greater than 3 metres shall be according to OPSS 1821. Box unit reinforcement shall be consistent throughout a culvert as specified in the Contract Documents.

422.05.05 Clay Seal

Clay seal shall be according to OPSS 1205.

422.05.06 Steel Reinforcement

Steel reinforcement for concrete appurtenances and concrete distribution slab shall be according to OPSS 1440.

422.05.07 Mortar

Mortar for joints shall be composed of one part Portland cement type GU and two parts mortar sand wetted with only sufficient water to make the mixture plastic. The Portland cement type GU shall be according to OPSS 1301, mortar sand shall be according to OPSS 1004, and water shall be according to OPSS 1302.

422.05.08 Preformed Gasket

Preformed gaskets shall be as specified by the manufacturer of the box units.

422.05.09 Joint Sealing Compound

Joint sealing compound shall be butyl mastic as specified by the manufacturer of the box units.

422.05.10 Grout

Grout shall be non-shrink and non-staining.

422.05.11 Geotextile

Geotextile type shall be as specified in the Contract Documents and according to OPSS 1860.

422.05.12 Native Material

Native material shall be classified according to the Unified Soil Classification System using the procedures prescribed in ASTM D 2488. When precise classification of native material is required, ASTM D 2487 shall be used.

422.05.13 Bedding

Bedding shall be as specified in the Contract Documents. Earth bedding shall be classified as Group I or Group II according to Table 1.

The maximum particle size for bedding shall not exceed 25 mm in diameter, unless the bedding layer has a thickness of 150 mm or greater, in which case the maximum particle size shall not exceed 38 mm in diameter.

422.05.14 Backfill

Backfill shall be as specified in the Contract Documents. Earth backfill shall be classified as Group I, Group II, or Group III according to Table 1.

Earth backfill shall be free of boulders over 100 mm in diameter, topsoil, frozen materials, organic matter, and other deleterious material.

422.05.15 Cover

Cover shall be as specified in the Contract Documents. Earth cover shall be classified as Group I or Group II according to Table 1.

Cover shall be free of boulders having a diameter greater than 100 mm, debris, organic matter, or frozen materials.

422.07 CONSTRUCTION

422.07.01 Selection of Box Units

The box units shall be selected from Table 1 in OPSS 1821 based on the dimensions and height of fill specified in the Contract Documents.

422.07.02 Excavation

The excavation for the installation of the box units shall be according to OPSS 902, including frost tapers and culvert end treatments.

422.07.03 Support Systems

Support systems shall be according to OPSS 404.

422.07.04 Dewatering

Dewatering shall be according to OPSS 517.

422.07.05 Temporary Protection Systems

Temporary protection systems shall be according to OPSS 539.

422.07.06 Foundations

The foundation shall be comprised of firm to hard in situ soil or compacted backfill.

When unsuitable or unstable material is encountered during the excavation for the foundation, the unsuitable or unstable material shall be removed to firm to hard in situ soil and replaced to the foundation grade with compacted backfill meeting the requirements of Group I or Group II, according to Table 1. The foundation on each side of the box unit, for a minimum distance equal to the inside width of the box unit shall be at least as stable as the foundation below the box unit.

422.07.07 Bedding

Bedding shall be placed to the dimensions shown in the Contract Documents.

The bedding shall be placed as uniformly as possible. Bedding under the middle third of the box unit base shall be loosely placed and uncompacted. Bedding requiring compaction shall be placed in layers not exceeding 200 mm in thickness, loose measurement, and each layer shall be compacted according to OPSS 501.

Bedding shall not be placed on frozen earth grade.

422.07.08 Levelling

The surface prepared to support the box units shall have a 75 mm minimum thickness top levelling course of uncompacted Granular A or fine aggregates.

422.07.09 Installing Box Units

422.07.09.01 Box Units

Box units shall be installed to the alignment and grade specified in the Contract Documents.

Box units shall not be installed on bedding containing frozen material.

End units to accommodate concrete appurtenances shall be as specified in the Contract Documents.

The box units shall be installed to make a continuous line forming a box culvert. The gap at box unit joints shall not exceed 20 mm.

For box units placed in parallel for multiple cell installations, a 60 mm $\pm$ 10 mm gap filled with grout between adjacent cells shall be provided.

Installation of the box units shall commence at the outlet end and proceed in the upstream direction with the bell ends of the box units facing upgrade. The box units shall be placed with the base of each box unit in uniform contact with the prepared bedding throughout its full length. The ends of the box units shall be joined so there is no unevenness along the inside. The box units and joint surfaces shall be kept clean as work progresses. Water shall not be allowed to flow through the box units during installation. The excavation shall be kept dry and the box units shall not be installed in water.

422.07.09.02 Geotextile at Joints

A 600 mm wide strip of geotextile shall be placed to form a continuous barrier centered around the exterior of all buried joints not covered by a distribution slab.

Geotextile shall be free of folds, tears, and wrinkles. The geotextile shall be joined so that the material laps a minimum of 500 mm and shall be pinned together. Alternatively, the geotextile shall be joined according to the seam requirements of OPSS 1860.

Geotextile shall not be placed between the top slab of box units and distribution slabs. Where a distribution slab is required, the geotextile shall be held in place by cover and geotextile ends shall be secured to the box units.

422.07.09.03 Mortared Joints

When mortared joints are specified in the Contract Documents, all joints shall be thoroughly cleaned and wetted. Mortar shall then be applied over the joint around the inner and outer perimeter. After the mortar joint is complete the joint inside shall be wiped clean and smooth.

422.07.09.04 Preformed Gasket

When a preformed gasket is specified in the Contract Documents for sealing the joint between the box units, it shall be placed according to the manufacturer's recommendations.

422.07.09.05 Joint Sealing Compound

When joint sealing compound is specified in the Contract Documents for sealing the joint between the box units, it shall be applied according to the manufacturer's recommendations.

422.07.09.06 Lift Holes

All lift holes shall be filled with mortar after installation of the box unit.

422.07.10 Concrete Appurtenances and Concrete Distribution Slab

Concrete placement, sampling, and testing shall be according to OPSS 904. Reinforcing steel shall be placed according to OPSS 905. Steel grating shall be provided as specified in the Contract Documents.

422.07.11 Backfill

Backfill shall be placed in layers not exceeding 200 mm in thickness, loose measurement. Compaction shall be according to OPSS 501.

Backfilling on each side of the box units shall be completed simultaneously. At no time shall the levels on each side differ by more than 400 mm.

When native material is specified as backfill in the Contract Documents, earth material may be substituted, when approved by the Contract Administrator. In areas within the roadway, for a depth equal to the frost treatment, earth backfill shall have frost susceptibility characteristics similar to the native material. The Contract Administrator shall decide on the suitability of the earth backfill that the Contractor proposes to substitute.

Rock may be used as backfill provided the installed box units are protected by a minimum thickness of cover material as specified in the Contract Documents.

Box unit installation and backfill shall be completed prior to the start of any subbase and base course construction over the box unit location.

Shoring and bracing shall be withdrawn and removed as the excavation is being backfilled.

422.07.12 Cover

Cover shall be placed in layers not exceeding 200 mm in thickness, loose measurement, and each layer shall be compacted according to OPSS 501.

Cover in trenches and in other locations where pavements require controlled differential settlement shall be of a type and compaction level to control pavement differential settlement within acceptable limits for the specified type of pavement.

422.07.13 Clay Seal

When a clay seal is specified in the Contract Documents, the clay seal shall be placed to the dimensions specified in the Contract Documents and compacted to a minimum of 95% of the maximum dry density (MDD). The MDD shall be determined from LS-706, carried out on a single representative sample. Field density and field moisture determinations shall be made according to ASTM D 2922 and ASTM D 3017.

422.07.14 Geotechnical Testing

When specified in the Contract Documents, compliance of earth backfill material type and compaction with the requirements of this specification shall be verified by a Geotechnical Engineer approved by the Contract Administrator.

422.07.15 Management and Disposal of Excess Material

Management and disposal of excess material shall be according to OPSS 180.

422.09 MEASUREMENT FOR PAYMENT

422.09.01 Actual Measurement

422.09.01.01 Precast Reinforced Concrete Box Culverts

Measurement of the actual length of box culvert installed shall be made in metres along the centreline of the invert of the box culvert.

422.09.02 Plan Quantity Measurement

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

422.10 BASIS OF PAYMENT

422.10.01 *"size"* Precast Concrete Box Culvert - Item

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

422.10.02 Clay Seal - Item

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

422.10.03 Granular

Granular material used for bedding and levelling courses, backfill, cover, and frost tapers shall be paid for under the appropriate granular items specified in the Contract Documents.

Payment will not be made for granular used to fill any area excavated beyond the lines specified in the Contract Documents or used as cover when acceptable earth cover is available.

422.10.04 Steel Reinforcement in Concrete Appurtenances

Payment for steel reinforcement in concrete appurtenances shall be according to OPSS 905.

422.10.05 Concrete in Appurtenances

Payment for concrete appurtenances shall be according to OPSS 904.

422.10.06 Excavation for Box Culverts

Payment for earth and rock excavation shall be according to OPSS 902.

422.10.07 Swamp Excavation

Where swamp excavation is required to place precast concrete box culverts, payment for the swamp excavation shall be under the tender item covering the swamp excavation for earth embankment construction.

TABLE 1
Group Classification for Earth Bedding, Backfill and Cover Materials

Group	Grain Size	Description	Symbols
I	Coarse	Well-Graded Gravel, Gravel-Sand Mixtures, little or no fines	GW
		Poorly-Graded Gravel, Gravel-Sand Mixtures, little or no fines	GP
		Well-Graded Sand, Gravelly Sand, little or no fines	SW
		Poorly-Graded Sand, Gravelly Sand, little or no fines	SP
II	Medium	Clayey Gravel or Gravel-Sand-Clay Mixtures	GC
		Clayey Sand or Sand-Clay Mixtures	SC
		Silty Sand or Sand-Silt Mixtures	SM
		Silty Gravels or Gravel-Sand-Silt Mixtures	GM
		Inorganic Silts and Very Fine Sands, Silty or Clayey Fine Sands, Clayey Silts	ML
III	Fine	Clayey Gravel or Gravel-Sand-Clay Mixtures	GC
		Clayey Sand or Sand-Clay Mixtures	SC
		Inorganic Clay, Gravelly Clay, Sandy Clay, Silty Clay, Lean Clay	CL
		Inorganic Silts, Micaceous or Diatomaceous Fine Sandy or Silty Soil	MH

Appendix 422-A, November 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The design should specify the following in the Contract Documents:

- Geotextile type. (422.05.11)

- Bedding. (422.05.13)

- Backfill. (422.05.14)

- Cover. (422.05.15)

- Dimensions of box units and height of fill. (422.07.01)

- Bedding dimensions. (422.07.07)

- Alignment and grade of the box units. (422.07.09.01)

- Minimum cover material requirements for installation protection against rock backfill. (422.07.11)

- Clay seal. (422.07.13)

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

- Concrete appurtenances. (422.07.09.01)

- Mortared joints. (422.07.09.03)

- Preformed gasket. (422.07.09.04)

- Joint sealing compound. (422.07.09.05)

- Steel grating. (422.07.10)

- Native backfill. (422.07.11)

- Geotechnical testing. (422.07.14)

To be complete, the tender item descriptions for Precast Concrete Box Culvert should include the size of the box unit.

Related Ontario Provincial Standard Drawings

OPSD 803.010	Backfill and Cover for Concrete Culverts
OPSD 3920.100	Precast Reinforced Concrete Box Culvert With Height Of Fill ≥ 0.6m
OPSD 3920.110	Precast Reinforced Concrete Box Culvert With Height Of Fill < 0.6m
OPSD 4040.05	Culverts Warning Message Layout Details
OPSD 4040.06	Culverts Warning Message Lettering Details

NOTICE TO USERS OF OPSS 450

CONSTRUCTION SPECIFICATION

FOR PIPELINE AND UTILITY INSTALLATION IN SOIL BY HORIZONTAL DIRECTIONAL DRILLING

OPSS 450 has been removed from this
OPS volume

The municipal version of OPSS 450 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 450

There is no PROV version.

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

NOTICE TO USERS OF OPSS 460

CONSTRUCTION SPECIFICATION

FOR GRAVITY PIPE AND SEWER REHABILITATION BY CURED-IN-PLACE PIPE

OPSS 460 has been removed from this
OPS volume

The municipal version of OPSS 460 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 460

There is no PROV version.

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

NOTICE TO USERS OF OPSS 462

CONSTRUCTION SPECIFICATION FOR

CEMENT MORTAR LINING OF WATERMAINS

OPSS 462 has been removed from this
OPS volume

The municipal version of OPSS 462 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 462

There is no PROV version.

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

ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION

METRIC
OPSS 463
NOVEMBER 2015

CONSTRUCTION SPECIFICATION FOR PIPELINE AND CONDUIT INSTALLATION BY PIPE BURSTING

TABLE OF CONTENTS

463.01 SCOPE

463.02 REFERENCES

463.03 DEFINITIONS

463.04 DESIGN AND SUBMISSION REQUIREMENTS

463.05 MATERIALS

463.06 EQUIPMENT

463.07 CONSTRUCTION

463.08 QUALITY ASSURANCE

463.09 MEASUREMENT FOR PAYMENT

463.10 BASIS OF PAYMENT

APPENDICES

463-A Commentary

463.01 SCOPE

This specification covers requirements for installation of pipelines and conduits using the trenchless technology known as pipe bursting.

463.01.01 Specification Significance and Use

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

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

463.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

463.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 407	Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber Installation
OPSS 409	Closed-Circuit Television Inspection of Pipelines
OPSS 441	Watermain Installation in Open Cut
OPSS 490	Site Preparation for Pipelines, Utilities, and Associated Structures
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities and Associated Structures
OPSS 493	Temporary Potable Water Supply Services
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS 539	Temporary Protection Systems

463.03 DEFINITIONS

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

Fusion means connecting product lengths into a continuous length using elevated temperatures and pressure.

Launch Pit means an access excavation or existing access structure to an existing product for the insertion of the pipe bursting head and product.

Pipe Bursting means the application of a pipe bursting head into the interior of and along the length of an existing product to split or fracture the existing product so that the existing product and surrounding material is opened up to a sufficient size to accommodate the insertion of a product in the cavity created, without leaving any significant voids around the product. Pipe bursting methods include static, pneumatic, and hydraulic. Pipe bursting is also known internationally as pipe cracking or pipe splitting.

Product means the new pipelines or conduits.

Pull means the installation of one continuous reach of product. Generally, a pull shall commence at a launch pit and terminate at a pull pit.

Pull Pit means an access excavation or existing access structure to an existing product to receive the product or pipe bursting head or both.

Structure means a maintenance hole, valve chamber, or other such facility to access the product.

463.04 DESIGN AND SUBMISSION REQUIREMENTS

463.04.01 Submission Requirements

The following information shall be submitted to the Contract Administrator 7 Days prior to the commencement of pipe bursting operations:

a) A work plan outlining the schedule, procedures, launch pit and pull pit locations, and Working Drawings required to execute the work on the product, service laterals, and structures.

b) A list of personnel, including backup personnel, and their qualifications and experience.

c) A traffic control plan.

d) Safety plan, including the contracting company safety manual and emergency procedures.

e) When fusion joining is used, written record of current training showing that the operator has been fully trained in the use of the fusion equipment by an authorized representative of the fusion equipment manufacturer and the product manufacturer or, when applicable, certified by the Owner or Utility for which the work is being completed.

f) When applicable, product bypass and temporary supply system plans, including installation, operation, and testing procedures and a list of material and equipment to be used.

g) Manufacturer's technical data containing complete information on product:

   i. Material composition, physical properties, inside diameter, and wall thickness.
   ii. Maximum tensile strength and corresponding maximum allowable pulling force.
   iii. Transporting, unloading, storing and handling recommendations.

iv. Repair.
v. Fusion times and temperatures.
vi. Minimum bend radius.
vii. Recommended restraint method in structure.
viii. Product recovery requirements.
ix. Relaxation requirements.

h) Contingency plans for the following potential conditions:

i. Unforeseen obstructions causing burst stoppage.
ii. Deviation from required alignment and grade.
iii. Extended service disruption.
iv. Damage to the existing service connections and the replacement of product's structural integrity and methods of repair.
v. Damage to other existing Utilities.
vi. Soil heaving or settlement.
vii. Contaminated soil or water.
viii. Alignment passing through buried structures.

463.05 MATERIALS

463.05.01 Pipe Materials

Pipe type, class, pressure rating, and size shall be as specified in the Contract Documents.

463.05.02 Valves

Valve type, class, pressure rating, and size shall be as specified in the Contract Documents.

463.05.03 Fittings

Fittings shall be suitable for and compatible with the type, class, pressure rating, and size of pipe with which they are used.

463.05.04 Lubricant

Lubricant used to reduce friction, to maintain the annular space created by the pipe bursting head, and to allow the insertion of the product shall be non-toxic and biodegradable.

463.06 EQUIPMENT

463.06.01 Pipe Bursting Head

The pipe bursting head shall be according to the manufacturer's specifications for head sizes recommended for various product diameters and types, as well as parameters associated with maximum allowable upsize percentages.

463.06.02 Pipe Bursting Power Source

The pipe bursting power source shall generate sufficient force to burst and compact the existing product into the surrounding material.

463.06.03 Fusion Equipment

Fusion equipment, when used, shall be sized and rated for the product. Fusion clamps shall be sized to clamp the product properly.

463.07 CONSTRUCTION

463.07.01 General

The product shall be installed following the alignment and grade of the existing pipe and to the ovality specified in the Contract Documents.

The Contract Administrator shall be notified at least 48 hours prior to commencement of work.

463.07.02 Site Preparation

Site preparation shall be according to OPSS 490 and as specified herein.

The work site shall be graded or filled to provide a level working area for the pipe bursting equipment. No alterations beyond what is required for the pipe bursting operations shall be made. All activities shall be confined to designated work areas.

463.07.03 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

When specified in the Contract Documents, an existing facility shall be exposed to verify its horizontal and vertical location. The number of exposures required to monitor work progress shall be as specified in the Contract Documents.

463.07.04 Transporting, Unloading, Storing, and Handling Materials

Manufacturer's recommendations for transporting, unloading, storing, and handling of materials shall be followed.

463.07.05 Trenching, Backfilling, and Compacting

Trenching, backfilling, and compacting for launch pits, pull pits, and other excavation locations shall be according to OPSS 401.

Launch pits and pull pits shall be sized to allow the use of the pipe bursting equipment and to allow the product to be installed such that the product manufacturer’s recommendations for product bending radius are not exceeded.

463.07.06 Support Systems

Support systems shall be according to OPSS 404.

463.07.07 Dewatering

Dewatering shall be according to OPSS 517.

463.07.08 Temporary Protection Systems

The construction of temporary protection systems shall be according to OPSS 539.

Where the stability, safety, or function of an existing roadway, railway, watercourse, other works, or proposed works may be impaired due to the method of operation, protection shall be provided. Protection may include sheathing, shoring, and piling where necessary to prevent damage to such works or proposed works.

463.07.09 Temporary Potable Water Supply Services

When specified in the Contract Documents, temporary potable water supply services shall be according to OPSS 493.

463.07.10 Product By-Pass

When specified in the Contract Documents, during the execution of the work the flow within the existing product shall be bypassed around the product being replaced and the continuity of service to each facility connected to the affected section of product shall be maintained.

The pumps and by-pass lines shall be of adequate capacity and size to handle all flows.

463.07.11 Preparation of Existing Product and Structures

All existing crosses, tees, valves, and service connections shall be located, exposed, and disconnected prior to any pipe bursting operation.

Prior to pipe bursting, the inlets, outlets, and benching of existing structures shall be enlarged sufficiently for clearance of the pipe bursting head and the product. Enlargements shall be made neatly and be no greater than that required for their purpose. Size of the enlargements shall be sufficient to allow for restoration and sealing to the product.

Existing product shall be cleared of obstructions (e.g., rocks and debris) or mechanical obstructions (e.g., repair sleeves, clamps, couplings, and intolerable deviations in grade or alignment) prior to pipe bursting.

463.07.12 Product Joining

463.07.12.01 General

The product shall be joined according to the manufacturer's recommendations.

The product shall be assembled and joined at the site to provide a leak-proof joint.

When space and the Contract Documents permit, the length of the product to be pulled shall be joined as one length prior to the commencement of the pulling operation.

When used, fusion shall be performed by technicians trained in the use of the fusion equipment.

Joints shall be capable of withstanding the loading of the installation process. All joints shall be subject to acceptance by the Contract Administrator prior to insertion.

463.07.12.02 Connection to Product or Structures

Product shall be allowed to recover from any induced stresses and strains before connection to new or existing product or structures are made. Product recovery time shall be according to the manufacturer's recommendations.

The product connection to the structure or to an existing product shall be leak-proof.

463.07.12.03 Service Connections

Service connection work shall be as specified in the Contract Documents.

Service connection work shall not commence until the product has fully recovered.

463.07.13 Product Installation

Installation procedures shall be according to the product manufacturer's guidelines.

The product shall be protected from damage during the installation process.

Suitable guides shall be used to protect the product from damage at the insertion point and at any intermediate re-entry points.

Upon commencement of the bursting process, product insertion shall be continuous from the launch pit to the pull pit, except when approved by the Contract Administrator. A pushing machine may be used to assist insertion from the rear.

When specified in the Contract Documents, a weak link, breakaway connector, or load monitor shall be used to prevent excess pulling force from damaging the product.

463.07.14 Structures and Valves

When the product enters or exits an existing structure, the structure wall shall be restored as specified in the Contract Documents. Restoration shall securely locate and anchor the product in the wall and shall produce a leak-proof seal.

The existing structure's benching shall be restored according to the requirements of the product, any other incoming product, and as specified in the Contract Documents.

When new structures or valves are specified, they shall be installed according to OPSS 407 and OPSS 441, respectively.

463.07.15 Testing

Testing of the product joining and installation shall be as specified in the Contract Documents.

When specified in the Contract Documents, closed-circuit television (CCTV) inspection shall be completed on the product after installation.

463.07.16 Record Keeping

Verification record requirements of the alignment and grade of the installed product shall be as specified in the Contract Documents. A copy of the verification records shall be given to the Contract Administrator at the completion of the pipe bursting operations.

463.07.17 Closed-Circuit Television Inspection

CCTV inspection shall be according to OPSS 409.

463.07.18 Site Restoration

Site restoration shall be according to OPSS 492.

463.07.19 Management of Excess Material

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

463.08 QUALITY ASSURANCE

463.08.01 Acceptance Criteria

Acceptance criteria for the product installation shall be as specified in the Contract Documents.

463.09 MEASUREMENT FOR PAYMENT

463.09.01 Actual Measurement

463.09.01.01 Product Installation by Pipe Bursting

Measurement for a product installation by pipe bursting shall be by length in metres along the horizontal centreline of the product between connecting points or, if there is no connecting point, to the end of the product. When the connecting point is a structure, measurement for a product installation shall be by length in metres to the centre of the structure.

463.09.01.02 Service Connections

For measurement purposes, a count shall be made of the number of existing services that are disconnected from the existing product and reconnected to the product.

463.09.02 Plan Quantity Measurements

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

463.10 BASIS OF PAYMENT

463.10.01 Product Installation by Pipe Bursting, *"type of product, diameter of product, use of product"* - Item
Product Bypass - Item
Service Connections - Item
Closed-Circuit Television Inspection - Item

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

463.10.02 Closed-Circuit Television Inspection

When the Contract does not contain a separate tender item for CCTV inspection, the Contract price for the Product Installation by Pipe Bursting item shall include full compensation for all labour, Equipment, and Material to do the work of CCTV inspection.

Appendix 463-A, November 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

This specification was written to encompass the majority of pipe bursting operations for small and medium sized projects. However, the basic design considerations should always include properly planned entry and exit points, grade of existing host pipe, adjacent Utilities, and connection requirements.

The International Pipe Bursting Association (IPBA) normally assigns pipe bursting work to one of three classifications. These following classifications (January 2012 version) are intended for use as general guidelines when considering replacement of existing pipe by pipe bursting techniques. The classification should be determined based on the more stringent parameter in the table below.

IPBA Classification and Degree of Difficulty	Depth of Pipe m	Existing Pipe Diameter mm	New Pipe Diameter Options	Burst Length m	Original Trench Width	Soil Type
A - Minimal	< 3.65	–50 - 300	Size on Size	0 - 100	Relatively wide trench compared to expander head outside diameter.	Compressible soils outside trench (loose sand, gravel, soft clay).
B - Moderate	> 3.66 to < 5.5	—350-450	Single Upsize	–100 - 150	Trench width less than 4" wider than the expander head outside diameter.	Moderately compressible soils outside trench (medium dense to dense sand, medium to stiff clay).
C - Comprehensive	> 5.6+	–500 - 900	Double / Triple Upsize	–150 - 300	Incompressible soils outside trench.	Constricted trench geometry (width less than or equal to outside diameter of bursting head).
D - Developmental						

The designer may consider a pre-qualification process to ensure that the contractor(s) possess the required capabilities and qualifications to undertake the work required under the contract.

The designer should include the following in the Contract Documents:

Appendix 463-A

- Pipe type, class, pressure rating, and size. (463.05.01)

- Valve type, class, pressure rating, and size. (463.05.02)

- Product ovality. (463.07.01)

- Service connection work. (463.07.12.03)

- Benching restoration. (463.07.14)

- Testing of product joining and installation. (463.07.15)

- Verification record requirements. (463.07.16)

- Acceptance criteria. (463.08.01)

The designer should determine if the following are required and, if so, they should be specified in the Contract Documents:

- Exposing existing facilities. (463.07.03)

- Use of temporary potable water supply services. (463.07.09)

- Product by-pass. (463.07.10)

- Joining and pulling product as one length. (463.07.12.01)

- Use of a weak link, breakway connector, or load monitor. (463.07.13)

- Wall restoration. (463.07.14)

- Completion of a CCTV inspection. (463.07.15)

The designer should give consideration, in consultation with the pipe manufacturer, to minimum allowable product bending radii commensurate with the pipeline's strength.

The designer should give special consideration to the required grades at the entry and exit points. The designer may undertake a CCTV inspection and location analysis prior to pipe bursting to review the existing line and grade to determine if deviations are acceptable.

Product upsizing by using a pipe bursting technique may induce stresses in the surrounding soil resulting in potential damage to nearby Utilities and foundations. The degree of distortion on the zone of influence is a function of the degree of upsizing, the pipe material of a nearby Utility, the location of nearby Utilities in relation to the pipe burst pipe, and the soil conditions. The designer may consider exposure of critical services by non-destructive methods to monitor the pipe bursting progress and impacts.

The designer should consider the need for product bypass, temporary potable water supply services, or temporary flow stoppage or blockage with inflatable plugs during the pipe bursting operation. The designer may require that during the execution of the work, the flow shall be bypassed around the product being replaced and the continuity of service to each facility connected to the affected section of product be maintained. The designer should consider what should be done if there is an extended service disruption.

Appendix 463-A

For certain product installations, the designer may consider the requirement of a weak link, breakaway connector, or load monitor to prevent excess pulling force from damaging the product.

The designer should consider the type of interface and the degree of continuity between the product and the existing structure to ensure appropriate anchoring and seals in order to prevent product retraction or inadvertent leaks to the new system.

The designer may specify the completion of a CCTV inspection of the product after installation, particularly when grade thresholds are critical. In smaller diameter product installations when the designer elects to complete a CCTV survey, the designer may wish to specify a lighter interior colour of the product installation, if available.

Testing of product joining and installation may include hydrostatic, air, BACT-T, etc.

Verification record requirements may include such information as reporting information available from the pipe bursting machine, daylighting, installation of tracer wire with the product, the use of acoustic or magnetic locating equipment, etc.

Acceptance criteria requirements may include such considerations as successful bursting operation from entry to pull back location; CCTV inspection, removal of extra coupon pipe length from the pull back pit to view for stresses, grade verification, etc.

The designer may consider including a process regarding payment for failed pipe bursting attempts in the Contract Documents.

The tender item description for Product Installation by Pipe Bursting should include reference to one or more of the attributes shown (i.e., type of product, diameter of product, and use of product) to be complete.

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

Related Ontario Provincial Standard Drawings

No information provided here.

NOTICE TO USERS OF OPSS 490

CONSTRUCTION SPECIFICATION
FOR SITE PREPARATION FOR PIPELINES, UTILITIES, AND ASSOCIATED STRUCTURES

OPSS 490 has been removed from this
OPS volume

The provincial version of OPSS 490 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 490

The municipal version of OPSS 490 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 490

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

NOTICE TO USERS OF OPSS 491

CONSTRUCTION SPECIFICATION FOR
PRESERVATION, PROTECTION, AND RECONSTRUCTION OF EXISTING FACILITIES

OPSS 491 has been removed from this
OPS volume

The provincial version of OPSS 491 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 491

The municipal version of OPSS 491 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 491

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

NOTICE TO USERS OF OPSS 492

CONSTRUCTION SPECIFICATION
FOR SITE RESTORATION FOLLOWING INSTALLATION OF PIPELINES, UTILITIES, AND ASSOCIATED STRUCTURES

OPSS 492 has been removed from this
OPS volume

The provincial version of OPSS 492 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 492

The municipal version of OPSS 492 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 492

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

NOTICE TO USERS OF OPSS 493

CONSTRUCTION SPECIFICATION

FOR TEMPORARY POTABLE WATER SUPPLY SERVICES

OPSS 493 has been removed from this
OPS volume

The municipal version of OPSS 493 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 493

There is no PROV version.

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

NOTICE TO USERS OF OPSS 506

CONSTRUCTION SPECIFICATION FOR
DUST SUPPRESANTS

OPSS 506 has been removed from this
OPS volume

There is no provincial version of OPSS 506

The municipal version of OPSS 506 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 506

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

NOTICE TO USERS OF OPSS 511

CONSTRUCTION SPECIFICATION
FOR RIP-RAP, ROCK PROTECTION, AND GRANULAR SHEETING

OPSS 511 has been removed from this
OPS volume

The provincial version of OPSS 511 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 511

The municipal version of OPSS 511 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 511

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

NOTICE TO USERS OF OPSS 602

CONSTRUCTION SPECIFICATION FOR INSTALLATION OF ELECTRICAL CHAMBERS

OPSS 602 has been removed from this OPS volume

The provincial version of OPSS 602 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 602

The municipal version of OPSS 602 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 602

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

NOTICE TO USERS OF OPSS 603

CONSTRUCTION SPECIFICATION FOR INSTALLATION OF DUCTS

OPSS 603 has been removed from this OPS volume

The provincial version of OPSS 603 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 603

The municipal version of OPSS 603 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 603

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

NOTICE TO USERS OF OPSS 604

CONSTRUCTION SPECIFICATION FOR
INSTALLATION OF CABLES

OPSS 604 has been removed from this
OPS volume

The provincial version of OPSS 604 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 604

The municipal version of OPSS 604 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 604

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

NOTICE TO USERS OF OPSS 609

CONSTRUCTION SPECIFICATION FOR GROUNDING

OPSS 609 has been removed from this OPS volume

The provincial version of OPSS 609 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 609

The municipal version of OPSS 609 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 609

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

NOTICE TO USERS OF OPSS 611

CONSTRUCTION SPECIFICATION FOR INSTALLATION OF UNDERPASS LUMINAIRES

OPSS 611 has been removed from this OPS volume

The provincial version of OPSS 611 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 611

The municipal version of OPSS 611 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 611

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

NOTICE TO USERS OF OPSS 614

CONSTRUCTION SPECIFICATION FOR
INSTALLATION OF POWER SUPPLY EQUIPMENT

OPSS 614 has been removed from this
OPS volume

The provincial version of OPSS 614 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 614

The municipal version of OPSS 614 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 614

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

NOTICE TO USERS OF OPSS 615

CONSTRUCTION SPECIFICATION FOR
ERECTION OF POLES

OPSS 615 has been removed from this
OPS volume

The provincial version of OPSS 615 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 615

The municipal version of OPSS 615 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 615

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

NOTICE TO USERS OF OPSS 616

CONSTRUCTION SPECIFICATION FOR FOOTINGS AND PADS FOR ELECTRICAL EQUIPMENT

OPSS 616 has been removed from this OPS volume

The provincial version of OPSS 616 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 616

The municipal version of OPSS 616 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 616

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

NOTICE TO USERS OF OPSS 617

CONSTRUCTION SPECIFICATION FOR INSTALLATION OF ROADWAY LUMINAIRES

OPSS 617 has been removed from this OPS volume

The provincial version of OPSS 617 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 617

The municipal version of OPSS 617 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 617

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

NOTICE TO USERS OF OPSS 620

CONSTRUCTION SPECIFICATION FOR
TRAFFIC SIGNAL EQUIPMENT

OPSS 620 has been removed from this
OPS volume

The provincial version of OPSS 620 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 620

The municipal version of OPSS 620 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 620

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

NOTICE TO USERS OF OPSS 631

CONSTRUCTION SPECIFICATION FOR CONCRETE FOOTING AND MAINTENANCE PLATFORMS FOR HIGH MAST LIGHTING POLES

OPSS 631 has been removed from this
OPS volume

The provincial version of OPSS 631 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 631

The municipal version of OPSS 631 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 631

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

NOTICE TO USERS OF OPSS 703

CONSTRUCTION SPECIFICATION FOR
PERMANENT SMALL SIGNS AND SUPPORT SYSTEMS

OPSS 703 has been removed from this
OPS volume

The municipal version of OPSS 703 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 703

The municipal version of OPSS 703 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 703

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

CONSTRUCTION SPECIFICATION FOR POST MOUNTED DELINEATORS

TABLE OF CONTENTS

704.01 **SCOPE**

704.02 **REFERENCES**

704.03 **DEFINITIONS - Not Used**

704.04 **DESIGN AND SUBMISSION REQUIREMENTS - Not Used**

704.05 **MATERIALS**

704.06 **EQUIPMENT - Not Used**

704.07 **CONSTRUCTION**

704.08 **QUALITY ASSURANCE - Not Used**

704.09 **MEASUREMENT FOR PAYMENT**

704.10 **BASIS OF PAYMENT**

APPENDICES

704-A **Commentary**

704.01 SCOPE

This specification covers the requirements for the installation of post mounted delineators.

704.01.01 Specification Significance and Use

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

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

704.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

704.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Material

OPSS 2001 Signs

Ontario Ministry of Transportation Publications

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

ASTM International

A 36/A 36M-12	Carbon Structural Steel
A 123/A 123M-13	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 153/A 153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
D 4956-13	Retroreflective Sheeting for Traffic Control

704.05 MATERIALS

704.05.01 Delineator Posts

Delineator post dimensions shall be as specified in the Contract Documents.

Delineator posts shall be fabricated from steel according to ASTM A 36M and hot dip galvanized after fabrication according to ASTM A 123M.

704.05.02 Hardware

Hardware shall be as specified in the Contract Documents. All hardware shall be hot dip galvanized according to ASTM A 153M.

704.05.03 Delineators

Delineators shall be outfitted with high intensity retroreflective sheeting according to ASTM D 4956, Type III or IV; and the colour according to OTM Book 11. Dimensions shall be as specified in the Contract Documents. Sign blanks shall be metal and according to OPSS 2001 with dimensions as specified in the Contract Documents.

704.07 CONSTRUCTION

704.07.01 General

Post mounted delineators shall be installed plumb and set according to alignment and grade according to and at the locations and spacing specified in the Contract Documents.

704.07.02 Delineators

Delineators shall be mounted on the posts as specified in the Contract Documents. Delineators shall be centred vertically and horizontally over the post holes. The type shall be as specified in the Contract Documents.

704.07.03 Management of Excess Material

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

704.09 MEASUREMENT FOR PAYMENT

704.09.01 Actual Measurement

704.09.01.01 Post Mounted Delineators

For measurement purposes, a count shall be made of the number of complete post mounted delineators installed.

704.09.02 Plan Quantity Measurement

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

704.10 BASIS OF PAYMENT

704.10.01 Post Mounted Delineators - Item

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

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

Appendix 704-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Post mounted delineator locations and spacing. (704.07.01)

- Type A or Type B post mounted delineators. (704.07.02)

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

Related Ontario Provincial Standard Drawings

OPSD 984.101 Post Mounted Delineator, Installation

CONSTRUCTION SPECIFICATION FOR FLEXIBLE DELINEATOR POSTS

TABLE OF CONTENTS

705.01 **SCOPE**

705.02 **REFERENCES**

705.03 **DEFINITIONS**

705.04 **DESIGN AND SUBMISSION REQUIREMENTS**

705.05 **MATERIALS**

705.06 **EQUIPMENT - Not Used**

705.07 **CONSTRUCTION**

705.08 **QUALITY ASSURANCE - Not Used**

705.09 **MEASUREMENT FOR PAYMENT**

705.10 **BASIS OF PAYMENT**

APPENDICES

705-A **Commentary**

705.01 SCOPE

This specification covers the requirements for the installation of permanent and temporary flexible delineator posts and relocation of temporary flexible delineator posts.

705.01.01 Specification Significance and Use

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

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

705.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

705.02 REFERENCES

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

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

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

Ontario Provincial Standards Specifications, Material

OPSS 1212 Hot Poured Rubberized Asphalt Joint Sealing Compound

Ontario Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 7 - Temporary Conditions
Book 11 - Pavement, Hazard and Delineation Markings

ASTM International

D 4956-13 Retroreflective Sheeting for Traffic Control

705.03 DEFINITIONS

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

Flexible Delineator Post means a tubular plastic marker installed vertically for the purpose of channelizing traffic or delineating roadside features in temporary or permanent applications. The tubular post is securely fixed to the ground surface by hinged (flexible) connection to a solid base. When impacted by a vehicle, the post has the ability to bend 90° from vertical and self-restore following impacts.

705.04 DESIGN AND SUBMISSION REQUIREMENTS

705.04.01 Submission Requirements

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

Installation of the flexible delineator posts shall not commence until the Contract Administrator has received the copy of the instructions.

705.05 MATERIALS

705.05.01 Flexible Delineator Posts

A list of approved manufacturers shall be as specified in the Contract Documents.

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

The height of the post shall be as specified in the Contract Documents.

The post colour shall match the colour of the reflective sheeting.

To maintain a visually consistent installation, only one product shall be used on the Contract.

705.05.02 Anchor and Support Hardware

Anchor and support hardware used to fix the flexible delineator post to the ground surface shall be supplied by the manufacturer.

705.05.03 Reflective Sheeting

Flexible delineator posts shall be outfitted with high intensity retroreflective sheeting according to ASTM D 4956, Type III or IV. For permanent conditions, the colour shall be according to OTM Book 11. For temporary conditions, the colour shall be according to OTM Book 7. Dimensions, spacing, and quantity shall be as specified in the Contract Documents.

705.05.04 Temporary Flexible Delineator Posts

Temporary flexible delineator posts may be reused provided each post meets each of the following criteria:

a) The ability to bend 90° from vertical and self-restore to a vertical position after impacts.

b) The base is intact and permits anchorage to the ground surface that is equivalent to a new post.

c) The post is intact without any cracks or fissures.

d) The retroreflective sheeting is fully intact with only minor tears or scratches that do not affect the reflectivity of the sheeting.

705.07 CONSTRUCTION

705.07.01 General

Permanent and temporary flexible delineator posts shall be installed and securely fixed to the ground surface according to the manufacturer's instructions at locations specified in the Contract Documents.

705.07.02 Relocation of Temporary Flexible Delineator Posts

Flexible delineator posts shall be relocated as specified in the Contract Documents, including the removal of existing and installation of new anchorage hardware and adhesives.

All holes resulting from the relocation of the delineator post assemblies shall be filled with a hot poured rubberized asphalt joint sealing compound according to OPSS 1212 when they are located in areas not to be resurfaced as part of the Work. At the time of filling, the holes shall be dry and free of dust and debris.

705.07.03 Maintenance of Temporary Flexible Delineator Posts

Flexible delineator posts shall be maintained for the duration of the construction period for which they are required.

Flexible delineator posts shall be monitored on a daily basis. Missing or broken flexible delineator posts shall be replaced within 48 hours.

Posts that do not have a uniform or satisfactory appearance to the satisfaction of the Contract Administrator shall be replaced or corrected within 48 hours of notification.

D 704.07.04 Removal of Temporary Flexible Delineator Posts

Flexible delineator posts and associated hardware and adhesives shall be removed at the completion of the construction period for which they were required.

All holes resulting from the removal of the delineator post assemblies shall be filled with a hot poured rubberized asphalt joint sealing compound according to OPSS 1212 when they are located in areas not to be resurfaced as part of the Work. At the time of filling, the holes shall be dry and free of dust and debris.

705.07.05 Management of Excess Material

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

705.09 MEASUREMENT FOR PAYMENT

705.09.01 Actual Measurement

705.09.01.01 Flexible Delineator Post - Permanent

For measurement purposes, a count shall be made of the number of complete flexible delineator posts installed.

705.09.01.02 Flexible Delineator Post - Temporary

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

705.09.01.03 Flexible Delineator Post - Relocation

For measurement purposes, a count shall be made of the number of complete flexible delineator posts relocated. Flexible delineator posts that are temporarily surplus and are required for future stages shall be paid for as one relocation for the combined moves into and out of storage, including any off-site storage required due to on-site restrictions.

705.09.02 Plan Quantity Measurement

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

705.10 BASIS OF PAYMENT

705.10.01 Flexible Delineator Post - Permanent - Item
Flexible Delineator Post - Temporary - Item
Flexible Delineator Post - Relocation - Item

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

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

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

Appendix 705-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- A list of approved manufacturers. (705.05.01)

- Post height. (705.05.01)

- Dimensions, spacing, and quantity of retroreflective sheeting. (705.05.03)

- Flexible delineator post locations. (705.07.01)

- Relocation of flexible delineator posts. (705.07.02)

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

Related Ontario Provincial Standard Drawings

No information provided here.

CONSTRUCTION SPECIFICATION FOR MODIFIED OVERHEAD SIGNBOARDS

TABLE OF CONTENTS

707.01 **SCOPE**

707.02 **REFERENCES**

707.03 **DEFINITIONS – Not Used**

707.04 **DESIGN AND SUBMISSION REQUIREMENTS – Not Used**

707.05 **MATERIALS – Not Used**

707.06 **EQUIPMENT – Not Used**

707.07 **CONSTRUCTION**

707.08 **QUALITY ASSURANCE – Not Used**

707.09 **MEASUREMENT FOR PAYMENT**

707.10 **BASIS OF PAYMENT**

APPENDICES

707-A **Commentary**

707.01 SCOPE

This specification covers the requirements for the installation of new overlay signboards on existing overhead extruded signboards.

707.01.01 Specification Significance and Use

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

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

707.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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.

707.02 REFERENCES

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

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

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

Ontario Ministry of Transportation Publications

Ontario Traffic Manual (OTM)
Sign Support Manual

707.07 CONSTRUCTION

707.07.01 General

All existing overlay signboard panels shall be removed by drilling out all pop rivets used to fasten it to the extruded sign.

New overlay signboard panels shall be installed according to the sign details.

Aluminum pop rivets, 1/8" X 7/16", shall be used to install the overlay panel directly on top of the existing extruded sign. The rivets shall be spaced around the perimeter of each overlay panel 25 mm (1") from the edge of the panel at 150 mm (6") centre to centre spacing.

Inside each 1220 mm (4') panel, 6 aluminum pop rivets shall be inserted equally spaced 610 mm (24") from the edge of the panel. Inside each 914 mm (3') panel, 6 aluminum pop rivets shall be inserted equally spaced 450 mm (18") from the edge of the panel. If the panel is over 1830 mm (6') in height, 6 pop rivets shall be installed equally spaced 450 mm (18") from the edge of the panel.

To ensure panels do not peel, ¼ " stainless steel self-tapping screws shall be attached to the corners of all overlay panels, regardless of size.

707.07.02 Sign Ordering

The following shall be submitted to the Contract Administrator a minimum of 12 weeks prior to the installation date:

a) List of all required overlay signboards,

b) Sign details for the overlay signboards, and

c) Date for pick-up.

707.07.03 Sign Pick up

All ordered signboards shall be picked up at the location specified in the "Schedule of Materials to be Supplied by the Owner" within 10 Business Days of receiving notice from the Contract Administrator that the signs are ready for pick up.

707.07.04 Management of Excess Material

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

707.09 MEASUREMENT FOR PAYMENT

707.09.01 Actual Measurement

707.09.01.01 Modified Overhead Signboards

For measurement purposes, a count shall be made of each modified signboard installed.

707.09.02 Plan Quantity Measurement

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

707.10 BASIS OF PAYMENT

707.10.01 Modified Overhead Signboards - Item

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

Appendix 707, November 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION

METRIC
OPSS 710
NOVEMBER 2010
(Formerly OPSS 532, June 1991)

CONSTRUCTION SPECIFICATION FOR PAVEMENT MARKING

TABLE OF CONTENTS

710.01 **SCOPE**

710.02 **REFERENCES**

710.03 **DEFINITIONS**

710.04 **DESIGN AND SUBMISSION REQUIREMENTS**

710.05 **MATERIALS**

710.06 **EQUIPMENT**

710.07 **CONSTRUCTION**

710.07.09 **Application**

710.08 **QUALITY ASSURANCE**

710.09 **MEASUREMENT FOR PAYMENT**

710.10 **BASIS OF PAYMENT**

APPENDICES

710-A **Commentary**

710.01 SCOPE

This specification covers the requirements for the application of pavement markings onto bituminous or concrete pavement.

710.01.01 Specification Significance and Use

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

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

710.01.02 Appendices Significance and Use

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

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710.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Material

OPSS 1712	Organic Solvent Based Traffic Paint
OPSS 1713	Thermoplastic Pavement Marking Materials
OPSS 1714	Field Reacted, Polymeric Pavement Marking Materials
OPSS 1715	Preformed Plastic Pavement Marking Tap
OPSS 1716	Water-Borne Traffic Paint
OPSS 1750	Traffic Paint Reflectorizing Glass Beads

Ontario Ministry of Transportation Publications

Manual of Uniform Traffic Control Devices for Ontario, MUTCD

710.03 DEFINITIONS

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

Durable Pavement Markings: refer to pavement markings produced by either thermoplastics, field reacted polymer or a preformed plastic tape of durable type.

Field Reacted Polymeric Pavement Marking Material: refers to a pavement marking material consisting of two separate components; a polymerizable component and a curing agent or a polymerization catalyst. These two components are designed to be mixed at the site at recommended proportions and applied during the pot life of the mixture.

Hot Applied Thermoplastic Pavement Marking Material: refers to a thermoplastic material that is specifically formulated for hot spray or screed application.

Organic Solvent Based Traffic Paint: refers to a traffic paint whose components are carried in an organic solvent system and will form a solid paint film on evaporation of the solvent after application.

Pavement Markings: refer to markings on pavements, used to delineate vehicle operating limits on highways and streets, conforming to the size and shape, as specified in the MUTCD.

Permanent Pavement Markings: refer to pavement markings placed other than Temporary Pavement Markings or short term pavement markings.

Preformed Plastic Pavement Marking Tape: refers to plastic material specifically designed and preformed into pliable rolls or ribbons of various lengths and widths or into symbols.

Premarking: refers to the indicating marks, required to identify the position of pavement markings.

Reflectorization: refers to a material, treatment or process to enable incident light to be returned in high proportions in the general direction of the light source.

Short Term Pavement Markings: refer to the markings placed prior to the placement of permanent pavement markings, on any milled, levelling, binder or top course pavements where existing lane widths, arrangements and alignments are maintained.

Temporary Pavement Markings: refer to pavement markings placed on temporary roadway surfaces or alignments during construction.

Temporary Pavement Marking Material: refers to pavement marking materials designed to maintain a service life of a minimum of three months.

Temporary Pavement Markings - Removable: refer to pavement markings using materials designed to be removed after use.

Temporary Raised Pavement Markers: refer to raised reflective devices.

Traffic Paint: refers to a paint specifically formulated for use as a pavement marking.

Water-Borne Traffic Paint: refers to a traffic paint whose components are carried in water either as an emulsion or a dispersion and will form a solid paint film on deposition and evaporation of water and volatiles after application.

710.04 DESIGN AND SUBMISSION REQUIREMENTS

710.04.01 General

One-litre samples of solvent based and/or water- borne paint; 500 g samples of thermoplastics; 500 g sample of field reacted polymeric materials, with an adequate amount of catalyst or curing agent; one metre section of preformed pavement marking tape and a 200 g sample of reflectorizing glass beads to be used on the contract shall be supplied to the Authority one month prior to use, prepaid, by the Contractor.

If any sample fails to conform to the specification requirements, none of the batch from which the sample was taken shall be used. New batches shall be obtained at no additional cost to the Authority and the new batches shall be tested until an acceptable batch is obtained.

710.05 MATERIALS

710.05.01 Classification

Pavement markings are classified into the following types based on performance requirements:

a. Traffic Paint
b. Pavement Marking - Durable
c. Pavement Marking - Temporary
d. Pavement Marking - Temporary - Removable

710.05.02 Organic Solvent Based Traffic

Organic solvent based traffic paint shall conform to OPSS 1712.

710.05.03 Thermoplastic Pavement Marking Materials

Thermoplastic pavement marking materials shall conform to OPSS 1713.

710.05.04 Field Reacted Polymeric Pavement Marking Materials

Field reacted polymeric pavement marking materials shall conform to OPSS 1714.

710.05.05 Preformed Plastic Pavement Marking Tape

Preformed plastic pavement marking tape shall conform to OPSS 1715.

710.05.06 Water-Borne Traffic Paint

Water-borne traffic paint shall conform to OPSS 1716.

710.05.07 Special Considerations

Materials not conforming to the no-tracking time requirements of the applicable specification, may be used when approved by the Authority.

710.06 EQUIPMENT

710.06.01 General

The equipment to be used for application or installation of pavement markings shall be as recommended by the manufacturer of the respective pavement marking material.

710.06.02 Spray Equipment

710.06.02.01 General

Spray equipment shall be used for application of solvent based traffic paint, water-borne traffic paint, thermoplastics and field reacted polymeric material recommended for spray application.

Spray equipment shall be fabricated from materials that will not contaminate the traffic paint and other pavement marking materials.

The spray equipment shall provide a uniform stripe to the required width and thickness, with sharp edges without excessive splatter or overspray. The equipment shall have the capability to provide pavement markings conforming to the MUTCD. The equipment shall be provided with glass bead dispenser to apply overlay glass beads at the recommended rate.

710.06.02.02 Thermoplastic Pavement Markings

Equipment to be used for the application of thermoplastic material shall be capable mixing, maintaining and applying the material at the recommended temperature.

710.06.03 Other Methods of Application

Field reacted polymeric materials and thermoplastics shall be applied using a screed applicator.

Preformed plastic tape shall be installed conforming to the manufacturer's recommendations.

710.07 CONSTRUCTION

710.07.01 General

As part of the work, the Contractor shall supply pavement marking and symbols conforming to the applicable shapes and sizes as outlined in the MUTCD.

The Contractor shall apply the pavement marking and symbols conforming to the contract drawings, when provided, MUTCD and the manufacturer's recommendations.

The work of pavement marking includes: providing samples of materials for testing for conformity to the appropriate material specification, surface preparation, pavement marking obliterating, premarking, application of temporary, short term and permanent pavement markings.

Where the pavement marking scheme is not shown in the contract drawings, it shall conform to the MUTCD or be provided by the Authority.

710.07.02 Surface Preparation

The pavement surface must be clean and dry. Contaminants such as dirt, loose asphalt particles and oily residue shall be removed prior to application of pavement marking.

710.07.03 Pavement Marking Obliterating

Durable markings and traffic paint shall be obliterated or removed using the method indicated in the contract at the location(s) specified.

710.07.04 Premarking

The Contractor shall provide the necessary measurements required to establish the position of all pavement markings.

710.07.05 Temporary Pavement Marking

Temporary markings shall include surface preparation, premarking and placement of temporary markings.

Temporary pavement marking shall be placed on temporary road surfaces prior to the opening to the general public, conforming to MUTCD or as specified in the contract.

710.07.06 Short Term Pavement Marking

Short term pavement marking is required when a paved roadway is to be opened to the general public prior to the application of permanent pavement markings.

As part of the work of pavement marking, the Contractor shall apply short term pavement markings for the centreline and lane lines.

Short term pavement markings shall be applied conforming to MUTCD and as amended by Table 1.

Short term pavement markings shall not conflict with permanent pavement markings.

Short term pavement markings placed on final surface course shall be of the removable type.

A temporary raised pavement marker may be used in place of one 0.3 m line.

710.07.07 Permanent Pavement Marking

Permanent pavement marking includes surface preparation, premarking, short term pavement marking, removal of short term pavement markings and placement of permanent pavement markings.

When permanent pavement markings cannot be placed prior to the opening to traffic, Freeways, Major and Minor Roadways must have short term pavement markings conforming to Division C of the MUTCD and as amended by Table 1.

Permanent pavement markings must be in place and maintained prior to any winter shut down.

TABLE 1
Short Term Pavement Markings

TYPE OF MARKING NOTE 1	TYPE OF ROADWAY	LENGTH OF LINES MIN.	LENGTH OF GAPS MAX.	LENGTH OF TIME BEFORE PERMANENT MARKINGS ARE PLACED MAX.
A	Freeway - six Lanes or Greater, Three Lanes per Direction	3 m Note 2	9 m Note 2	15 Working Days
B	Freeway - Four Lanes, Two Lanes per Direction	0.3 m	15 m	15 Working Days
C	Major Roadways- Six Lanes or Greater, Three Lanes per Direction	3 m Note 2	6 m Note 2	15 Working Days
D	Major Roadways - Four Lanes, or Less	0.3 m	15 m	15 Working Days
E	Minor Roadways	0.3 m	15 m	20 Working Days

Notes: 1. Type of marking as specified elsewhere in the contract.
2. Same as MUTCD.

710.07.08 Selection of Materials

When the item Pavement Marking, or Pavement Marking Symbols, is called for, the Contractor is restricted to traffic paint.

When the item Pavement Marking, Durable or Pavement Marking Symbols, Durable is called for, the Contractor's choice of material is restricted to:

- durable preformed plastic tape
- field reacted polymeric pavement marking material
- thermoplastic pavement marking material

When the item Pavement Marking, Temporary, or Pavement Marking Symbols, Temporary, is called for the Contractor may choose from all marking materials.

When the item Pavement Marking, Temporary Removable, or Pavement Marking Symbols, Temporary - Removable is called for, the Contractor's choice of material is restricted to temporary preformed, removable pavement marking tape.

Selection of pavement marking material for use on a particular type of pavement surface shall conform to the manufacturer's recommendations.

710.07.09 Application

710.07.09.01 General

All pavement markings shall be accurately spaced and present a clean-cut, uniform appearance during either the day or night.

The application of pavement marking materials shall conform to the following requirements and the manufacturer's recommendations.

710.07.09.02 Organic Solvent Based Traffic Paint

Paint shall be applied when the pavement surface temperature is 5°C and above, unless otherwise approved in writing by the Authority.

Paint shall be applied at a rate which results in a uniform thickness of 230 ± 25 microns dry film. Reflectorizing glass beads, conforming to OPSS 1750, shall be applied uniformly at a rate as shown below, immediately after paint application, to ensure embedment of the glass beads.

Overlay glass beads shall not be applied on to black paint which is used for obliterating previous markings.

Rate of Application for Overlay Glass Beads per litre of Traffic Paint

% Volume Solids of Traffic Paint	Glass Beads Required in kg
40-56	0.7
57-70	0.8

The paint temperature shall be between 40°C and 70°C when applied to the pavement.

710.07.09.03 Water-Borne Traffic Paint

Paint shall be applied as specified in clause 710.07.09.02 except that the pavement surface temperature shall be 10°C and above.

710.07.09.04 Thermoplastic Pavement Marking Material

The material shall be applied when the pavement surface temperature is 5°C and above. The maximum relative humidity shall be 70%. At pavement surface temperatures below 5°C, the pavement shall be preheated immediately prior to material application.

Thermoplastics shall be applied at a rate which results in a uniform thickness of 1.90 mm ± 0.40 mm, measured dry. Markings shall not be applied over pavement joints.

Reflectorizing glass beads conforming to OPSS 1750 with the exception of the requirements for silicone coating shall be applied uniformly at a rate of 1.5 kg ± 0.10 kg per 10 m^2 of marking immediately after marking material applications and before the material hardens.

710.07.09.05 Field Reacted Polymeric Pavement Marking Materials

Field reacted polymeric pavement marking materials which are recommended for screed application shall be applied at a rate which results in a uniform thickness of 1.90 mm ± .40 mm, measured dry. Markings shall not be applied over pavement joints.

The materials shall be applied when the pavement surface temperature is 5°C and above. The maximum surface temperature shall be 35°C. The maximum relative humidity shall be 70%.

Reflectorizing glass beads conforming to OPSS 1750 with the exception of the requirement for silicone coating, shall be applied uniformly at a rate of 1.5 kg ± 0.10 kg per 10 m^2 of marking, immediately before the material hardens.

Field reacted polymeric pavement marking materials recommended for spray application shall be applied at a uniform thickness of .30 mm ± .15 mm, unless otherwise approved in writing by the Authority.

710.07.09.06 Preformed Plastic Tape

The tape shall be applied when the pavement surface temperature is 21°C and above. The maximum relative humidity shall be 70%.

Joints of marking tape shall be butt joints without overlaps. Preformed markings shall not be applied over pavement joints.

710.07.09.07 Pavement Marking, Temporary Removable

Temporary removable pavement markings shall be applied conforming to the manufacturer's recommendation and shall be removed as indicated. Removed material shall be disposed of outside the right-of-way.

710.07.09.08 Raised Pavement Markers, Temporary

The Contractor shall supply and install temporary raised pavement markers conforming to the Authority's requirements and the manufacturer's recommendations. Markers used shall be capable of remaining in place for a period of one to six months as specified in the contract. Temporary raised pavement markers shall be removed as specified in the contract. Removed material shall be disposed of outside the right-of-way.

710.08 QUALITY ASSURANCE

710.08.01 General

Random sampling may be carried out by the Authority during material application to assess line quality.

710.08.02 Line Quality

Line width, thickness, the nature of the edges and uniformity in appearance will be assessed by the Authority. The dry film thickness will be measured by a paint inspection gauge or a coating thickness gauge.

Glass bead distribution will be inspected for evenness in distribution, degree of embedment and retroreflectance.

710.08.03 Measurement of Temperature and Humidity

The testing of ambient and surface temperature will be by thermometer, and surface thermometer, respectively. Humidity will be measured using recording hygrometer.

710.09 MEASUREMENT FOR PAYMENT

710.09.01 Actual Measurement

710.09.01.01 Pavement Marking
Pavement Marking, Durable
Pavement Marking, Temporary
Pavement Marking, Temporary - Removable
Pavement Marking Obliterating

Measurement for pavement marking is by the horizontal length in metres of 10 cm wide line excluding gaps. Wider lines are measured in 10 cm equivalents.

Each symbol to be obliterated will be approximately equated in area to a 10 cm wide line.

710.09.01.02 **Pavement Marking Symbols**
Pavement Marking Symbols, Durable
Pavement Marking Symbols, Temporary
Pavement Marking Symbols, Temporary - Removable
Raised Pavement Markers, Temporary

The unit of measurement is each.

710.09.02 **Plan Quantity Measurement**

710.09.02.01 **Pavement Marking**
Pavement Marking, Durable
Pavement Marking, Temporary
Pavement Marking, Temporary - Removable
Pavement Marking Obliterating

Measurement for Pavement Markings is by Plan Quantity, as may be revised by Adjusted Plan Quantity, of the horizontal length in metres of 10 cm wide line, excluding gaps. Wider lines are measured in 10 cm equivalents.

Each symbol to be obliterated will be approximately equated in area to a 10 cm wide line.

710.09.02.02 **Pavement Marking Symbols**
Pavement Marking Symbols, Durable
Pavement Marking Symbols, Temporary
Pavement Marking Symbols, Temporary - Removable
Raised Pavement Markers, Temporary

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity. The unit is each.

710.10 **BASIS OF PAYMENT**

710.10.01 **Pavement Marking - Item**
Pavement Marking Symbols - Item
Pavement Marking, Durable - Item
Pavement Marking Symbols, Durable - Item
Pavement Marking, Temporary - Item
Pavement Marking Symbols, Temporary - Item
Pavement Marking, Temporary Removable - Item
Pavement Marking Symbols, Temporary - Removable - Item
Raised Pavement Markers, Temporary - Item
Pavement Marking Obliterating - Item

Payment at the contract price for the above item(s) shall be full compensation for all labour, equipment and material required to do the work.

Appendix 710-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Method and locations of markings and paint obliteration and removal. (710.07.03)

- Temporary pavement marking requirements. (710.07.05)

- Type of markings. (710.07.07)

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

Related Ontario Provincial Standard Drawings

No information provided here.

ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION

METRIC
OPSS 740
NOVEMBER 2010
(Formerly OPSS 553, February 1991)

CONSTRUCTION SPECIFICATION FOR CONCRETE BARRIERS

TABLE OF CONTENTS

740.01 **SCOPE**

740.02 **REFERENCES**

740.03 **DEFINITIONS**

740.04 **DESIGN AND SUBMISSION REQUIREMENTS**

740.05 **MATERIALS**

740.06 **EQUIPMENT - Not Used**

740.07 **CONSTRUCTION**

740.08 **QUALITY ASSURANCE**

740.09 **MEASUREMENT FOR PAYMENT**

740.10 **BASIS OF PAYMENT**

APPENDICES

740-A **Commentary**

740.01 SCOPE

This specification covers the requirements for the construction of permanent concrete barriers and temporary concrete barriers.

740.01.01 Specification Significance and Use

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

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

740.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

740.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 301	Restoring Unpaved Roadway Surfaces
OPSS 310	Asphaltic Concrete, Hot Mix, Hot Laid and Hot Mix Patching
OPSS 314	Untreated Granular Subbase, Base, Surface, Shoulder and Stockpiling
OPSS 501	Compacting
OPSS 904	Concrete Structures
OPSS 919	Formwork and Falsework

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Granular A, B, M, and Select Subgrade Material
OPSS 1150	Asphaltic Concrete, Hot Mix and Hot Laid
OPSS 1305	Moisture Vapour Barriers
OPSS 1306	Burlap
OPSS 1308	Joint Filler (Concrete)
OPSS 1315	White Pigmented Membrane Curing Compounds for Concrete
OPSS 1350	Concrete (Materials and Production)

OPSS 1352 Precast Concrete Barriers
OPSS 1440 Steel Reinforcement for Concrete
OPSS 1442 Epoxy Coated Steel Reinforcement for Concrete

Ontario Ministry of Transportation Publications

Manual of Uniform Traffic Control Devices of Ontario, M.U.T.C.D.

CSA Standards

CAN/CSA-G40.21-M87 - Structural Quality Steels
CSA-G164-M1981 - Hot Dip Galvanizing of Irregularly Shaped Articles

740.03 DEFINITIONS

Asymmetric: refers to the barrier placed where the pavement elevations on each side of the barrier differ.

740.04 DESIGN AND SUBMISSION REQUIREMENTS

740.04.01 General

Where the Contractor wishes to use a concrete barrier design other than as called for in the contract, he shall request permission from the Authority, at least four weeks prior to starting any work affected by his proposed change.

740.05 MATERIALS

740.05.01 Concrete - General

The concrete mix design for all concrete barriers shall be the responsibility of the Contractor.

740.05.02 Concrete for Cast-in-place Barrier

The concrete for cast-in-place concrete barrier shall be a minimum strength of 30 MPa, except that the Tall Wall Concrete Barrier, shall be a minimum strength of 35 MPa, and shall conform to OPSS 1350 using a nominal maximum size aggregate of 19.0 mm. All coarse aggregate used for slip formed Tall Wall concrete barrier shall have all faces crushed.

740.05.03 Precast Concrete Barrier

Precast concrete barrier shall conform to OPSS 1352.

740.05.04 Concrete Pad for Precast Concrete Barrier

The concrete pad under the precast concrete barrier shall be a minimum strength of 30 MPa and shall conform to OPSS 1350.

740.05.05 Curing

Membrane curing compound shall conform to OPSS 1315. Burlap shall conform to OPSS 1306 moisture vapour barrier shall conform to OPSS 1305.

740.05.06 Joint Filler

Joint filler for permanent concrete barrier shall conform to OPSS 1308.

740.05.07 Formwork

Formwork for permanent concrete barrier shall conform to OPSS 919.

740.05.08 Reinforcing Steel

All reinforcing steel in permanent precast concrete barriers shall be epoxy coated conforming to OPSS 1442.

Epoxy patching compound shall be applied to all welds of epoxy coated reinforcing steel.

Reinforcing steel in temporary concrete barriers shall conform to OPSS 1440.

740.05.09 Asphaltic Concrete

Asphaltic concrete shall conform to OPSS 1150.

740.05.10 Granular

Granular foundation material shall conform to OPSS 1010.

740.05.11 Interlocking Components

Hollow structural steel and wide flange steel sections used in permanent precast concrete barrier shall be 350W grade conforming to CAN/CSA G40.21 and shall be hot dip galvanized after fabrication conforming to CSA G164.

740.07 CONSTRUCTION

740.07.01 Concrete Barrier

The work shall include foundation preparation, placement of the concrete barrier or precast concrete barrier units, expansion joints, construction joints, curing of the concrete, surface finish and treatment at bridge piers.

Construction of permanent concrete barrier shall be by use of the following methods:

1. conventional wooden or steel formwork;

2. slip-form;

3. precast concrete barrier units.

Permanent concrete barrier constructed by methods 1. and 2. above shall conform to OPSS 904 and 919 except as otherwise stated in this specification.

Precast concrete barrier containing the I-Lock connection, may be used in permanent installations. The precast concrete barrier shall be secured in place with 50 mm of asphalt placed on both sides of the barrier as shown on the contract drawings.

740.07.01.01 Foundation Preparation

Preparation of the granular foundation shall conform to OPSS 314 and 301, as appropriate. Immediately ahead of placing concrete, the Contractor shall wet down the subgrade by means of a uniform spray of water sufficient to wet the subgrade thoroughly without leaving standing water.

Placement of asphaltic concrete pavement beneath and adjacent to the precast concrete barrier shall conform to OPSS 310.

The concrete pad for the precast barrier shall conform to OPSS 904 and shall be placed in such a manner and to such width and thickness as to ensure that there are no voids between the concrete pad and the barrier and that the barrier is set to the correct line and grade.

740.07.01.02 Tolerances

The dimensions of the completed barrier shall not deviate by more than 10 mm from the dimensions specified.

The horizontal alignment shall not deviate more than 10 mm from the required lines indicated in the contract.

When a 3 m long, straight edge is placed on the top and faces of the cast-in-place concrete barrier surface, the surface of the concrete shall not vary more than 6 mm from the edge of the straight edge.

When the slipformed concrete barrier does not conform to the tolerances, the Contractor may correct to the required tolerances, using a magnesium float, while the concrete is still plastic, providing the surface and/or the barrier is not damaged during such adjustments.

740.07.01.03 Surface Finish

The surface of the concrete barrier placed with conventional forms shall be given a basic treatment and Class "B" finish conforming to OPSS 904.

The slip-formed barrier surface shall not be brushed. Offsets and fins shall be removed immediately by light trowelling. Surface blemishes 10 mm or less in diameter shall be left untouched. If surface blemishes larger than 10 mm diameter occur, adjustments in the operation shall be made to correct the condition. If the adjustments do not correct the condition within 10 m, the operation shall be halted until the condition is corrected either by adjustments to the operation or to the concrete mix.

The use of water on the completed barrier to correct imperfections shall not be permitted.

740.07.01.04 Curing

Curing for unformed surfaces of cast-in-place slip form concrete barrier shall conform to OPSS 904 for unformed surfaces.

Curing for formed surfaces shall conform to OPSS 904 for formed surfaces.

When joints are made after the application of curing compound the exposed face of the barrier in the vicinity of the joint shall be retreated with curing compound.

When white pigmented membrane is used as curing compound on slip formed barrier, it shall also be used on adjacent preformed barrier sections for colour uniformity.

740.07.01.05 Cold Weather Concreting

Concrete shall not be placed by slip-forming when the air temperature is below 0°C.

Placing concrete by slip-forming shall not be carried out when the air temperature is below 5°C unless the concrete at the time of placing is between 15°C and 30°C. Concrete placed by slip-forming when the air temperature is below 5°C or concrete subject to temperatures below 5°C during the first 7 days shall conform to OPSS 904.

740.07.01.06 Expansion Joints

Expansion joints 12 mm min. in width shall be installed where concrete barrier abuts a structure, adjacent to piers, over existing deck expansion joints and at the locations indicated in the contract. The expansion joint shall be filled with Type 'A' expansion joint filler.

If forming the joint is performed before the concrete has hardened, the adjacent portions of the barrier shall be supported firmly to ensure the design shape of the barrier wall is constructed as specified.

740.07.01.07 Construction Joints

Construction joints located at the end of a days placement shall be squared.

Continuity between adjacent sections of the construction joint shall be achieved by installing three horizontal epoxy coated reinforcing bars, size 25 mm x 1 m long, placed 500 mm on each side of the joint. The three bars shall be located on the barrier centreline placed 150 mm from the top and equally spaced at 150 mm.

Tall Wall concrete barrier, Type E design, shall contain five horizontal epoxy coated reinforcing bars, spaced as above, at each construction joint.

740.07.01.08 Treatment at Bridge Piers

Granular A material with asphalt surface shall be used to fill the area between concrete barriers where separation occurs at bridge piers or at other locations where separation of the barriers is required. Compaction of granular shall conform to OPSS 501. The asphalt surface shall conform to OPSS 310.

740.07.02 Temporary Concrete Barrier

The work shall include foundation preparation, placement of the precast concrete barrier units, placement of construction markers and removal of the barrier and barrier debris from the contract site upon completion of the contract.

Construction of temporary concrete barrier shall be by use of precast concrete barrier units.

The precast units shall be installed with interlocking devices properly engaged. Each run of precast concrete barrier shall consist of units having the same type of connecting device including the end treatments.

Repaired precast concrete barrier units may be used providing the structural integrity of the unit conforms to OPSS 1352.

740.07.02.01 Restrictions on Use of Connections

For contracts awarded on or before December 31, 1992, Contractors may use precast concrete barrier units with one of the following connections:

I-Lock
Concrete Key
Hook & Eye

For contracts awarded after December 31, 1992, Contractors shall use only precast concrete barrier units with I-Lock connection on:

a. divided roadways with two or more lanes in each direction, and

b. on other roadways with posted speeds of 80 km/h or greater.

For contracts awarded on or before December 31, 1995, Contractors may continue to use one of the three above connections on:

c. roadways with posted speeds of less than 80 km/h.

For contracts awarded after December 31, 1995, only the I-Lock connection shall be permitted on all roadways.

740.07.02.02 Foundation Preparation

Temporary concrete barrier shall be installed on a solid foundation having a slope of up to 6% maximum measured perpendicular to the installation. Two days shall be allowed between the placement of final asphalt surface and placement of temporary concrete barrier. Temporary concrete barrier shall be in place prior to the opening of traffic operations.

Drainage shall be maintained under the temporary concrete barrier.

740.07.02.03 Tolerances

The horizontal and vertical alignment at the junction of each barrier section shall be within 15 mm. The maximum radius on which the barrier may be placed shall be as specified for each interlocking design.

740.07.02.04 Construction Markers

Construction markers shall be placed in advance of the temporary precast concrete barrier installation to assist in directing the traffic away from the flared approach end treatment. "Lane Closure Taper Length" and "Maximum Distance Between Markers" shall conform to the M.U.T.C.D.

740.07.02.05 On Site Storage

Temporary concrete barrier being stored on site for re-use on the same contract shall be stored:

a. with protection by means of a standard temporary concrete barrier installation placed at a minimum of 1.0 m from the edge of the driving lane.

b. without protection, storage shall be offset from the edge of the driving lane conforming to the following:

Posted Speed kph	Offset m
100	10.0
90	9.0
80	7.0
70	6.0
60	5.0
50	3.0

740.07.03 Temporary Concrete Barrier, Relocation

The work shall include the relocation of temporary concrete barrier and shall conform to subsection 740.07.02. Removal of the barrier units from the Contract site upon completion of the Contract is included with the item "Temporary Concrete Barrier".

740.07.04 Reflectors

Reflectors placed on temporary and permanent concrete barrier shall conform to the M.U.T.C.D.

740.07.05 Management of Excess Material

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

740.08 QUALITY ASSURANCE

740.08.01 Acceptance Criteria for Precast Concrete Barrier

Final inspection of the precast units will not be made until they have been installed.

Precast units damaged in transit or during placement shall be replaced by the Contractor at his own expense.

All temporary concrete barrier units shall meet each of the following criteria.

a. The elements of each connecting device shall be intact and shall provide an effective connection equivalent in strength to that of a newly manufactured connection.

b. Concrete within 200 mm of each connecting device shall be structurally sound, free of cracks, spalling and breakage, to ensure safe and satisfactory performance of the connection.

c. Concrete breakouts in areas, other than a addressed in (b), shall not exceed 150 mm in diameter in either vertical or longitudinal directions.

d. Individual areas of surface damage including concrete spalls shall not measure more than 150 mm in any direction and shall not exceed a 25 mm depth. (Max. 150 x 150 x 25 mm). The accumulated total surface damage on the traffic side of the unit shall not exceed 10% of the total surface area of the respective side.

e. Other than as addressed by (d) there shall be no exposed coarse aggregate, such as honeycombing. The top and bottom surface of the precast unit are excluded from this condition.

f. Cracks shall not extend through the precast unit.

740.09 MEASUREMENT FOR PAYMENT

740.09.01 Actual Measurement

740.09.01.01 Concrete Barrier
Tall Wall Barrier
Asymmetric Concrete Barrier
Asymmetric Tall Wall Barrier

Measurement will be made in metres along the centreline of the barrier, from end to end of installation, and shall include the length required for lighting pole footings and over-head sign structure footings.

Where two concrete barriers are constructed back to back, Type B or E1, they will be treated as a single installation and the length will be measured only once for payment purposes.

740.09.01.02 Granular

Measurement will conform to OPSS 314.

740.09.01.03 Asphaltic Concrete

Measurement will conform to OPSS 310.

740.09.01.04 Temporary Concrete Barrier

Measurement will be made along the centreline of the barrier in metres from end to end of the installation, including temporary end sections for the supply, installation and removal of the maximum length of barrier required to be in place at any one time during the life of the contract.

740.09.01.05 Temporary Concrete Barrier, Relocation

Measurement will be made along the centreline of the barrier, in metres from end to end including end sections for each relocation.

Barrier that is temporarily surplus for intermediate stages, but will be required for later stages, will be paid as one relocation for the combined moves into and out of on site storage, including any off site storage required due to space restrictions.

740.09.02 Plan Quantity Measurement

740.09.02.01 Concrete Barrier
Tall Wall Barrier
Asymmetric Concrete Barrier
Asymmetric Tall Wall Barrier

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity of the length in metres along the centreline of the barrier, from end to end of the installation, and shall include the length for lighting pole footings and overhead sign structure footings. Where two concrete barriers are constructed back to back, Type B or E1, they will be treated as a single installation for measurement and payment purposes.

740.09.02.02 Temporary Concrete Barrier

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity, of the length in metres along the centreline of the barrier from end to end of the installation, for the supply, installation and removal of the maximum length of barrier required to be in place at any one time during the life of the contract.

740.09.02.03 Temporary Concrete Barrier, Relocation

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity, of the length in metres along the centreline of the barrier from end to end of the installation for each relocation.

Barrier that is temporarily surplus for intermediate stages, but will be required for later stages, will be paid as one relocation for the combined moves into and out of on site storage, including any off site storage required due to space restrictions.

740.10 BASIS OF PAYMENT

740.10.01 Concrete Barrier -Item
Tall Wall Barrier - Item
Asymmetric Concrete Barrier - Item
Asymmetric Tall Wall Barrier - Item

Payment at the contract price for the above item(s) shall be full compensation for all labour, equipment and material required to construct the barriers, including any concrete backfill between Type B or E1 concrete barriers at the location of bridge piers or transitions.

When the Contractor installs precast units as a permanent concrete barrier, the contract price shall include full compensation for placing the concrete pad.

740.10.02 Granular

Granular material used as backfill between concrete barriers shall be paid for at the contract price for the appropriate granular items.

740.10.03 Asphaltic Concrete

Asphaltic concrete laid as a foundation or used as asphalt surface at bridge piers shall be paid for at the contract price for the appropriate hot mix item.

740.10.04 Temporary Concrete Barrier - Item
Temporary Concrete Barrier, Relocation - Item

Payment at the contract price for the above item(s) shall be full compensation for all labour, equipment and material required to do the work.

Appendix 740-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Horizontal alignment. (740.07.01.02)

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

Related Ontario Provincial Standard Drawings

No information provided here.

CONSTRUCTION SPECIFICATION FOR TEMPORARY CONCRETE BARRIERS

TABLE OF CONTENTS

741.01 **SCOPE**

741.02 **REFERENCES**

741.03 **DEFINITIONS - Not Used**

741.04 **DESIGN AND SUBMISSION REQUIREMENTS - Not Used**

741.05 **MATERIALS**

741.06 **EQUIPMENT - Not Used**

741.07 **CONSTRUCTION**

741.08 **QUALITY ASSURANCE**

741.09 **MEASUREMENT FOR PAYMENT**

741.10 **BASIS OF PAYMENT**

APPENDICES

741-A **Commentary**

741.01 SCOPE

This specification covers the requirements for the construction of temporary concrete barriers.

This specification also covers the requirements for installation of restraint systems for temporary concrete barrier, Type M connection only, by the following three methods: pinning to asphalt pavement, strapping to concrete, or bolting through concrete.

741.01.01 Specification Significance and Use

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

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

741.01.02 Appendices Significance and Use

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

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.

741.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Material

OPSS 1350 Concrete - Materials and Production
OPSS 1440 Steel Reinforcement for Concrete
OPSS 1504 Steel Beam Guide Rail
OPSS 1601 Wood, Preservative Treatment, and Shop Fabrication

Ontario Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 7 - Temporary Conditions
Book 11 - Pavement, Hazard and Delineation Markings

MTO Form:
PH-CC-876 Certification of Temporary Precast Concrete Barrier Installations

CSA Standards

G40.20-13/G40.21-13	Rolled or Welded Structural Quality Steel/Structural Quality Steel
W59-13	Welded Steel Construction (Metal Arc Welding)

ASTM International

A 123/A 123M-13	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
D 4956-13	Retroreflective Sheeting for Traffic Control

741.05 MATERIALS

741.05.01 Concrete

Concrete shall be according to OPSS 1350, except that the restrictions on volume batching shall not apply. The Contractor shall assume the responsibility for the mix design. The following specific requirements shall apply:

a) Class of concrete: Nominal minimum 28-Day compressive strength of 35 MPa

b) Coarse aggregate: 19.0 mm nominal maximum size

741.05.02 Reinforcing Steel Bars

Reinforcing steel bars shall be according to OPSS 1440 and the Contract Documents.

741.05.03 Connection Assembly Components

Connection assembly components including steel shapes and hollow sections for the I-Lock connection shall be Grade 350W according to CSA G40.20/G40.21 and the Contract Documents. Connection assembly components for other non-proprietary temporary concrete barrier systems shall be according to the Contract Documents.

Connection assembly components for proprietary temporary concrete barrier systems shall be according to manufacturer's specifications and the Contract Documents.

741.05.04 Restraint Systems, Type M Connection Only

All materials required for the restraint systems shall be according to the Contract Documents.

741.05.05 Thrie Beam Guide Rails, Bolts, and Nuts

Thrie beam guide rails shall be fabricated according to OPSS 1504 and the Contract Documents. Bolts and nuts shall be according to OPSS 1504.

741.05.06 Steel Plates, Bolts, and Nuts

Steel plates shall be fabricated according to CSA G40.20/G40.21 and the Contract Documents. Steel plates shall have minimum yield strength of 345 MPa. All steel plates shall be hot dip galvanized after fabrication according to ASTM A 123. Bolts and nuts shall be according to OPSS 1504.

741.05.07 Wooden Block

Wooden blocks shall be according to OPSS 1601.

741.05.08 Delineators

Delineators shall be two-sided and each side shall have a minimum reflective surface of 100 x 100 mm; high intensity retroreflective sheeting according to ASTM D 4956, Type VIII; orange colour; and flexibility to bend 90° from vertical and self restore.

741.05.09 Marking

All temporary concrete barrier units manufactured before March 1, 2008 shall be permanently and legibly marked by the manufacturer on the top or sides of each temporary concrete barrier as follows:

a) Name or trademark of the manufacturer.

b) Identification of plant if manufacturer has more than one plant.

c) The date of manufacture identifying at minimum the year of manufacture with two digits.

d) Markings shall be stencilled in indelible ink, stencilled in paint, or embossed.

All temporary concrete barrier units manufactured on or after March 1, 2008 shall be permanently and legibly marked by the manufacturer on each temporary concrete barrier as follows:

a) Name or trademark of manufacturer on file with Owner including identification of plant if manufacturer has more than one plant and year of manufacture embossed on top of each temporary concrete barrier at one end.

b) Owner approved three digit code of manufacturer and plant identification, and six digit code for date of manufacture (Year Month Day, example January 15, 2008 is 080115) stencilled in minimum 50 mm high digits with indelible ink or paint on top of each temporary concrete barrier at opposite end of embossed markings.

c) Duplicate three digit code of manufacturer and plant identification, and six digit code for date of manufacture, stencilled in minimum 50 mm high digits with indelible ink or paint on the vertical face of one end elevation of each temporary concrete barrier.

d) Markings are not permitted on traffic faces of temporary concrete barrier.

741.07 CONSTRUCTION

741.07.01 Temporary Concrete Barrier

Temporary concrete barrier shall be installed at locations specified in the Contract Documents.

Construction of temporary concrete barrier shall be by use of precast concrete barrier units.

Temporary concrete barrier shall be installed with connections properly engaged.

It is acceptable to transition from one type of temporary concrete barrier to another type of temporary concrete barrier using the temporary concrete barrier transition detail according to the Contract Documents. The proportion of each type of approved temporary concrete barrier used for the Work shall be at the Contractor's discretion. However, a minimum continuous length of 100 m of any one type of temporary concrete barrier is required prior to transitioning to another type.

741.07.01.01 Restrictions on Use of Connections

Contractors shall use temporary concrete barriers with one of the following types of connections:

a) Type J

b) Type M

c) Type T

Contractors shall be permitted to use temporary concrete barriers with I-Lock connections on roadways with posted speeds less than 70 km/h.

At locations where restrained temporary concrete barriers are specified in the Contract Documents, temporary concrete barriers with Type M connections shall be used.

741.07.01.02 Foundation Preparation

Temporary concrete barrier shall be installed on a solid foundation having a slope of up to 6% maximum measured perpendicular to the installation. Two Days shall be allowed between the placement of final asphalt surface and placement of temporary concrete barrier. Temporary concrete barrier shall be in place prior to the opening of traffic operations.

Drainage shall be maintained under the temporary concrete barrier.

741.07.01.03 Tolerances

The horizontal and vertical alignment at the junction of each barrier section shall be within 15 mm. The minimum radius on which the barrier may be placed shall be as specified for each type of connection.

741.07.01.04 Construction Markers

Construction markers shall be placed in advance of the temporary precast concrete barrier installation to assist in directing the traffic away from the flared approach end treatment. Taper length for full lane closures and the maximum distance between markers shall be according to OTM Book 7.

741.07.01.05 Quality Control

The Contractor is responsible to supply and install the temporary precast units and certify that they meet the acceptance criteria listed under the Acceptance Criteria for Temporary Precast Concrete Barrier clause. The Contractor shall do an initial inspection of the units prior to installation and a further inspection of the units after each installation. When the installed or relocated units do not meet the acceptance criteria, the Contractor shall remove such units and replace them with units that meet the acceptance criteria. Each installation and relocation of units shall be certified by submitting to the Contract Administrator a completed MTO Form PH-CC-876 Certification of Temporary Precast Concrete Barrier Installations within 24 hours of installation or relocation of the units. Certification shall be done by an authorized representative of the Contractor.

While in-service on the Contract and when units have been damaged or alignment discontinuity is beyond that allowable by the acceptance criteria, the affected units shall be reinstalled or replaced as necessary. The Contractor shall perform the repair within a 48 hour period, starting at the occurrence or first awareness.

Repaired precast concrete barrier units may be used provided that the structural integrity of the unit is maintained. An Engineer's seal and signature shall be affixed to documentation certifying that the repair method used shall not impact the structural integrity of the unit.

741.07.01.05.01 Acceptance Criteria for Temporary Precast Concrete Barrier

For all applications, any unit that fails one or more of the following acceptance criteria shall be rejected:

a) Dimensions of each unit shall not deviate from those specified by more than the following tolerance:

   i. Specified dimensions up to 300 mm $\pm$ 5 mm
   ii. Specified dimensions greater than 300 mm $\pm$ 10 mm

b) Steel elements of each connecting device shall be free of visible fracture, distortion, and perforation.

c) Concrete within 200 mm of a connecting device shall be free of visible cracks that exceed 0.3 mm in width, measured at the widest point of the crack.

d) All cracks wider than 0.3 mm, other than addressed in c), shall neither extend through the precast unit nor be longer than 300 mm.

e) The unit shall be free of honeycombing.

f) The end of any unit shall not be located further than 50 mm from the horizontal alignment of the installation.

In addition to the above criteria, when the precast units are used on facilities with a posted regulatory speed limit of 80 km/h or higher, any unit that fails one or more of the following acceptance criteria shall be rejected:

a) Damage to edges shall not extend more than 100 mm onto any adjacent face. When edge damage extends more than 50 mm onto such a face, damage to the opposite side of that edge shall not extend more than 50 mm onto the opposite face.

b) The total length of concrete breakout damage to edges flanking the connecting devices, whether repaired or not, shall not exceed 25% of the respective connecting device length on each side of each connecting device.

c) The concrete damage in the area of the drainage recess shall not reach higher than one third of the lower sloped surface containing the recess.

d) Concrete breakouts on the traffic faces or on the top of the precast unit other than addressed in a) to c) above shall not be greater than 150 mm in any direction measured on the surface, nor shall the breakout depth at any point exceed 25 mm measured perpendicularly to the face.

e) Accumulated total concrete breakouts addressed in d) on the traffic sides of the unit shall not exceed 10% of the total surface area of the respective side.

f) Drilled holes into the barrier shall not have diameter greater than 40 mm.

g) The horizontal and vertical alignment discontinuity between adjacent units shall not exceed 20 mm, as measured with a 1 m straightedge.

741.07.02 Drainage Gaps for Temporary Concrete Barrier

Gaps for drainage shall be installed according to the Contract Documents and at locations specified in the Contract Documents.

741.07.03 Temporary Concrete Barrier Restraint Systems, Type M Connection Only

741.07.03.01 General

Type M temporary concrete barrier used for temporary concrete barrier restraint systems shall have been manufactured after October 2011, as verified by the markings.

Restraint systems shall be installed at locations specified in the Contract Documents.

Mechanical and adhesive anchoring systems shall be installed according to the manufacturer's specifications to the minimum embedment depth specified in the Contract Documents.

All welds shall be according to CSA W59.

741.07.03.02 Restoration of Asphalt and Concrete Surfaces

Restoration of asphalt and concrete disturbed during the installation and removal of restrained temporary concrete barrier shall be as specified in the Contract Documents.

741.07.03.03 Transitions

Transitions between restrained temporary concrete barrier and unrestrained temporary concrete barrier shall be as specified in the Contract Documents.

Transitions between unrestrained temporary concrete barrier and permanent concrete barrier shall be as specified in the Contract Documents.

741.07.04 Delineators

Delineators according to OTM Book 11 shall be installed at 4 m intervals.

Delineators shall be securely fastened to the top of the temporary concrete barrier with reflective surfaces clearly visible.

Delineators shall be maintained at all times.

741.07.05 Management of Excess Material

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

741.08 QUALITY ASSURANCE

741.08.01 General

The Owner may conduct random Quality Assurance checks on units that have been supplied and installed or relocated to verify the Contractor's ability to ensure compliance with the acceptance criteria. Units that are identified by the Owner's representative as not meeting the acceptance criteria or those units that have been repaired and do not have documentation certifying the method of repair must be removed and replaced with units that meet the acceptance criteria for temporary precast concrete barrier. This shall be done within a 48 hour period of notice to the Contractor, unless agreed otherwise in writing.

741.09 MEASUREMENT FOR PAYMENT

741.09.01 Actual Measurement

741.09.01.01 Temporary Concrete Barrier

Measurement of barriers shall be by length in metres along the centreline of the barrier, from end to end, including temporary end sections installed and removed, up to the maximum length of barriers required to be placed at any one time during the Contract.

741.09.01.02 Temporary Concrete Barrier, Relocation

Measurement of barriers shall be by length in metres along the centreline of the barrier, from end to end, including temporary end sections relocated.

Barriers that are temporarily surplus, but are required for future stages shall be paid for as one relocation for the combined moves into and out of storage, including any off-site storage required due to on-site restrictions.

741.09.01.03 Temporary Concrete Barrier, Drainage Gap

For measurement purposes, a count shall be made of the number of temporary concrete barrier drainage gaps delivered and accepted.

741.09.01.04 Temporary Concrete Barrier Restraint System, Pinned
Temporary Concrete Barrier Restraint System, Strapped
Temporary Concrete Barrier Restraint System, Bolted

Measurement of barrier restraint systems shall be by length in metres along the centreline of the barrier restraint system, from end to end, installed and removed. Transitions shall be included with the appropriate restraint system.

741.09.02 Plan Quantity Measurement

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

741.10 BASIS OF PAYMENT

741.10.01 Temporary Concrete Barrier - Item
Temporary Concrete Barrier, Relocation - Item
Temporary Concrete Barrier, Drainage Gap - Item
Temporary Concrete Barrier Restraint System, Pinned - Item
Temporary Concrete Barrier Restraint System, Strapped - Item
Temporary Concrete Barrier Restraint System, Bolted - Item

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

Costs associated with any required removals and replacements of defective workmanship or materials shall be the Contractor's responsibility at no cost to the Owner.

Appendix 741-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Locations where temporary concrete barriers are required. (741.07.01)

- Drainage gap locations. (741.07.02)

- Locations where temporary concrete barriers are restrained. Temporary concrete barrier restraint systems should be considered for use on a high speed roadway, typically with a posted speed of 70 km/h or more, when barrier protection is required within 0.5 m of an excavation, within 1.0 m of structures not designed for impacts (e.g., scaffolding), or within 1.0 m of the edge of a bridge deck. (741.07.03.01)

- Details should be provided to cover the method and payment for the restoration of asphalt and concrete surfaces that are disturbed during the installation and removal of temporary concrete barrier restraint systems. (741.07.03.02)

- Locations where transitions are required between unrestrained temporary concrete barrier and restrained temporary concrete barrier and between unrestrained temporary concrete barrier and permanent concrete barrier. (741.07.03.03)

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

Related Ontario Provincial Standard Drawings

OPSD 911.140 to OPSD 911.430	Guide Rail System, Concrete Barrier Drawings

CONSTRUCTION SPECIFICATION FOR CONNECTICUT IMPACT ATTENUATION SYSTEM (CIAS)

TABLE OF CONTENTS

753.01 **SCOPE**

753.02 **REFERENCES**

753.03 **DEFINITIONS - Not Used**

753.04 **DESIGN AND SUBMISSION REQUIREMENTS - Not Used**

753.05 **MATERIALS**

753.06 **EQUIPMENT - Not Used**

753.07 **CONSTRUCTION**

753.08 **QUALITY ASSURANCE - Not Used**

753.09 **MEASUREMENT FOR PAYMENT**

753.10 **BASIS OF PAYMENT**

APPENDICES

753-A **Commentary**

753.01 SCOPE

This specification covers the requirements for the installation of Connecticut Impact Attenuation Systems (CIAS).

753.01.01 Specification Significance and Use

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

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

753.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

753.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 314	Untreated Granular, Subbase, Base, Surface, Shoulder, and Stockpiling
OPSS 904	Concrete Structures

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete

CSA Standards

G40.20-04/G40.21-04	Rolled or Welded Structural Quality Steels
W47.1-03	Certification of Companies for Fusion Welding of Steel
W59-03	Welded Steel Construction (Metal Arc Welding)

ASTM International

A 53/A 53M-07	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A 123/A 123M-09	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 153/A 153M-03	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 307-07	Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

753.05 MATERIALS

753.05.01 Concrete

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

753.05.02 Granular Base

Granular base shall be Granular A according to OPSS 1010.

753.05.03 Reinforcing Steel Bars

Reinforcing steel bars for concrete backwall shall be according to OPSS 1440.

753.05.04 Fasteners

Bolts, nuts, washers, and spacers shall be according to ASTM A 307 and hot dip galvanized according to ASTM A 153.

753.05.05 Steel Cylinders

Cylinders shall be fabricated from steel according to CSA G40.21, Grade 300W, and hot dip galvanized after fabrication to provide a zinc coating not less than 610 g/m^2 according to ASTM A 123.

Cylinders shall be cut square and seamless or electric welded. The finished cylinder shall be within 15 mm of true round. Each cylinder shall be labelled at the top with the designated A to N alphabetical character.

All edges shall be machined and free of burrs and sharp edges.

753.05.06 Steel Rails

Steel rails shall be fabricated as specified in the Contract Documents from flat stock steel according to CSA G40.21, Grade 300W, and hot dip galvanized after fabrication to provide a zinc coating not less than 610 g/m^2 according to ASTM A 123.

753.05.07 Steel Straps, Lid Support Angles, and Lifting Devices

Steel straps, lid support angles, and lifting devices shall be steel according to CSA G40.21, Grade 300W. All straps shall be cut to the width and length and welded to the cylinder as specified in the Contract Documents.

753.05.08 Steel Pipes

Steel pipes shall be 48.3 mm OD, standard weight, Schedule 40 steel pipe according to ASTM A 53 and welded to one side of the cylinder as specified in the Contract Documents.

753.05.09 Steel Pipe Retainers

Steel pipe retainers shall be 50 mm by 32 mm OD, standard weight, Schedule 40 steel pipe according to ASTM A 53 and welded to the side of the cylinder as specified in the Contract Documents.

753.05.10 Lids

Lids shall be fabricated from low-density polyethylene composed of 25% recycled plastic materials. Lids shall be black in colour and UV stabilized to a minimum rating of UV8D. The lid shall be of sufficient strength to support a centred point load having a mass of 60 kg producing a maximum deflection of 100 mm.

Each lid shall have a steel restraining chain for attachment of the lid to the cylinder.

Associated metal hardware for the lids, such as washers, eye bolts, chains, and screws shall be hot dip galvanized according to ASTM A 153 or equivalent electroplated or anodized treated.

753.05.11 Welds

All welding shall be according to CSA W47.1 and CSA W59.

753.07 CONSTRUCTION

753.07.01 General

Connecticut Impact Attenuation Systems shall be installed according to and at locations specified in the Contract Documents.

753.07.02 Concrete Pads and Backwalls

Levelling and site preparation required for the existing granular base shall be performed prior to placing the concrete pad and backwall.

Concrete pads and backwalls shall be constructed as specified in the Contract Documents. Concrete shall be placed, cured, and finished according to OPSS 904. Cross fall of the concrete pad is desirably 6% or less and shall not exceed 10%. All exposed edges of the backwall shall have a 25 mm chamfer. Drilling of anchor holes shall commence a minimum of five days after concrete has been placed.

753.07.03 Granular Base

The granular base below the concrete pad shall be a minimum depth of 150 mm and shall be placed according to OPSS 314. The granular material shall be compacted to 95% of the maximum dry density.

753.07.04 Connection to Barriers

The concrete backwall shall be connected to the barrier as specified in the Contract Documents.

753.07.05 Delineation

Delineation shall be provided as specified in the Contract Documents.

753.07.06 Management of Excess Material

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

753.09 MEASUREMENT FOR PAYMENT

753.09.01 Actual Measurement

753.09.01.01 Connecticut Impact Attenuation System

For measurement purposes, a count shall be made of the number of complete Connecticut Impact Attenuation Systems installed.

753.09.02 Plan Quantity Measurement

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

753.10 BASIS OF PAYMENT

753.10.01 Connecticut Impact Attenuation System - Item

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

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

Appendix 753-A, November 2013
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Connecticut Impact Attenuation System locations. (753.07.01)

The designer should determine to which standard Connecticut Impact Attenuation Systems should be installed and specify it in the Contract Documents:

a) The Connecticut Impact Attenuation System should only be installed at a 10° skew to the centreline of the roadway when the length of the median hazard and the median width can accommodate a Connecticut Impact Attenuation System at each end of the hazard within the limits specified in OPSD 923.245. In this case, the designer should specify that the system be installed according to OPSD 923.245.

b) The Connecticut Impact Attenuation System should only be installed at a 0° skew to the centreline of the roadway when the length of the median hazard is too long and the median width is too narrow to accommodate a Connecticut Impact Attenuation System at each end of the hazard within the limits specified in OPSD 923.245. In this case, the designer should specify that the system be installed according to OPSD 923.244.

Wherever possible, the designer should eliminate the use of curb with gutter, in advance of and along the length of end treatments and crash cushions. See the MTO Roadside Safety Manual for additional information.

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

Related Ontario Provincial Standard Drawings

OPSD 923.201	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Component - Steel Cylinder
OPSD 923.202	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Component - Polyethylene Lid
OPSD 923.204	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Component - Concrete Backwall
OPSD 923.242	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Installation
OPSD 923.244	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Installation - Long Median Hazard
OPSD 923.245	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Installation - Short Median Hazard
OPSD 984.205	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Delineation, Installation - Permanent

NOTICE TO USERS OF OPSS 760

CONSTRUCTION SPECIFICATION FOR NOISE BARRIER SYSTEMS

OPSS 760 has been removed from this
OPS volume

The municipal version of OPSS 760 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 760

There is no provincial version of OPSS 760

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

NOTICE TO USERS OF OPSS 772

CONSTRUCTION SPECIFICATION FOR
CHAIN-LINK FENCE

OPSS 772 has been removed from this
OPS volume

The provincial version of OPSS 772 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 772

The municipal version of OPSS 772 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 772

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

CONSTRUCTION SPECIFICATION FOR EXPANDED METAL ANTI-GLARE SCREEN

TABLE OF CONTENTS

791.01 **SCOPE**

791.02 **REFERENCES**

791.03 **DEFINITIONS - Not Used**

791.04 **DESIGN AND SUBMISSION REQUIREMENTS - Not Used**

791.05 **MATERIALS**

791.06 **EQUIPMENT - Not Used**

791.07 **CONSTRUCTION**

791.08 **QUALITY ASSURANCE - Not Used**

791.09 **MEASUREMENT FOR PAYMENT**

791.10 **BASIS OF PAYMENT**

APPENDICES

791-A **Commentary**

791.01 SCOPE

This specification covers the requirements for the installation of expanded metal anti-glare screens on concrete barrier, steel beam guide rail, and chain-link fence.

791.01.01 Specification Significance and Use

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

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

791.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

791.02 REFERENCES

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

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

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

Canadian General Standards Board (CGSB)

138.2-96	Steel Framework for Chain Link Fence

CSA Standards

W59-13	Welded Steel Construction (Metal Arc Welding)

ASTM International

A 27/A 27M-13	Steel Castings, Carbon, for General Application
A 123/A 123M-13	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 153/A 153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 325-10	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
A 824-01 (2012)	Metallic-Coated Steel Marcelled Tension Wire for Use With Chain-Link Fence
A 1011/A 1011M-14	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
B 209-10	Aluminum and Aluminum-Alloy Sheet and Plate

791.05 MATERIALS

791.05.01 Mesh

Steel mesh panels shall be fabricated from expanding quality hot rolled sheets according to ASTM A 1011M.

Aluminum mesh panels shall be fabricated from expanding utility grade 3003 H14 sheets or 1100 H14 rolls.

Mesh panels shall consist of regular 19 mm diamond shaped patterns formed by expanding 1.6 mm thick panels to provide panels 600 mm or 1,200 mm in width and a minimum of 2,400 mm plus one diamond width in length. The diamonds shall be according to the following:

a) Width of diamond, centre to centre of strand shall be 22 mm.

b) Length of diamond, centre to centre of strand shall be 50 mm.

c) Width of strand shall be 5 mm.

d) Cut-off angle shall be a minimum of 21 degrees.

Mesh panels installed on concrete barrier and steel beam guide rail shall be 600 mm in width.

Mesh panels installed on chain-link fence shall be 1,200 mm in width.

The size of the finished mesh panels shall not deviate more than 3 mm from the specified width and more than 12 mm from the specified length.

Mesh panels shall be levelled and wire brushed after the expanding operation.

Mesh panels fabricated from steel sheets shall be hot dip galvanized after fabrication to provide a mass of zinc coating not less than 610 g/m^2 of total surface.

791.05.02 Posts and Wire Fasteners

Posts shall be steel pipe and according to CAN/CGSB 138.2.

Posts installed on concrete barrier shall be fabricated with a welded steel base plate grade 300W, hot dip galvanized after fabrication according to ASTM A 123, and according to the Contract Documents. All welds shall be to a low hydrogen classification according to CSA W59. Manual electrodes shall be E7015, E7016, or E7018. All welds shall be continuous.

Wire fasteners for fastening the mesh panels to the line posts shall be made of aluminum, galvanized steel, or stainless steel.

791.05.03 Top Wires, Bottom Wires, Diagonal Brace Wires, and Tie Wires

Top wires, bottom wires, and diagonal brace wires shall be 4.5 mm diameter marcelled tension wire Type II according to ASTM A 824 with a minimum Class 5 galvanized coating.

Tie wires shall be 3.5 mm diameter aluminum or galvanized steel or 1.0 mm diameter stainless steel wire. Tie wires shall be made with the same type of material as the mesh panels or stainless steel.

791.05.04 Miscellaneous Hardware

Washers, nuts, and bolts shall be according to ASTM A 325. All hardware shall be galvanized according to ASTM A 153 and to provide a mass of zinc coating of not less than 305 g/m^2 of total surface.

Metal discs used to fasten mesh panels to the chain-link fence fabric shall be fabricated from 1.6 mm thick steel and hot dip galvanized after fabrication to provide a mass of zinc coating of not less than 610 g/m^2 of the total surface.

791.05.05 Post Caps

All posts shall be fitted with waterproof metal caps according to ASTM F 626 and in a colour matching the posts. Post caps shall be designed to fit and fasten securely over the posts. All line post caps shall carry the top wire as specified in the Contract Documents.

791.05.06 Turnbuckles

Turnbuckles shall be drop forged steel according to ASTM A 27 and shall be galvanized according to ASTM A 153.

The average overall length shall be approximately 300 mm with ends in the closed position. Bolt diameter shall be approximately 10 mm and capable of taking up a minimum of 150 mm slack.

791.07 CONSTRUCTION

791.07.01 General

Expanded metal anti-glare screens shall be installed at locations specified in the Contract Documents. Mesh panels shall be oriented as specified in the Contract Documents.

791.07.02 Expanded Metal Anti-Glare Screens on Concrete Barrier

Mesh panels and posts shall be fastened to the concrete barrier as specified in the Contract Documents.

791.07.03 Expanded Metal Anti-Glare Screens on Steel Beam Guide Rail

Tops of guide rail posts shall be cut to accommodate the mesh panels as specified in the Contract Documents. Exposed surfaces of the guide rail posts shall be field treated with two applications of a preservative compatible with that used for the pressure treatment of the post.

791.07.04 Expanded Metal Anti-Glare Screens on Chain-Link Fence

Mesh panels shall be fastened to the chain-link fence as specified in the Contract Documents.

791.07.05 Marking

Identification plates, provided by the material supplier, shall be securely attached to the completed expanded metal anti-glare screen installation at the following intervals:

a) At the start and end of each expanded metal anti-glare screen installation.

b) At a maximum interval of 300 m.

The expanded metal anti-glare screen identification plate shall be located within 300 mm of a terminal post with the top of the plate located approximately 300 mm from the top of the expanded metal anti-glare screen. The maximum dimensions of the plate shall be 200 by 200 mm. The plate shall be made from 0.81 mm thick anodized aluminum sheet according to ASTM B 209 series 1100 or 5005-H34.

Each expanded metal anti-glare screen identification plate shall be engraved with the following information:

a) Contract number.

b) Name or trademark of anti-glare screen Subcontractor.

c) Name or trademark of anti-glare screen supplier (i.e., suppliers) of expanded metal anti-glare screen and posts).

d) Date of completed installation (i.e., yyyy-mm).

The height of the letters and numerals shall be within the range of 6 to 32 mm.

791.07.06 Management of Excess Material

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

791.08 QUALITY ASSURANCE

791.08.01 Construction

The Contract Administrator may perform a spot visual inspection to determine conformance with the workmanship, design, and dimensional requirements of this specification.

Failure to conform to the specifications may result in a partial or complete inspection of the installation and removal and replacement of all defective workmanship or materials.

791.09 MEASUREMENT FOR PAYMENT

791.09.01 Actual Measurement

791.09.01.01 Expanded Metal Anti-Glare Screen

Measurement of expanded metal anti-glare screen shall be by length in metres along the length of concrete barrier, steel beam guide rail, or chain-link fence for the actual length of screen installed.

791.09.02 Plan Quantity Measurement

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

791.10 BASIS OF PAYMENT

791.10.01 Expanded Metal Anti-Glare Screen - Item

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

Appendix 791-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Locations of expanded metal anti-glare screens. (791.07.01)

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

Related Ontario Provincial Standard Drawings

OPSD 991.130	Expanded Metal Anti-Glare Screen, Installation - Concrete Barrier
OPSD 991.131	Expanded Metal Anti-Glare Screen, Installation - Steel Beam Guide Rail with Wooden Post
OPSD 991.132	Expanded Metal Anti-Glare Screen, Installation - Chain-Link Fence

NOTICE TO USERS OF OPSS 801

CONSTRUCTION SPECIFICATION FOR THE PROTECTION OF TREES

OPSS 801 has been removed from this OPS volume

The provincial version of OPSS 801 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 801

The municipal version of OPSS 801 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 801

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

NOTICE TO USERS OF OPSS 802

CONSTRUCTION SPECIFICATION
FOR TOPSOIL

OPSS 802 has been removed from this
OPS volume

The municipal version of OPSS 802 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 802

There is no PROV version.

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

NOTICE TO USERS OF OPSS 803

CONSTRUCTION SPECIFICATION FOR SODDING

OPSS 803 has been removed from this OPS volume

The provincial version of OPSS 803 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 803

The municipal version of OPSS 803 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 803

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

NOTICE TO USERS OF OPSS 805

CONSTRUCTION SPECIFICATION FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES

OPSS 805 has been removed from this OPS volume

The provincial version of OPSS 805 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 805

The municipal version of OPSS 805 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 805

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

NOTICE TO USERS OF OPSS 810

CONSTRUCTION SPECIFICATION FOR
ROOTWAD STRUCTURES

OPSS 810 has been removed from this
OPS volume

The provincial version of OPSS 810 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 810

The municipal version of OPSS 810 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 810

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

NOTICE TO USERS OF OPSS 811

CONSTRUCTION SPECIFICATION FOR LARGE WOODY DEBRIS

OPSS 811 has been removed from this OPS volume

The provincial version of OPSS 811 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 811

The municipal version of OPSS 811 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 811

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

NOTICE TO USERS OF OPSS 812

CONSTRUCTION SPECIFICATION FOR
LUNKERS

OPSS 812 has been removed from this
OPS volume

The provincial version of OPSS 812 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 812

The municipal version of OPSS 812 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 812

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

NOTICE TO USERS OF OPSS 820

CONSTRUCTION SPECIFICATION FOR
RIFFLES ON STREAMBEDS

OPSS 820 has been removed from this
OPS volume

The provincial version of OPSS 820 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 820

The municipal version of OPSS 820 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 820

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

NOTICE TO USERS OF OPSS 821

CONSTRUCTION SPECIFICATION FOR POOLS IN STREAMBEDS

OPSS 821 has been removed from this OPS volume

The provincial version of OPSS 821 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 821

The municipal version of OPSS 821 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 821

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

NOTICE TO USERS OF OPSS 822

CONSTRUCTION SPECIFICATION FOR
ROCKY RAMPS ON STREAMBEDS

OPSS 822 has been removed from this
OPS volume

The provincial version of OPSS 822 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 822

The municipal version of OPSS 822 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 822

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

NOTICE TO USERS OF OPSS 823

CONSTRUCTION SPECIFICATION FOR
LOW FLOW CHANNELS

OPSS 823 has been removed from this
OPS volume

The provincial version of OPSS 823 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 823

The municipal version of OPSS 823 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 823

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

NOTICE TO USERS OF OPSS 824

CONSTRUCTION SPECIFICATION FOR
BAFFLES IN A CULVERT

OPSS 824 has been removed from this
OPS volume

The provincial version of OPSS 824 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 824

The municipal version of OPSS 824 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 824

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

NOTICE TO USERS OF OPSS 830

CONSTRUCTION SPECIFICATION FOR LOCAL SEED BANK

OPSS 830 has been removed from this OPS volume

The provincial version of OPSS 830 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 830

The municipal version of OPSS 830 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 830

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

NOTICE TO USERS OF OPSS 902

CONSTRUCTION SPECIFICATION FOR EXCAVATING AND BACKFILLING – STRUCTURES

OPSS 902 has been removed from this OPS volume

The provincial version of OPSS 902 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 902

The municipal version of OPSS 902 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 902

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

NOTICE TO USERS OF OPSS 906

CONSTRUCTION SPECIFICATION FOR STRUCTURAL STEEL FOR BRIDGES

OPSS 906 has been removed from this OPS volume

The provincial version of OPSS 906 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 906

The municipal version of OPSS 906 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 906

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

CONSTRUCTION SPECIFICATION FOR STRUCTURAL WOOD SYSTEMS

TABLE OF CONTENTS

907.01 **SCOPE**

907.02 **REFERENCES**

907.03 **DEFINITIONS**

907.04 **DESIGN AND SUBMISSION REQUIREMENTS**

907.05 **MATERIALS**

907.06 **EQUIPMENT**

907.07 **CONSTRUCTION**

907.08 **QUALITY ASSURANCE - Not Used**

907.09 **MEASUREMENT FOR PAYMENT**

907.10 **BASIS OF PAYMENT**

APPENDICES

907-A **Commentary**

907.01 SCOPE

This specification covers the requirements for structural wood systems.

907.01.01 Specification Significance and Use

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

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

907.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

907.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 501	Compacting
OPSS 902	Excavating and Backfilling - Structures
OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete
OPSS 910	Stressing Systems for Post-Tensioning

Ontario Provincial Standard Specifications, Material

OPSS 1010	Granular - Base, Subbase, Selected Subgrade and Backfill Material
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1601	Wood - Material, Preservative Treatment and Shop Fabrication
OPSS 1860	Geotextiles

Ontario Ministry of Transportation Publications

Structural Manual

CSA Standards

B111-1974 (R2003)	Wire Nails, Spikes and Staple
G40.20-04/G40.21-04 (R2009)	General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
O86-09	Consolidation, Engineering Design in Wood
S6-06	Canadian Highway Bridge Design Code

ASTM International

A 47/A 47M-99 (2009)	Ferritic Malleable Iron Castings
A 307-10	Carbon Steel Bolts and Studs, 60000 psi Tensile Strength
A 653/A 653M-10	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process
A 722/A 722M-07	Uncoated High-Strength Steel Bar for Prestressed Concrete

907.03 DEFINITIONS

For the purpose of this specification, definitions in OPSS 1601 and the following definitions apply:

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

Fastener means hardware used to connect wood members or components.

Girders means generally very large size beams and stringers or glued-laminated member for use in bending with load applied to the narrow face.

Groove and Dap means the wood base of a wood-concrete composite deck using alternating height laminations where the higher laminate is grooved and dapped according to CAN/CSA-S6.

Laminated Wood Deck means dimension lumber placed side by side on its narrow face to form a wood slab.

Lamination means dimension lumber sizes when used in a laminated wood deck.

Longitudinally Laminated Deck means a deck where the wood laminations are placed on edge and oriented parallel to the longitudinal centreline of the deck.

Notch and Spike means the wood base of a wood-concrete composite deck using uniform height laminations, where all laminations have square notches reinforced with spikes according to CAN/CSA-S6.

Reinforcing Spike means a common nail used to reinforce the shear key in notch and spike wood-concrete composite decks.

Stress-Laminated Wood Deck means a laminated wood deck, which is held together by pressure applied perpendicular to the laminations using high-strength bars according to CAN/CSA-S6.

Stringers means sawn wood that has a minimum thickness of 114 mm and a width at least 51 mm greater than the thickness for use in bending with load applied to the narrow face.

Transversely Laminated Deck means a deck in which the wood laminations are placed on edge and oriented transversely to the longitudinal centre line of the deck.

Truss Plates means a sheet of steel that has been punched by a special die, where the displaced material forms sharp teeth, used to connect laminations at butt joints in wood-concrete composite decks.

Wood-Concrete Composite Deck means a deck that has a laminated wood base made composite with a reinforced concrete overlay.

907.04 DESIGN AND SUBMISSION REQUIREMENTS

907.04.01 Submission Requirements

907.04.01.01 General

All Working Drawings, stressing details, and calculations shall bear the seal and signature of an Engineer.

At least 14 Days prior to commencement of work, 5 copies of any proposal shall be submitted to the Contract Administrator.

When other authorities are involved in the approval of the design or construction of a highway structure, the submission shall be made at least 5 weeks prior to commencement of the work. One additional set is required to be submitted for each authority.

907.04.01.02 Submission of Working Drawings for Fabrication and Fastening Details

At least 4 weeks before the commencement of fabrication, the Contractor shall submit 5 complete sets of the Working Drawings to the Contract Administrator.

Fabrication details shall include the following:

a) The grade and species of all wood components and all necessary specifications.

b) The type of preservative treatments to be used for all wood components, including the penetration, and retention required.

c) Details of shop fabrication.

d) Details of all fabrication to be performed in the field.

e) Details of all field cuts and field boring.

f) Special handling or protection details required in the shop, during shipping, or in the field.

g) The field installation details of any temporary attachments such as running planks, barricades, and railings.

h) Protective treatment of heat-treated alloy components.

i) Fastening details.

907.04.01.03 Submission of Erection Procedures

Erection procedures shall bear the seal and signature of an Engineer.

At least 4 weeks before commencement of erection, the Contractor shall submit to the Contract Administrator, 5 complete sets of the erection procedures, including lifting point locations, details of all temporary supports, and prestressing procedures.

907.04.01.04 Return of Submissions

Two copies of each submission to be returned shall be marked as one of the following:

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

In this case, work can commence upon the Contractor's receipt of the Working Drawings. A copy of the Working Drawings shall be available at the site prior to and during construction.

b) Stamped with wording that allows for permission to construct as noted.

In this case, work can start upon the Contractor's receipt of the Working Drawings. The Working Drawings shall be updated as noted and shall have a stamp affixed that is signed by an Engineer stating that the Working Drawings have been revised according to the noted comments. A copy of the stamped updated Working Drawings shall be available at the site prior to and during construction.

c) Showing only required changes.

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

907.05 MATERIALS

907.05.01 Wood

Wood shall be according to OPSS 1601.

907.05.02 Preservatives

The preservatives shall be according to OPSS 1601.

For wood structural systems in bridges, preservatives shall also be according to the CAN/CSA-S6 and the Structural Manual.

907.05.03 Fasteners and Hardware

907.05.03.01 Bolts, Rods, and Lag Screws

Bolts, rods, and lag screws shall be according to ASTM A 307 or CSA G40.20/G40.21.

907.05.03.02 Truss Plates

Sheet steel for manufacturing truss plates shall be according to ASTM A 653, Type A or Type B.

907.05.03.03 Split Ring and Shear Plate Connectors

Split ring and shear plate connectors shall be according to CSA O86.

907.05.03.04 Glulam Rivets

Glulam rivets shall be according to CSA O86.

907.05.03.05 Nails and Spikes

Nails and spikes shall be according to CSA B111.

907.05.03.06 Drift Pins

Steel used for drift pins shall have minimum yield strength of 280 MPa and shall be according to CSA G40.20/G40.21.

907.05.03.07 Washers

Steel washers shall be according to CSA G40.20/G40.21. Malleable iron casting washers shall be according to ASTM A 47M.

907.05.03.08 High-Strength Bars

High-strength bars shall be according to ASTM A 722M.

907.05.03.09 Galvanizing

All fasteners and hardware shall be hot dip galvanized according to CSA G164, after manufacture.

Heat-treated alloy components shall be galvanized according to the manufacturers specifications.

907.05.04 Granular Materials

Granular materials shall be according to OPSS 1010.

907.05.05 Geotextile

Geotextile shall be non-woven, Class II according to OPSS 1860, Table 1, with an FOS of 75-150 µm.

907.05.06 Concrete

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

907.05.07 Steel Reinforcement

Steel reinforcement for concrete shall be according to OPSS 1440.

907.06 EQUIPMENT

907.06.01 Hydraulic and Mechanical Press

Hydraulic or mechanical presses capable of applying uniform pressure over the whole area of truss plates shall be used for the installation of all truss plates.

907.06.02 Hydraulic Jack System Stress-Laminated Wood Decks

The stressing equipment shall be according to OPSS 910.

The hydraulic jack system shall be capable of stressing a minimum of six post-tensioning locations at a time. For longitudinally laminated decks, the number of jacks shall not be less than those required to stress a length of deck equal to one half the width of the deck at the same time.

907.07 CONSTRUCTION

907.07.01 Handling and Storage of Wood

All wood shall be handled, stacked, and protected according to OPSS 1601.

907.07.02 Shop Fabrication

Shop preparation and fabrication shall be according to OPSS 1601.

907.07.03 Field Fabrication

Field fabrication shall only be permitted when specified in the Contract Documents.

Field cut portions of treated wood members shall not be buried or placed in contact with the ground.

Cutting and boring shall not puncture the internal voids of bridge decks containing the post-tensioning bars.

Field cuts, abrasions, and boreholes made in fabricated wood after preservative treatment shall be trimmed and treated to be according to OPSS 1601.

907.07.04 Fasteners

907.07.04.01 Bolts, Rods, and Lag Screws

Holes shall be prebored as specified in the Contract Documents. Holes shall be aligned and the bolts and rods shall be driven, with a hammer not larger than 0.5 kg, in order to make the connection. Lag screws shall be turned into the wood, not driven.

Holes for smooth dowels and drift pins shall be 1.5 mm less in diameter than the dowels or pins. Holes for galvanized bolts shall be bored with a bit 1.5 mm larger in diameter than the bolt.

Holes for lag screws shall have the same diameter and depth as the shank of the screw, plus a lead hole for the threaded portion with the diameter approximately 75% of the shank diameter.

Washers shall be placed under all bolt heads and nuts. Excess bolt lengths of more than 50 mm shall be cut off to a level where at least 5 threads are still extending beyond the nut. The cut ends of galvanized bolts shall receive 2 coats of zinc rich paint. After final tightening, all nuts shall be checked and threads burred effectively with a pointing tool to prevent loosening. Field cuts or damaged surfaces shall be touched-up with a zinc rich paint within 10 hours of exposure.

907.07.04.02 Nailing for Laminated Decks

Gauge lines for horizontal nailing shall be followed. Nails in the upper gauge line shall be inclined slightly downward and those in the lower gauge line inclined slightly upward. The nailheads shall be flush and well set so that they do not protrude from the surface. Power nailing devices shall be permitted for stress-laminated wood decks according to the CAN/CSA-S6.

907.07.05 Wood in Cribs

Excavation shall be according to OPSS 902.

Cribs shall be erected to the dimensions shown in the Contract Documents with each layer horizontal before placing the next. Wood with the least surface oils shall be located in or nearest to the water. Wood, which appears to be more heavily treated, shall be placed at the back of the crib against the ground.

The cribs shall be filled to 1 m below the top of the crib with boulder or rock fragments having dimensions in the range 200 to 600 mm. The top metre of the cribs shall be filled with Granular A or B. The granular material shall be protected against migration into the rock layer by the placement of geotextile fabric between the rock and the granular layers. The geotextile shall be placed uniformly, free of tears and as specified in the Contract Documents. All seams shall have a minimum overlap of 500 mm and the geotextile shall be fixed to prevent movement. Filling of the cribs shall be such that distortion is avoided. Fill material shall be placed in even horizontal layers and shall be compacted according to the requirements of OPSS 501.

907.07.06 Placement of Members

907.07.06.01 Stringers and Girders

Stringers and girders shall be placed and adjusted when necessary so that full and accurate bearing is achieved on the supports. Sawn wood members shall be oriented so that elevation differences between adjacent members, due to natural curvatures along their lengths, are minimized.

907.07.06.02 Laminated Wood Deck

Each lamination shall be placed in the bridge so that initially, full and accurate bearing is achieved. Subsequently the alignment of predrilled holes in stress-laminated decks or slots in composite wood-concrete decks shall be achieved. Finally, the laminations shall be brought to position by nailing.

907.07.07 Stress-Laminated Wood Decks

907.07.07.01 Stressing

Hydraulic jacks shall be used for stressing the stress-laminated wood decks. For transversely laminated decks, all tendons shall be uniformly stressed at the same time.

High-strength bars shall be stressed to the forces shown in the Contract Documents. The tensioning shall be performed in the following sequence:

a) Initial stressing - at time of construction of deck.

   The initial stressing shall consist of two stressing operations not less than 12 hours apart.

b) 1st restressing - not less than 2 weeks after completion of the initial stressing.

c) 2nd Restressing - not less than 4 weeks after the 1st restressing.

The allowable variation of prestressing force in each bar shall be 5%.

The Contract Administrator may increase the time periods between restressings, when the ambient temperature is below 0 °C.

907.07.07.02 Securing of Deck

The deck shall not be secured to the supporting members, except as specified in the Segmental Construction clause, until after the 1st restressing. When a deck requires restraint against buckling during stressing, the restraint shall not inhibit free movement of the deck perpendicular to the laminates.

907.07.07.03 Segmental Construction

When a deck is to be constructed in segments, each segment shall undergo all restressings as specified in the Stressing clause before being installed. The method of installation of the segments shall be such that the final assembled deck is continuous.

When the method of installation requires the temporary release of stressing in a segment in order to facilitate installation, that segment shall then be stressed twice before any segments are attached to it. The first stressing shall be at the time of installation of that segment. The second stressing shall be performed no sooner than 4 x T after the first stressing, where T equals the total time period the segment was not under stress.

907.07.08 Wood-Concrete Composite Decks

907.07.08.01 Wood Base Construction

Wood-concrete interface construction of the deck shall be according to CAN/CSA-S6.

907.07.08.02 Concrete

Concrete placement and testing shall be according to OPSS 904.

907.07.08.03 Steel Reinforcement

Steel reinforcement for concrete shall be placed according to OPSS 905 and CAN/CSA-S6.

907.07.08.04 Reinforcing Spikes

Reinforcing spikes, for notch and spike construction, shall be driven into the top of the laminations in every notch of alternate laminations. These spikes shall be inclined at about 30° from the vertical toward the nearest internal support or end support. If the notches in adjacent laminations are staggered by more than 50 mm, then all laminations involved shall contain reinforcing spikes. Reinforcing spikes shall be a minimum of 50 mm longer than the full vertical depth of the wood deck.

907.07.09 Management of Excess Material

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

907.09 MEASUREMENT FOR PAYMENT

907.09.01 Actual Measurement

907.09.01.01 Wood in Cribs

Measurement of wood in cribs shall be by volume in cubic metres using dressed dimensions of the wood with no deductions for grooves, notches, and holes.

907.09.02 Plan Quantity Measurement

When measurement is by plan quantity, such measurement shall be based on the units shown in the clause under Actual Measurement.

907.10 BASIS OF PAYMENT

907.10.01 Wood in Structure - Item
Wood in Cribs - Item

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

When rock is available on the Contract, no deduction shall be made from the tender item “Rock Excavation, Grading,” for the quantity of rock used in cribs.

907.10.02 Excavation for Wood Cribs

When excavation for wood cribs overlaps excavation for other work, measurement of the overlapping excavation shall be according to the specification for such other work.

Appendix 907-A, April 2011
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The following should be specified in the Contract Documents:

- Allowable field fabrication. (907.07.03)

- Prebored holes for bolts, rods, and lag screws. (907.07.04.01)

- Crib details. (907.07.05)

- Geotextile placement details. (907.07.05)

- Stressing forces for high-strength bars. (907.07.07.01)

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

Related Ontario Provincial Standard Drawings

No information provided here.

NOTICE TO USERS OF OPSS 913

CONSTRUCTION SPECIFICATION FOR EMBEDDED WORK IN STRUCTURES FOR ELECTRICAL SYSTEMS

OPSS 913 has been removed from this OPS volume

The provincial version of OPSS 913 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 913

The municipal version of OPSS 913 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 913

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

NOTICE TO USERS OF OPSS 918

CONSTRUCTION SPECIFICATION FOR MODULAR BRIDGE STRUCTURES FOR TEMPORARY INSTALLATIONS

OPSS 918 has been removed from this OPS volume

The provincial version of OPSS 918 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 918

The municipal version of OPSS 918 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 918

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

CONSTRUCTION SPECIFICATION FOR FORMWORK AND FALSEWORK

TABLE OF CONTENTS

919.01 **SCOPE**

919.02 **REFERENCES**

919.03 **DEFINITIONS**

919.04 **DESIGN AND SUBMISSION REQUIREMENTS**

919.05 **MATERIALS**

919.06 **EQUIPMENT - Not Used**

919.07 **CONSTRUCTION**

919.08 **QUALITY ASSURANCE - Not Used**

919.09 **MEASUREMENT FOR PAYMENT - Not Used**

919.10 **BASIS OF PAYMENT**

APPENDICES

919-A **Commentary**
919-B **Supplemental Requirements for Using OPSS 919 in Municipal Contracts**

919.01 SCOPE

This specification covers the design and construction requirements for formwork, falsework, and temporary supports used in the construction and rehabilitation of structures.

919.01.01 Specification Significance and Use

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

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

919.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

919.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 501 Compacting
OPSS 903 Deep Foundations
OPSS 906 Structural Steel

Ontario Provincial Standard Specifications, Material

OPSS 1010 Aggregates - Base, Subbase, Selected Subgrade, and Backfill Material
OPSS 1350 Concrete - Materials and Production
OPSS 1801 Corrugated Steel Pipe Products

CSA Standards

A23.3-04	Design of Concrete Structures
G40.20-04/40.21-04	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
G164-M92	Hot Dip Galvanizing of Irregularly Shaped Articles
O86-M84 (R1992)	Engineering Design in Wood
O121-08	Douglas Fir Plywood
O122-06	Structural Glued-Laminated Timber
S16-1969	Steel Structures for Buildings
S157/S157.1-05	Strength Design in Aluminum/Commentary on CSA S157-05, Strength Design in Aluminum
S269.1-1975 (R2003)	Falsework for Construction Purposes
S269.3-M92 (R2008)	Concrete Formwork

National Research Council (NRC)

National Building Code of Canada-2005

919.03 DEFINITIONS

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

Bulkhead means the vertical form that supports the end width of a deck pour of concrete.

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

Culvert means a structure that provides an opening through an embankment and in which roadway loads are distributed to the structure through fill or that is designated as a culvert in the Contract Documents.

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

Exposed Surface means all external formed surfaces not to be covered by backfill material.

Falsework means any temporary structural support, including bracing, used to support all or part of the formwork or of the structure during its construction or rehabilitation until it becomes self-supporting.

Formwork means the mould into which the fresh concrete is placed.

Foundation means the ground immediately below the mudsills that supports the falsework or that portion of ground supporting the falsework piles.

Grade means:

a) For steel, the designation of the quality of the steel that can be determined by referring to the appropriate CSA standard or by specimen testing.

b) For wood, the designation of the quality of a piece of wood that can be determined by referring to the appropriate CSA Standard.

Hardwood means wood with a degree of hardness at least equal to a species, such as hard maple, oak, or beech.

Joist means one of a series of horizontal members, usually with narrow face up, to which form material is fastened.

Ledger means a horizontal flexural member usually supporting joists and resting on vertical supports.

Mudsill means a mat of timbers or a small footing on the ground used as a base from which the remainder of the falsework structure is erected.

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

Shoring means a system of vertical or inclined supports for forms or structure components. Shoring may be wood or metal posts, scaffold-type frames, or various patented members or other system of falsework.

Stay-in-Place Forms means forms that are not removed.

Structure means any bridge, culvert, tunnel, retaining wall, wharf, dock, or guideway.

Stud means one of a series of usually vertical members used in framing to support the plywood or formwork fastened to it.

Timber means felled trees or logs suitable for conversion by sawing or otherwise or a piece of sawn lumber having a minimum nominal dimension greater than or equal to 125 mm.

Wood means lumber and timber.

919.04 DESIGN AND SUBMISSION REQUIREMENTS

919.04.01 Design Requirements

919.04.01.01 Formwork Design

Formwork design shall be according to CAN/CSA S269.3.

919.04.01.02 Falsework Design

Falsework design shall be according to CSA S269.1 and as specified herein.

The allowable stresses for wood design shall be according to CSA/CAN3-086.

The allowable stresses for structural steel design shall be according to CSA S16, except the stresses allowed may be increased by 15% for temporary loading.

Deflection of beams shall be limited to L/270, where L is the span. The loading for deflection shall be the weight of concrete and formwork.

When deflection of a beam is 10 mm or more, provision shall be made to compensate for deflection. When provision is made to compensate for deflection, the deflection of the beams shall be limited to L/240, where L is the span. The tolerance shall be ± 5 mm.

Aluminum components shall be designed according to CAN3-S157.

Concrete components shall be designed according to CSA A23.3.

Where scaffolding, fabricated shoring, or patented accessories are used, the design shall be according to the manufacturer's recommendations.

Where another authority is involved, any additional requirements specified by the authority shall also be satisfied.

919.04.01.03 Vertical Loadings

Vertical loading shall be:

a) The weight of the concrete being supported or 2.50 kN/m^2 on the horizontal projected area of the formwork, whichever is the greater.

b) The weight of normal concrete, as it is placed, shall be considered as a liquid having a weight of 24.00 kN/m^3.

c) The weight of the formwork supported by the falsework or 0.50 kN/m^2 of the horizontal projected area, whichever is greater.

d) The weight of workers, equipment, and tools that is to be supported during the concrete placing and finishing operations or 2.00 kN/m^2 of horizontal projected area of formwork whichever is greater. When motorized placing equipment is used this minimum load shall be increased to 3.00 kN/m^2.

e) Load due to any special conditions of construction likely to occur.

f) Loads for temporary supports as specified.

919.04.01.04 Horizontal Loading

The horizontal loadings shall include the effects of environmental factors, such as wind; the rate of placing of concrete; the temperature of the concrete; the effect of vibration of the concrete; the consistency of the mix; and other pertinent factors.

Wind pressures shall be based on those listed in the National Building Code of Canada using 1/30 probability for falsework and 1/10 probability for formwork with a gust factor of 2 and a minimum wind pressure of 0.8 kPa.

Notwithstanding the above, a minimum transverse and longitudinal force of 2% of vertical loading or 1.50 kN/m of deck edge applied at the mid-depth of the deck, whichever is greater, shall be used.

919.04.01.05 Tower Leg Loads

The vertical loads on the tower legs may be based on simple span assumptions. The loads supported by a tower leg may be assumed to be those loads applied to the area immediately above the tower leg that is bounded by lines located one halfway between each of the bays adjacent to the tower leg being considered.

When locating towers, the following criteria shall apply:

The maximum design load on one leg of a frame shall not exceed four times the design load on the other leg under full or partial loading conditions.

The maximum design load on one of the two frames making up a tower shall not exceed four times the design load on the opposite frame under any loading condition.

919.04.01.06 Minimum Bracing Requirements

The minimum bracing requirements are as follows:

a) Connections Between Joists and Ledgers

Every fourth joist shall be connected to a ledger.

Ledgers on top of frames shall be axially continuous across the shoring system to evenly distribute horizontal forces to individual scaffold towers below. Ledgers with a splice designed to take the axial load are considered axially continuous.

b) Bracing in the Transverse Direction

When the shoring height is composed of three frames or the shoring height is more than three times the tower width or the total shoring height is more than 5 m, one horizontal brace made continuous shall be installed on one face of each tower.

The brace shall be located at the mid-height of a two-frame tower and at the top of the second frame for a three-frame tower.

When shoring towers are adequately braced against transverse movement by tying to an adjacent structure or adjacent tower, the above height-to-width restriction applies only to the tower grouping.

When the shoring height is composed of more than three frames, at least one horizontal brace made continuous and one diagonal brace made continuous shall be attached to one transverse face of each tower for every three frames of shoring height. In addition, the maximum spacing of the horizontal brace shall be three times the tower width. The horizontal brace shall be located near the top of a frame. Diagonal braces on adjacent towers shall be installed in opposite directions.

When superelevation is 4% or greater, a horizontal transverse brace shall be attached to one tower face of the top frame in addition to the bracing required by the preceding paragraph.

When the shoring height is greater than 20 m, guy wires shall be installed. The spacing of the guy wires shall not be greater than 15 m horizontally.

c) Bracing in the Longitudinal Direction

When the shoring height is composed of three frames or the total height is more than 5 m, one horizontal brace made continuous shall be installed spaced horizontally not more than 6 m apart. The brace shall be located at the top of the first frame of a two-frame tower and the top of the second frame of a three-frame tower.

When the shoring height is composed of four frames or more, horizontal braces and diagonal braces made continuous shall be attached on a tower and spaced horizontally not more than 6 m apart. The lowest brace shall be located no higher than the third frame and additional braces shall be spaced vertically at the top of every third frame thereafter.

When the bridge is on a longitudinal grade of 4% or greater, braces parallel to the grade shall be attached to one tower face of the top frame and spaced not more than 6 m apart horizontally.

d) Tie Back Bracing - Falsework Opening Towers

The falsework opening towers shall be longitudinally braced to two rows of scaffold towers behind them according to the Bracing in the Longitudinal Direction requirements above, regardless of the height, and shall be continuously braced transversely.

919.04.01.07 Mudsills

The mudsills shall be designed such that the settlement of mudsills shall not exceed 12 mm.

919.04.02 Submission Requirements

919.04.02.01 Working Drawings

919.04.02.01.01 General

Working Drawings shall be submitted for all falsework used in the construction or rehabilitation of structures, except for culverts less than 3 m in span.

Working Drawings are required for the following formwork:

a) Inside forms for post-tensioned decks;

b) Bulkheads in post-tensioned decks 2.0 m or greater in height;

c) All columns and walls, 2.4 m or greater in height, of abutments, piers, and retaining walls.

Working Drawings for other formwork shall only be submitted, when specified in the Contract Documents.

Formwork and falsework shall not be supported by, braced to, or come in contact with another structure unless written permission is received from the owner of the other structure. In order to obtain written permission, 3 copies of Working Drawings shall be submitted to the owner of the other structure showing the support locations and imposed loads as they are applied to that structure and certify that the structure can safely support all the imposed loads from the Contractor's method of construction. Prior to a submission, an Engineer's seal and signature shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

During formwork and falsework construction, the Contractor shall have a copy of the Working Drawings at the site.

919.04.02.01.02 Falsework

The Contractor shall submit 3 sets of falsework Working Drawings to the Contract Administrator at least 1 Day prior to commencement of erection of falsework, for information purposes only. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

Where multi-discipline engineering work is depicted on the same Working Drawing and the design or design-checking Engineer or both are unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be sealed and signed by as many additional design and design-checking Engineers as necessary.

When other authorities are involved, 1 set of Working Drawings shall be submitted for each authority at least 5 weeks prior to the commencement of falsework construction.

The Working Drawings for the falsework for each structure shall include all details of all falsework to be erected.

Falsework Working Drawings shall include at least the following:

a) Longitudinal, lateral, vertical, live, impact, and anticipated construction loads used in the design.

b) Allowable bearing capacity of the soil beneath the mudsills.

c) Maximum column loads.

d) Deflection diagrams for beams having a deflection of 10 mm or more.

e) The grade and actual size of all structural materials.

f) Posts, connections, bracing and welding sufficiently detailed to demonstrate compliance with the structural analysis and erection requirements.

g) Fully detailed frame shoring.

h) Type and mass of moving or stationary equipment to be supported by the falsework.

i) Sequence, method, and rate of concrete placement.

j) All proprietary equipment sufficiently identified to demonstrate compliance with the structural analysis and erection requirements.

k) Full details and locations of all splices.

l) Method of maintaining rotational and lateral stability of bridge girders.

m) Vertical stiffening details and lateral restraint for ledgers and subledgers.

n) Lateral restraint details for falsework supporting beams spanning openings.

o) Fluid concrete loads, assumed for design purposes.

p) Location of screed rail supports and design load.

q) Anticipated settlement of falsework, including settlement of mudsill.

919.04.02.01.03 Formwork

The Contractor shall submit 3 sets of formwork Working Drawings to the Contract Administrator at least 1 Day prior to commencement of erection of formwork, for information purposes only. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents and sound engineering practices.

Where multi-discipline engineering work is depicted on the same Working Drawing and the design or design-checking Engineer or both are unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be sealed and signed by as many additional design and design-checking Engineers as necessary.

When other authorities are involved, 1 set of Working Drawings shall be submitted for each authority at least 5 weeks prior to the commencement of falsework construction.

The Working Drawings shall show all necessary design and construction details, including the grade and size of materials used and the pressure diagrams used in the design.

919.04.02.02 Foundation Information

919.04.02.02.01 Falsework Foundation Design Report

Three copies of a Falsework Foundation Design Report shall be submitted to the Contract Administrator. The report shall bear the seal and signature of an Engineer, shall include the rationale used to determine the soil bearing capacity, and shall include the following information:

a) The soil bearing capacity.

b) Site preparation details.

A Falsework Foundation Design Report is not required when the mudsill bears on mass concrete poured directly on bedrock or when the mudsill bears on compacted Granular A of depth 1.0 m or less placed directly on bedrock.

919.04.02.02.02 Interim Inspection after Construction of Falsework Foundation

Upon completion of the falsework foundation and prior to installation of falsework, the Quality Verification Engineer shall conduct an interim inspection of the work to verify that the falsework foundation has been constructed according to the Falsework Foundation Design Report and issue the Contractor written permission to proceed with the work.

919.04.02.03 Proprietary Shoring, Forms, and Accessories

When proprietary shoring, forms, and accessories are used, the manufacturers' allowable loads with supporting test data shall be submitted with the Working Drawings.

919.04.02.04 Splices for Stay-In-Place Forms

Details of the method of joining round stay-in-place forms shall be shown on the Working Drawings.

919.04.02.05 Revised Submissions

When falsework design considerations or field conditions necessitate amendments to the falsework, revisions shall be resubmitted according to the Working Drawings clause.

919.05 MATERIALS

919.05.01 General

Forms and falsework shall be constructed of wood, metal, or concrete.

919.05.02 Wood

Wood shall be according to CSA/CAN3-O86.

919.05.03 Plywood

Plywood for formwork shall be 7 ply, 17 mm minimum thickness exterior grade Douglas Fir Plywood according to CSA O121.

For exposed surfaces, the finish side shall be medium density overlay plywood; however, this finish is not required in the following locations:

a) The underside of a deck between girders.

b) The ends of decks.

c) The face of ballast walls.

d) The internal faces of a culvert.

919.05.04 Structural Glued-Laminated Timber

Structural glued-laminated timber shall be exterior grade according to CAN/CSA O122.

919.05.05 Metal

Structural steel shall be according to CAN/CSA G40.20/G40.21 and be of the grade shown on the Working Drawings.

Aluminum shall be according to CSA-S157 and be of the alloy and temper shown on the Working Drawings.

Used metal shall be in good condition. All previous fabrication, adversely affecting the required strength, shall be corrected.

919.05.06 Concrete

Concrete shall be according to OPSS 1350.

919.05.07 Accessories

All accessories used shall comply with the details shown on the Working Drawings or with the recommendations of the manufacturer of the specified accessory.

Deck hangers and hardware left in place, either exposed or embedded in concrete within 20 mm of its surface, shall be hot dip galvanized.

All form ties left in place in barrier and parapet walls shall be hot dip galvanized, coated with an approved material, or non-corrodible. Where stainless steel reinforcement is used within the form, all form ties left in place in barrier and parapet walls shall be of stainless steel type 304.

The maximum diameter of plastic cones for form ties shall be 30 mm.

Hot dip galvanizing shall be according to CAN/CSA G164-M.

919.05.08 Void Tubes

Corrugated steel pipe shall be according to OPSS 1801 and need not be coated.

The thickness of the plate in the corrugated pipe shall be as follows:

a) Diameters equal to or less than 900 mm - 0.9 mm thick.

b) Diameters over 900 mm to 1200 mm - 1.1 mm thick.

Steel void forms shall have an outside diameter, top of corrugation to top of corrugation, equal to the diameter of the voids shown on the Working Drawings.

Paper fibre tubes shall be coated, spiral wound, wood fibre paperboard manufactured with waterproof glue.

919.05.09 Granular A

Granular A shall be according to OPSS 1010.

919.07 CONSTRUCTION

919.07.01 Formwork

919.07.01.01 General

Forms shall be smooth; clean; free from warps, splits, holes, and bulges; and constructed and maintained to be mortar tight.

919.07.01.02 Exposed Surfaces

Forms for exposed surfaces shall be new, except that forms may be re-used for exposed surfaces providing their condition is such as to produce a surface equal to one that would be attained using new materials. Where possible, plywood used on exposed surfaces shall be in full sheets and, except when used to form the underside of deck slabs for slab-on-girder construction, shall be so arranged that the face grain is perpendicular to the studs or joists.

919.07.01.03 Studs, Joists, and Decking

Studs and joists shall be spaced not more than 400 mm on centres. Edges of abutting sheets shall be nailed to the same stud or joist with 50 mm nails at not more than 200 mm centres. When used to form the underside of deck slabs in post-tensioned slab and rigid frame bridges, the joints between sheets abutting over joists shall be staggered a minimum of 400 mm. When prefabricated form panels are used, adjacent panels shall be placed such that the joints are maintained flush.

919.07.01.04 Form Release Oil

Non-staining form release oil shall be applied to the faces of forms against which concrete is to be placed. The form release oil shall be applied before placing reinforcement.

919.07.01.05 Ties

When internal form ties are used, concrete cover to any metal left upon removal of the forms shall be 20 mm minimum.

All ties, securing stay-in-place forms in position and extending below the deck soffit shall be loosened before any stressing commences.

Holes left in the deck soffit after removal of hanger coil rods shall be left open.

919.07.01.06 Exposed Corners

All exposed corners on concrete work and the edges of the box void slabs on the soffit of the structure shall be chamfered. The chamfer shall have a vertical and horizontal dimension of 20 mm.

919.07.01.07 Stay-in-Place Forms

Stay-in-place forms shall only be used when specified in the Contract Documents or under the following conditions:

a) Round void tubes of metal in cast-in-place hollow prestressed concrete decks and round void tubes of metal or paper fibre in precast prestressed hollow slab deck units.

   Where round voids are used, individual lengths shall be joined by an inner or outer sleeve or other method. Details of the method of joining shall be submitted to the Contract Administrator, for information purposes only.

b) Box voids in precast concrete box girder deck units less than 1.2 m in depth.

919.07.02 Falsework

919.07.02.01 General

Sound adjustable falsework shall be built such that the structure remains true to line and grade after anticipated settlement.

Mudsills shall not be placed until the Contractor has a set of falsework Working Drawings on site.

The use of tack welds for hangers or other attachments to structural steel is not allowed, except that tack welds may be used on shear studs where it is not detrimental to the connection between the stud and the structural steel.

All welding of structural steel shall be according to OPSS 906.

919.07.02.02 Foundation Work

The falsework structure shall be supported on mudsills, structure footings, or piles.

Where the existing ground is unable to take the applied loads, piles driven according to OPSS 903 shall be used to support the falsework.

Where a timber pile in a falsework bent is too short, the Contractor shall cut off all the piling in the bent to the same elevation and cap the bent. An extension bent shall then be constructed. A pile splice shall only be used with the approval of the Contract Administrator.

Where steel piles are used in a falsework bent, a splice designed and fabricated for 100% of the pile section may be used to make up the required length of any pile.

All caps shall be continuous for the entire length of the bent or sliced as approved by the Contract Administrator. When splices in caps are approved, they shall be located at the centreline of a pile.

For traffic openings, a minimum horizontal space of 1.0 m shall be provided between the back face of the concrete barrier and the front edge of the mudsill.

A levelling pad consisting of a minimum of 100 mm of Granular A, compacted according to OPSS 501, or of poured in place concrete shall be placed under mudsills on bedrock to provide a level surface.

Where the ground is sloped and the Contractor elects to excavate steps, the slopes between the horizontal steps shall not be steeper than 1H:1V. A minimum horizontal width of 300 mm shall be provided between the mudsill and the top edge of slope.

Reduction of the bearing capacity of existing ground or compacted fill, due to water or ice, shall be prevented by suitable drainage or protection.

919.07.02.03 Wooden Shoring

All wooden posts shall be solid, not built up. Where splicing is necessary, the posts shall be cut square and the two pieces shall be in full contact over the splice. Scabbing shall be provided on all four faces of a post to be spliced. Each post shall be braced in two directions both above and below the splice immediately adjacent to the scabbing. Splices on adjacent posts shall be staggered.

Splicing of round posts shall not be permitted.

Bracing material shall be at least 38 x 89 mm lumber except for cross bracing for side forms where 19 x 138 mm lumber may be used. Bracing shall be nailed to each post with at least two 100 mm nails for 38 x 89 mm lumber and two 75 mm nails for 19 x 138 mm lumber. Splicing of bracing shall not be permitted.

Wedges used for purposes of falsework adjustment or to facilitate removal shall be hardwood.

919.07.02.04 Metal Shoring

Erection of metal frame shoring shall be according to CSA S269.1.

The maximum extension of jacks shall not exceed the lesser of the manufacturer's recommendations or 600 mm.

Shims used for levelling mudsills shall be fir plywood or solid lumber.

Wedges used to provide full bearing in U-heads shall be hardwood.

919.07.03 Temporary Supports

The construction of temporary supports shall be as specified in the Contract Documents.

919.07.04 Screed Rail Supports in Slab on Girder Construction

In slab-on-girder construction, screed rail supports shall not be located outside the centreline of the web of the outside girders.

When screed rail supports are not located over the webs of girders, a system of support shall be installed such that the deflection of the system under the load of the screed machine shall not exceed 5 mm.

919.07.05 Certificate of Conformance

Certificates of Conformance shall be submitted for all formwork and falsework for which Working Drawings are submitted.

A completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of formwork and falsework installation and before any concreting takes place. The Qualification Verification Engineer’s seal and signature shall be affixed on the completed Certificate of Conformance confirming that the formwork and falsework have been installed in general conformance with the Working Drawings and Contract Documents.

919.07.06 Removal of Formwork, Falsework, and Temporary Supports

All formwork and falsework shall be removed. When authorized by the Contract Administrator, piles used for falsework may be left in place provided the top is 1.2 m below the finished grade or ground level or is at least 0.6 m below a streambed.

The method and sequence of removal of the formwork and falsework shall be such that it permits the concrete to take up the stresses gradually.

Falsework shall not be removed from post-tensioned structures until the post-tensioning is completed.

When a component is not post-tensioned, falsework may be removed after the concrete has attained a minimum strength of 20 MPa.

Formwork shall not be removed until the concrete has attained a minimum strength of 20 MPa; however, formwork for cast-in-place barrier walls and parapet walls may be removed 24 hours after completion of the placement.

Where insulation is used, the side forms may be slackened off 24 hours after concrete placement to help control temperature.

Removal of temporary supports shall be as specified in the Contract Documents.

919.07.07 Management of Excess Material

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

919.10 BASIS OF PAYMENT

919.10.01 Formwork and Falsework

The Contract price for the concrete tender item directly associated with formwork and falsework shall include full compensation for all labour, Equipment, and Material to do the work.

919.10.02 Temporary Support - Item

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

Appendix 919-A, November 2011
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Stay-in-place forms. (919.07.01.07)

- Construction of temporary supports. (919.07.03)

- Removal of temporary supports. (919.07.06)

The design should determine if the following is required and, if so, it should be specified in the Contract Documents:

- Submissions of other formwork Working Drawings. (919.04.02.01.01)

OPSS 919 contains information written for provincial contracts. To ensure completeness of municipal Contract Documents, the designer should invoke Appendix 919-B. The appendix contains supplemental requirements that modify OPSS 919 so it can be used by a municipality in its contracts.

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

Related Ontario Provincial Standard Drawings

OPSD 3310.100	Deck, Girders, Concrete, Method of Obtaining Screed Elevations
OPSD 3311.100	Deck, Girders, Steel, Method of Obtaining Screed Elevations
OPSD 3332.100	Deck, Round Voids, Form Supports and Tie Downs
OPSD 3333.100	Deck, Round Voids, Drains
OPSD 3333.101	Deck, Trapezoid Voids, Drains
OPSD 3390.100	Deck, Drip Channel
OPSD 3390.150	Falsework Clearance to Traffic Lanes
OPSD 3940.150	Figures In Concrete, Warning Message, Layout
OPSD 3940.151	Figures In Concrete, Warning Message Letters
OPSD 3940.200	Figures In Concrete, Site Number and Date Layout

Appendix 919-B, November 2009
FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

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

Supplemental Requirements for Using OPSS 919 in Municipal Contracts

OPSS 919, Formwork and Falsework, is amended as follows:

919.03 Definitions

Section 919.03 is amended by the deletion of the definitions for Certificate of Conformance and for Quality Verification Engineer.

Section 919.03 is amended by the addition of the following:

Certificate of Installation means a document issued by the design Engineer or design-checking Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

919.04.02.01.02 Falsework

The first paragraph of clause 919.04.02.01.02 is deleted in its entirety and replaced by the following:

The Contractor shall submit 5 sets of Working Drawings to the Contract Administrator at least 14 Days prior to commencement of the erection of falsework. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

919.04.02.01.03 Formwork

The first paragraph of clause 919.04.02.01.03 is deleted in its entirety and replaced by the following:

The Contractor shall submit 5 sets of Working Drawings to the Contract Administrator at least 14 Days prior to commencement of the erection of formwork. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

919.04.02.02.02 Interim Inspection after Construction of Falsework

Clause 919.04.02.02.02 is deleted in its entirety and replaced by the following:

Upon completion of the falsework foundation and prior to installation of falsework, the design Engineer or the design-checking Engineer shall conduct an interim inspection of the work to verify that the falsework foundation has been constructed according to the Falsework Foundation Design Report and issue the Contractor written permission to proceed with the work.

Appendix 919-B

919.04.02 Submission Requirements

Subsection 919.04.02 is amended by the addition of the following:

919.04.02.06 Return of Submissions

Two copies of each submission shall be returned as one of the following:

a) Stamped with the wording that allows for permission to construct. In this case, work can commence on receipt of the drawings by the Contractor.

b) Stamped with the wording that allows for permission to construct as noted. In this case, work can start on receipt of the drawings by the Contractor. The drawings shall be updated as noted and shall be sealed and signed by the design Engineer and the design-checking Engineer stating the drawings have been revised according to the noted comments.

c) Showing only required changes. In this case, the drawings shall be updated as required and the submission process repeated.

919.07.05 Certificate of Conformance

Clause 919.07.05 is deleted in its entirety and replaced by the following:

919.07.05 Certificate of Installation

Certificates of installation shall be submitted for all formwork and falsework for which Working Drawings are submitted.

A completed certificate of installation shall be submitted to the Contract Administrator upon completion of the formwork and falsework installation prior to the placement of concrete. The design Engineer or design-checking Engineer's seal and signature shall be affixed on the completed certificate of installation confirming that the formwork and falsework have been installed in general conformance with the Working Drawings and Contract Documents. The certificate of installation shall also certify that the interim milestone inspections have been completed as specified in the Contract Documents.

NOTICE TO USERS OF OPSS 929

CONSTRUCTION SPECIFICATION FOR ABRASIVE BLAST CLEANING – CONCRETE CONSTRUCTION

OPSS 929 has been removed from this OPS volume

The provincial version of OPSS 929 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 929

The municipal version of OPSS 929 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 929

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

NOTICE TO USERS OF OPSS 931

CONSTRUCTION SPECIFICATION FOR STRUCTURE REHABILITATION - SHOTCRETE

OPSS 931 has been removed from this OPS volume

The provincial version of OPSS 931 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 931

The municipal version of OPSS 931 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 931

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

NOTICE TO USERS OF OPSS 932

CONSTRUCTION SPECIFICATION FOR CRACK REPAIR - CONCRETE

OPSS 932 has been removed from this OPS volume

The provincial version of OPSS 932 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 932

The municipal version of OPSS 932 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 932

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

NOTICE TO USERS OF OPSS 942

CONSTRUCTION SPECIFICATION FOR PRESTRESSED SOIL AND ROCK ANCHORS

OPSS 942 has been removed from this OPS volume

The provincial version of OPSS 942 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 942

The municipal version of OPSS 942 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 942

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