

Ontario Provincial Standards for Roads and Public Works



- Volume 1 -

MUNICIPAL AND PROVINCIAL COMMON

GENERAL AND CONSTRUCTION SPECIFICATIONS



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



Municipal
Engineers
Association

MANUAL REVISION RECORD

Municipal and Provincial Common

Volume 1 – General and Construction Specifications

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

REVISION NUMBER	REVISION DATE	ENTERED BY	REVISION NUMBER	DATE	ENTERED BY
74	APRIL 2005	Included in new manuals	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		
80	APRIL 2008	Included in new manuals	105		
81	NOV 2008	Included in new manuals	106		
82	APRIL 2009	Included in new manuals	107		
83	NOV 2009	Included in new manuals	108		
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85	JULY 2010	Included in new manuals	110		
86	NOV 2010	Included in new manuals	111		
87	APRIL 2011	Included in new manuals	112		
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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		
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Ontario Provincial Standards Unit
301 St. Paul St., 2nd Floor North
St. Catharines, ON L2R 7R4

REVISION INFORMATION SHEET

ONTARIO PROVINCIAL STANDARDS FOR ROADS AND PUBLIC WORKS

VOLUME 1 MUNICIPAL AND PROVINCIAL COMMON GENERAL AND CONSTRUCTION SPECIFICATIONS

MANUAL REVISION #103

APRIL 2019

UPDATING ONTARIO PROVINCIAL STANDARDS FOR YOUR USE

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for use of Ontario Provincial Standards; therefore, manual holders are cautioned about immediately discarding superseded and cancelled standards.

ACCESSING AND OBTAINING ONTARIO PROVINCIAL STANDARDS

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

- The eight OPS manuals of standards are also available for free as well in a single PDF format on the website.

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

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

WAITING TO HEAR FROM YOU

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

THIS MANUAL IS REVISED AS FOLLOWS:

Index Pages Volume 1

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

Standard Specifications Volume 1

Superseded/Cancelled (Remove)		Revised/New (Insert)		Remarks
OPSS	Dated	OPSS	Dated	
201	Nov 2011	201	Apr 2019 Notice to Users of OPSS 201	“CONSTRUCTION SPECIFICATION FOR CLEARING, CLOSE CUT CLEARING, GRUBBING, AND REMOVAL OF SURFACE AND PILED BOULDERS” Superseded by OPSS.PROV 201 in OPS Volume 5 and OPSS.MUNI 201 in OPS Volume 7.
703	Nov 2014	703	Apr 2019 Notice to Users of OPSS 703	“CONSTRUCTION SPECIFICATION FOR PERMANENT SMALL SIGNS AND SUPPORT SYSTEMS” Superseded by OPSS.PROV 703 in OPS Volume 5 and OPSS.MUNI 703 in OPS Volume 7.
760	Nov 2014	760	Apr 2019 Notice to Users of OPSS 760	“CONSTRUCTION SPECIFICATION FOR NOISE BARRIER SYSTEMS” Superseded by OPSS.MUNI 760 in OPS Volume 7.



DATE	SPEC. NO. OPSS	TITLE
DIVISION 1 - GENERAL SPECIFICATIONS		
APR 2007	100	Notice to Users of OPSS 100 (General Conditions of Contract)
NOV 2018	102	Notice to Users of OPSS 102 (Weighing of Materials)
APR 2017	106	Notice to Users of OPSS 106 (Electrical Work)
NOV 2014	120	Notice to Users of OPSS 120 (The Use of Explosives)
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
NOV 2016	180	Notice to Users of OPSS 180 (Management of Excess Materials)
NOV 2012	182	Notice to Users of OPSS 182 (Environmental Protection for Construction in Waterbodies and on Waterbody Banks - <i>Reissued 2010-11</i>)
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)
NOV 2013	206	Notice to Users of OPSS 206 (Grading)
NOV 2014	209	Notice to Users of OPSS 209 (Embankments Over Swamps and Compressible Soils)
NOV 2013	212	Notice to Users OPSS 212 (Earth Borrow)
NOV 2014	220	Notice to Users of OPSS 220 (Wick Drain Installation)



DATE	SPEC. NO. OPSS	TITLE
DIVISION 3 - PAVEMENT (FLEXIBLE AND RIGID)		
NOV 2018	301	Notice to Users of OPSS 301 (Restoring Unpaved Roadway Surface)
NOV 2016	302	Notice to Users of OPSS 302 (Priming Granular Base)
NOV 2018	303	Notice to Users of OPSS 303 (Double Chip Seal)
NOV 2016	304	Notice to Users OPSS 304 (Single and Double Surface Treatment)
NOV 2016	305	Notice to Users of OPSS 305 (Granular Sealing)
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)
APR 2007	313	Notice to Users of OPSS 313 (Hot Mix Asphalt - End Result)
NOV 2015	314	Notice to Users of OPSS 314 (Untreated Subbase, Base, Surface, Shoulder, Selected Subgrade, And Stockpiling)
NOV 2018	316	Notice to Users of OPSS 316 (Extruded Expanded Polystyrene Frost Heave Treatment)
NOV 2014	320	Notice to Users of OPSS 320 (Open Graded Drainage Layer)
NOV 2014	330	Notice to Users of OPSS 330 (In-Place Full Depth Reclamation of Bituminous Pavement and Underlying Granular)



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NOV 2015	331	Notice to Users of OPSS 331 (Full Depth Reclamation with Expanded Asphalt Stabilization)
NOV 2016	332	Notice to Users of OPSS 332 (Hot In-Place Recycling and Hot In-Place Recycling with Integral Overlay)
NOV 2015	333	Notice to Users of OPSS 333 (Cold In-Place Recycling)
NOV 2016	334	Notice to Users of OPSS 334 (Cold Recycled Mix)
NOV 2015	335	Notice to Users of OPSS 335 (Cold In-Place Recycling with Expanded Asphalt)
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
NOV 2015	351	Concrete Sidewalk
NOV 2016	353	Notice to Users of OPSS 353 (Concrete Curb and Gutter Systems)
NOV 2014	355	Notice to Users of OPSS 355 (Installation of Interlocking Concrete Pavers)
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 2011	361	Rubblizing Concrete Pavement and Concrete Base
APR 2017	362	Notice to Users of OPSS 362 (Fast Track Full Depth Repairs to Concrete Pavement)
NOV 2014	363	Notice to Users of OPSS 363 (Repairing Rigid Pavement with Precast Concrete Slabs)



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APR 2017	364	Notice to Users of OPSS 364 (Partial Depth Repairs in Concrete Pavement)
NOV 2014	365	Notice to Users of OPSS 365 (Cross-Stitching Longitudinal Cracks in Concrete Pavement and Concrete Base)
NOV 2018	369	Notice to Users of OPSS 369 (Sealing or Resealing of Joints and Cracks in Concrete Pavement and Concrete Base)
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NOV 2015	401	Notice to Users of OPSS 401 (Trenching, Backfilling, And Compacting)
NOV 2016	402	Notice to Users of OPSS 402 (Excavating, Backfilling, and Compacting for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers) (Formerly OPSS 516)
NOV 2016	403	Notice to Users of OPSS 403 (Rock Excavation for Pipelines, Utilities, and Associated Structures in Open Cut) (Formerly OPSS 515)
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 2015	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 2015	410	Notice to Users of OPSS 410 (Pipe Sewer Installation In Open Cut)
NOV 2015	411	Cleaning and Flushing of Pipe Sewers, Catch Basins, Maintenance Holes, Ditch Inlets, and Oil-Grit Separators



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NOV 2018	412	Notice to Users of OPSS 412 (Sewage Forcemain Installation in Open Cut)
NOV 2014	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	421	Notice to Users of OPSS 421 (Pipe Culvert Installation In Open Cut)
NOV 2015	422	Precast Reinforced Concrete Box Culverts in Open Cut
NOV 2016	441	Notice to Users of OPSS 441 (Watermain Installation in Open Cut) (Formerly OPSS 701)
NOV 2016	442	Notice to Users of OPSS 442 (Corrosion Protection of New and Existing Watermains)
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 2014	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 2015	493	Temporary Potable Water Supply Services (Reissued 2010-11)



DATE	SPEC. NO. OPSS	TITLE
DIVISION 5 - MISCELLANEOUS		
NOV 2014	501	Notice to Users of OPSS 501 (Compacting)
NOV 2009	503	Site Preparation for Pipelines, Utilities, and Associated Structures (Relocated: Now OPSS 490)
NOV 2009	504	Preservation, Protection, and Reconstruction of Existing Facilities (Relocated: Now OPSS 491)
NOV 2017	506	Notice to Users of OPSS 506 (Dust Suppressants)
NOV 2005	507	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures (Relocated: Now OPSS 492)
NOV 2014	510	Notice to Users of OPSS 510 (Removal)
NOV 2013	511	Rip-Rap, Rock Protection, and Granular Sheeting
NOV 2014	512	Notice to Users of OPSS 512 (Installation of Gabions)
NOV 2009	514	Trenching, Backfilling, and Compacting (Relocated: Now OPSS 401)
NOV 2005	515	Rock Excavation for Pipelines, Utilities, and Associated Structures in Open Cut (Relocated: Now OPSS 403)
NOV 2005	516	Excavating, Backfilling, and Compacting for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers (Relocated: Now OPSS 402)
NOV 2010	517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
NOV 2016	518	Notice to Users of OPSS 518 (Control of Water from Dewatering Operations)
JUNE 1991	532	Pavement Marking (Relocated: Now OPSS 710)
NOV 2005	538	Support Systems (Relocated: Now OPSS 404)
NOV 2014	539	Notice to Users of OPSS 539 (Temporary Protection Systems)



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NOV 2005	541	Chain-Link Fence (Relocated: Now OPSS 772)
NOV 2006	542	Expanded Metal Anti-Glare Screen (Relocated: Now OPSS 791)
DEC 1990	543	Traffic Control Signing (Relocated: Now OPSS 706)
NOV 2008	552	Steel Beam Guide Rail and Cable Guide Rail (Relocated: Now OPSS 721)
FEB 1991	553	Concrete Barriers (Relocated: Now OPSS 740)
NOV 2008	555	Guide Rail End Treatment - Eccentric Loader Terminal System (Relocated: Now OPSS 730)
NOV 2008	556	Connecticut Impact Attenuation System (Relocated: Now OPSS 753)
NOV 2008	558	Guide Rail End Treatment - Crash-Cushion Attenuating Terminal System (Relocated: Now OPSS 731)
APR 2008	559	Guide Rail End Treatment - Steel Beam Energy Attenuating Terminal Systems (Relocated: Now OPSS 732)
NOV 2007	565	The Protection of Trees (Relocated: Now OPSS 801)
NOV 2007	570	Topsoil (Relocated: Now OPSS 802)
NOV 2007	571	Sodding (Relocated: Now OPSS 803)
NOV 2003	572	Seed and Cover (Relocated: Now OPSS 804)
NOV 2006	577	Temporary Erosion and Sediment Control Measures (Relocated: Now OPSS 805)



DATE	SPEC. NO. OPSS	TITLE
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 2012	609	Grounding
NOV 2016	610	Notice to Users of OPSS 610 (Removal of Electrical Equipment and Materials) (Reissued 2010-11)
NOV 2013	611	Installation of Underpass Luminaires
NOV 2012	614	Installation of Power Supply Equipment
APR 2017	615	Notice to Users of OPSS 615 (Erection of Poles)
APR 2018	616	Notice to Users of OPSS 616 (Footings and Pads for Electrical Equipment)
NOV 2013	617	Installation of Roadway Luminaires
APR 2017	620	Notice to Users of OPSS 620 (Traffic Signal Equipment)
NOV 2016	630	Notice to Users of OPSS 630 (Installation of Sectional Steel High Mast Lighting Poles)
NOV 2015	631	Concrete Footings and Maintenance Platforms for High Mast Lighting Poles
DIVISION 7 - TRAFFIC SAFETY		
NOV 2009	701	Watermain Installation in Open Cut (Relocated: Now OPSS 441)
NOV 2008	702	Cathodic Protection of New and Existing Watermains (Relocated: Now OPSS 442)
APR 2019	703	Notice to Users of OPSS 703 (Permanent Small Signs and Support Systems)
NOV 2014	704	Post Mounted Delineators



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NOV 2016	706	Notice to Users of OPSS 706 Traffic Control Signing (Formerly OPSS 543)
NOV 2015	707	Modified Overhead Signboards
NOV 2010	710	Pavement Marking (Formerly OPSS 532)
NOV 2014	721	Notice to Users of OPSS 721 (Steel Beam Guide Rail and Cable Guide Rail)
APR 2015	723	Notice to Users of OPSS 723 (Energy Attenuators)
NOV 2014	732	Notice to Users of OPSS 732 (Guide Rail End Treatment - Steel Beam Energy Attenuating Terminal Systems)
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 2014	771	Notice to Users of OPSS 771 (Standard Highway Fence) (Formerly OPSS 540)
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

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NOV 2010	802	Topsoil (Formerly OPSS 570)



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NOV 2014	804	Notice to Users of OPSS 804 (Seed and Cover)
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)
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)
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NOV 2010	902	Excavating and Backfilling - Structures
APR 2016	903	Notice to Users of OPSS 903 (Deep Foundations)
APR 2010	904	Notice to Users of OPSS 904 (Concrete Structures)
NOV 2014	905	Notice to Users of OPSS 905 (Steel Reinforcement for Concrete)



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NOV 2012	906	Structural Steel for Bridges
APR 2011	907	Structural Wood Systems
NOV 2014	908	Notice to Users of OPSS 908 (Metal Traffic Barriers and Metal Railings for Structures)
NOV 2016	909	Notice to Users of OPSS 909 (Prestressed Concrete - Precast Members)
APR 2008	910	Notice to Users of OPSS 910 (Stressing Systems for Post-Tensioning)
NOV 2014	911	Notice to Users of OPSS 911 (Coating Structural Steel Systems)
NOV 2017	913	Notice to Users of OPSS 913 (Embedded Work in Structures for Electrical Systems)
NOV 2014	914	Notice to Users of OPSS 914 (Waterproofing Bridge Decks with Hot Applied Asphalt Membrane)
NOV 2014	915	Notice to Users of OPSS 915 (Sign Support Structures)
APR 2017	918	Notice to Users of OPSS 915 (Modular Bridge Structures for Temporary Installations)
NOV 2011	919	Formwork and Falsework
NOV 2008	920	Notice to Users of OPSS 920 (Deck Joint Assemblies, Preformed Seals, Joint Fillers, Joint Seals, Joint Sealing Compounds, and Waterstops - Structures)
NOV 2016	922	Notice to Users of OPSS 922 (Installation of Bearings)
APR 2012	928	Notice to Users of OPSS 928 (Structure Rehabilitation - Concrete Removal)
NOV 2017	929	Notice to Users of OPSS 929 (Abrasive Blast Cleaning - Concrete Construction)
NOV 2014	930	Notice to Users of OPSS 930 (Structure Rehabilitation - Concrete Patches and Overlays)
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NOV 2009	932	Crack Repair - Concrete
NOV 2009	942	Prestressed Soil and Rock Anchors



NOTICE TO USERS OF OPSS 100

GENERAL CONDITIONS OF CONTRACT

General Conditions of Contract has been removed
from this OPS volume

The provincial version of the General Conditions is now in:

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

The municipal version of the General Conditions is now in:

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

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



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 120

GENERAL SPECIFICATION FOR THE USE OF EXPLOSIVES

OPSS 120 has been removed from this
OPS volume

The provincial version of OPSS 120 is now in:

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

The municipal version of OPSS 120 is now in:

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

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



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
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GENERAL SPECIFICATION FOR SUPPLY OF PRE-QUALIFIED MATERIAL AND PRODUCTS

TABLE OF CONTENTS

128.01	SCOPE
128.02	REFERENCES
128.03	DEFINITIONS
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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 specification unless invoked by the Owner.

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

128.02 REFERENCES

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

MINISTRY Publication:

Designated Sources for Materials (DSM)

MUNICIPALITY Listing:

Municipal Product Listing (MPL)

AGENCY Listing:

Agency Product Listing (APL)

Information Resource:

The Road Authority (TRA)

128.03 DEFINITIONS

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

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

Product means the same as Material.

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

128.04 PRE-QUALIFIED MATERIAL AND PRODUCTS INFORMATION

128.04.01 Submission

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

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

128.04.02 Pre-Qualified Material and Products

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

128.04.03 Material and Product Endorsement

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

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

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

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

128.05 SUPPLY OF MATERIAL AND PRODUCTS

128.05.01 General

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

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

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

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

128.05.02 Queries

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

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

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

128.05.03 Product Listings

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

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

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

128.06 QUALITY ASSURANCE

128.06.01 Material and Product Quality and Quantity

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

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

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

Designer Action/Considerations

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

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

Related Ontario Provincial Standards Drawings

None.



NOTICE TO USERS OF OPSS 180

GENERAL SPECIFICATION FOR THE MANAGEMENT OF EXCESS MATERIALS

OPSS 180 has been removed from this
OPS volume

The provincial version of OPSS 180 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 180

The municipal version of OPSS 180 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 180

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



NOTICE TO USERS OF OPSS 182

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

OPSS 182 has been removed from this
OPS volume

The provincial version of OPSS 182 is now in:

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

The municipal version of OPSS 182 is now in:

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

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



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
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NOTICE TO USERS OF OPSS 206

CONSTRUCTIONS SPECIFICATION FOR GRADING

OPSS 206 has been removed from this
OPS volume

The provincial version of OPSS 206 is now in:

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

The municipal version of OPSS 206 is now in:

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

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



NOTICE TO USERS OF OPSS 209

CONSTRUCTION SPECIFICATION FOR EMBANKMENTS OVER SWAMPS AND COMPRESSIBLE SOILS

OPSS 209 has been removed from this
OPS volume

The provincial version of OPSS 209 is now in:

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

The municipal version of OPSS 209 is now in:

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

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



NOTICE TO USERS OF OPSS 212

CONSTRUCTIONS SPECIFICATION FOR BORROW

OPSS 212 has been removed from this
OPS volume

The provincial version of OPSS 212 is now in:

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

The municipal version of OPSS 212 is now in:

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

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
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NOTICE TO USERS OF OPSS 220

CONSTRUCTION SPECIFICATION FOR WICK DRAIN INSTALLATION

OPSS 220 has been removed from this
OPS volume

The provincial version of OPSS 220 is now in:

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

The municipal version of OPSS 220 is now in:

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

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



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
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NOTICE TO USERS OF OPSS 302

CONSTRUCTION SPECIFICATION FOR PRIMING GRANULAR BASE

OPSS 302 has been removed from this
OPS volume

The municipal version of OPSS 302 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 302

**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 304

CONSTRUCTION SPECIFICATION FOR SINGLE AND DOUBLE SURFACE TREATMENT

OPSS 304 has been removed from this
OPS volume

The provincial version of OPSS 304 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 304

The municipal version of OPSS 304 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 304

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



NOTICE TO USERS OF OPSS 305

CONSTRUCTION SPECIFICATION FOR GRANULAR SEALING

OPSS 305 has been removed from this
OPS volume

The provincial version of OPSS 305 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 305

The municipal version of OPSS 305 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 305

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

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309.01 SCOPE

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

309.01.01 Specification Significance and Use

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

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

309.01.02

Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

309.02

REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

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

Ontario Provincial Standard Specifications, Material

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

Ministry of Transportation Publications

MTO Laboratory Testing Manual:

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

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

309.03 DEFINITIONS

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

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

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

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

309.04 SUBMISSION AND DESIGN REQUIREMENTS

309.04.01 Mix Design

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

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

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

309.05 MATERIALS

309.05.01 Emulsified Asphalt

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

309.05.02 Aggregates

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

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

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

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

309.05.03.01 General

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

309.05.03.02 Open Graded Mix

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

309.05.03.03 Dense Graded Mix

Dense graded mix shall be according to Table 4.

309.06 EQUIPMENT

309.06.01 Production and Placement

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

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

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

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

309.06.02 Cold Mix Plants

309.06.02.01 General Requirements

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

309.06.02.02 Emulsified Asphalt Storage

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

309.06.02.03 Aggregate Feed System

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

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

Vibratory pan feeders shall not be acceptable for proportioning aggregates.

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

309.06.02.04 Pugmill

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

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

The mixing time or cycle shall be adjustable.

309.06.02.05 Emulsified Asphalt Pump

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

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

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

The system shall be interlocked through a master control switch.

309.06.02.06 Discharge Holding Hopper

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

309.06.03 Rollers

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

309.06.04 Cover Aggregate Spreaders

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

Spinner type spreaders are not allowed.

309.07 CONSTRUCTION

309.07.01 Emulsified Asphalt

Emulsified asphalt shall be thoroughly mixed with the aggregate.

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

309.07.02.01 Operational Constraints

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

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

309.07.02.02 Preparation of the Foundation

309.07.02.02.01 Granular Base

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

309.07.02.02.02 Pavement

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

309.07.02.03 Production and Placement

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

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

309.07.02.04 Compaction

309.07.02.04.01 General

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

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

309.07.02.04.02 Open Graded Mix

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

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

309.07.02.04.03 Dense Graded Mix

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

309.07.02.05 Trial Application

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

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

309.07.02.06 Surface Tolerance

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

309.07.02.07 Surface Appearance

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

309.07.02.08 Sampling

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

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

309.07.02.09 Tolerances

The mix samples shall be according to the following tolerances:

Residual asphalt content: $\pm 0.3\%$

Aggregate retained on the 4.75 mm sieve:

For open graded mix $\pm 2.0\%$

For dense graded mix $\pm 6.0\%$

309.07.03 Cover Aggregate

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

309.07.04 Management of Excess Material

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

309.08 QUALITY ASSURANCE

309.08.01 Testing

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

309.09 MEASUREMENT FOR PAYMENT

309.01.01 Actual Measurement

309.09.01.01 Emulsified Asphalt

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

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

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

309.10**BASIS OF PAYMENT****309.10.01**

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

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

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

TABLE 1
Emulsified Asphalt and Residual Asphalt Content

Type of Mix	Emulsified Asphalt Content kg/t	Residual Asphalt Content by Mass (Note 1)
CL 2 Open Graded, Surface or Levelling Course	69-122	4.5 - 8.0%
CL3 Open Graded, Surface or Levelling Course	65-115	4.2 - 7.5%
CL4 Open Graded, Binder or Levelling Course	61-107	4.0 - 7.0%
CL8 Open Graded, Binder or Levelling Course	55-77	3.5 - 5.0%
Dense Graded	61-107	4.0 - 7.0%
Note: 1. As determined by test LS-282.		

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

Sieve Designation	% Passing			
	CL 2	CL 3	CL 4	CL 8
26.5 mm				100
19.0 mm			100	95-100
16.0 mm		100	96-100	65-90
13.2 mm	100	96-100	67-86	-
9.5 mm	75-100	50-73	29-52	20-55
6.7 mm	0-40	-	-	-
4.75 mm	0-10	0-10	0-10	0-10
2.36 mm	0-5	0-5	0-5	0-5
75 µm (Note 1)	0-2	0-2	0-2	0-2
Note: 1. Open graded mix aggregates with more than 2.0% passing the 75 µm sieve will be rejected.				

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

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

Note:

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

TABLE 4
Physical Requirements for Cold Mixed Dense Graded Bituminous Mix

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

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

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Type of CL mix. (309.07.02.03)

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

- Second course of CL mix. (309.07.02.03)

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

Related Ontario Provincial Standard Drawings

No information provided here.



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
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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
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NOTICE TO USERS OF OPSS 313

CONSTRUCTION SPECIFICATION FOR HOT MIX ASPHALT - END RESULT

OPSS 313 has been removed from this
OPS volume and placed in

OPS Volume 5,
Provincial-Oriented
MTO General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.PROV 313

**USE OF THE SPECIFICATION IS AS SPECIFIED
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There is not an OPSS.MUNI 313



NOTICE TO USERS OF OPSS 314

CONSTRUCTION SPECIFICATION FOR UNTREATED SUBBASE, BASE, SURFACE, SHOULDER, SELECTED SUBGRADE, AND STOCKPILING

OPSS 314 has been removed from this
OPS volume

The provincial version of OPSS 314 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 314

The municipal version of OPSS 314 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
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NOTICE TO USERS OF OPSS 316

CONSTRUCTION SPECIFICATION FOR EXTRUDED EXPANDED POLYSTYRENE FROST HEAVE TREATMENT

OPSS 316 has been removed from this
OPS volume

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OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
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OPS Volume 7,
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General and Construction Specifications
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NOTICE TO USERS OF OPSS 320

CONSTRUCTION SPECIFICATION FOR OPEN GRADED DRAINAGE LAYER

OPSS 320 has been removed from this
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OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
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OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 320

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NOTICE TO USERS OF OPSS 330

CONSTRUCTION SPECIFICATION FOR IN-PLACE FULL DEPTH RECLAMATION OF BITUMINOUS PAVEMENT AND UNDERLYING GRANULAR

OPSS 330 has been removed from this
OPS volume

The provincial version of OPSS 330 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 330

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OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 330

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NOTICE TO USERS OF OPSS 331

CONSTRUCTION SPECIFICATION FOR FULL DEPTH RECLAMATION WITH EXPANDED ASPHALT STABILIZATION

OPSS 331 has been removed from this
OPS volume

The provincial version of OPSS 331 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 331

The municipal version of OPSS 331 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 331

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NOTICE TO USERS OF OPSS 332

CONSTRUCTION SPECIFICATION FOR HOT IN-PLACE AND HOT IN-PLACE RECYCLING WITH INTEGRAL OVERLAY

OPSS 332 has been removed from this
OPS volume

The provincial version of OPSS 332 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
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OPS Volume 7,
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NOTICE TO USERS OF OPSS 333

CONSTRUCTION SPECIFICATION FOR COLD IN-PLACE RECYCLING

OPSS 333 has been removed from this
OPS volume

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General and Construction Specifications
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OPS Volume 7,
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NOTICE TO USERS OF OPSS 334

CONSTRUCTION SPECIFICATION FOR COLD RECYCLED MIX

OPSS 334 has been removed from this
OPS volume

The municipal version of OPSS 334 is now in:

OPS Volume 7,
Municipal-Oriented
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NOTICE TO USERS OF OPSS 335

CONSTRUCTION SPECIFICATION FOR COLD IN-PLACE RECYCLING WITH EXPANDED ASPHALT

OPSS 335 has been removed from this
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Provincial-Oriented
General and Construction Specifications
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NOTICE TO USERS OF OPSS 336

CONSTRUCTION SPECIFICATION FOR MICRO-SURFACING

OPSS 336 has been removed from this
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Provincial-Oriented
General and Construction Specifications
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General and Construction Specifications
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NOTICE TO USERS OF OPSS 337

CONSTRUCTION SPECIFICATION FOR SLURRY SEAL

OPSS 337 has been removed from this
OPS volume

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Provincial-Oriented
General and Construction Specifications
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The municipal version of OPSS 337 is now in:

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

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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
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The municipal version of OPSS 341 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
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CONSTRUCTION SPECIFICATION FOR CONCRETE PAVEMENT AND CONCRETE BASE

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350.01 SCOPE

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

350.02 REFERENCES

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

Ontario Provincial Standard Specifications, Construction:

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

Ontario Provincial Standard Specifications, Material:

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

Canadian Standards Association:

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

Ministry of Transportation Publication:

MTO Laboratory Testing Manual:

LS-101 Procedures for Calculating Percent Within Limits

350.03 DEFINITIONS

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

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

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

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

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

350.04 SUBMISSION AND DESIGN REQUIREMENTS

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

350.05 MATERIALS

350.05.01 Concrete

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

- a. The coarse aggregate for concrete pavement and concrete base shall have a combined gradation of nominal maximum size 37.5 mm and 19.0 mm aggregate and shall be according to the requirements of OPSS 1002.
- b. The class of concrete shall be 30 MPa according to OPSS 1350. The Cementing Materials Content subsection and the Strength Tests and Requirements subsection of OPSS 1350 do not apply.
- c. For all concrete pavement and concrete base, the air content shall be $6.0\% \pm 1.5\%$.
- d. If the concrete is formed, the slump shall be $70 \text{ mm} \pm 20 \text{ mm}$.
- e. Concrete shall be placed with a mix temperature within the range of 10°C and 28°C .

350.05.02 Burlap

Burlap shall be according to OPSS 1306.

350.05.03 Moisture Vapour Barrier for Curing

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

350.05.04 Curing Compound

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

350.05.05 Water for Curing

Water for curing shall be according to OPSS 1302.

350.05.06 Tie Bars and Load Transfer Devices

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

350.05.07 Joint Materials

Expansion joint filler shall be according to OPSS 1308.

Joint sealant material shall be according to OPSS 369.

350.06 EQUIPMENT

350.06.01 Compacting

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

350.06.02 Hot Poured Rubberized Asphalt Joint Sealing

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

350.06.03 Forms

Forms shall be according to OPSS 919.

350.06.04 Automatic Dowel Bar Inserter

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

350.06.05 Diamond Grinder

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

350.07 CONSTRUCTION

350.07.01 Preparation Work

350.07.01.01 General

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

350.07.02 Joints

350.07.02.01 General

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

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

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

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

350.07.02.02 Load Transfer Devices

Load transfer devices shall be as shown in the Contract.

350.07.02.03 Transverse Construction Joints

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

350.07.02.04 Position and Alignment Tolerances

350.07.02.04.01 Dowel Bars

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

350.07.02.04.02 Joints

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

350.07.02.05 Tie Bars

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

350.07.02.06 Dowel Bars at Transverse Joints

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

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

350.07.02.07 Protection of Tie Bars and Dowel Bars

Protection of dowel bars shall be according to OPSS 905.

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

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

350.07.03 Concreting

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

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

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

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

350.07.03.01 Consolidating

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

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

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

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

350.07.03.02 Finishing

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

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

350.07.03.03 Texturing of Surface

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

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

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

350.07.03.04 Surface Tolerance

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

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

350.07.04 Curing

350.07.04.01 General

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

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

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

350.07.05 Joint Sealing

Joint sealing shall be according to OPSS 369.

350.07.06 Miscellaneous Protection

350.07.06.01 Rain

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

350.07.06.02 Traffic

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

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

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

350.07.06.03 Shoulders

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

350.07.06.04 Cold Weather

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

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

350.07.06.04.01 Insulation Removal for Sawcutting

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

350.07.07 Concrete Base

350.07.07.01 General

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

350.07.07.02 Joints

A final reservoir cut is not required at the joints.

350.07.07.03 Texturing of Surface

Texturing of the surface is not required.

350.07.07.04 Joint Sealing

The sealing of joints in concrete base is not required.

350.07.07.05 Surface Tolerance

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

350.07.08 Sampling and Testing

350.07.08.01 Slump and Air Content

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

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

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

Table 1
Sampling and Testing - Minimum Frequencies

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

350.07.08.02 Coring

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

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

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

350.07.08.03 Filling of Core Holes

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

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

350.07.08.04 Identification of Cores

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

350.07.08.05 Transportation of Cores

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

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

350.08 QUALITY ASSURANCE

350.08.01 Acceptance Criteria for Strength and Thickness

350.08.01.01 General

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

350.08.01.02 Core Compressive Strength and Slab Thickness

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

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

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

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

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

350.08.01.03 Lot Size

350.08.01.03.01 Compressive Strength and Thickness

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

Each lot will be divided into 1000 m² sublots or a minimum of three sublots for compressive strength and thickness. The Owner will test one core from each subplot to determine the core compressive strength and slab thickness.

350.08.01.04 Re-testing

350.08.01.04.01 Compressive Strength and Thickness

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

350.08.01.05 Removal of Unacceptable Concrete

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

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

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

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

350.08.01.06 Cracking in Concrete Pavement

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

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

350.09 MEASUREMENT FOR PAYMENT

350.09.01 Actual Measurement

350.09.01.01 Concrete Pavement Concrete Base

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

350.09.02 Plan Quantity Measurement

350.09.02.01 Concrete Pavement Concrete Base

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

350.10 BASIS OF PAYMENT

350.10.01 Concrete Pavement - Item Concrete Base - Item

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

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

350.10.01.01 Compressive Strength and Slab Thickness

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

For concrete pavement and concrete base:

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

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

Table 2

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

350.10.01.02 Additional Coring and Testing

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



CONSTRUCTION SPECIFICATION FOR CONCRETE SIDEWALK

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351-A	Commentary

351.01 SCOPE

This specification covers the requirements for the construction of concrete sidewalks.

351.01.01 Specification Significance and Use

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

Use of this specification or any other specification shall be as specified in the Contract Documents.

351.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

351.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 314	Untreated Granular, Subbase, Base, Surface, Shoulder and Stockpiling
OPSS 408	Adjusting or Rebuilding Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 501	Compacting
OPSS 904	Concrete Structures
OPSS 919	Formwork and Falsework

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1212	Hot Poured Rubberized Asphalt Joint Sealing Compound
OPSS 1308	Joint Filler in Concrete
OPSS 1315	White Pigmented Curing Compounds for Concrete
OPSS 1350	Concrete - Materials and Production

ASTM International

C 171-07	Sheet Materials for Curing Concrete
A 48M-03	Gray Iron Castings
C 1028-07	Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method

351.03 DEFINITIONS

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

Cold Weather means as defined in OPSS 904.

Sidewalk Bay means the area between two transverse joints, regardless of the type of joint.

351.04 DESIGN AND SUBMISSION REQUIREMENTS

351.04.01 Tactile Walking Surface Indicator Plate Submission Requirements

One copy of the manufacturer's installation instructions and Working Drawings for each type of tactile walking surface indicator plates shall be submitted to the Contract Administrator prior to the installation of the plates.

When requested, a certificate from the manufacturer for the tactile walking surface indicator plates that confirms the product was manufactured and met the test requirements according to the Contract Documents shall be submitted to the Contract Administrator. The certificate shall include test results from an independent testing laboratory currently accredited by the Standards Council of Canada.

351.05 MATERIALS

351.05.01 Concrete

Concrete shall be according to OPSS 1350, with a minimum specified 28-Day compressive strength of 30 MPa. Coarse aggregate for the concrete shall have a nominal maximum size of 19.0 mm.

351.05.02 Expansion Joint Material

Expansion joint filler material shall be asphalt impregnated fibreboard having a minimum of 12 mm thickness and shall be according to OPSS 1308, Type A.

Hot poured rubberized asphalt joint sealing compound shall be according to OPSS 1212.

351.05.03 Subgrade Moisture Vapour Barrier

Subgrade moisture vapour barrier shall be according to ASTM C 171.

351.05.04 Granular

Granular base shall be according to OPSS 1010.

351.05.05 Curing Compound

Curing compound shall be according to OPSS 1315.

351.05.06 Tactile Walking Surface Indicator Plates

Gray cast iron tactile walking surface indicator plates shall be as specified in the Contract Documents. Castings shall be according to ASTM A 48M, Class 35B, and shall be bare and not coated with paint or other coatings or substances. Castings shall be sound, free from pouring faults, cracks, blowholes, and other defects.

The surface of each new cast iron plate on both the tops of the truncated domes and the field between the truncated domes shall have a minimum wet and dry static coefficient of friction of 0.8 according to ASTM C 1028.

The initials or trademark of the manufacturer, year of manufacture, and country of manufacture shall be distinctly cast and legible in raised letters on the top side of each plate.

351.06 EQUIPMENT

351.06.01 Forms

Forms shall be according to OPSS 919.

351.06.02 Slip Forming

The equipment used for slip forming shall have automatic horizontal and vertical alignment controls shall be used in conjunction with at least one stringline.

351.07 CONSTRUCTION

351.07.01 General

The work required for concrete sidewalk shall include earthwork, granular base, compaction, preparation work, formwork, Utility adjustment and isolation, concrete placing and finishing, jointing, curing, and protection.

Concrete sidewalk shall be constructed at the locations and to the widths and thicknesses specified in the Contract Documents.

Excavation and embankment construction shall be according to OPSS 206.

351.07.02 Grading Tolerances

351.07.02.01 Subgrade

When the subgrade is prepared for:

- a) granular base, the finished subgrade surface shall be within a 15 mm deviation measured at any point on a 3 m long straight edge.
- b) sidewalk, the finished subgrade surface shall be within a 12 mm deviation from the specified grade and cross-section, with the surface being within a 10 mm deviation measured at any point on a 3 m long straight edge.

351.07.02.02 Granular Base

Placement of granular base material shall be according to OPSS 314.

When a granular base is prepared for sidewalk, the finished granular surface shall be within a 12 mm deviation from the specified grade and cross-section, with the surface being within a 10 mm deviation measured at any point on a 3 m long straight edge.

351.07.03 Compaction

Compaction shall be according to OPSS 501.

351.07.04 Preparation Work

351.07.04.01 General

Before placing concrete on:

- a) subgrade, the subgrade shall be wetted down, except where clays occur.
- b) granular base, the granular immediately ahead of the concrete placing operation shall be wetted down thoroughly.

The wetting down shall be carried out without leaving standing water.

Alternatively, a subgrade moisture vapour barrier may be placed to completely cover the subgrade under the sidewalk. Adjacent strips shall be lapped 100 mm minimum and ends shall be lapped 300 mm minimum.

351.07.05 Form Setting

Throughout their entire length, forms shall be set true to the lines, grades, and thickness specified in the Contract Documents and in direct contact with the subgrade or granular base.

351.07.06 Utility Adjustment

Work done on adjustment of maintenance holes, valve chambers, and catch basins shall be according to OPSS 408. Utility appurtenances shall be adjusted flush with the surface of the new sidewalk.

Appurtenances maintained by Utility companies other than the Owner shall be adjusted by the Utility company concerned under arrangement by the Contract Administrator. The Contractor shall excavate to the edge of the appurtenance and indicate the required grade of the new sidewalk.

351.07.07 Utility Isolation in Sidewalk

The required Utility isolations shall be constructed in the concrete sidewalk to the details and at the locations specified in the Contract Documents.

351.07.08 Placing Concrete

Concrete shall be placed, consolidated, and finished in a manner that ensures uniform consistency. Any excess concrete beyond the sidewalk edge shall be removed. Concrete shall be placed by a continuous pour method. Where concrete placing is interrupted for more than 45 minutes a 12 mm thick asphalt impregnated fibreboard joint filler shall be installed vertically across the sidewalk width before resuming concrete placing.

Concrete shall not be placed against any material which is at a temperature above 35 °C or against any material whose temperature is below 0 °C.

351.07.09 Tactile Walking Surface Indicator Plate Installation

A set of two cast iron tactile walking surface indicator plates shall be set into wet prepared concrete at each concrete sidewalk ramp as specified in the Contract Documents and according to the plate manufacturer's installation instructions.

Plates shall be cleaned after installation.

351.07.10 Concrete Finishing

Finishing of the concrete surface shall take place while the concrete is sufficiently plastic to achieve the desired grades, elevations, and texture.

The surface of the sidewalk shall be uniform, dense, free from undulations and projections, struck off true to grade and cross-section, and finished with a float.

Excessive fines and water shall not be drawn to the surface.

Surface evaporation retardants shall not be used as an aid for finishing concrete.

The application of water, cement, or combination of both to the concrete surface shall not be permitted as a finishing aid.

Localized defects shall be repaired using concrete.

The sidewalk shall be given a broomed texture after finishing with a float.

The presence of footprints or other marks in the completed sidewalk shall require sawcutting, removal, and replacement of the complete sidewalk bay.

351.07.11 Joints

351.07.11.01 General

Longitudinal and transverse joints shall be constructed of the type and at the locations specified in the Contract Documents. The concrete adjacent to all formwork and joints shall be finished with a tool that produces a 5 mm rounded edge and a smooth, horizontal surface with a maximum width of 50 mm. All tooling shall be uniform and straight and shall be depressed to a maximum of 1 mm below the adjacent surface. Any ridges along the tooled marks shall be removed.

351.07.11.02 Dummy Joints

Dummy joints shall be hand formed using a 5 mm radius dummy joint tool.

351.07.11.03 Contraction Joints

Contraction joints shall be placed at every third dummy joint and shall be sawcut or formed to a depth that is one quarter the thickness of the sidewalk.

When the sidewalk width is 2.5 m or greater, a longitudinal contraction joint shall be sawn or formed at a maximum spacing interval of 1.5 m.

351.07.11.04 Expansion Joints

Expansion joints shall be constructed to the full depth of the slab.

Expansion joints shall be filled with expansion joint material and shall be clean and dry at the time of construction.

Expansion joints shall be constructed where the sidewalk abuts a rigid object or changes direction.

351.07.12 Identification Stamp

At the request of the Contract Administrator, the sidewalk shall be clearly and legibly marked with an approved stamp each end of the work, and at other places as directed. The stamp shall be centred on the sidewalk bay next to and parallel to a transverse joint. The stamp shall identify the Contractor's name and the year of construction.

351.07.13 Concrete Curing

Concrete shall be cured using a membrane-curing compound applied according to OPSS 904.

For the purpose of membrane-curing compound application, the application rate shall be 0.2 L/m².

351.07.14 Cold Weather Concreting

The placing and protection of concrete sidewalks in cold weather shall be according to OPSS 904.

351.07.15 Protection of Sidewalk

Vehicular traffic shall be restricted from crossing the sidewalk after the concrete has been placed for a minimum period of three days or until the concrete has reached 75% of the specified 28-Day compressive strength.

351.07.16 Sidewalk Tolerances

The surface of the concrete, after texturing, shall be within a 6 mm deviation measured at any point on a 3 m long straight edge.

The minimum acceptable thickness of the sidewalk shall be the specified thickness minus 8 mm. If the thickness deficiency exceeds 8 mm, the sidewalk shall be removed and replaced.

Core samples of the finished concrete may be taken to establish the actual thickness of the slab at locations determined by the Contract Administrator.

Unacceptable areas of sidewalk identified by the Contract Administrator shall require the sawcutting, removal, and replacement of the complete sidewalk bay by the Contractor.

351.07.17 Tactile Walking Surface Tolerances

Tolerances for the tactile walking surface indicator plates shall be as specified in the Contract Documents. If the tactile walking surface indicator plates are not within the specified tolerances, the plates shall be rejected.

Rejected plates shall be removed and replaced as directed by the Contract Administrator.

351.07.18 Field Sampling and Testing of Concrete

Field sampling and testing of concrete shall be according to OPSS 1350.

351.07.19 Management of Excess Material

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

351.09 MEASUREMENT FOR PAYMENT

351.09.01 Actual Measurement

351.09.01.01 Concrete Sidewalk

Measurement of concrete sidewalk shall be by area in square metres.

351.09.01.02 Tactile Walking Surface Indicators for Concrete Sidewalk Ramps

For measurement purposes a count shall be made for each set of tactile walking surface indicator plates installed at each concrete sidewalk ramp. A set shall consist of two tactile walking surface indicator plates.

351.09.02 Plan Quantity Measurement

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

351.10 BASIS OF PAYMENT

351.10.01 Concrete Sidewalk - Item

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

Repair or removal and replacement of an unacceptable sidewalk bay shall be completed at no extra cost to the Owner.

351.10.02 Tactile Walking Surface Indicators for Concrete Sidewalk Ramps – Item

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

351.10.03 Excavation

Payment for excavation shall be under the tender item Earth Excavation, Grading or Rock Excavation, Grading according to OPSS 206.

351.10.04 Utility Adjustment

Payment for the adjustment of Utility appurtenances shall be paid under the appropriate items according to OPSS 408.

No payment shall be made for appurtenances adjusted by the Utility company.

Appendix 351-A, November 2015 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Locations of sidewalks wider than 1.5m in areas with higher pedestrian volumes (see TAC GDG, Section 2.2.6.5 and MTO GDSOH, Section D.8.4) (351.07.01)
- Line, grade, and thickness requirements of concrete sidewalk (351.07.01 and 351.07.05)
- Details and locations of required Utility isolations (351.07.07)

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

Related Ontario Provincial Standard Drawings

OPSD 310.010	Concrete Sidewalk
OPSD 310.020	Concrete Sidewalk Adjacent to Curb and Gutter
OPSD 310.030	Concrete Sidewalk Ramps at Intersections
OPSD 310.031	Concrete Sidewalk Ramps at Signalized Intersections with Intersecting Crosswalks
OPSD 310.033	Concrete Sidewalk Ramps at Unsignalized Intersections
OPSD 310.039	Concrete Sidewalk Ramps Tactile Walking Surface Indicators Component
OPSD 310.040	Utility Isolation in Concrete Sidewalks
OPSD 310.050	Concrete Sidewalk Driveway Entrance Details
OPSD 310.060	Joint Detail for Concrete Pedestrian Crosswalk at Signalized Intersection



NOTICE TO USERS OF OPSS 353

CONSTRUCTION SPECIFICATION FOR CONCRETE CURB AND GUTTER SYSTEMS

OPSS 353 has been removed from this
OPS volume

The municipal version of OPSS 353 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 353

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



NOTICE TO USERS OF OPSS 355

CONSTRUCTION SPECIFICATION FOR THE INSTALLATION OF INTERLOCKING CONCRETE PAVERS

OPSS 355 has been removed from this
OPS volume

The provincial version of OPSS 355 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 355

The municipal version of OPSS 355 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 355

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



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**



**CONSTRUCTION SPECIFICATION FOR
RUBBLIZING CONCRETE PAVEMENT AND CONCRETE BASE**

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361-A	Commentary

361.01 SCOPE

This specification covers the requirements for in-place rubblizing of concrete pavement or concrete base and compaction of the rubblized concrete.

361.01.01 Specification Significance and Use

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

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

361.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

361.02 REFERENCES

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

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

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

Ontario Provincial Standard Specification, Construction

OPSS 501 Compacting

Ontario Provincial Standard Specification, Material

OPSS 1010 Aggregates - Base, Subbase, Select Subgrade, and Backfill Material

361.03 DEFINITIONS

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

Concrete Base means a rigid pavement structure that is overlaid with asphaltic concrete on the same Contract and may include concrete shoulders.

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

Rubblizing means the thorough fracturing of plain or reinforced concrete slabs with or without dowels to produce an in-place material for use as a base or subbase.

361.05 MATERIAL

361.05.01 Granular A

Granular A shall be according to OPSS 1010.

361.06 EQUIPMENT

361.06.01 Rubblizing

The rubblizing equipment shall be a self-contained, self-propelled, resonant frequency pavement-breaking unit capable of producing high frequency, low amplitude blows with a minimum impact energy of 8,000 Newtons at a rate of not less than 44 impacts per second. The equipment shall be capable of rubblizing concrete pavement and concrete base in-place.

The compactor shall be a self-propelled, vibratory, single smooth steel drum grade roller with a minimum weight of 9,200 kg.

The equipment shall apply water for dust suppression, as required.

361.07 CONSTRUCTION

361.07.01 Operational Constraints

All new and existing pavement drainage systems shall be fully operational for two weeks prior to rubblizing.

Prior to rubblizing, adequate lateral support shall be provided against the existing concrete slab, either by the existing or the new granular shoulders or base.

All overlying bituminous material shall be fully removed prior to rubblizing.

Only construction traffic shall be permitted on the rubblized surface. Construction traffic shall be limited on the rubblized surface, and the compacted condition of the rubblized pavement shall be maintained prior to placing the overlying material.

The rubblizing operation shall not damage exposed road appurtenances and fixtures.

A full depth saw cut shall be made along an existing joint at all ramps and mainline pavement where rubblized concrete abuts pavement that is to remain in place. All dowels between the planned rubblizing and concrete pavement to remain in place shall be severed.

In areas where the roadway is to be overlaid with hot mix asphalt one lane at a time, rubblizing shall extend a minimum of 15 cm beyond the edge of pavement to be overlaid

361.07.02 Compaction of Granular A

Compaction of Granular A shall be according to OPSS 501.

361.07.03 Gradation Requirement for Rubblized Concrete

The rubblized concrete shall meet the following gradation requirements:

- a) No particles shall exceed 150 mm in the largest dimension.
- b) A maximum of 10%, by mass, shall pass the 75 µm sieve.

Any pieces of rubblized concrete greater than 150 mm shall be removed or reduced to an acceptable size. The resulting void shall be replaced with compacted Granular A material.

361.07.04 Test Section

The proposed rubblizing operation shall be demonstrated by the Contractor over a 100 m full width test section. The test section location shall be subject to the approval of the Contract Administrator.

The resultant rubblized concrete shall meet the specified requirements. When the rubblizing operation does not conform to the specification, appropriate adjustments shall be made to the operation to ensure conformance to the specification and an additional test section shall be performed.

361.07.05 Compaction and Proof Rolling

The rubblized concrete shall be compacted with a minimum of two passes, each pass being up and back, of the self-propelled, vibratory, single smooth steel drum grade roller. The roller shall be operated at a speed not exceeding 5 km/h. Where deflections and associated movement of the rubblized concrete surface are apparent, remedial action shall be taken as directed by the Contract Administrator.

361.07.06 Sampling

A minimum of one sample per day of production shall be taken on a random basis by the Contractor at locations determined by the Contract Administrator. The sample size shall be a minimum of one square metre for the full depth of the rubblized concrete, including the embedded steel. The sampling frequency may be reduced at the discretion of the Contract Administrator. The removed rubblized material shall be visibly inspected by the Contract Administrator for conformance to the specification.

After sampling, the sampled area shall be backfilled and compacted with Granular A material.

361.07.07 Embedded Steel

All embedded steel reinforcement in the rubblized concrete shall be left in place. Where reinforcement is present, the bond between the concrete and the reinforcement shall be broken. Any steel exposed or protruding above the surface shall be cut off flush with the surface and removed from the site.

361.07.08 Management of Excess Material

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

361.09 MEASUREMENT FOR PAYMENT

361.09.01 Actual Measurement

**361.09.01.01 Rubblizing of Concrete Pavement
Rubblizing of Concrete Base**

Measurement of rubblizing of concrete pavement and concrete base shall be by area in square metres.

361.09.02 Plan Quantity Payment

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

361.10 BASIS OF PAYMENT

**361.10.01 Rubblizing of Concrete Pavement - Item
Rubblizing of Concrete Base - Item**

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

Asphalt removal shall be paid for under a separate item.

Appendix 361-A, November 2011 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

Other concrete pavement rehabilitation treatments should be considered prior to specifying rubblizing. For effective rubblizing, the concrete slab shall be free of delamination and material deterioration.

This specification is written as a method specification identifying a unique process incorporating a resonant frequency pavement breaker. Gradation control of the final product is based on visual assessment of the rubblized material. When greater gradation control is required of the final product, full depth removal of the concrete pavement and off-site crushing is recommended.

All overlying bituminous material shall be fully removed prior to rubblizing. Payment for removal of bituminous material shall be under separate items.

The designer should ensure that areas previously repaired with full depth asphalt are removed to ensure uniform performance of the rubblized material.

Proper subgrade support for the rubblizing operation shall be assessed during precontract engineering.

Granular A material for backfill purposes may be substituted with an alternate crushed granular material. When paving directly on the rubblized surface, a hot mix asphalt levelling course is recommended. If an alternate material is required, this must be indicated in the Contract Documents.

The designer should identify the thickness of the concrete slab to be rubblized and identify the type of embedded steel in the concrete slab.

Pavement drainage systems including ditch, sub-drains, and outlets are to be staged so that they are installed and operational prior to rubblizing operations beginning.

Operations should be staged so that the lateral pavement edge support remains in place until the rubblizing operations are completed. This is to ensure that the maximum impact energy is transferred to the concrete slab.

Since only construction traffic is permitted on the rubblized surface, traffic staging should be shown in the Contract Documents.

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

Related Ontario Provincial Standard Drawings

No information provided here.



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 363

CONSTRUCTION SPECIFICATION FOR REPAIRING RIGID PAVEMENT WITH PRECAST CONCRETE SLABS

OPSS 363 has been removed from this
OPS volume

The provincial version of OPSS 363 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 363

The municipal version of OPSS 363 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 363

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



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 365

CONSTRUCTION SPECIFICATION FOR CROSS-STITCHING LONGITUDINAL CRACKS IN CONCRETE PAVEMENT AND CONCRETE BASE

OPSS 365 has been removed from this
OPS volume

The provincial version of OPSS 365 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 365

The municipal version of OPSS 365 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 365

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



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 401

CONSTRUCTION SPECIFICATION FOR TRENCHING, BACKFILLING, AND COMPACTING

OPSS 401 has been removed from this
OPS volume

The provincial version of OPSS 401 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 401

The municipal version of OPSS 401 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 401

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



NOTICE TO USERS OF OPSS 402

CONSTRUCTION SPECIFICATION FOR EXCAVATING, BACKFILING AND COMPACTING FOR MAINTENANCE HOLES, CATCH BASINS, DITCH INLETS AND VALVE CHAMBERS

OPSS 402 has been removed from this
OPS volume

The provincial version of OPSS 402 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 402

The municipal version of OPSS 402 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 402

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



NOTICE TO USERS OF OPSS 403

CONSTRUCTION SPECIFICATION FOR ROCK EXCAVATION FOR PIPELINES, UTILITIES AND ASSOCIATED STRUCTURES IN OPEN CUT

OPSS 403 has been removed from this
OPS volume

The provincial version of OPSS 403 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 403

The municipal version of OPSS 403 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 403

**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**



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

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407-A	Commentary

407.01	SCOPE

This specification covers the requirements for the installation of maintenance holes, catch basins, ditch inlets, and valve chambers.

407.01.01 Specification Significance and Use

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

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

407.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

407.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 353	Concrete Curb and Gutter Systems
OPSS 402	Excavating, Backfilling, and Compacting for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 404	Support Systems
OPSS 408	Adjusting or Rebuilding Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 490	Site Preparation for Pipelines, Utilities, and Associated Structures
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 510	Removal
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS 904	Concrete Structures
OPSS 920	Deck Joint Assemblies, Preformed Seals, Joint Fillers, Joint Seals, Joint Sealing Compounds, and Waterstops - Structures

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production
OPSS 1351	Precast Reinforced Concrete Components for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1850	Frames, Grates, Covers, and Gratings
OPSS 1853	Rubber Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers
OPSS 1854	High Density Polyethylene (HDPE) and Expanded Polystyrene (EPS) Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers

Canadian General Standards Board (CGSB)

1.181-99	Ready-Mixed Organic Zinc-Rich Coating

ASTM International

C 923M-08	Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

407.03 DEFINITIONS

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

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

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

407.04 DESIGN AND SUBMISSION REQUIREMENTS

407.04.01 Submission Requirements

The Contract Administrator shall be notified in writing a minimum of 10 Days prior to precast components for structures being delivered to the site of the works giving the following information:

- a) Name of the company that shall be supplying the materials.
- b) The schedule for the delivery of each component to the site of the works.

407.05 MATERIALS

407.05.01 Concrete

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

407.05.02 Steel Reinforcement

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

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

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

407.05.04 Steps and Ladders

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

Ladders shall be as specified in the Contract Documents.

407.05.05 Adjustment Units

Precast concrete adjustment units shall be according to OPSS 1351.

Rubber adjustment units shall be according to OPSS 1853.

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

407.05.06 Mortar and Grout

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

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

407.05.07 Frames With Covers or Grates

Frames with covers or grates shall be according to OPSS 1850 and as specified in the Contract Documents.

407.05.08 Aluminum Safety Platforms

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

407.05.09 Joint Seal Systems

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

407.05.10 Zinc Rich Paint

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

407.05.11 Resilient Connectors

Resilient connectors between pipes and structures shall be according to ASTM C 923M.

407.07 CONSTRUCTION

407.07.01 General

Structures of the type specified in the Contract Documents shall be installed on undisturbed and competent foundations at the locations and to the elevations specified in the Contract Documents and shall be constructed plumb and true to alignment.

The top of structures shall be installed below the final grade to allow for the placement of adjustment units to facilitate the placement of the top of the frame with grate or cover to the final grade.

407.07.02 Restrictions

The following restrictions shall apply:

- a) Precast concrete maintenance hole tees may be used only when the mainline pipe sewer is concrete.
- b) Precast concrete maintenance hole tees may not be used when a change in pipe size, longitudinal grade, or direction is required.

407.07.03 Site Preparation

Site preparation shall be according to OPSS 490.

407.07.04 Preservation and Protection of Existing Facilities

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

407.07.05 Protection Against Floatation

Damage to the structure due to floatation shall be prevented during construction and until completion of the work.

407.07.06 Cold Weather Work

All work shall be protected from freezing. Structures shall not be installed on frozen ground.

407.07.07 Transporting, Unloading, Storing, and Handling

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

Materials that are unsound or damaged shall be rejected.

407.07.08 Excavating, Backfilling, and Compacting

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

407.07.09 Support Systems

Support systems shall be according to OPSS 404.

407.07.10 Dewatering

Dewatering shall be according to OPSS 517.

407.07.11 Cast-In-Place Structures

Concrete placement shall be according to OPSS 904.

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

407.07.12 Precast Structures

Precast or mono bases shall be placed level. Subsequent sections complete with joint seal systems shall be installed according to the manufacturer's recommendations. Joint seal systems for special site conditions (infiltration/exfiltration) shall be as specified in Contract Documents.

Adjustment of the structure shall be carried out by lifting the affected sections free of the excavation, re-leveling the base, if necessary, and re-installing the sections. Damaged sections and gaskets shall be replaced.

Lift holes shall be plugged with mortar.

407.07.13 Installation of Inlet and Outlet Pipes Into Concrete Structures

Inlet and outlet pipes shall be securely set into the structure's concrete base or walls using grout or approved pipe connectors so that the structure is watertight.

One of the following connections shall be provided where a pipe connects to a structure:

- a) A flexible pipe joint shall be provided within 300 mm of the outside face of the structure for flexible and rigid pipe.
- b) A concrete cradle to the first joint for rigid pipe.
- c) A resilient connector (i.e., a flexible, watertight connector) in the structure opening for flexible and rigid pipe.
- d) A special approved structure designed for pipe support.

Installation of pipe connectors shall be according to the manufacturer's recommendations.

All pipes, except in valve chambers, shall be flush with the inside walls of the structure.

When specified in the Contract Documents, cast iron or medium density polyethylene goss traps shall be placed at the outlet pipe of the catch basin.

When a subdrain is specified in the Contract Documents, the opening for the connection of the subdrain outlet shall be formed by coring. The subdrain outlet pipe shall be sealed into place using non-shrink grout. A 50 mm diameter weep hole shall be cored into the same wall as the subdrain connection and at the same invert elevation.

407.07.14 Benching and Channelling

When specified in the Contract Documents, the inside concrete bottom of the structures shall be benched and channelled to accommodate the pipe.

Where benching is hand finished, it shall have a wood float finish and channelling shall have a steel trowel finish. Channelling shall be smooth and flush with adjacent pipe inverts.

407.07.15 Installation of Adjustment Units

Installation of adjustment units shall be according to OPSS 408.

407.07.16 Installation of Frames with Grates or Covers

When precast concrete adjustment units are used, frames with grates or covers shall be set in a full bed of mortar on the precast concrete adjustment units.

When HDPE or EPS adjustment units are used, frames with grates or covers shall be installed and sealed according to the HDPE or EPS adjustment unit manufacturer's instructions.

When rubber adjustment units are used, frames with grates or covers shall be set firmly in place on the rubber adjustment unit by laying a continuous strip of butyl tape on the top surface of the rubber adjustment units and on the bottom of the frame.

Ditch inlet grates shall be installed as specified in the Contract Documents.

Installation of frames with grates or covers which lie within the flow lines of a curb and gutter system shall be according to OPSS 353.

407.07.17 Installation of Aluminum Safety Platforms

Aluminum safety platforms shall be installed as specified in the Contract Documents.

407.07.18 Installation of Extension Stems and Boxes for Valve Chambers

Extension stems and boxes shall be installed as specified in the Contract Documents.

Caps for valve boxes shall be installed flush with the final grade. Guides for the valve extension stems shall be securely anchored to the valve chamber.

407.07.19 Installation of Ladders and Steps

Ladders shall be installed as specified in the Contract Documents.

Steps shall be installed according to OPSS 1351. Steps shall be accurately set in the forms and supported to prevent their displacement if they are being cast-in-place during the placing of concrete for the structure.

407.07.20 Installation of Frost Straps

Frost straps shall be installed as specified in the Contract Documents.

407.07.21 Valve Chamber Insulation

Insulation for the roof, wall, or access way of the valve chamber shall be installed as specified in the Contract Documents.

407.07.22 Catch Basin Apron

Curb and gutter with concrete aprons on existing catch basins shall be constructed at the locations as specified in the Contract Documents.

The work shall include, but not be limited to, the following:

- a) Remove existing curb and gutter and existing pavement by saw cutting to the limits shown in the Contract Documents.
- b) Disposal of all materials designated for removal shall be according to OPSS 510.
- c) Construction of concrete curb and gutter shall be according to OPSS 353.
- d) Adjustment of frame and grate to suit final pavement elevations shall be according to OPSS 408.
- e) Placement of concrete for concrete apron shall be according to OPSS 904.
- f) Concrete for curb and gutter and apron shall be poured in place as one structure.
- g) Placement of hot-poured rubberized asphalt joint sealing compound and joint filler in construction joints shall be according to OPSS 920.
- h) The horizontal limits of the concrete apron to fit local conditions.

407.07.23 Clean Out of Structures

During the progress of the work and until completion and acceptance of the work, structures shall be kept clean and free of all foreign material.

407.07.24 Site Restoration

Site restoration shall be according to OPSS 492.

407.07.25 Leakage Test

Sanitary sewer maintenance holes and storm sewer maintenance holes shall be tested for leakage when specified in the Contract Documents. Leakage shall not exceed a rate of 3 litres per hour per metre of head above the lowest pipe invert in the maintenance hole.

The test shall be performed by plugging all pipe openings in the maintenance hole and filling the maintenance hole with water. After one hour has elapsed, the distance the surface of the water has dropped shall be measured and the leakage determined by calculating the volume of that portion of the maintenance hole formerly occupied by the water.

Maintenance holes failing the initial test shall have the leaks repaired and be re-tested until the leakage is below the allowable limit.

There shall be no visible infiltration.

407.07.26 Management of Excess Material

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

407.09 MEASUREMENT FOR PAYMENT

407.09.01 Actual Measurement

407.09.01.01 Maintenance Holes, Catch Basins, Apron, Ditch Inlets, and Valve Chambers

For measurement purposes, a count shall be made of the number of structures installed and adjusted.

407.09.01.02 Maintenance Hole Leakage Testing

For measurement purposes, a count shall be made of the number of maintenance holes passing the leakage test.

407.09.02 Plan Quantity Measurement

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

407.10 BASIS OF PAYMENT

**407.10.01 Maintenance Holes, “type, size” - Item
Catch Basins “type, size” - Item
Ditch Inlets “size” - Item
Valve Chambers “size” - Item
Maintenance Hole Leakage Testing - Item
Catch Basin Apron - Item**

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

The horizontal limits of the concrete apron to fit local conditions shall be at no additional cost to the Owner.

When the Owner raises or lowers the depth of a maintenance hole by up to and including 150 mm, it shall not constitute a Change in the Work and adjustment shall not be made to the payment. Where the depth of a maintenance hole is raised or lowered by more than 150 mm, this shall then constitute a Change in the Work for the full extent of the change from the original grade.

Appendix 407-A, November 2015 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer may consider including soil boring data, a geotechnical report, a subsurface report, and/or a soils report in the Contract Documents.

The designer should specify the following in the Contract Documents:

- Material requirements for:
 - Precast units. (407.05.03)
 - Steps and ladders. (407.05.04)
 - Frames with covers or grates. (407.05.07)
 - Aluminum safety platforms. (407.05.08)
- Structure type, location, and elevation. (407.07.01)
- Type and location of goss traps. (407.07.13)
- Subdrains. (407.07.13)
- Benching. (407.07.14)
- Installation of:
 - Ditch inlet grates. (407.07.16)
 - Aluminum safety platforms. (407.07.17)
 - Extension stems and boxes. (407.07.18)
 - Ladders and steps. (407.07.19)
 - Frost straps. (407.07.20)
 - Valve chamber insulation. (407.07.21)
 - Curb and gutter with concrete aprons. (407.07.22)

The Contractor may use any of the connections shown in subsection 407.07.13 d). If a specific connection is required, it shall be specified in the Contract Documents.

Designer should determine if leakage testing for storm and sanitary sewer maintenance holes is required. If it is required, it shall be specified in the Contract Documents. Ground water conditions shall determine the type of test required and shall be specified in the Contract Documents. Alternative leakage test method(s) can be considered such as air or CCTV inspection. (407.07.25)

The tender item description for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers should include reference to one or more of the attributes shown (i.e., type of structure or size of structure, to be complete). (407.10.01)

Appendix 407-A

The tender item description for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers should include reference to one or more of the attributes shown (i.e., type of structure or size of structure, to be complete). (407.10.01)

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

Related Ontario Provincial Standard Drawings

OPSD 400.001	Hoisting Hook Rib for Cast Iron Frames for Catch Basins, Maintenance Holes, and Valve Chambers
OPSD 400.010 to 400.120	Cast Iron Catch Basin Frames With Grates
OPSD 401.010 to 401.060	Cast Iron Maintenance Hole Frames With Covers
OPSD 402.010 to 402.021	Cast Iron Valve Chamber Frames With Covers
OPSD 403.010	Galvanized Steel Honey Comb Grating for Ditch Inlets
OPSD 404.010 to 404.022	Aluminum Safety Platforms
OPSD 405.010 to 405.020	Maintenance Hole Steps
OPSD 610.010 to 610.030	Catch Basin Frame With Grate Installation
OPSD 701.010 to 701.015	Precast Concrete Maintenance Holes, 1,200 to 3,600 mm in Diameter
OPSD 701.021	Maintenance Hole Benching and Pipe Opening Details
OPSD 701.030 to 701.081	Precast Concrete Maintenance Hole Components, 1,200 to 3,600 mm in Diameter
OPSD 701.100	Frost Strap Installation
OPSD 702.040 to 702.050	Precast Concrete Ditch Inlet Maintenance Hole
OPSD 703.011 to 703.015	Precast Concrete Single Inlet Flat Cap, 1,500 to 3,600 mm in Diameter
OPSD 703.021 to 703.024	Precast Concrete Twin Inlet Flat Cap, 1,500 to 3,000 mm in Diameter
OPSD 704.010 to 704.012	Maintenance Hole, Catch Basin, and Valve Chamber Adjustment Units
OPSD 705.001 to 705.002	Concrete Catch Basin Apron
OPSD 705.010 to 705.020	Precast Concrete Catch Basins
OPSD 705.030 to 705.040	Precast Concrete Ditch Inlets
OPSD 706.010 to 706.041	Precast Concrete Ditch Inlets Types A and B with 1,500 to 3,000 mm Diameter Flat Cap
OPSD 707.010	Precast Maintenance Hole Manufactured Tee
OPSD 708.020	Support for Pipe at Catch Basin or Maintenance Hole
OPSD 1100.010	Cast-In-Place Chamber for Valves Up to 350 mm Diameter
OPSD 1101.010	Precast Valve Chamber 1,200 mm and 1,500 mm Diameter
OPSD 1101.020	Valve Operator



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

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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 410

CONSTRUCTION SPECIFICATION FOR PIPE SEWER INSTALLATION IN OPEN CUT

OPSS 410 has been removed from this
OPS volume

The provincial version of OPSS 410 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 410

The municipal version of OPSS 410 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 410

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



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

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APPENDICES

411-A	Commentary

411.01	SCOPE

This specification covers the requirements for the cleaning and flushing of pipe sewers, catchbasins, maintenance holes, ditch inlets, and oil-grit separators.

411.01.01 Specification Significance and Use

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

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

411.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

411.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 409	Closed-Circuit Television Inspection of Sewers
OPSS 410	Pipe Sewer Installation in Open Cut

411.03 DEFINITIONS

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

Air Gap Method means a clear vertical separation between the pressurized potable water supply and a non-pressurized, non-potable water receiving vessel.

Backflow Prevention means a device used to protect potable water supplies from contamination or pollution due to backflow.

Cleaning means suction and vacuuming removal of debris within pipe sewers, catchbasins, maintenance holes, ditch inlets, and oil-grit separators.

Combination Hydro-Jet Cleaner means a service vehicle or equipment capable of pressure washing, suction vacuum cleaning of debris.

Debris means sludge, dirt, sand, gravel, rocks, bricks, other solid and semi-solid materials, and roots, grease, and encrustations and other materials that may cause restriction to flow in pipe sewers, catchbasins, maintenance holes, ditch inlets, and oil-grit separators.

Flushing means hydraulic pressure washing using various nozzles, pressure and flow rates to flush debris within pipe sewer systems downstream.

Oil-grit separator means a device designed to separate oil and suspended solids from water.

Pipe Sewer means as defined in OPSS 410.

411.04 DESIGN AND SUBMISSION REQUIREMENTS

When Equipment requiring an environmental compliance approval for a waste management system, issued by the Ontario Ministry of Environment and Climate Change, will be used for the work, a copy of the environmental compliance approval shall be submitted to the Contract Administrator a minimum of two weeks prior to commencement of the work.

411.05 MATERIALS

411.05.01 Water Source

Water source shall be as specified in the Contract Documents. When the source is not specified, water shall be clean and free from oil, acid, alkali, organic matter, or other deleterious substances.

Backflow prevention and air gap methods shall be used when water is taken from potable water systems.

411.06 EQUIPMENT

411.06.01 Combination Hydro-Jet Cleaner

A combination hydro-jet cleaner specifically designed for the purpose of cleaning pipe sewers, catch basins, maintenance holes, ditch inlets, oil-grit separators, and similar facilities, using a selection of nozzles and attachments to permit reaming and root cutting as required, shall be used for the work. The equipment shall be sufficient to clear blockages and remove debris from pipe sewer systems with varied sizes and downstream constraints.

411.07 CONSTRUCTION

411.07.01 General

The work shall commence at the upstream end of pipe sewer systems and progress to the downstream end.

The conditions of the site and the pipe sewer system shall be thoroughly assessed, including the degree of pipe blockage and types of debris. The equipment, nozzles, flow rates, and pressures necessary to complete the work shall be determined. Any supplemental information regarding the sewer network and the assessment method shall be as specified in the Contract Documents.

For post installation inspections, sewers requiring cleaning and flushing shall be as specified in the Contract Documents.

The Owner may request additional documentation of findings after cleaning and flushing operations as specified in the Contract Documents.

Prior to using any mechanical equipment, verify with CCTV inspections if any utility clearance is required.

Water flow volumes and pressures shall not cause damage to the pipe sewer system or flooding of property. Water flow volumes and pressures shall be appropriate for the age and condition of the pipe sewer system.

Debris that cannot be removed by flushing shall be loosened and broken up using reamers and root cutters as required.

No blockage to service connections shall occur as a result of the cleaning and flushing or cleanout operation.

Protection of waterbodies and waterbody banks shall be as specified in the Contract Documents.

411.07.02 Pipe Sewer Cleaning and Flushing

Flushing shall be used to transport debris from each section of pipe sewer to the downstream maintenance hole or catchbasin. Each section of pipe sewer between maintenance holes, catch basins, ditch inlets shall be cleaned and flushed before cleaning and flushing the next downstream section. Debris shall be continuously cleaned from the downstream maintenance hole or catchbasin as flushing occurs.

The passage of debris from one section of pipe sewer to another shall not be permitted, unless specified in the Contract Documents. A weir or sediment trap shall be placed in the maintenance hole to prevent passage of debris from the upstream pipes. When cleaning and flushing is completed for each section, the weir or sediment trap shall be removed.

Cleaning and flushing shall continue for each section of pipe sewer until no further debris is flushed from the pipe, and the pipe sewer section is free of impediments to flow. A minimum of 90% of the pipe sewer circumference shall be free of debris.

If cleanout cannot be completed due to damaged or broken pipe sewer, catchbasin, maintenance hole, or ditch inlet, the Contract Administrator shall be immediately notified.

411.07.03 Catchbasin, Maintenance hole, and Ditch Inlet Cleanout

A combination hydro-jet cleaner shall remove debris from catchbasins, maintenance holes, and ditch inlets separately.

411.07.04 Oil-Grit Separator Cleanout

Oil-grit separators shall be cleaned out by closing or blocking off the inlet and outlet pipes, dewatering the system, removal of debris by vacuum or other mechanical means, and cleaning and flushing to remove sediment. The inlet and outlet pipes shall not be reopened or unblocked until after the separator has been inspected by the Contract Administrator.

411.07.05 Closed-Circuit Television Inspection

Unless otherwise specified in the Contract Documents, pipe sewers shall be inspected after cleaning by closed-circuit television (CCTV) according to OPSS 409. The Contract Administrator shall be notified a minimum 24 hours prior to the inspection.

When specified in the Contract Documents, water shall be added immediately prior to CCTV inspection to the upstream end of the sewer system for minimum flow to the system low point by gravity.

411.07.06 Management of Excess Material

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

Debris removed from pipe sewers, catchbasins, maintenance holes, ditch inlets, and oil-grit separators shall be managed as excess material according to the Contract Documents.

Liquid shall be decanted or filtered and returned to the sewer of origin. The decanted or filtered liquid shall comply with Provincial Water Quality Objectives and local municipal bylaws.

411.09 MEASUREMENT FOR PAYMENT

411.09.01 Actual Measurement

411.09.01.01 Pipe Sewer Cleaning and Flushing

Measurement for pipe sewer cleaning and flushing shall be by length in metres, by time in hours, or by volume in cubic metres, as specified in the Contract Documents.

411.09.01.01.01 By Length

Measurement shall be in metres and along the centreline of the pipe sewer from the centre of the maintenance hole, catch basin, or ditch inlet at each end of the pipe sewer system to be cleaned out.

When cleaning and flushing is incomplete due to a collapsed pipe or immovable blockage, the length of collapsed pipe or blockage shall be deducted from the length measured for payment.

411.09.01.01.02 By Time

Measurement shall be by time in hours that the combination hydro-jet cleaner is in effective operation.

411.09.01.01.03 By Volume

Measurement shall be by volume in cubic metres of decanted debris, in predetermined truck box capacities.

411.09.01.02 Catchbasin, Maintenance Hole, Ditch Inlet, and Oil-Grit Separator Cleanout

For measurement purposes, a count shall be made of the number of structures cleaned.

411.09.02 Plan Quantity Measurement

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

411.10

BASIS OF PAYMENT

411.10.01

**Pipe Sewer Cleaning and Flushing – Item
Catchbasin, Maintenance Hole, Ditch Inlet Cleanout, and Oil-Grit Separator
Cleanout – Item**

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

Appendix 411-A, November 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- The owner shall provide any available information on the condition of the sewer network (e.g. size, age, constraints, material, known defects, vulnerable sections). (411.07.01)
- The owner may choose to evaluate, specify or approve the assessment method of pipe prior to work. (411.07.01)
- For post installation inspections, the owner shall identify sewers requiring flushing and cleaning (411.07.01)
- If access to the waterbody or a waterbody bank is required, necessary protection measures shall be specified (411.07.01)
- The individual owners may request documentation of findings after flushing completion (e.g. presence of grease, roots, construction debris, pipe defect and; an estimate of the light/medium/heavy level of material removed, where applicable; and submission of inspection reports and maps) (411.07.01)
- The owner shall identify if passing material between maintenance holes will be permitted (411.07.02)
- The owner shall designate if CCTV inspection is not required (411.07.05)
- The owner shall designate if additional water for minimum flow is required prior to the camera inspection (411.05)
- The owner shall designate water source where applicable including any metering or tracking if required (411.07.05.01)
- The owner shall designate disposal sites where applicable, designating as temporary or permanent, as necessary, including any additional environmental requirements (411.07.06)
- Method of measurement for pipe sewer cleaning and flushing. (411.09.01.01)

Related Ontario Provincial Standard Drawings

No information provided here.



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**



CONSTRUCTION SPECIFICATION FOR MANURE PIPELINE INSTALLATION IN OPEN CUT

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413-A	Commentary

413.01 SCOPE

This specification covers the requirements for installing permanent manure pipelines in open cut.

413.01.01 Specification Significance and Use

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

Use of this specification or any other specification shall be as specified in the Contract Documents.

413.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

413.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 490	Site Preparation for Pipeline, Utilities, and Associated Structures
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS 539	Temporary Protection Systems

Ontario Provincial Standard Specifications, Material

OPSS 1350	Concrete - Materials and Production
OPSS 1842	Pressure Polyethylene Pipe Products

CSA Standards

- B137.2-13 PVC Injection-Moulded Gasketed Fittings for Pressure Applications
[Part of CAN/CSA-B137-02, Thermoplastic Pressure Piping Compendium - B137 Series]
B137.3-13 Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications
[Part of CAN/CSA-B137-02, Thermoplastic Pressure Piping Compendium - B137 Series]

ASTM International

- A 153/A 153M-09 Zinc Coating (Hot Dip) on Iron and Steel Hardware
A 276-13a Stainless Steel Bars and Shapes
A 307-12 Carbon Steel Bolts, Studs, and Threaded Rods 60,000 PSI Tensile Strength
B 633-13 Electrodeposited Coatings of Zinc on Iron and Steel
B 766-86 (2008) Electrodeposited Coatings of Cadmium
D 3139-98 (2011) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

American Water Works Association (AWWA)

- C104/A21.4-13 Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
C110/A21.10-12 Ductile-Iron and Gray-Iron Fittings
C111/A21.11-12 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
C153/A21.53-11 Ductile-Iron Compact Fittings
C509-09 Resilient-Seated Gate Valves for Water-Supply Service

American Society of Mechanical Engineers (ASME)

- B18.2.1-2012 Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series), Includes Errata (2013)

413.03 DEFINITIONS

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

Associated Appurtenance means structures, devices, and appliances, other than pipe and conduit that are used in connection with a manure pipeline system, such as valves, riser, and thrust restraints.

Backfilling means as defined in OPSS 401.

Excavation, Earth and Rock means the excavation classified as earth and rock according to OPSS 206.

Fitting means connections, appliances, and adjuncts designed to be used in connection with pipes. Examples are: elbows and bends to alter the direction of a pipe; tees and crosses to connect a branch with a sewer main; plugs and caps to close a pipe end; and bushings, diminishers, or reducers to couple two pipes of different diameters.

Manure Pipeline means an installation designed for the conveyance of liquid manure under pressure using circular pipe.

413.05 MATERIALS

413.05.01 General

Pipe size shall be according to the requirements specified in the Contract Documents. Pipe material and class shall be as specified in the Contract Documents.

Pipe smaller than 100 mm in diameter shall not be used.

Fittings shall be suitable for and compatible with the pipe material and class with which they will be used.

413.05.02 Polyvinyl Chloride Pipe Products

Polyvinyl chloride pipe and fittings shall be according to CSA B137.3 and supplied from a plant approved by an organization accredited by the Standards Council of Canada.

Flexible elastomeric seals for bell and spigot joints shall be according to ASTM D 3139.

Fittings shall be either:

- a) gray iron according to AWWA C110/A21.10;
- b) ductile iron according to AWWA C110/A21.10 or AWWA C153/A21.53, and shall be cement lined according to AWWA C104/A21.4;
- c) injection moulded polyvinyl chloride according to CSA B137.2; or
- d) prefabricated polyvinyl chloride pipe diameters 200 mm and larger according to CSA B137.3.

413.05.03 Polyethylene Pipe Products

Polyethylene pressure pipe shall be according to OPSS 1842.

Fitting shall be either:

- a) flanged gray iron according to AWWA C110/A21.10;
- b) flanged ductile iron according to AWWA C110/A21.10 or AWWA C153/A21.53 and shall be cement lined according to AWWA C104/A21.4; or
- c) polyethylene according to OPSS 1842.

Ductile iron pipe and fittings shall be cement lined according to AWWA C104/A21.4.

413.05.04 Valves

413.05.04.01 General

All valves shall open by operating in a counter-clockwise direction.

Valves shall be designed for a minimum cold water working pressure of 1,035 kPa.

Valves shall be cast or ductile iron gate valves.

Fasteners shall be made from material meeting the strength requirements of ASTM A 307 with dimensions according to ANSI ASME B18.2.1. Bolts, studs, and nuts shall be cadmium plated according to ASTM B 766 or zinc coated according to ASTM A 153M or ASTM B 633. Fasteners for mechanical joints shall be ductile iron according to AWWA C111/A21.11.

413.05.04.02 Gate Valves

Gate valves shall be according to AWWA C509.

Stem sealing on non-rising stem valves shall utilize O-ring type seals that do not require adjustment.

The gate valve end configuration shall be as specified in the Contract Documents.

413.05.04.03 Air Release and Air/Vacuum Valves

Air release and air/vacuum valves shall be sewage type.

413.05.05 Risers

Riser type shall be as specified in the Contract Documents.

413.05.06 Concrete

Concrete for thrust blocks and fitting and appurtenance supports shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 20 MPa.

413.05.07 Straps, Tie-Rods, Angles, Nuts, and Bolts

Stainless steel straps, tie-rods, angles, nuts, and bolts used with concrete thrust blocks shall be according to ASTM A 276, Type 316 stainless steel.

413.07 CONSTRUCTION

413.07.01 Site Preparation

Site preparation shall be according to OPSS 490.

413.07.02 Preservation and Protection of Existing Facilities

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

413.07.03 Protection Against Floatation

Damage to the pipeline due to floatation shall be prevented during construction and until completion of the work.

413.07.04 Cold Weather Work

All work shall be protected from freezing. Pipe and bedding material shall not be installed on frozen ground.

413.07.05 Transporting, Unloading, Storing, and Handling Materials

All pipes, fittings, and gaskets that are unsound or damaged shall be rejected.

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

413.07.06 Excavation

Excavation for the placement of forcemains shall be according to OPSS 401.

413.07.07 Support Systems

Support systems shall be according to OPSS 404.

413.07.08 Dewatering

Dewatering shall be according to OPSS 517.

413.07.09 Temporary Protection Systems

The construction of all temporary protection systems shall be according to OPSS 539. Where the stability, safety, or function of an existing roadway, railway, other works, or proposed works may be impaired due to the method of construction, such protection as may be required shall be provided. Protection may include sheathing, shoring, and the driving of piles where necessary to prevent damage to such works or proposed works.

413.07.10 Installation of Pipe

Pipe shall be laid in a dry trench.

Ends of pipe shall be kept clean.

Pipe shall be laid within the alignment and grade tolerances specified in the Contract Documents. The barrel of each pipe shall be in contact with the shaped bed throughout its full length.

Pipe shall be kept clean and dry as work progresses. A removable watertight bulkhead shall be installed at the open end of the last pipe laid whenever work is suspended.

Pipe shall not be laid until the preceding pipe joint has been completed and the pipe carefully embedded and secured in place.

413.07.11 Jointing

413.07.11.01 General

Joint surfaces shall be clean. Pipe ends shall be lubricated with material recommended by the pipe manufacturer.

Manufacturer's instructions for jointing of pipe shall be followed.

Joints and all connections shall be made watertight.

All bolts, nuts, coupling, rubber rings, and connecting pieces shall be cleaned thoroughly prior to installation.

Pipe shall be aligned on centreline to previously laid pipe.

Pipe shall be pulled or pushed only by a hand-operated winch. A backhoe shall not be used for pushing pipe.

Joints shall be prevented from opening after the pipe has been laid.

413.07.11.02 Polyvinyl Chloride Pressure Pipe

Joints shall be bell and spigot with rubber gaskets. If gaskets are supplied separately, they shall be inserted in the groove of the bell end of the pipe.

The spigot shall be lubricated. The spigot end shall be inserted and pushed into the bell until the second reference mark is flush with the face of the bell.

413.07.11.03 Polyethylene Pressure Pipe

Polyethylene pipe 100 mm diameter and larger shall be joined by the thermal butt fusion process. Procedures recommended by the pipe manufacturer shall be followed.

Connections to non-polyethylene fittings and appurtenances shall be made with flanged joints according to the manufacturer's recommendations. Bolts shall be tightened to the torque specified by the manufacturer for the particular size and type of stub end.

413.07.12 Cutting of Pipe

Whenever cutting of pipe is required, the pipe shall be cut according to the recommendations of the pipe manufacturer.

413.07.13 Change in Line and Grade

413.07.13.01 Polyvinyl Chloride Pipe

Polyvinyl chloride pressure pipe joints may be deflected, but shall not exceed manufacturer's recommendations. Otherwise, fabricated bends shall be used.

413.07.13.02 Polyethylene Pipe

Use of pipe flexibility may be allowed, but shall not exceed manufacturer's recommendations.

413.07.14 Installation of Valves

413.07.14.01 General

The work of installing valves shall include the valves and couplings, and when specified in the Contract Documents, valve boxes. Valves shall be installed at locations and be of the type specified in the Contract Documents. Valves and connecting pipes shall be aligned accurately and supported as specified in the Contract Documents.

413.07.14.02 Air Release and Air/Vacuum Valves

Air release and air/vacuum valves shall be installed at locations specified in the Contract Documents.

Each air release and air/vacuum valve shall be provided with an isolating valve.

413.07.15 Installation of Riser Sets

The work of installing riser sets shall include the placing of risers, riser isolating valves, riser tees, restraining devices, riser caps, and safety and support devices.

Riser sets shall be installed at locations specified in the Contract Documents.

413.07.16 Thrust Restraints

All connections, caps, and bends shall be restrained by concrete blocking or restrained joints as specified in the Contract Documents. Concrete for thrust blocks shall be placed against undisturbed ground. Joints and couplings shall remain free from concrete.

413.07.17 Backfilling and Compacting

Backfilling and compacting shall be according to OPSS 401.

413.07.18 Hydrostatic Testing

413.07.18.01 General

Hydrostatic testing shall be conducted under the supervision of the Contract Administrator upon completion of the pipeline, including backfilling.

A test section shall be either a section between valves or the completed pipeline.

Test pressure shall be 1,035 kPa.

The test section shall be filled slowly with water and all air shall be removed from the pipeline. A 24-hour absorption period may be allowed before starting the test. The test section shall be subjected to the specified continuous test pressure for two hours.

413.07.18.02 Polyethylene Pipe

The test procedure shall consist of initial expansion and test phases.

During the initial expansion phase, the test section shall be pressurized to the test pressure and sufficient make-up water added each hour for 3 hours to return to test pressure. After the initial expansion phase, the test phase shall begin.

The test phase shall be 2 hours after which a measured amount of make-up water is added to return the test pressure. If the amount of make-up water added does not exceed the values shown in Table 1, leakage is not indicated.

If the amount of make-up water exceeds the values shown in Table 1, all leaks shall be located and repaired and the test section shall be retested until a satisfactory result is obtained.

The test duration should not exceed 8 hours. If the pressure test is not completed, the test section shall be de-pressurized and allowed to relax for 8 hours prior to bringing the test section up to pressure again.

413.07.18.03 Other Pipe

The test section shall be subject to the specified continuous test pressure for 2 hours.

The leakage is the amount of water added to the test section to maintain the specified test pressure for the test duration. The measured leakage shall be compared with the allowable leakage as calculated for the test section. The allowable leakage is 0.082 litres per millimetre of pipe diameter per kilometre of pipe for the 2-hour test period.

If the measured leakage exceeds the allowable leakage, all leaks shall be located and repaired and the test section shall be retested until a satisfactory result is obtained.

413.07.19 Cleaning and Flushing Pipe

All pipe shall be cleaned and flushed.

413.07.20 Site Restoration

Site restoration shall be according to OPSS 492.

413.07.21 Management of Excess Material

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

413.09 MEASUREMENT FOR PAYMENT

413.09.01 Actual Measurement

413.09.01.01 Pipeline

Measurement of pipeline shall be by length in metres along the horizontal centreline of the pipe from the point of connection to portable equipment or existing pipeline to a point vertically above the end of the new pipeline.

413.09.01.02 Valves

For measurement purposes, a count shall be made of the number of valves installed regardless of the type and size.

413.09.01.03 Riser Sets

For measurement purposes, a count shall be made of the number of riser sets installed regardless of the type.

413.09.02 Plan Quantity Measurement

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

413.10 BASIS OF PAYMENT

**413.10.01 Pipeline - Item
Valves - Item
Riser Sets - Item
Connections to Existing Pipelines - Item**

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

When the Owner raises or lowers the invert of a pipeline by up to 150 mm, it shall not constitute a Change in the Work and adjustment shall not be made to the payment. Where the invert of a pipeline is raised or lowered by more than 150 mm, this shall then constitute a Change in the Work for the full extent of the change from the original grade.

TABLE 1
Test Phase Make-Up Amount for Pressure Polyethylene Pipe

Pipe Diameter mm	Make-Up Water litre/km
100	31.0
150	74.5
200	124.2
250	161.4
300	285.6
350	335.2

Appendix 413-A, November 2014 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer may consider including soil boring data, a geotechnical report, a subsurface report, or a soils report in the Tender Documents.

The designer should include the following in the Contract Documents:

- Pipe size, material, and class. (413.05.01)
- Gate valve end configuration. (413.05.04.02)
- Type of risers. (413.05.05)
- Alignment and grade tolerances for the pipe installation. (413.07.10)
- Valve type, location, and support. (413.07.14.01)
- Air release and air/vacuum valve locations. (413.07.14.02)
- Locations of riser sets. (413.07.15)
- Type of thrust restraints. (413.07.16)

The pipe diameter should be adequate to develop a flow velocity of 0.8 to 2.5 m/s in the pumping system.

Corrosion protection system provisions should be specified, if appropriate.

Tracer wire or tracer tape should be specified, if appropriate

Under conditions of high ground water, external fluids may enter via air release and air/vacuum release valves; therefore, appropriate measures should be taken.

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

Related Ontario Provincial Standard Drawings

OPSD 1103.010	Concrete Thrust Blocks for Tees, Plugs, and Horizontal Bends
OPSD 1103.020	Concrete Thrust Blocks for Vertical Bends



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**



NOTICE TO USERS OF OPSS 421

CONSTRUCTION SPECIFICATION FOR PIPE CULVERT INSTALLATION IN OPEN CUT

OPSS 421 has been removed from this
OPS volume

The provincial version of OPSS 421 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 421

The municipal version of OPSS 421 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 421

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



**CONSTRUCTION SPECIFICATION FOR
PRECAST REINFORCED CONCRETE BOX CULVERTS
IN OPEN CUT**

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422.01 SCOPE

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

422.01.01 Specification Significance and Use

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

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

422.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

422.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, General

OPSS 180 Management and Disposal of Excess Material

Ontario Provincial Standard Specifications, Construction

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

Ontario Provincial Standard Specifications, Material

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

MTO Laboratory Testing Manual

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

ASTM International

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

422.03 DEFINITIONS

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

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

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

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

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

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

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

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

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

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

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

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

Soil means soil as defined in OPSS 902.

422.04 DESIGN AND SUBMISSION REQUIREMENTS

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

422.05 MATERIALS

422.05.01 Concrete

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

422.05.02 Granulars

Granulars shall be according to OPSS 1010.

422.05.03 Fine Aggregates for Levelling Course

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

422.05.04 Precast Reinforced Concrete Box Units

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

422.05.05 Clay Seal

Clay seal shall be according to OPSS 1205.

422.05.06 Steel Reinforcement

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

422.05.07 Mortar

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

422.05.08 Preformed Gasket

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

422.05.09 Joint Sealing Compound

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

422.05.10 Grout

Grout shall be non-shrink and non-staining.

422.05.11 Geotextile

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

422.05.12 Native Material

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

422.05.13 Bedding

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

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

422.05.14 Backfill

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

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

422.05.15 Cover

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

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

422.07 CONSTRUCTION

422.07.01 Selection of Box Units

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

422.07.02 Excavation

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

422.07.03 Support Systems

Support systems shall be according to OPSS 404.

422.07.04 Dewatering

Dewatering shall be according to OPSS 517.

422.07.05 Temporary Protection Systems

Temporary protection systems shall be according to OPSS 539.

422.07.06 Foundations

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

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

422.07.07 Bedding

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

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

Bedding shall not be placed on frozen earth grade.

422.07.08 Levelling

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

422.07.09 Installing Box Units

422.07.09.01 Box Units

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

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

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

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

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

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

422.07.09.02 Geotextile at Joints

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

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

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

422.07.09.03 Mortared Joints

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

422.07.09.04 Preformed Gasket

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

422.07.09.05 Joint Sealing Compound

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

422.07.09.06 Lift Holes

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

422.07.10 Concrete Appurtenances and Concrete Distribution Slab

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

422.07.11 Backfill

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

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

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

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

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

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

422.07.12 Cover

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

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

422.07.13 Clay Seal

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

422.07.14 Geotechnical Testing

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

422.07.15 Management and Disposal of Excess Material

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

422.09 MEASUREMENT FOR PAYMENT

422.09.01 Actual Measurement

422.09.01.01 Precast Reinforced Concrete Box Culverts

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

422.09.02 Plan Quantity Measurement

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

422.10 BASIS OF PAYMENT

422.10.01 “size” Precast Concrete Box Culvert - Item

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

422.10.02 Clay Seal - Item

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

422.10.03 Granular

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

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

422.10.04 Steel Reinforcement in Concrete Appurtenances

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

422.10.05 Concrete in Appurtenances

Payment for concrete appurtenances shall be according to OPSS 904.

422.10.06 Excavation for Box Culverts

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

422.10.07 Swamp Excavation

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

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

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

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

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

Designer Action/Considerations

The design should specify the following in the Contract Documents:

- Geotextile type. (422.05.11)
- Bedding. (422.05.13)
- Backfill. (422.05.14)
- Cover. (422.05.15)
- Dimensions of box units and height of fill. (422.07.01)
- Bedding dimensions. (422.07.07)
- Alignment and grade of the box units. (422.07.09.01)
- Minimum cover material requirements for installation protection against rock backfill. (422.07.11)
- Clay seal. (422.07.13)

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

- Concrete appurtenances. (422.07.09.01)
- Mortared joints. (422.07.09.03)
- Preformed gasket. (422.07.09.04)
- Joint sealing compound. (422.07.09.05)
- Steel grating. (422.07.10)
- Native backfill. (422.07.11)
- Geotechnical testing. (422.07.14)

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

Related Ontario Provincial Standard Drawings

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



NOTICE TO USERS OF OPSS 441

CONSTRUCTION SPECIFICATION FOR WATERMAIN INSTALLATION IN OPEN CUT

OPSS 441 has been removed from this
OPS volume

The provincial version of OPSS 441 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 441

The municipal version of OPSS 441 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 441

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



NOTICE TO USERS OF OPSS 442

CONSTRUCTION SPECIFICATION FOR CORROSION PROTECTION OF NEW AND EXISTING WATERMAINS

OPSS 442 has been removed from this
OPS volume

The provincial version of OPSS 442 has not been implemented by the
MTO:

The municipal version of OPSS 442 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 442

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



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**



CONSTRUCTION SPECIFICATION FOR CEMENT MORTAR LINING OF WATERMAINS

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462.01	SCOPE

This specification covers the requirements for the rehabilitation of cast or ductile iron watermain by the installation of cement mortar lining.

462.01.01 Specification Significance and Use

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

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

462.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

462.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 409	Closed-Circuit Television (CCTV) Inspection of Pipelines
OPSS 441	Watermain Installation in Open Cut
OPSS 442	Corrosion Protection of New and Existing Watermains
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 493	Temporary Potable Water Supply Services
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS 539	Temporary Protection Systems

American Water Works Association (AWWA)

C602-11	Cement-Mortar Lining for Water Pipelines in Place - 4 in. (100 mm) and Larger

462.03 DEFINITIONS

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

Associated Appurtenance means as defined in OPSS 441.

Fitting means as defined in OPSS 441.

462.04 DESIGN AND SUBMISSION REQUIREMENTS

462.04.01 Submission Requirements

The following information shall be submitted to the Contract Administrator 14 Days prior to the commencement of cement mortar lining operations:

- a) If applicable, pre-mixed mortar mix design.
- b) Location of access pits.
- c) Pipe cleaning procedures.
- d) Flushing, disinfection, and commissioning plan.

462.05 MATERIALS

462.05.01 Cement Mortar Lining

Materials shall be according to ANSI/AWWA C602, except as noted below or, alternatively, a pre-mixed mortar may be submitted for approval by the Contract Administrator.

Chemicals or additives of any kind shall not be permitted, unless prior written approval from the Contract Administrator has been obtained.

462.05.02 Service Boxes

Service boxes shall be as specified in the Contract Documents.

462.05.03 Valves

Valves shall be according to OPSS 441.

462.05.04 Fittings

Fittings shall be according to OPSS 441.

462.05.05 Repair Pipe

Repair pipe shall be polyvinyl chloride pipe or ductile iron pipe according to OPSS 441.

462.05.06 Sacrificial Anodes

Sacrificial anodes shall be according to OPSS 442.

462.06 EQUIPMENT

462.06.01 Cement Mortar-Lining Machine

The cement mortar-lining machine shall be provided with attachments for mechanically trowelling the mortar to produce a smooth surface so that the freshly placed and trowelled mortar is not touched until it has set. The design of the attachment shall be so as to permit operations in pipes that may be out of round, as well as to permit trowelling through bends that deflect up to and including 22.5 degrees.

462.07 CONSTRUCTION

462.07.01 General

The Contract Administrator shall be notified at least 48 hours in advance of starting work.

All fittings and appurtenances removed to facilitate the lining process shall be replaced with new fittings and appurtenances.

All fittings and appurtenances removed shall be delivered to the location specified in the Contract Documents.

462.07.02 Preservation and Protection of Existing Facilities

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

462.07.03 Transporting, Unloading, Storing, and Handling Materials

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

462.07.04 Trenching, Backfilling, and Compacting

Trenching, backfilling, and compacting for any access pits shall be according to OPSS 401.

462.07.05 Support Systems

Support systems shall be according to OPSS 404.

462.07.06 Dewatering

Dewatering shall be according to OPSS 517.

462.07.07 Temporary Protection Systems

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

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

462.07.08 Service Boxes

In advance of working on the street, service boxes shall be located and inspected to ensure that the curb stop is functioning and marked.

Service boxes to be adjusted to final grade and service boxes or curb stops to be replaced shall be identified to the Contract Administrator for approval. After receiving approval, the service boxes shall be adjusted or the service boxes or curb stops shall be replaced.

462.07.09 Temporary Potable Water Supply Services

Temporary potable water supply services shall be according to OPSS 493.

462.07.10 Rehabilitation of Watermains

462.07.10.01 Access Pits

When possible, existing valve and fitting locations shall be used as access pit locations. Access pit locations shall be approved by the Contract Administrator prior to the beginning of construction.

When an access pit is to be located in close proximity to a closed live watermain valve, the active thrust force of the valve shall be addressed to prevent dislocation of the valve or adjacent piping and to ensure safe working conditions.

462.07.10.02 Replacement of Valves

All valves along the length of pipe to be cement mortar lined shall be removed and replaced with the type and size of valve specified in the Contract Documents. In all cases, a jumper wire shall be thermite welded to the existing cast or ductile iron pipe on both sides of the replaced valve.

462.07.10.03 Replacement of Fittings

All fittings along the length of pipe to be cement mortar lined shall be removed and replaced with the type and size of fitting specified in the Contract Documents. In all cases, a jumper wire shall be thermite welded to the existing cast or ductile iron pipe on both sides of the replaced fitting.

462.07.10.04 Cutting of Pipe

Pipes shall be cut so that the ends are smooth and square to ensure proper reconnection.

462.07.10.05 Cleaning Existing Pipe

All rust, tubercles, deposits, loose or deteriorated remains of original coating, and other foreign material shall be removed from the inside of the pipe without damaging the structural integrity of the existing pipe. A cleaning device shall be passed through the pipe as many times as is necessary to obtain results satisfactory to the Contract Administrator. To confirm satisfactory cleaning, a closed-circuit television (CCTV) inspection of the pipe section shall be undertaken.

Solids removed during the cleaning, flushing, and pumping operations shall be captured before flowing into the drainage system and then disposed of as specified in the Contract Documents.

462.07.10.06 Bulkheads on Open Pipe Ends

All pipes shall be closed using a mechanical joint plug or cap anytime there is no work being performed on the pipe. The bulkhead shall be capable of preventing water from entering or exiting the pipe and shall be equipped with a relief valve.

462.07.10.07 Cement Mortar Lining

462.07.10.07.01 General

The lining shall consist of a one-course application of pre-mixed cement mortar, 5 mm $\pm$ 1.5 mm thick, and shall be placed by a machine projecting the mortar against the wall of the pipe and long radius bends, by centrifugal force, without injurious rebound and with sufficient velocity to cause the mortar to be densely packed and to adhere in place. The travel of the machine and the rate of discharge of mortar shall be controlled so as to produce a uniform thickness of lining around the interior and along the length of pipe.

Mortar that has attained its initial set shall not be used.

Mortar of improper consistency that does not provide a dense homogenous lining that holds itself firmly against the pipe surface and all waste materials, spatter, etc., shall be removed from the pipe. Only mortar of suitable consistency and applied with sufficient velocity to adhere firmly to the surface of the pipe shall form the lining.

If any section of the lining fails or shows evidence of failure or unusual irregularity, the faulty section of lining shall be removed to the extent indicated by the Contract Administrator and the pipe re-cleaned and the lining replaced.

462.07.10.07.02 Trowelling

The interior surface of the pipe shall be mechanically trowelled to produce a smooth surface.

462.07.10.07.03 Hand Work

Edges of linings at openings or ends of lined sections shall be neatly finished. Edges shall be rounded or beveled so as to avoid sharp angles or abrupt changes in sections. Surfaces of cement mortar lining to which additional mortar is to be placed shall be moistened just before the mortar is applied.

Hand finishing work in a section of the pipe shall be completed within 24 hours following the machine application of the mortar lining.

462.07.10.08 Closing of Pipe

Immediately upon completion of the cement mortar lining of a section of pipe, all openings in the pipe shall be closed in accordance with the Bulkheads on Open Pipe Ends clause to prevent circulation of air.

462.07.10.09 Curing

As soon as practical, without damaging the cement mortar lining, water shall be introduced into the section of pipe between bulkheads in order to maintain a moist environment.

462.07.10.10 Backflushing

When the lining has achieved sufficient set, all services shall be backflushed with water or another method approved by the Contract Administrator to remove any mortar deposited in them.

462.07.10.11 Obstruction in the Water Services

Should any water service be partially or fully obstructed, the obstruction shall be removed in a manner approved by the Contract Administrator.

462.07.10.12 Closed-Circuit Television (CCTV) Inspection

CCTV inspections shall be according to OPSS 409.

Equipment used for CCTV inspections shall have been used exclusively for the inspection of potable watermain systems in the past.

CCTV inspections shall be carried out on cleaned pipe sections and again on newly lined sections of pipe to ensure proper cleaning or cement mortar application.

All water shall be removed prior to the inspection of the watermain.

If the cleaning or cement mortar lining of any pipe section is unacceptable, the deficiency with the cleaning or mortar lining shall be corrected and the pipe section shall be reinspected.

Any valves, main stops, or other associated appurtenances that are found to have been damaged due to cleaning or lining operations shall be replaced.

462.07.10.13 Repair of Pipe

Upon application of the cement mortar lining, the openings in the pipe shall be closed as soon as possible using polyvinyl chloride pipe or ductile iron pipe and couplings approved by the Contract Administrator. Thrust restraints shall be installed according to OPSS 441. In all cases, a jumper wire shall be thermite welded to the existing cast or ductile iron pipe on both sides of the repair.

462.07.10.14 Sacrificial Anodes

Sacrificial anodes of the type and size specified in the Contract Documents shall be installed at each new valve and cast or ductile iron fitting and at each access pit according to OPSS 442 and the Contract Documents.

462.07.10.15 Hydrostatic Testing

When specified in the Contract Documents, hydrostatic testing shall be carried out according to OPSS 441.

462.07.10.16 Flushing and Disinfecting

Flushing and disinfecting of the completed watermain shall be according to OPSS 441.

462.07.10.17 Return of Watermain to Service and Removal of Temporary Potable Water Supply System

Upon receipt of satisfactory test results on water samples, the watermain shall be flushed and returned to service, permanent water service connections restored, excavations backfilled, and temporary service lines removed without interruption of the water supply.

462.07.11 Site Restoration

Site restoration shall be according to OPSS 492.

462.07.12 Management of Excess Material

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

462.09 MEASUREMENT FOR PAYMENT

462.09.01 Actual Measurement

462.09.01.01 Locating, Inspecting, and Marking Service Boxes

For measurement purposes, a count shall be made of the number of service boxes located, inspected, and marked.

462.09.01.02 Adjusting Service Boxes

For measurement purposes, a count shall be made of the number of service boxes adjusted to final grade.

462.09.01.03 Replacing Service Boxes

For measurement purposes, a count shall be made of the number of service boxes excavated and replaced.

462.09.01.04 Replacing Curb Stops

For measurement purposes, a count shall be made of the number of curb stops excavated and replaced.

462.09.01.05 Access Pits

For measurement purposes, a count shall be made of the number of approved access pits excavated, backfilled, compacted, and restored.

462.09.01.06 Cement Mortar Lining

Measurement of cement mortar lining shall be by length in metres horizontally along the centreline of the pipe being lined.

462.09.01.07 Valves

For measurement purposes, a count shall be made of the number of valves installed along the cement mortar lined pipe.

462.09.01.08 Fittings

For measurement purposes, a count shall be made of the number of fittings installed along the cement mortar lined pipe.

462.09.01.09 Repair of Pipe

For measurement purposes, a count shall be made of the number of sections of pipe repaired.

462.09.01.10 Sacrificial Anodes

For measurement purposes, a count shall be made of the number of sacrificial anodes installed.

462.09.02 Plan Quantity Measurement

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

462.10 BASIS OF PAYMENT

462.10.01 Locating, Inspecting, and Marking Service Boxes - Item
Adjusting of Service Boxes - Item
Replacing of Service Boxes - Item
Replacing of Curb Stops - Item
Access Pits - Item
"type, size" Repair of Pipe - Item
"type, size" Sacrificial Anodes - Item
Flushing and Disinfecting - Item

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

462.10.02 Rehabilitation of Watermains

462.10.02.01 Cement Mortar Lining - Item

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

Removal and replacement of valves, main stops, curb stops, service boxes, and other associated appurtenances damaged due to cleaning or lining operations shall be at no additional cost to the Owner.

Re-inspection of an unacceptably cleaned or cement lined pipe after correction of a deficiency shall be at no additional cost to the Owner.

462.10.02.02 "type, size" Valves - Item

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

462.10.02.03 "type, size" Fittings - Item

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

462.10.02.04 Obstructions in Water Services

When excavation and repair of a water service is required and not caused by the negligence of the Contractor, payment shall be made as Extra Work.

When water services are partially or fully obstructed due to the ingress of loosened foreign materials from the cleaning or lining process, the obstruction shall be removed at no additional cost to the Owner.

462.10.03 Closed-Circuit Television Inspection

When the Contract does not contain a separate tender item for CCTV inspection, the Contract price for product installation shall include full compensation for all labour, Equipment, and Material to do the work of CCTV Inspection.

Appendix 462-A, November 2014 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Service box requirements. (462.05.02)
- Location for delivery of removed fittings and appurtenances. (462.07.01)
- Type and size of replacement valves. (462.07.10.02)
- Type and size of replacement fittings. (462.07.10.03)
- Disposal of solids from the cleaning, flushing, and pumping operations. (462.07.10.05)
- Type and size of sacrificial anodes to be installed. (462.07.10.14)

The designer should determine if hydrostatic testing of the watermain is required and, if so, it should be specified in the Contract Documents. (462.07.10.15)

The tender item descriptions for repair of pipe should include reference to the attributes shown (i.e., type and size of pipe to be complete). (462.10.01)

The tender item description for sacrificial anodes should include reference to the attribute shown (i.e., type and size of anode to be complete). (462.10.01)

The tender item descriptions for valves should include reference to the attributes shown (i.e., type and size of valve to be complete). (462.10.02.02)

The tender item descriptions for fittings should include reference to the attributes shown (i.e., type and size of fitting to be complete). (462.10.02.03)

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

Related Ontario Provincial Standard Drawings

OPSD 1109.010	Cathodic Protection for Metallic Watermain Systems
OPSD 1109.011	Cathodic Protection for PVC Watermain Systems



CONSTRUCTION SPECIFICATION FOR PIPELINE AND CONDUIT INSTALLATION BY PIPE BURSTING

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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:

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- Pipe type, class, pressure rating, and size. (463.05.01)
- Valve type, class, pressure rating, and size. (463.05.02)
- Product ovality. (463.07.01)
- Service connection work. (463.07.12.03)
- Benching restoration. (463.07.14)
- Testing of product joining and installation. (463.07.15)
- Verification record requirements. (463.07.16)
- Acceptance criteria. (463.08.01)

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

- Exposing existing facilities. (463.07.03)
- Use of temporary potable water supply services. (463.07.09)
- Product by-pass. (463.07.10)
- Joining and pulling product as one length. (463.07.12.01)
- Use of a weak link, breakway connector, or load monitor. (463.07.13)
- Wall restoration. (463.07.14)
- Completion of a CCTV inspection. (463.07.15)

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

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

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

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

Appendix 463-A

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

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

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

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

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

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

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

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

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

Related Ontario Provincial Standard Drawings

No information provided here.



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

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490.01	SCOPE
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APPENDICES

490-A	Commentary

490.01 SCOPE

This specification covers the requirements of site preparation for the installation of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, watermains and associated appurtenances, and other underground Utilities; maintenance holes, catch basins, ditch inlets, or valve chambers; and any other specified subsurface construction.

490.01.01 Specification Significance and Use

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

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

490.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

490.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 201	Clearing, Close Cut Clearing, Grubbing, and Removal of Surface and Piled Boulders
OPSS 206	Grading
OPSS 412	Sewage Forcemain Installation in Open Cut
OPSS 441	Watermain Installation in Open Cut
OPSS 706	Traffic Control Signing
OPSS 801	Protection of Trees
OPSS 802	Topsoil
OPSS 805	Temporary Erosion and Sediment Control Measures

490.03 DEFINITIONS

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

Associated Appurtenances means as defined in OPSS 412 for a sewer system, and OPSS 441 for a watermain.

490.07 CONSTRUCTION

490.07.01 General

Site preparatory work shall be performed prior to the installation of the pipelines, Utilities, and associated structures.

490.07.02 Removal of Existing Signing

Removal of existing signing shall be according to OPSS 706.

490.07.03 Clearing and Grubbing

Clearing and grubbing and related work shall be according to OPSS 201.

490.07.04 Shrub and Tree Relocation

Shrubs and trees to be relocated shall be protected according to OPSS 801 in their original and final locations.

Shrub and tree relocation shall be as specified in the Contract Documents.

490.07.05 Tree Protection and Pruning

Tree protection and pruning shall be according to OPSS 801.

490.07.06 Stripping and Stockpiling Topsoil

Stripping of topsoil shall be according to OPSS 206. Topsoil shall be removed carefully in the Work Areas and shall not be mixed with subsoil or other materials.

Stockpiling of topsoil shall be according to OPSS 802 and as specified in the Contract Documents. Topsoil shall not be placed in or near tree stands, along flood plains, and in areas containing natural wildlife habitats. Perimeter drainage ditches shall be constructed to intercept and divert run-off to adjacent settling ponds. Temporary erosion and sediment control measures shall be according to OPSS 805. Stockpiles shall be protected to ensure minimum environmental interference.

490.07.07 Removal of Fences and Guide Rails

Property owners or occupants shall be given at least 24 hours notice in advance of dismantling fences. Fences and guide rails shall be dismantled, where necessary. All components that are broken, bent, or damaged as a result of the operation shall be removed from the site and replaced with new components. All reusable components shall be stored and protected.

490.07.08 Management of Excess Material

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

490.10**BASIS OF PAYMENT**

Payment at the Contract price for the appropriate tender items for the installation of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, watermains and associated appurtenances, and other underground Utilities; maintenance holes, catch basins, ditch inlets, or valve chambers; and any other specified subsurface construction shall be full compensation for all labour, Equipment, and Material to do the work of site preparation.

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

Appendix 490-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the shrub and tree relocation and planting requirements in the Contract Documents. (490.07.04)

The designer may choose to specify a specific location for stockpiled topsoil in the Contract Documents. (490.07.06)

If separate items are required to cover the various components of site preparation, they should be included in the Contract Documents.

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

Related Ontario Provincial Standard Drawings

No information provided here.



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**



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

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492.09	MEASUREMENT FOR PAYMENT - Not Used
492.10	BASIS OF PAYMENT

APPENDICES

492-A	Commentary

492.01 SCOPE

This specification covers the requirements for the restoration of a site following installation of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, watermains and associated appurtenances, and other underground utilities; maintenance holes, catch basins, ditch inlets, or valve chambers; and any other specified subsurface construction.

492.01.01 Specification Significance and Use

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

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

492.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

492.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 304	Single and Double Surface Treatment
OPSS 310	Hot Mix Asphalt
OPSS 313	Hot Mix Asphalt - End Result
OPSS 314	Untreated Granular, Subbase, Base, Surface Shoulder, and Stockpiling
OPSS 350	Concrete Pavement and Concrete Base
OPSS 351	Concrete Sidewalk
OPSS 353	Concrete Curb and Gutter Systems
OPSS 412	Sewage Forcemain Installation in Open Cut
OPSS 441	Watermain Installation in Open Cut
OPSS 490	Site Preparation for Pipelines, Utilities, and Associated Structures
OPSS 721	Steel Beam Guide Rail and Cable Guide Rail
OPSS 771	Standard Highway Fence
OPSS 772	Chain-Link Fence
OPSS 802	Topsoil
OPSS 803	Sodding
OPSS 804	Seed and Cover

Ontario Provincial Standard Specification, Material

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1540	Standard Highway Fence Components
OPSS 1541	Chain-Link Fence Components
OPSS 1601	Wood - Material, Preservative Treatment, and Shop Fabrication

Canadian General Standards Board (CGSB)

138.2-96	Steel Framework for Chain Link Fence

492.03 DEFINITIONS

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

Associated Appurtenances means as defined in OPSS 412 and OPSS 441.

492.05 MATERIALS

492.05.01 Granular Materials

Granular materials shall be according to OPSS 1010.

492.05.02 Barbed Wire

Barbed wire shall be according to CAN/CGSB-138.2.

492.05.03 Electric Fence Wire

Electric fence wire shall be 2 mm diameter hot dipped galvanized wire.

492.05.04 Wood Fence

Wood fence material shall be according to OPSS 1601.

492.05.04.01 Board or Split Rail Fence

Posts and boards shall be the same size and type as used in the original fence.

Rails shall be split cedar in good condition and of adequate lengths to build either a straight or snake fence.

492.05.04.02 Wood Braces for Wire Fence

Diagonal wood braces shall be according to OPSS 1540.

492.05.05 Highway Fence

Highway fence material shall be according to OPSS 1540.

492.05.06 Steel Posts

Steel posts shall be according to OPSS 1540.

492.05.07 Chain-Link Fence

Chain-link fence material shall be according to OPSS 1541.

492.05.08 Gates

Gates shall be fabricated from material suitable to the fence on either side of the gate opening. Material for highway fence gates shall be according to OPSS 1540. Material for chain-link fence gates shall be according to OPSS 1541.

492.05.09 Guide Rail

Guide rail material shall be according to OPSS 721.

492.05.10 Concrete

Concrete for sidewalks shall be according to OPSS 351.

Concrete for curb and gutter shall be according to OPSS 353.

492.07 CONSTRUCTION

492.07.01 General

All disturbed areas shall be restored to an equivalent or better condition than existed prior to the commencement of construction.

492.07.02 Grading

Rough grading shall be performed to the levels, grades, and contours as specified in the Contract Documents allowing for the placement of surface materials. Soil shall not be disturbed within the drip line of trees and shrubs during grading.

Final grading shall be performed to the lines and elevations specified in the Contract Documents. The final grading shall be according to OPSS 206.

492.07.03 Roadway Restoration

The restoration of the roadway shall be scheduled to follow closely behind trench backfilling. The roadway shall be made and maintained safe for the passage of vehicular and pedestrian traffic after completion of backfilling and until permanent restoration takes place, as specified in the Contract Documents.

Granular subbase and base courses of the type specified in the Contract Documents shall be placed on the prepared subgrade to the dimensions specified in the Contract Documents and shall be according to OPSS 314.

The surface course of the type specified in the Contract Documents shall be placed on the prepared base course to the dimensions specified in the Contract Documents in accordance as follows:

- a) Asphalt pavement shall be according to OPSS 310 or OPSS 313 as specified in the Contract Documents.
- b) Concrete paving shall be not less than 150 mm in thickness and shall be according to OPSS 350.

- c) Gravel surface courses shall be according to OPSS 314.
- d) Surface treatment shall be according to OPSS 304.

492.07.04 Fences and Guide Rails

Fences and guide rails shall be restored with the same type of fence or guide rail that existed prior to construction along the lines and levels specified in the Contract Documents. A maximum clearance of 150 mm from ground level shall be maintained at any point along the fence line.

The erection of highway fence shall be according to OPSS 771.

The erection of chain-link fence shall be according to OPSS 772.

Posts for fences other than highway and chain-link fences shall be installed to the spacing that existed prior to construction.

Gates shall be installed at the same location and height as the gates that existed prior to construction. Gate size shall be according to the dimensions of the gate that existed prior to construction. Gates shall be secured with fittings to match the fence complete with latches, hinges, stops, and all necessary fittings.

Colour and finish material of the restored fence shall match the existing colour scheme and finish material. Where required, two coats of finish material shall be applied.

The construction of guide rails shall be according to OPSS 721.

492.07.05 Topsoil

Topsoil shall be placed after final grading operations have been completed and immediately prior to seeding or sodding operations. Topsoil shall be obtained from stockpiles prepared according to OPSS 490 or, if the required quantity is not obtainable from stockpiles, the Contractor shall import the required topsoil.

The quality of the topsoil and the construction methods for placing topsoil shall be according to OPSS 802. Stockpile sites within or adjacent to the Contract limits shall be restored to the original condition or to a condition acceptable to the Contract Administrator.

492.07.06 Shrub and Tree Replanting

Shrubs and trees shall be replanted as specified in the Contract Documents.

492.07.07 Sodding and Seeding

Lawns and grassed areas shall be sodded or seeded and covered as specified in the Contract Documents.

Sodding shall be according to OPSS 803.

Seeding and cover shall be according to OPSS 804.

492.07.08 Sidewalk and Concrete Curb and Gutter Systems

Concrete sidewalk shall be placed according to OPSS 351. Alignment and dimensions shall match existing sidewalk on either end of the restored sidewalk. Damaged sections of any sidewalk slab shall be removed and replaced to the nearest joint on either end of the damaged section.

Concrete curb and gutter systems shall be placed according to OPSS 353. Alignment and dimensions shall match the existing curb and gutter systems on either side of the restored curb and gutter. Damaged sections of curb and gutter shall be removed and replaced to the nearest joint or neat saw cut.

Placement of Granular A shall be according to OPSS 314 with a minimum depth of 100 mm as a base for the curb and gutter and sidewalk.

492.07.09 Management of Excess Material

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

492.10 BASIS OF PAYMENT

Payment at the Contract price for the appropriate tender items for the installation of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, watermains and associated appurtenances, and other underground utilities; maintenance holes, catch basins, ditch inlets, or valve chambers; and any other specified subsurface construction shall be full compensation for all labour, Equipment, and Material to do the work of site restoration.

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

Appendix 492-A, November 2015 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Levels, grades, and contours for rough grading. (492.07.02)
- Lines and elevations for final grading. (492.07.02)
- Requirements for temporary roadway. (492.07.03)
- Type of granular subbase and base courses and surface course. (492.07.03)
- Dimensions of the granular subbase and base courses and surface course. (492.07.03)
- OPSS 310 or OPSS 313 for asphalt pavement. (492.07.03, a))
- Lines and levels for restoration of fences and guide rails. (492.07.04)
- Replanting of shrubs and trees. (492.07.06)
- Sodding or seeding and cover of lawns and grassed areas. (492.07.07)

Designer should determine if the Contract is to have separate items to cover the various components of site restoration or if the items for the installation of pipelines, utilities, and their associated structures will be all inclusive to cover the work. If separate items are desired, they should then be included in the Contract Documents along with the details of the work.

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

Related Ontario Provincial Standard Drawings

OPSD 912.101 to 912.532	Guide Rail System, Steel Beam
OPSD 913.101 to 913.130	Guide Rail System, Cable
OPSD 971.101 to 971.102	Fence, Highway Installation
OPSD 972.101 to 972.131	Fence, Chain-Link



CONSTRUCTION SPECIFICATION FOR TEMPORARY POTABLE WATER SUPPLY SERVICES

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493.01	SCOPE

This specification covers the requirements for the installation of temporary watermain, service connections, and associated appurtenances prior to disconnecting service of an existing watermain on a temporary basis.

493.01.01 Specification Significance and Use

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

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

493.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

493.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 441	Watermain Installation in Open Cut

CSA Standards

B64.5-94	Double Check Valve (DCVA) Backflow Preventers [Part of B64 Series-07, Backflow Preventers and Vacuum Breakers Compendium]

American Water Works Association (AWWA)

C510-07	Double Check Valve Backflow Prevention Assembly

ASTM International

D 1784-11	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
D 2241-15	Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
D 3139-98 (2001)	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
F 477-14	Elastomeric Seals (Gaskets) for Joining Plastic Pipe

NSF International

61-2014a Drinking Water System Components - Health Effects

493.03

DEFINITIONS

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

Associated Appurtenance means structures, devices, and appliances, other than pipe and conduit that are used in connection with a water distribution system, such as valves, hydrants, corporation cocks, services, and thrust restraints.

Excavation, Earth and Rock means the excavation classified as earth and rock according to OPSS 206.

Temporary Hydrant means temporary fire hydrant and all associated temporary appurtenances.

Temporary Potable Water Supply Services means temporary watermains, services, hydrants, and all associated appurtenances.

Temporary Services means temporary potable water supply services installed on or just below the ground surface for the purpose of providing potable water to customers while the existing watermain is out of service.

Temporary Watermain means temporary potable water supply hose or pipe installed on or just below the ground surface for the purpose of providing potable water to temporary services and temporary fire hydrants while the existing watermain is out of service.

Watermain means an installation designed for the conveyance of water under pressure using circular pipe.

493.04

DESIGN AND SUBMISSION REQUIREMENTS

493.04.01

Submission Requirements

The following information shall be submitted to the Contract Administrator 14 Days prior to the commencement of any work requiring temporary potable water supply services:

- a) Temporary potable water supply services plans including installation, operation, testing procedures, and a list of material and equipment to be used.
- b) Temporary hydrant details.

493.05 MATERIALS

493.05.01 General

The pipe size, type, and class shall be as specified in the Contract Documents.

Fittings shall be suitable for and compatible with the pipe material and class with which they are used.

All materials in contact with potable water shall be NSF/ANSI 61 compliant and, if being reused, shall have been used exclusively for potable water services in the past.

All materials shall be capable of withstanding 860 kPa pressure and all other conditions of use.

493.05.02 Temporary Potable Water Supply Services

The pipe, hose, and all other materials used in conjunction with the temporary potable water supply services shall be as follows:

- a) Flexible hose jackets shall be abrasion resistant, either double jacket or specially coated, and be capable of being driven over by vehicles periodically without short term effects.
- b) Hose lining shall be of material that does not impart any taste or odour to the water.
- c) Hose shall come complete with aluminium couplings with threads.
- d) Rigid pipe shall be made of class 12454-B PVC material according to ASTM D 1784. Material shall have a minimum hydrostatic design stress of 14 MPa.
- e) PVC shall be formulated with impact modifiers, heat stabilizers, and ultraviolet inhibitors.
- f) Pipe extrusion shall meet or exceed all requirements of ASTM D 2241.
- g) Joints and couplings shall be according to ASTM D 3139.
- h) O-rings shall be according to ASTM F 477.
- i) Double check valve backflow preventers shall be according to CSA B64.5 and AWWA C510.

493.05.03 Valves

Valves shall be according to OPSS 441.

493.05.04 Temporary Hydrants

Temporary hydrants shall be as specified in the Contract Documents.

493.07 CONSTRUCTION

493.07.01 General

Written notices to all affected property owners are required a minimum of 48 hours prior to any disruption of water service as a result of the temporary by-pass.

Temporary water services shall be connected to the temporary watermain for each single residential unit or other building.

Connection to the private plumbing system of a residential unit shall be via a wye at an outside tap or an existing water service as specified in the Contract Documents. The connection of single residential units in series is not permitted. Each temporary water service shall have its own valved connection to the temporary watermain.

Connection to other buildings shall be as specified in the Contract Documents.

An adequate water supply shall be available at all times. If the temporary potable water supply service fails, it shall be restored within the time period specified in the Contract Documents.

Care shall be exercised during the installation of temporary potable water supply services to avoid contamination of the services.

No work shall be done during freezing weather, unless directed by the Contract Administrator. No temporary watermains or temporary water services shall be installed or operated during freezing weather. Pipes already in use shall be removed or drained and existing services restored when so directed by the Contract Administrator.

493.07.02 Temporary Watermains

The temporary watermain shall be of a size to provide adequate water supply during peak demand of connected users.

At any connection of a temporary watermain to the water supply and distribution system (e.g., at hydrants) a double check valve backflow preventer shall be installed. Source connections shall be as specified in the Contract Documents.

493.07.03 Temporary Potable Water Supply Services

Temporary potable water supply services for single residential units shall be a minimum of 19 mm inside diameter. Temporary potable water supply services for other users, including flow to maintain fire protection systems, shall be as specified in the Contract Documents.

The temporary potable water supply service connections shall be valved near the point of connection to the temporary watermain and also valved near the point of connection to a private plumbing system so that both the temporary watermain and the temporary potable water supply services may be disinfected.

493.07.04 Temporary Hydrants

When a hydrant is removed from service, a temporary hydrant and the necessary valves and fittings shall be installed and maintained according to the Contract Documents.

Before permanently shutting down the existing watermain, the temporary hydrants shall be tested to ensure that they are in proper working order.

The hydrants that are out of service during construction operations shall be bagged and clearly marked with a "HYDRANT OUT OF SERVICE" tag.

Once in use, the temporary hydrants shall be maintained until the existing or new hydrants are restored to service.

All temporary potable water supply service attachments to fire hydrants shall be easily removable for fire fighting purposes.

All temporary hydrants shall have reflective tape on the barrel for increased visibility. The temporary hydrants shall stand in an upright position at all times.

493.07.05 Valves

Valves shall be installed at each branch of a temporary watermain.

Before permanently shutting down the existing watermain, the valves shall be tested to ensure that they are in proper working order.

493.07.06 Protection

The Contractor shall provide protection of the temporary potable water supply services at locations such as road crossings, sidewalks, driveways, and walkways.

When temporary watermain crosses over the roadway, the asphalt pavement shall be saw cut and removed and the temporary watermain shall be buried. Under no circumstance is a pipe road crossing to remain open and unprotected from vehicular and pedestrian traffic. If a concrete road base exists, it shall not be disturbed.

When temporary potable water supply services are used on full right-of-way reconstruction projects, the temporary potable water supply service piping shall also be buried at all sidewalks, driveways, and walkways.

When temporary potable water supply services are used on projects when the road surface is not being reconstructed, the temporary service piping shall be buried only at all road crossings. When temporary watermain or temporary potable water supply services cross a driveway or a sidewalk, asphalt or another acceptable material shall be mounded over the pipe. A polyethylene sheet shall be placed as a barrier on concrete or interlocking driveways. If the work performed or material used is not to the satisfaction of the Contract Administrator, action shall be taken to rectify the problem. Safety flashers and barricades, as may be required, shall be furnished and maintained. In general, the temporary potable water supply service pipe shall be laid where it causes the least obstruction and is least likely to be damaged.

The Contractor shall protect the temporary potable water supply services installed across all road crossings, sidewalks, driveways, and walkways during the extent of the construction schedule. This shall include earth excavation, backfill, asphalt reinstatement, and ramping material required as directed by the Contract Administrator.

The Contractor shall provide adequate signage at locations where hoses are exposed and may present a public safety hazard, such as blow off hoses at catchbasins.

493.07.07 Leakage Testing

The temporary potable water supply service shall be watertight.

Leakage testing shall be conducted in the presence of the Contract Administrator upon completion of the watermain, including services. All leaks shall be repaired prior to covering the pipe.

493.07.08 Flushing and Disinfecting Temporary Watermain and Services

Flushing and disinfecting operations shall be conducted in the presence of the Contract Administrator. The Contract Administrator shall be notified at least 2 Business Days in advance of the proposed date on which flushing and disinfecting operations are to commence. Watermain shall be flushed in a sequence approved by the Contract Administrator. All temporary watermain and services shall be flushed at a flow velocity adequate to remove any foreign debris and until the discharged water runs clear.

After flushing is completed, water from the existing distribution system shall be allowed to flow at a controlled rate into the new temporary watermain. Liquid chlorine solution shall be introduced so that the chlorine is distributed throughout the section being disinfected at chlorine concentration of 50 mg/litre minimum throughout the section. The system shall be left charged with the chlorine solution for 24 hours.

Sampling and testing for chlorine residual shall be carried out in the presence of the Contract Administrator. The chlorine residual shall be tested in the section after 24 hours. If tests indicate a chlorine residual of 25 mg/litre minimum, the section shall be flushed completely and recharged with water normal to the operation of the system. If the test does not meet the requirements, the chlorination procedure shall be repeated until satisfactory results are obtained.

Twenty-four hours after the system has been recharged and ready for operation, the Contract Administrator shall ensure that samples are taken for bacteriological tests. Samples shall be collected from every 350 m of the new watermain plus one sample from each end of each line and at least one sample from each branch. If there is indication of contamination, the disinfection procedure shall be repeated.

The temporary water supply service shall not be put into operation or the existing watermain removed from operation until approval has been given by the Contract Administrator.

Regular sampling and testing for chlorine residual shall be carried out by the Contract Administrator.

493.07.09 Removal of Temporary Potable Water Supply Services

Temporary potable water supply services may be used from approximately mid-April to mid-October. All temporary services shall be completely removed by mid-November. Any variation from this schedule shall be approved by the Contract Administrator.

493.07.10 Management of Excess Material

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

All chlorinated water used for testing, flushing, or disinfecting watermains shall be directed to an acceptable outlet in a manner that meets the requirements of all applicable regulations. The method of disposal of chlorinated water is subject to the approval of the Contract Administrator.

493.10 BASIS OF PAYMENT

493.10.01 Temporary Potable Water Supply Services - Item

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

On completion of the supply, installation, flushing, disinfecting, and testing of the temporary potable water supply services prior to putting it in operation, a progress payment to 60% of the above item shall be made. The balance shall be prorated over the remainder of the working period.

Removal or draining of the temporary potable water supply services during freezing weather and its subsequent return to service shall be at no additional cost to the Owner.

Appendix 493-A, November 2009
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer may consider including soil boring data, a geotechnical report, a subsurface report, or a soils report in the Tender Documents.

The designer should include the following in the Contract Documents:

- Pipe size, type, and class. (493.05.01)
- Temporary hydrant requirements. (493.05.04)
- Temporary potable water supply services connection requirements to buildings other than single residential units. (493.07.01)
- Time requirements for restoring the temporary potable water supply service should it fail. (493.07.01)
- Temporary potable water supply services to buildings other than single residential units, including flow to maintain fire protection systems. (493.07.03)
- Temporary hydrant and the necessary valves and fittings to be installed and maintained. (493.07.04)

Where conditions of high ground water exist, external fluids may enter via air release and air/vacuum release valves, therefore, appropriate measures shall be taken.

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

Related Ontario Provincial Standard Drawings

OPSD 1104.030 25 mm Blow Off Installation



NOTICE TO USERS OF OPSS 501

CONSTRUCTION SPECIFICATION FOR COMPACTING

OPSS 501 has been removed from this
OPS volume

The provincial version of OPSS 501 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 501

The municipal version of OPSS 501 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 501

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



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

References to OPSS 503 shall be deemed to mean
OPSS 490, Construction Specification for
Site Preparation for Pipelines,
Utilities, and Associated Structures

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 490:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



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

References to OPSS 504 shall be deemed to mean
OPSS 491, Construction Specification for
Preservation, Protection, and
Reconstruction of Existing Facilities

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 491:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



NOTICE TO USERS OF OPSS 506

CONSTRUCTION SPECIFICATION FOR DUST SUPPRESSANTS

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



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

References to OPSS 507 shall be deemed to mean
OPSS 492, Construction Specification for
Site Restoration Following Installation of
Pipelines, Utilities, and Associated Structures

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 492:

- The specification was reviewed by an OPS specialty committee, and some of the technical content has changed.
- The specification designation, publication date, and references to other renumbered specifications have been changed.



NOTICE TO USERS OF OPSS 510

CONSTRUCTION SPECIFICATION FOR REMOVAL

OPSS 510 has been removed from this
OPS volume

The provincial version of OPSS 510 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 510

The municipal version of OPSS 510 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 510

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



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 512

CONSTRUCTION SPECIFICATION FOR INSTALLATION OF GABIONS

OPSS 512 has been removed from this
OPS volume

The provincial version of OPSS 512 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 512

The municipal version of OPSS 512 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 512

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



**CONSTRUCTION SPECIFICATION FOR
TRENCHING, BACKFILLING, AND COMPACTING**

References to OPSS 514 shall be deemed to mean
OPSS 401, Construction Specification for
Trenching, Backfilling, and Compacting

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 401:

- The specification was reviewed by an OPS specialty committee, and some of the technical content has changed.
- The specification designation, publication date, and references to other renumbered specifications have been changed.



**CONSTRUCTION SPECIFICATION FOR
ROCK EXCAVATION FOR PIPELINES, UTILITIES,
AND ASSOCIATED STRUCTURES IN OPEN CUT**

References to OPSS 515 shall be deemed to mean
OPSS 403, Construction Specification for
Rock Excavation for Pipelines, Utilities,
and Associated Structures in Open Cut

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 403:

- The specification was reviewed by an OPS specialty committee, and some of the technical content has changed.
- The specification designation, publication date, and references to other renumbered specifications have been changed.



**CONSTRUCTION SPECIFICATION FOR
EXCAVATING, BACKFILLING, AND COMPACTING
FOR MAINTENANCE HOLES, CATCH BASINS,
DITCH INLETS, AND VALVE CHAMBERS**

References to OPSS 516 shall be deemed to mean
OPSS 402, Construction Specification for
Excavating, Backfilling, and Compacting
for Maintenance Holes, Catch Basins,
Ditch Inlets, and Valve Chambers

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 402:

- The specification was reviewed by an OPS specialty committee, and some of the technical content has changed.
- The specification designation, publication date, and references to other renumbered specifications have been changed.



NOTICE TO USERS OF OPSS 517

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

OPSS 517 has been removed from this
OPS volume

The provincial version of OPSS 517 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 517

The municipal version of OPSS 517 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 517

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



NOTICE TO USERS OF OPSS 518

CONSTRUCTION SPECIFICATION FOR CONTROL OF WATER FROM DEWATERING OPERATIONS

OPSS 518 has been removed from this
OPS volume

The provincial version of OPSS 518 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 518

The municipal version of OPSS 518 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 518

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



CONSTRUCTION SPECIFICATION FOR PAVEMENT MARKING

References to OPSS 532 shall be deemed to mean
OPSS 710, Construction Specification for
Pavement Marking

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 710:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR SUPPORT SYSTEMS

References to OPSS 538 shall be deemed to mean
OPSS 404, Construction Specification for
Support Systems

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 404:

- The specification was reviewed by an OPS specialty committee, and some of the technical content has changed.
- The specification designation, publication date, and references to other renumbered specifications have been changed.



NOTICE TO USERS OF OPSS 539

CONSTRUCTION SPECIFICATION FOR TEMPORARY PROTECTION SYSTEMS

OPSS 539 has been removed from this
OPS volume

The provincial version of OPSS 539 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 539

The municipal version of OPSS 539 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 539

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



CONSTRUCTION SPECIFICATION FOR STANDARD HIGHWAY FENCE

References to OPSS 540 shall be deemed to mean
OPSS 771, Construction Specification for
Standard Highway Fence

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 771:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR CHAIN-LINK FENCE

References to OPSS 541 shall be deemed to mean
OPSS 772, Construction Specification for
Chain-Link Fence

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 772:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR EXPANDED METAL ANTI-GLARE SCREEN

References to OPSS 542 shall be deemed to mean
OPSS 791, Construction Specification for
Expanded Metal Anti-Glare Screen

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 791:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR TRAFFIC CONTROL SIGNING

References to OPSS 543 shall be deemed to mean
OPSS 706, Construction Specification for
Traffic Control Signing

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 706:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR STEEL BEAM GUIDE RAIL AND CABLE GUIDE RAIL

References to OPSS 552 shall be deemed to mean
OPSS 721, Construction Specification for
Steel Beam Guide Rail and Cable Guide Rail

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 721:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR CONCRETE BARRIERS

References to OPSS 553 shall be deemed to mean
OPSS 740, Construction Specification for
Concrete Barriers

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 740:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



**CONSTRUCTION SPECIFICATION FOR
GUIDE RAIL END TREATMENT -
ECCENTRIC LOADER TERMINAL SYSTEM**

References to OPSS 555 shall be deemed to mean
OPSS 730, Construction Specification for
Guide Rail End Treatment -
Eccentric Loader Terminal System

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 730:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR CONNECTICUT IMPACT ATTENUATION SYSTEM

References to OPSS 556 shall be deemed to mean
OPSS 753, Construction Specification for
Connecticut Impact Attenuation System

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 753:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



**CONSTRUCTION SPECIFICATION FOR
GUIDE RAIL END TREATMENT -
CRASH-CUSHION ATTENUATING TERMINAL SYSTEM**

References to OPSS 558 shall be deemed to mean
OPSS 731, Construction Specification for
Guide Rail End Treatment -
Crash-Cushion Attenuating Terminal System

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 731:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



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

References to OPSS 559 shall be deemed to mean
OPSS 732, Construction Specification for
Guide Rail End Treatment -
Steel Beam Energy Attenuating Terminal Systems

The renumbered specification has been relocated to Division 7 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 732:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR THE PROTECTION OF TREES

References to OPSS 565 shall be deemed to mean
OPSS 801, Construction Specification for
the Protection of Trees

The renumbered specification has been relocated to Division 8 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 801:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR TOPSOIL

References to OPSS 570 shall be deemed to mean
OPSS 802, Construction Specification for
Topsoil

The renumbered specification has been relocated to Division 8 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 802:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR SODDING

References to OPSS 571 shall be deemed to mean
OPSS 803, Construction Specification for
Sodding

The renumbered specification has been relocated to Division 8 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 803:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR SEED AND COVER

References to OPSS 572 shall be deemed to mean
OPSS 804, Construction Specification for
Seed and Cover

The renumbered specification has been relocated to Division 8 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 804:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



CONSTRUCTION SPECIFICATION FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES

References to OPSS 577 shall be deemed to mean
OPSS 805, Construction Specification for
Temporary Erosion and Sediment Control Measures

The renumbered specification has been relocated to Division 8 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 805:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



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**



CONSTRUCTION SPECIFICATION FOR GROUNDING

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609-A	Commentary

609.01 SCOPE

This specification covers the requirements for the installation of electrical grounding equipment and grounding systems.

609.01.01 Specification Significance and Use

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

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

609.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

609.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 501	Compacting
OPSS 603	Installation of Ducts
OPSS 610	Removal of Electrical Equipment and Materials

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous

CSA Standards

C22.2 No. 38-10	Thermoset-Insulated Wires and Cables
C22.2 No. 41-07	Grounding and Bonding Equipment
G40.20/G40.21-04 (R2009)	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles

ASTM International

B 3-01 (2007) Soft or Annealed Copper Wire

Electrical Safety Authority (ESA)

Ontario Electrical Safety Code

Underwriters Laboratories (UL)

UL 467-Sept 2007 Grounding and Bonding Equipment

Others

IEEE 837-2002 Standard for Qualifying Permanent Connections Used in Substation Grounding

609.03 DEFINITIONS

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

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

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

609.05 MATERIALS

609.05.01 Ground Rods

Ground rods shall be solid steel, 19 mm diameter, 3 m long, copper clad for the full length and shall be according to CSA C22.2 No 41.

609.05.02 Ground Plates

Ground plates shall be hot dip galvanized solid steel, 600 x 600 x 10 mm minimum dimensions. Steel shall be according to CAN/CSA G40.20/G40.21, Grade 260W, and shall be galvanized according to CAN/CSA G164.

609.05.03 Bare Ground Wire

Bare ground wire shall be soft drawn stranded copper and shall be according to ASTM B 3.

609.05.04 Insulated Ground Wire

Insulated ground wire shall be stranded copper, insulation colour green and shall be according to CSA C22.2 No. 38, type RWU 90 - cross-link.

609.05.05 Ground Connectors

Moulded connectors shall consist of metallic alloys and fusible powder mixtures held in place by suitable moulds and connected using an exothermic type welding process. Physical requirements of the connection shall be according to CSA C22.2 No. 41.

Mechanical connectors shall be according to CSA C22.2 No. 41 or UL 467.

High pressure irreversible compression connectors shall be:

- a) Made of pure wrought copper extrusion.
- b) Made of the same material as the conductors.
- c) According to CSA 22.2 No. 41, UL 467, and IEEE 837.
- d) Connected according to the manufacturer's recommendations.
- e) Connected using a minimum compressive force of 100 kN and a minimum compressive pressure of 70 MPa.

High pressure irreversible compression connectors shall have crimp verification for the inspection and verification of CSA and UL compliance markings.

609.05.06 Solder

Solder shall be 60/40, tin/lead mix, resin core type.

609.05.07 Sand Bedding

Sand bedding shall consist of sand conforming to the gradation requirements of mortar sand according to OPSS 1004.

609.05.08 Ducts and Fittings

Ducts and fittings shall be CSA approved and as specified in the Contract Documents.

609.07 CONSTRUCTION

609.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

All metallic components shall be connected to system ground.

All compaction shall be according to OPSS 501.

609.07.02 Removals

Removals shall be according to OPSS 610.

609.07.03 Excavation and Backfill

Earth and rock excavation and backfill shall be according to OPSS 603.

609.07.04 Ground Wire in Ducts

Ground wire shall be pulled through ducts using cable lubricant, mechanical aids, and pulling cables or ropes as required. The pulling tension shall be according to the cable manufacturer's specifications.

609.07.05 Ground Wire, Direct Buried

When ground wire crosses over direct buried cables, a minimum depth of 100 mm of sand bedding material shall be placed between the ground wire and the buried cables at the point of crossing.

When ground wire does not share a common trench with ducts or direct buried cable, the ground wire shall be installed at a minimum depth of 600 mm below finished grade.

609.07.06 Ground Wire on Poles or Open Surfaces

Ground wire installed on concrete or metal poles shall be run in rigid duct. Ground wire installed on wooden poles shall be run in protective moulding or in rigid duct. In both cases, the conduit or moulding shall be aligned in straight runs complementing the taper of the pole.

Conduit shall be mechanically fastened to wooden poles using PVC conduit clamps and galvanized lag screws. Moulding shall be mechanically fastened to wooden poles using galvanized steel staples. Stainless steel strapping shall be installed to secure conduit on concrete or metal poles.

When ground wire is to be installed on a concrete surface, the concrete shall be drilled to accommodate expandable metal anchors for nylon cable clamps held in place with stainless steel bolts. For installation on wooden surfaces, galvanized steel staples shall be installed. For installation on metal surfaces, nylon cable clamps and stainless steel screws or bolts, nuts, and washers shall be installed. The ground wire shall be installed in straight, neat lines and shall be supported at maximum intervals of 450 mm.

609.07.07 Ground Wire in Electrical Chambers or Enclosures

Ground wires in electrical chambers and enclosures shall be trained towards the structure walls with bend radii greater than the minimum recommended by the cable manufacturer. Ground wires shall be fastened with mechanical supports when required.

Ground wire in electrical chambers shall be connected to ground lugs attached to the frame. For electrical chambers with metallic covers and non-metallic frames, the ground wire shall be connected to the ground lugs attached to the cover. Ground wire in electrical enclosures shall be connected to the ground lug provided.

609.07.08 Ground Wire Connections

Ground connectors shall be used on all ground wire connections. All surfaces shall be cleaned to bare metal prior to making ground connections.

Moulded connectors or high pressure irreversible compression connectors shall be used at pad mounted electrical-electronic equipment, power supply locations, and all locations where the ground connectors are direct buried or inaccessible.

Messenger cables shall be grounded using compression connectors.

609.07.09 Coils of Ground Wire

Coiled ground wire shall be left at the locations shown in the Contract Documents. Coils shall be neatly taped and left in a safe readily accessible location.

609.07.10 Ground Electrodes

609.07.10.01 General

The installation of ground electrodes shall be according to the Ontario Electrical Safety Code.

The work for ground electrodes shall include the work to install ground rods, ground plates, and the associated work described in this specification.

When bedrock, rock fill, or similar materials unsuitable for driving ground rods are encountered at depths of 450 mm to 2.0 m below finished grade, the ground rod shall be replaced with a ground plate.

When bedrock, rock fill, or similar materials are encountered at less than 450 mm below finished grade, the ground electrode shall be installed at a different location when driving of a ground rod or installation of a ground plate is possible.

609.07.10.02 Ground Rods

Ground rods shall be driven in a vertical position when soil conditions allow. When rocks, stones, or similar materials are encountered, ground rods may be driven at a maximum angle of 45° to the vertical.

609.07.10.03 Ground Plates

Ground plates shall be installed on a minimum 150 mm thick compacted bed of suitable native earth material over rock.

609.07.11 Bonding Jumpers

The work for bonding jumpers shall include the work described for ground wire on poles or open surfaces, and ground wire connections.

609.07.12 Grounding Systems

The work included shall be as described for ground wires, ground electrodes, and bonding jumpers.

609.07.13 Testing Requirements

At pad and pole mounted power supply locations, the resistance to ground of the grounding grid shall be tested and measured. In soils of low conductivity, additional ground rods, ground plates, and ground wires shall be added as required by the Contract Administrator or the Electrical Safety Authority. The Contract Administrator shall be notified 48 hours prior to resistance to ground measurements are taken. These measurements shall be undertaken with the Contract Administrator present under dry soil conditions, and when frost penetration has not exceeded 150 mm. Readings shall not exceed 25 ohms. The test results shall be documented by the Contractor and a copy of the test results shall be given to the Contract Administrator.

609.07.14 Quality Control

609.07.14.01 Pre-Installation Testing and Inspection

Grounding cables, bonding jumpers, ground electrodes, and connection components are to be inspected prior to and during installation to ensure that they meet the requirements of the Contract Documents.

609.07.14.02 Proof of Performance Testing and Inspection

All system and components grounding shall be inspected and tested to ensure that they meet the requirements of the Contract Documents. All electrical grounding connections and splices shall be inspected to ensure they have been properly installed.

At pad and pole mounted power supply locations, the resistance to ground of the grounding grid shall be tested and measured. These measurements shall be undertaken when frost penetration does not exceed 150 mm. Readings shall not exceed 25 ohms. In soils of low conductivity, additional ground rods, ground plates, and ground wires shall be added, as required. Copies of all test documentation shall be submitted to the Contract Administrator.

A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Quality Verification Engineer shall affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:

- a) Work
- b) Material and installations
- c) Inspection, testing, and test results

609.07.15 Temporary Electrical Work

The work for temporary electrical installations shall be the same as for permanent installations of the same type of work, except the work shall include the removal of the installations when they are no longer required.

609.07.16 Restoration

Site restoration shall be according to OPSS 492.

609.07.17 Management of Excess Material

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

609.09 MEASUREMENT FOR PAYMENT

609.09.01 Actual Measurement

609.09.01.01 Ground Wires

Measurement for ground wire shall be by length in metres horizontally along the longitudinal axis of the duct or trench, or open surface, from centre to centre of poles, pole footings, electrical chambers, or enclosures; sign footings; controller cabinet pads, and ground electrodes; or the face of bridge structures, retaining walls, and substation pads.

609.09.01.02 Ground Electrodes

For measurement purposes, a count shall be made of the number of ground electrodes installed.

609.09.01.03 Bonding Jumpers

For measurement purposes, a count shall be made of the number of bonding jumpers installed.

609.09.02 Plan Quantity Measurement

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

609.10 BASIS OF PAYMENT

**609.10.01 Ground Wires - Item
Ground Electrodes - Item
Bonding Jumpers - Item
Grounding Systems - Item**

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

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

**609.10.02 Ground Wires (Temporary) - Item
Ground Electrodes (Temporary) - Item
Bonding Jumpers (Temporary) - Item**

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

Progress payment for temporary installation of the above tender items shall be based on the following percentages of the Contract price:

80% for supply and installation
20% for removal

609.10.03 Rock Excavation for Electrical Installation

Payment for rock excavation for electrical installation shall be according to OPSS 603.

Appendix 609-A, November 2012 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Duct and fitting requirements. (609.05.08)
- Coiled ground wire locations. (609.07.09)

Grounding should be shown symbolically on the contract drawings.

Quantity sheets should include such information as location by station to station or structure to structure, quantities for each location, size of wire, whether bare or insulated wire is used, number of electrodes and bonding jumpers.

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

Related Ontario Provincial Standard Drawings

OPSD 2117.01	Electrical Maintenance Holes, General Installation Requirements
OPSD 2117.02	Electrical Handholes, General Installation Requirements
OPSD 2126.010	Distribution Assembly, Concrete Pad and Ducts, Plan and Section A-A
OPSD 2126.020	Distribution Assembly, Concrete Pad and Ducts, Section B-B
OPSD 2130.01	Supply Control Cabinet Installation, Overhead and Underground Services
OPSD 2240.01	Wood Pole with Elliptical Bracket, Overhead and Underground Circuits
OPSD 2255.010	Pole Wiring Diagram, 120V System
OPSD 2255.020	Pole Wiring Diagram, 120/240V System
OPSD 2255.030	Pole Wiring Diagram, 347/600V System
OPSD 2255.040	Pole Wiring Diagram, Lighting Pole on Bridge Structure
OPSD 2265.01	Grounding for Steel Beam Guide Rail
OPSD 2265.02	Grounding for Box Beam Median Barrier
OPSD 2400.030	Distribution Assembly, Wiring Schematic
OPSD 2440.010	Supply Control Cabinet Assembly Type 1, 120/240V, 100A, 1-Phase, 3-Wire
OPSD 2440.020	Supply Control Cabinet Assembly Type 2, 120/208V, 100A, 3-Phase, 4-Wire
OPSD 2441.000	Supply Control Cabinet Assembly Type 3, 120/240V, 100A, 1-Phase, 3-Wire
OPSD 2453.170	High Mast Lighting Pole, Internal Drive Raising and Lowering Equipment, 374/600V, 3-Phase, Wiring Diagram
OPSD 2453.180	High Mast Lighting Pole, Internal Drive Raising and Lowering Equipment, 120/240V, 1-Phase, Wiring Diagram
OPSD 2453.210	High Mast Lighting Pole, External Drive Raising and Lowering Equipment, 374/600V, 3-Phase, Wiring Diagram
OPSD 2453.220	High Mast Lighting Pole, External Drive Raising and Lowering Equipment, 120/240V, 1-Phase, Wiring Diagram
OPSD 2528.01	Traffic Signal Equipment, Pole Wiring Diagram
OPSD 2532.01	Flasher Beacon and Downlight for Roadway Sign and Wiring Diagram
OPSD 2534.010	Sign Light Assembly for Keep Right Sign and Wiring Diagram

Appendix 609-A

OPSD 2536.010	Flasher Beacons for Roadway Sign and Downlight and Wiring Diagram
OPSD 2540.01	Aerial Traffic Signal Installation
OPSD 2540.02	Aerial Flasher Beacon Installation
OPSD 2547.01	Controller Cabinet Grounding System
OPSD 2550.01	Installation for Aerial Interconnection Cables at Terminal Board
OPSD 2552.01	Traffic Signal System Equipment on Wooden or Concrete Poles, Overhead Wiring Installation
OPSD 2554.010	Traffic Signal System Equipment on Wooden or Concrete Poles, Underground Wiring Installation



NOTICE TO USERS OF OPSS 610

CONSTRUCTION SPECIFICATION FOR REMOVAL OF ELECTRICAL EQUIPMENT AND MATERIALS

OPSS 610 has been removed from this
OPS volume

The provincial version of OPSS 610 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 610

The municipal version of OPSS 610 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 610

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



CONSTRUCTION SPECIFICATION FOR INSTALLATION OF UNDERPASS LUMINAIRES

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611-A	Commentary
611-B	Supplemental Requirements for Using OPSS 611 in Municipal Contracts

611.01 SCOPE

This specification covers the requirements for the installation, replacement, and relamping of underpass luminaires.

611.01.01 Specification Significance and Use

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

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

611.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

611.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 603	Installation of Ducts
OPSS 604	Cable Installation
OPSS 609	Grounding
OPSS 610	Removal of Electrical Equipment and Materials

Ontario Provincial Standard Specifications, Material

OPSS 2434	Underpass Luminaires

CSA Standards

C22.2 No. 49-10	Flexible Cords and Cables
C22.2 No. 248.8-11	Low-Voltage Fuses - Part 8: Class J Fuses
C22.2 No. 65-13	Wire Connectors
C22.2 No. 197-M1983 (R2008)	PVC Insulating Tape
C22.2 No. 227.2.1-04 (R2009)	Liquid-Tight Flexible Nonmetallic Conduit

G40.20-04/G40.21-04 (R2009)	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
W59-03 (R2008)	Welded Steel Construction (Metal Arc Welding)
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles

American National Standards Institute (ANSI)

C78.380-2007 Electric Lamps - High Intensity Discharge Lamps, Method of Designation

Illuminating Engineering Society of North America (IESNA)

LM-63-02	Standard File Format for Electronic Transfer of Photometric Data and Related Information
LM-79-08	Electrical and Photometric Measurements of Solid-State Lighting Products

611.03 DEFINITIONS

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

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

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

611.04 DESIGN AND SUBMISSION REQUIREMENTS

611.04.01 Submission Requirements

A photometric test report shall be submitted for each photometric curve used in the luminaires to be installed under the Contract. The testing and test reports for high intensity discharge (HID) luminaires (e.g., high pressure sodium) shall be according to IESNA LM-63. The testing and test reports for LED luminaires shall be according to IESNA LM-79. The testing and test reports shall be completed by an independent laboratory or a National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory, which is accredited for testing the type of luminaire to be installed under the Contract (i.e., accredited for IESNA LM-63 for HID luminaires or IESNA LM-79 for LED luminaires). Each test report shall be dated and signed. The test reports shall be submitted to the Contract Administrator prior to the commencement of fabrication.

611.05 MATERIALS

611.05.01 Luminaires

Underpass luminaires shall be according to OPSS 2434.

611.05.02 Lamps

Lamps shall be clear or coated as specified in the Contract Documents and shall meet the requirements of ANSI C78.380.

611.05.03 Low-Voltage Cables

Single conductor low-voltage cables for use in conduit systems shall be according to OPSS 604.

Low-voltage cable for entry to luminaires shall be single conductor stranded copper and shall be according to CSA C22.2 No. 49, Type GTF.

611.05.04 Wire Connectors

Wire connectors shall be of the insulated spring or compression type and shall be according to CAN/CSA C22.2 No. 65.

611.05.05 Ground Wire

Ground wire shall be Type GTF.

611.05.06 Fuses

Fuses shall be according to CSA C22.2 No. 248.8, 600V, 10 amps rating.

611.05.07 Ducts and Fittings

Non-metallic flexible liquid-tight ducts and connectors shall be according to CAN/CSA C22.2 No. 227.2.1.

611.05.08 Tape

Electrical insulating tape shall be according to CSA C22.2 No. 197 rated for 600 V and -10 to 90 °C working temperature.

611.05.09 Luminaire Mounting Brackets

Luminaire brackets shall be steel according to CSA G40.20/G40.21, Grade 260W, and shall be hot dip galvanized according to CSA G164.

Welding of members shall be carried out according to CSA W59.

611.05.10 Protective Guard

The luminaires shall be supplied with the luminaire manufacturer's protective guard as specified in the Contract Documents.

611.07 CONSTRUCTION

611.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

The work for the installation, replacement, or relamping of the luminaires shall include all required hardware and fixtures to ensure operation of the unit.

611.07.01.01 Ordering Luminaires

Immediately following the award of the Contract, the Contractor shall order the luminaires as required for this Contract.

The Contractor shall obtain verification of the delivery dates of the luminaires from the supplier and notify the Contract Administrator of the delivery dates within 72 hours after the award of the Contract.

The Contractor shall ensure timely and accurate communication with both the Owner and the supplier regarding the delivery, schedules, and requirements for the luminaires.

Delivery and off-loading of the luminaires shall be completed in a timely and efficient manner.

611.07.02 Removals

Removals shall be according to OPSS 610.

611.07.03 Surface-Mounted Ducts

Non-metallic, flexible, liquid-tight ducts and connectors shall be used for connecting the underpass luminaires to the closest junction boxes as specified in the Contract Documents.

Surface-mounted ducts shall be installed according to OPSS 603.

611.07.04 Luminaire Mounting Brackets

When specified in the Contract Documents, the luminaries shall be installed on mounting brackets.

Luminaire mounting brackets shall be fastened to concrete surfaces by drilling and inserting metal expansion anchors and securing the bracket with 10 mm diameter stainless steel machine bolts and lock washers.

Luminaire mounting brackets shall be fastened to steel structural members as specified in the Contract Documents, using stainless steel hardware.

The luminaire mounting bracket shall be fastened to the surfaces to allow the level installation of the luminaire.

611.07.05 Wiring

Wiring shall be installed according to OPSS 604. Each luminaire shall be individually protected with a fuse. The fuse shall be located either in the junction box or in the luminaire. All connectors shall be insulated and secured with tape.

Each luminaire shall be wired with Type GTF conductors connected to the ballast leads with insulated spring connectors secured with tape. GTF conductors shall be connected to the underpass lighting circuits in the junction box with insulated spring connectors secured with tape.

611.07.06 Grounding

Underpass luminaires shall be connected to the system ground according to OPSS 609.

611.07.07 Installation of Luminaires

Luminaires shall be protected from conditions where moisture or dirt could damage the ballasts or reflecting surfaces of the optical system.

Luminaires shall be mounted on concrete surfaces specified in the Contract Documents by drilling and inserting metal expansion anchors and securing the luminaires with 10 mm diameter stainless steel machine bolts, lock washers, and PVC spacers.

Luminaires shall be mounted on the steel structural members specified in the Contract Documents, using stainless steel hardware.

All underpass luminaires are to be installed level using stainless steel hardware.

The luminaire reflector and refractor shall be thoroughly cleaned prior to installing lamps.

The wire guard and housing hardware shall be securely fastened in place.

611.07.08 Replacing Luminaires

When specified in the Contract Documents, existing luminaires, associated flexible conduit, and wiring shall be removed and new luminaires, associated flexible conduit, fittings, and wiring shall be installed.

When new luminaires are of a different style than the existing luminaires, new concrete anchors or mounting hardware shall be installed.

611.07.09 Relamping

Existing lamps shall be removed, the luminaires thoroughly cleaned, and new lamps installed.

611.07.10 Quality Control

611.07.10.01 Pre-Installation Testing and Inspection

Luminaires, brackets, socket setting, refractor type, and ballast type shall be inspected to ensure they meet the requirements of the Contract Documents.

611.07.10.02 Proof of Performance Testing and Inspection

Luminaires shall be inspected and tested to ensure that they meet the requirements of the Contract Documents. The Contractor shall ensure that all lamps installed in luminaires have undergone a minimum burning-in period of 100 consecutive nighttime hours prior to acceptance of the work by the Contract Administrator. For daytime tunnel illumination systems, the burn-in time is not required to be continuous and shall be achieved during normal daytime hours.

Low-voltage system tests required on the wiring system shall be performed according to OPSS 604.

A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Quality Verification Engineer shall affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:

- a) Work
- b) Material and installations
- c) Inspection, testing, and test results

611.07.11 Temporary Electrical Work

The work for temporary electrical installations shall be the same as for permanent installations of the same type of work, except the work shall include the removal of the installations when they are no longer required.

611.07.12 Management of Excess Material

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

611.09 MEASUREMENT FOR PAYMENT

611.09.01 Actual Measurement

611.09.01.01 Underpass Luminaires

For measurement purposes, a count shall be made of the number of underpass luminaires installed.

611.09.01.02 Replace Underpass Luminaires

For measurement purposes, a count shall be made of the number of underpass luminaires replaced.

611.09.01.03 Relamp Underpass Luminaires

For measurement purposes, a count shall be made of the number of underpass luminaires relamped.

611.09.02 Plan Quantity Measurement

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

611.10 BASIS OF PAYMENT

**611.10.01 Underpass Luminaires - Item
Replace Underpass Luminaires - Item
Relamp Underpass Luminaires - Item**

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

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

611.10.02 Underpass Luminaires, Temporary - Item

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

Progress payments for temporary installation of the above tender item shall be based on the following percentages of the Contract price:

80% for supply and installation
20% for removal

Appendix 611-A, November 2013
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Clear or coated lamps. (611.05.02)
- Junction box locations. (611.07.03)
- Location of luminaire installations. (611.07.07)

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

- Luminaires mounted on brackets. (611.07.04)
- Luminaire replacement. (611.07.08)

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

Related Ontario Provincial Standard Drawings

OPSD 2305.020	Underpass Luminaires, Wall Mounted Installation
OPSD 2310.010	Underpass Luminaire, Ceiling Mounted Installation with Tee Bracket
OPSD 2310.020	Tee Bracket for Ceiling Mounted Underpass Luminaire
OPSD 2310.030	Wedge Mounting Bracket for Underpass Luminaire
OPSD 2310.040	Support Bracket for Column Mounted Underpass Luminaire
OPSD 2315.010.	Underpass Luminaire Wiring Detail

Appendix 611-B, November 2013

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

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

Supplemental Requirements for Using OPSS 611 in Municipal Contracts

OPSS 611 Installation of Underpass Luminaires, is amended as follows:

611.03 Definitions

Section 611.03 is amended by the deletion of the definition for Quality Verification Engineer and replaced by the following:

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



CONSTRUCTION SPECIFICATION FOR INSTALLATION OF POWER SUPPLY EQUIPMENT

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614-A	Commentary

614.01 SCOPE

This specification covers the requirements for the installation of distribution assemblies and supply control cabinet assemblies.

614.01.01 Specification Significance and Use

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

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

614.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

614.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 603	Installation of Ducts
OPSS 604	Installation of Cable
OPSS 609	Grounding
OPSS 616	Footings and Pads for Electrical Equipment

Ontario Provincial Standard Specifications, Material

OPSS 2414	Power Supply Equipment
OPSS 2485	Photoelectric Controllers

Electrical Safety Authority (ESA)

Ontario Electrical Safety Code

614.03 DEFINITIONS

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

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

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

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

Service Box means an approved assembly consisting of an enclosure designed and constructed so that it can be effectually locked or sealed, contain either service fuses and a service switch or a circuit breaker, and allow the switch or circuit breaker to be manually operated.

614.04 DESIGN AND SUBMISSION REQUIREMENTS

614.04.01 Submission Requirements

The following information shall be submitted to the Contract Administrator:

- a) Actual breakdown cost of Utility work, such as hook up, transformation, etc.
- b) Utility company contact person's name, title, address, and telephone and mobile phone numbers.

Working drawings shall be submitted according to OPSS 2414.

614.05 MATERIALS

614.05.01 Distribution Assemblies

Distribution assemblies shall be according to OPSS 2414 and the Contract Documents.

614.05.02 Supply Control Cabinet Assemblies

Supply control cabinet assemblies shall be according to OPSS 2414 and the Contract Documents.

614.05.03 Service Boxes

Non-metallic enclosures for service boxes shall be certified or approved and marked Suitable for Use as Service Equipment.

614.05.04 Photoelectric Controllers

Photoelectric controllers shall be according to OPSS 2485.

614.05.05 Cables and Cable Connectors

Cables and cable connectors shall be according to OPSS 604.

614.05.06 Grounding Materials

Grounding materials shall be according to OPSS 609.

614.05.07 Conduit and Fittings

Rigid ducts and fittings shall be according to OPSS 603.

614.07 CONSTRUCTION

614.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

Concrete pads shall be according to OPSS 616 and as specified in the Contract Documents.

614.07.02 Distribution Assemblies

Equipment enclosures shall be installed squarely and symmetrically on concrete pads.

A neoprene gasket shall be attached squarely and symmetrically on the bottom base H-beam of the enclosure prior to installation. Base H-beam anchor bolts shall be secured in place at locations specified in the Contract Documents.

614.07.03 Supply Control Cabinet Assemblies

Supply control cabinet assemblies shall be mounted securely on poles using stainless steel strapping.

Rigid ducts and fittings shall be installed on wooden poles using two-hole galvanized pipe straps one trade size larger with galvanized lag screws and on metal or concrete poles using stainless steel strapping, at intervals specified in the Ontario Electrical Safety Code. The conduit system shall be installed in straight lengths to follow the taper of the pole. Offset bends, meter hubs, terminal adapters, and fittings shall be used when required to avoid pole attachments and be kept free of kinks or scorch marks.

When specified in the Contract Documents, a meter socket, acceptable to the power supply authority, shall be installed.

614.07.04 Cables and Fuses

Cables, terminations, and connections shall be installed according to OPSS 604. Service cables from the point of service connection to the main disconnecting means shall be installed according to the Ontario Electrical Safety Code and the requirements of the power supply authority.

Only high-voltage fuses that have a current rating approved by the power supply authority shall be installed.

614.07.05 Grounding

All grounding work shall be according to OPSS 609.

All concrete pad mounted equipment shall be bonded by means of bonding jumpers connected between the equipment ground bus and the exterior ground grid. Lightning arrestors shall have the ground cable connected securely to the equipment ground bus. The neutral bus of the main disconnecting means or the secondary neutral terminal of the transformer shall be grounded.

The system ground wire and the service ground wire shall be connected to the neutral bus in supply control cabinet assemblies.

614.07.06 Photoelectric Controllers

614.07.06.01 General

Photo-conductive cell windows shall be set to face in a northerly direction and away from any nearby light sources.

614.07.06.02 Distribution Assemblies

Photoelectric controllers shall be installed according to the Contract Documents.

614.07.06.03 Supply Control Cabinet Assemblies

Photoelectric controllers shall be installed on poles with twist lock mounting sockets and brackets. Brackets shall be mounted on metal or concrete poles with stainless steel strapping or on wooden poles with galvanized lag screws.

614.07.07 Quality Control

614.07.07.01 Pre-Installation Testing and Inspection

Power supply equipment shall be inspected prior to installation to ensure that it meets the requirements of the Contract Documents. A visual inspection of all the power supply equipment shall be performed prior to its delivery. The following components shall be inspected to ensure that they meet the requirements of the Contract Documents:

a) Barriers and raceways	k) Grounding connections
b) Breakers	l) Insulation
c) Cabinet materials	m) Labels
d) Conduits and tubings	n) Lightning arrestors
e) Contactors	o) Panelboards
f) Disconnect switches	p) Photoelectric controllers
g) Doors and latching mechanisms	q) Switches
h) Enclosure materials	r) Transformers
i) Cabinet general appearance	s) Wires and connectors
j) Grounding and bonding materials	

614.07.07.02 Proof of Performance Testing and Inspection

The installed power supply equipment shall be inspected and tested. All components listed under the Pre-Installation Testing and Inspection clause shall be inspected. Low voltage system tests shall be performed on wiring of the equipment according to OPSS 604. Grounding of equipment shall be tested according to OPSS 609.

A Certification of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Quality Verification Engineer shall affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:

- a) Work
- b) Material and installations
- c) Inspection, testing, and test results

614.07.08 As Constructed Drawings

In the event changes to the accepted Working Drawings are necessary, as constructed drawings bearing the stamp and signature of an Engineer shall be submitted to the Contract Administrator.

614.07.09 Temporary Electrical Work

The work for temporary electrical installations shall be the same as for permanent installations of the same type of work, except the work shall include the removal of the installations when they are no longer required.

614.07.10 Management of Excess Material

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

614.09 MEASUREMENT FOR PAYMENT

614.09.01 Actual Measurement

**614.09.01.01 Distribution Assemblies
Supply Control Cabinet Assemblies**

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

614.09.02 Plan Quantity Measurement

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

614.10 BASIS OF PAYMENT

**614.10.01 Distribution Assemblies - Item
Supply Control Cabinet Assemblies - Item**

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

614.10.02**Distribution Assemblies, Temporary - Item
Supply Control Cabinet Assemblies, Temporary - Item**

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

Progress payment for temporary installation of the above tender items shall be based on the following percentages of the Contract price:

80% for supply and installation

20% for removal

Additional payment shall not be made for the electrical energy and service required to do the work.

Appendix 614-A, November 2012
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Distribution assembly material requirements as follows: (614.05.01)

Distribution assembly, pad mounted, ____ kVA
600 V, 3-phase, complete with:
____ amp Main fused disconnect ____ volt
____ amp Main unfused disconnect
____ amp Main lighting breaker
____ amp Main auxiliary system fused disconnect
____ - ____ amp ____ volt Auxiliary system fused disconnect
____ - ____ amp Branch breakers (for lighting panelboard)
____ - ____ amp Branch breakers (for ____ volt panelboard)
____ amp Meter socket (as per local power supply authority standards)
Meter socket catalogue No. _____

Supply control cabinet assembly material requirements as follows: (614.05.02)

Supply control cabinet assembly, type ____, ____ volt
____ amp ____ -phase, complete with:
____ amp Main circuit breaker
____ amp Traffic signal circuit breaker
____ amp Circuit breakers
____ amp Meter socket (as per local power supply authority standards)
Meter socket catalogue No. _____

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

- Meter sockets. (614.07.02)

The designer should coordinate with the power supply authority the payment for electrical energy and service.

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

Related Ontario Provincial Standard Drawings

Power Supply Equipment Drawings:

OPSD 2126.010 to OPSD 2130.01
OPSD 2400.000 to OPSD 2400.030
OPSD 2440.010 to OPSD 2441.020



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**



CONSTRUCTION SPECIFICATION FOR INSTALLATION OF ROADWAY LUMINAIRES

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617.01 SCOPE

This specification covers the requirements for the installation of luminaires and brackets on poles complete with associated wiring and connections.

617.01.01 Specification Significance and Use

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

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

617.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

617.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 604	Installation of Cable
OPSS 609	Grounding
OPSS 610	Removal of Electrical Equipment and Materials

Ontario Provincial Standard Specifications, Material

OPSS 2432	High Pressure Sodium Luminaires for Highway Lighting

CSA Standards

C22.2 No. 9.0-96 (R2011)	General Requirements for Luminaires
C22.2 No. 65-13	Wire Connectors
C22.2 No. 211.2-06 (R2011)	Rigid PVC (Unplasticized) Conduit
C22.2 No. 248.8-11	Low-Voltage Fuses - Part 8: Class J Fuses
C83-96 (R2011)	Communication and Power Line Hardware

American National Standards Institute (ANSI)

C78.380-2007 High-Intensity Discharge Lamps, Method of Designation

Illuminating Engineering Society of North America (IESNA)

LM-63-02 Standard File Format for Electronic Transfer of Photometric Data and Related Information
LM-79-08 Electrical and Photometric Measurements of Solid-State Lighting Products

617.03 DEFINITIONS

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

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

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

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

617.04 DESIGN AND SUBMISSION REQUIREMENTS

617.04.01 Submission Requirements

A photometric test report shall be submitted for each photometric curve used in the luminaires to be installed under the Contract. The testing and test reports for high intensity discharge (HID) luminaires (e.g., high pressure sodium) shall be according to IESNA LM-63. The testing and test reports for LED luminaires shall be according to IESNA LM-79. The testing and test reports shall be completed by an independent laboratory or a National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory, which is accredited for testing the type of luminaire to be installed under the Contract (i.e., accredited for IESNA LM-63 for HID luminaires or IESNA LM-79 for LED luminaires). Each test report shall be dated and signed. The test reports shall be submitted to the Contract Administrator prior to the commencement of fabrication.

617.05 MATERIALS

617.05.01 Luminaires

617.05.01.01 Roadway Lighting Type

Roadway lighting luminaires shall be according to OPSS 2432 and the Contract Documents.

617.05.01.02 High Mast Lighting Type

High mast lighting luminaires shall be according to OPSS 2432 and the Contract Documents.

617.05.01.03 Floodlighting Type

Floodlighting luminaires shall be according to CSA C22.2 No. 9.0 and the Contract Documents.

617.05.02 Lamps

Lamps shall be high pressure sodium according to ANSI C78.380 with ANSI lamp designations shown in Table 1. Lamp wattages shall be permanently marked using a label affixed to the underside of the luminaires as specified in the Contract Documents.

617.05.03 Low-Voltage Cables

Single conductor low-voltage cables shall be according to OPSS 604.

617.05.04 Wire Connectors

Wire connectors shall be of the compression type and shall be according to CAN/CSA C22.2 No. 65.

617.05.05 Insulating Covers

Insulating covers for connectors shall be of the vinyl snap lock type or heat shrink tubing type and rated at 600 V.

617.05.06 Brackets

Brackets shall be as specified in the Contract Documents.

617.05.07 Conduit and Fittings

Conduit and fittings required for wooden pole mounting shall be of the rigid PVC type according to CSA C22.2 No. 211.2.

617.05.08 Hardware

Hardware for wooden pole mounting shall be according to CSA C83.

617.05.09 Grounding Materials

Ground wire and connectors shall be according to OPSS 609.

617.05.10 Fuse Holders and Fuses

Fuse holders shall be of the in-line type suitable for use with #12 AWG conductors, rated 600 V, and shall be complete with protective boots. Fuses shall be according to CSA C22.2 No. 248.8, 600 V with a current rating as specified in the Contract Documents.

617.07 CONSTRUCTION

617.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

617.07.01.01 Ordering Luminaires

Immediately following the award of the Contract, the Contractor shall order the luminaires as required for this Contract.

The Contractor shall obtain verification of the delivery dates of the luminaires from the supplier and notify the Contract Administrator of the delivery dates within 72 hours after the award of the Contract.

The Contractor shall ensure there is timely and accurate communication with both the Owner and the supplier regarding the delivery, schedules, and requirements for the luminaires.

Delivery and off-loading of the luminaires shall be completed in a timely and efficient manner.

617.07.02 Removals

Removals shall be according to OPSS 610.

617.07.03 Lamp Installation

Lamps shall be installed after poles have been erected and the brackets and luminaires mounted and levelled.

617.07.04 Brackets

617.07.04.01 Roadway Lighting Type

Brackets shall be installed at right angles to the centreline of the roadway being served. Bracket clamping assemblies shall be securely tightened. Brackets shall be mounted on wooden poles using 16 mm diameter galvanized steel square head through bolts, nuts, and 50 x 50 mm washers.

617.07.04.02 Floodlighting Type

Bracket assemblies shall be oriented to give the floodlight aiming specified in the Contract Documents. Bracket clamping assemblies shall be securely tightened.

617.07.05 Luminaires

617.07.05.01 General

Luminaires shall be stored in conditions free of moisture, dirt, and other factors that could damage the ballasts or reflecting surfaces of the optical system.

Luminaires shall be mounted on brackets and shall be installed level along both the longitudinal and transverse axis.

Luminaire clamping assemblies shall be securely tightened upon completion of levelling.

Luminaires shall be orientated and aimed using the horizontal and vertical angles specified in the Contract Documents. When instructed by the Contract Administrator, each luminaire or luminaire component shall be readjusted once under nighttime operating conditions.

Glass refractors shall be installed complete with gaskets. Mounting hardware shall be securely tightened. The luminaire reflector and refractor shall be thoroughly cleaned prior to installing lamps. Lamps shall be installed with the installation date marked on the lamp base.

If required, the refractor and the lamp holder shall be reset or replaced according to manufacturer's instructions to give the proper type of light distribution specified in the Contract Documents.

When specified in the Contract Documents, the luminaires shall be equipped with shields. The shields shall be mounted in such a manner so as to prevent loosening, turning, or falling when subject to vibration or wind loading in the installed position and to permit relamping without removing or distorting the alignment of the shields.

The shield shall be installed according to the manufacturer's instructions. The orientation of each shield shall be as specified in the Contract Documents. After the shield is attached to the luminaire-retaining ring, it shall be rotated such that its centre (the deepest point) is aligned with the specified angle. The angle specified is based on geometric rotation with the true north as its reference (0 degrees). Once the shield is aligned to the specified angle, it shall be secured in place by tightening the holding ring.

The luminaire assembly when closed and in the operating position shall not be subject to damage by vibration.

617.07.05.02 High Mast Lighting Type

A maximum of one luminaire shall be installed on each arm of the luminaire ring.

Each luminaire shall be bolted and secured onto its respective luminaire arm.

617.07.06 Wiring and Connections

Riser wires in metal and concrete poles shall be terminated at the luminaire terminal block and installed through the bracket and pole to the pole handhole.

Riser wires on wooden poles shall enter the bracket with a drip loop and shall be installed in conduit when the distance from the bracket to the low voltage bus exceeds 450 mm.

Connections or riser wires to the assigned feeder conductors shall be made with compression connectors insulated with insulating covers.

In-line fuse holders and fuses shall be installed in the pole handhole and placed in an accessible location. For wooden poles, in-line fuse holder and fuses shall be installed at the point of connection.

617.07.07 Grounding

Grounding shall be according to OPSS 609.

For metal or concrete pole mounting, a #12 AWG insulated (green) stranded copper ground wire shall be installed between the luminaire housing ground terminal and the ground stud in the pole handhole.

For wooden pole mounting, a #12 AWG insulated (green) stranded copper ground wire shall be installed between the luminaire housing ground terminal and the system ground.

617.07.08 Replacing Luminaires

Existing luminaires shall be removed and new luminaires shall be installed according to the Contract Documents. Existing riser wires and luminaire ground wire shall be salvaged and connected to the new luminaires.

617.07.09 Relamping

When required, existing lamps shall be removed. The existing luminaires shall be thoroughly cleaned and new lamps shall be installed according to the Contract Documents.

617.07.10 Quality Control

617.07.10.01 Pre-Installation Testing and Inspection

Luminaires, brackets, socket setting, refractor type and ballast type shall be tested and inspected to ensure that they are according to the Contract Documents.

617.07.10.02 Proof of Performance Testing and Inspection

Luminaires shall be tested and inspected to ensure that they are levelled correctly and according to the Contract Documents. All lamps installed in luminaires shall have a minimum burning-in period of 100 nighttime hours prior to acceptance of the work by the Contract Administrator. All luminaire shielding shall be installed prior to the start of the burn-in period.

All tests required on the wiring system shall be according to OPSS 604.

A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Quality Verification Engineer shall affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:

- a) Work
- b) Material and installations
- c) Inspection, testing, and test results

617.07.11 Temporary Electrical Work

The work for temporary electrical installations shall be the same as for permanent installations of the same type of work, except the work shall include the removal of the installations when they are no longer required.

617.07.12 Management of Excess Material

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

617.09 MEASUREMENT FOR PAYMENT

617.09.01 Actual Measurement

617.09.01.01 Roadway Lighting Luminaires and Bracket Assemblies

For measurement purposes, a count shall be made of the number of roadway lighting luminaires and bracket assemblies installed.

617.09.01.02 High Mast Lighting Luminaires

For measurement purposes, a count shall be made of the number of high mast lighting luminaires installed.

617.09.01.03 Floodlighting Luminaires and Bracket Assemblies

For measurement purposes, a count shall be made of the number of floodlighting luminaires and bracket assemblies installed.

617.09.01.04 Replace Roadway Lighting Luminaires

For measurement purposes, a count shall be made of the number of roadway lighting luminaires replaced.

617.09.01.05 Replace High Mast Lighting Luminaires

For measurement purposes, a count shall be made of the number of high mast lighting luminaires replaced.

617.09.01.06 Replace Floodlighting Luminaires

For measurement purposes, a count shall be made of the number of floodlighting luminaires replaced.

617.09.01.07 Relamp Roadway Lighting Luminaires

For measurement purposes, a count shall be made of the number of new lamps installed in existing roadway lighting luminaires.

617.09.01.08 Relamp High Mast Lighting Luminaires

For measurement purposes, a count shall be made of the number of new lamps installed in existing high mast lighting luminaires.

617.09.01.09 Relamp Floodlighting Luminaires

For measurement purposes, a count shall be made of the number of new lamps installed in existing floodlighting luminaires.

617.09.02 Plan Quantity Measurement

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

617.10 BASIS OF PAYMENT

**617.10.01 Roadway Lighting Luminaires and Bracket Assemblies - Item
High Mast Lighting Luminaires - Item
Floodlighting Luminaires and Bracket Assemblies - Item
Replace Roadway Lighting Luminaires - Item
Replace High Mast Lighting Luminaires - Item
Replace Floodlighting Luminaires - Item
Relamp Roadway Lighting Luminaires - Item
Relamp High Mast Lighting Luminaires - Item
Relamp Floodlighting Luminaires - Item**

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

**617.10.02 Roadway Lighting Luminaires and Bracket Assemblies (Temporary) - Item
Floodlighting Luminaires and Bracket Assemblies (Temporary) - Item
High Mast Lighting Luminaires (Temporary) - Item**

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

Progress payments for the above tender items shall be based on the following percentages of the Contract price:

80% for supply and installation
20% for removal

TABLE 1
Lamps for Roadway Lighting

Lamp Type	Lamp Wattage	Lamp Nominal Operating Voltage	Lamp Finish	ANSI Lamp Designation
High Pressure Sodium (HPS)	100	55	Clear	S54-100
	150	55	Clear	S55-150
	200	100	Clear	S66-200
	200	100	Coated	S66/D-22
	250	100	Clear	S50-250
	310	100	Clear	S67-310
	400	100	Clear	S51-400
	600	105	Clear	S106-600
	750	120	Clear	S111-750
	1000	250	Clear	S52-1000

Appendix 617-A, November 2013 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Roadway lighting luminaire requirements. (617.05.01.01)
- High mast lighting luminaire requirements. (617.05.01.02)
- Floodlighting luminaire requirements. (617.05.01.03)
- Bracket type. (617.05.06)
- Fuse current rating. (617.05.10)
- Floodlight bracket orientation. (617.07.04.02)
- Light distribution requirements. (617.07.05.01)
- High mast lighting horizontal and vertical orientation angles. (617.07.05.01)

The designer should determine if the following are required and, if they are, specify them in the Contract Documents:

- Luminaire shields. (617.07.05.01)
- Luminaire shield orientation. (617.07.05.01)

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

Related Ontario Provincial Standard Drawings

OPSD 2418.010	1.8 m and 2.7 m Steel Truss Bracket for Steel Poles
OPSD 2420.01	1.8 m and 2.4 m Aluminum Tapered Elliptical Bracket
OPSD 2421.010	Lamp Wattage Label for Luminaire
OPSD 2453.000	High Mast Lighting Pole, Luminaire and Handhole Orientation
OPSD 2453.060	High Mast Lighting Pole, Flood Light Luminaire Mounting Details
OPSD 2453.070	High Mast Lighting Pole, Luminaire Support Ring
OPSD 2453.090	High Mast Lighting Pole, Luminaire Shroud
OPSD 2453.091	High Mast Lighting Pole, Luminaire Shroud Details

Appendix 617-B, November 2013

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

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

Supplemental Requirements for Using OPSS 617 in Municipal Contracts

OPSS 617 Installation of Roadway Luminaires, is amended as follows:

617.03 Definitions

Section 617.03 is amended by the deletion of the definition for Quality Verification Engineer and replaced by the following:

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



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 630

CONSTRUCTION SPECIFICATION FOR INSTALLATION OF SECTIONAL STEEL HIGH MAST LIGHTING POLES

OPSS 630 has been removed from this
OPS volume

The provincial version of OPSS 630 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 630

The municipal version of OPSS 630 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 630

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



**CONSTRUCTION SPECIFICATION FOR
CONCRETE FOOTINGS AND MAINTENANCE PLATFORMS
FOR HIGH MAST LIGHTING POLES**

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631-A	Commentary

631.01 SCOPE

This specification covers the requirements for the installation of concrete footings and maintenance platforms for high mast lighting poles.

631.01.01 Specification Significance and Use

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

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

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

Appendices are developed for the Owner's use only.

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

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

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

631.02**REFERENCES**

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 501	Compacting
OPSS 603	Installation of Ducts
OPSS 609	Grounding
OPSS 903	Deep Foundations
OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete
OPSS 906	Structural Steel for Bridges

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1202	Bearings - Elastomeric Plain and Steel Laminated
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1801	Corrugated Steel Pipe (CSP) Products
OPSS 2474	Anchorage Assembly - High Mast Lighting Pole

631.03 DEFINITIONS

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

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

Earth means as defined in OPSS 206.

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

631.05 MATERIALS

631.05.01 Concrete

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

631.05.02 Steel Reinforcement

Steel reinforcement shall be according to OPSS 1440.

631.05.03 Structural Steel

Structural steel shall be according to OPSS 906.

631.05.04 Corrugated Steel Pipe

Corrugated steel pipe shall be according to OPSS 1801 and as specified in the Contract Documents.

631.05.05 Neoprene Pad

Neoprene pad shall be according to the plain bearing requirements specified OPSS 1202.

631.05.06 Granular A

Granular A shall be according to OPSS 1010.

631.05.07 Sleeves and Ducts

Sleeves and ducts shall be according to OPSS 603.

631.05.08 Anchorage Assemblies

Anchorage assemblies shall be according to OPSS 2474.

631.07 CONSTRUCTION

631.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

Concrete footings and maintenance platforms for high mast lighting poles shall be as specified in the Contract Documents.

631.07.02 Concrete Footings for High Mast Lighting Poles

631.07.02.01 Earth Excavation

Excavation of the pole base shall be to the neat lines and grades specified in the Contract Documents. When additional excavation beyond the neat limits is required, such excavation shall be a minimum of 300 mm beyond the neat dimensions of the footing to accommodate backfill.

The Contractor is responsible for constructing excavations without disturbing the sides or bases of the excavation.

When rock is encountered, the earth excavation shall be widened to the dimensions suitable for rock excavation or rock drilling operations. Rock excavation shall be according to OPSS 603.

631.07.02.02 Caisson Pile

Caisson piles shall be as specified in the Contract Documents and placed according to OPSS 903.

The base of the caisson or shallow foundation shall be cleaned of loosened or softened materials or both and inspected prior to pouring concrete. Complete documentation of the inspection and installation of each caisson shall be maintained and submitted to the Contract Administrator.

631.07.02.03 Steel Reinforcement

Steel reinforcement shall be placed according to OPSS 905.

631.07.02.04 Anchorage Assemblies

Anchorage assemblies of the size, diameter, length, and type specified in the Contract Documents shall be positioned in footings to obtain the proper position and handhole orientation.

Anchorage assemblies shall be securely tied to the steel reinforcement and provided with supports to maintain the position of the anchorage assembly during the placing of concrete. The anchorage assembly shall not be welded to the steel reinforcement.

The anchorage setting templates shall remain in place until immediately prior to the installation of the poles.

631.07.02.05 Sleeves and Ducts

Sleeves and ducts for footings shall be located to suit incoming duct or cable systems and shall be securely tied to the steel reinforcement and supported prior to the placing of concrete.

The number of sleeves shall be as specified in the Contract Documents.

Sleeves shall be cut off cleanly above the footing to a minimum of 150 mm above the pole base plate.

Sleeves shall be temporarily plugged or sealed until wiring is installed.

631.07.02.06 Concrete

Concrete shall be placed according to OPSS 904, except as noted herein.

In earth, concrete may be placed directly against the undisturbed earth or may be formed in place such that a minimum of 300 mm all around the footing is available for the placing of granular backfill. The upper portion of the footing shall be formed to a minimum of 150 mm below grade level. Formwork shall be removed to a minimum depth of 150 mm below finished grade prior to placing granular backfill.

In rock, concrete shall be placed directly against the excavated rock surfaces. Portions of footings in earth above the top of the rock surface shall be formed as noted in the previous paragraph.

Prior to the installation of the pole, the concrete shall have reached the minimum strength specified in the Contract Documents.

Concrete for the high mast lighting pole footings shall be cured according to OPSS 904, except as noted herein.

- a) Wet burlap shall be applied to the top surface of the footing immediately after completion of the finishing operation without damaging or marring the surface of the concrete and shall be kept wet during the curing period.
- b) When white pigmented membrane is used as a curing compound on adjacent concrete barrier wall, a minimum of one coat of the curing compound shall be applied to the concrete footing immediately after completion of the curing cycle for the footing. Additional curing compound shall be applied as necessary to ensure colour uniformity with the adjacent concrete barrier wall.
- c) The curing compound shall only be used on the exposed final surfaces of the footing. Curing compound shall not be applied to construction joints.

631.07.02.07 Granular Backfill

Granular A backfill shall be placed around footings in earth and compacted according to OPSS 501.

631.07.02.08 Granular Apron

A granular apron consisting of Granular A shall be placed around each high mast lighting pole footing as specified in the Contract Documents.

631.07.02.09 Grading

Earth grading around the high mast lighting pole footings shall be as specified in the Contract Documents and OPSS 206.

631.07.03 Maintenance Platforms for High Mast Lighting Poles

631.07.03.01 Neoprene Pad

The size of the neoprene pad shall be as specified in the Contract Documents.

631.07.03.02 Fabrication, Delivery, and Installation

Fabrication, delivery, and installation of the platform and railing shall be according to OPSS 906 and the Contract Documents.

631.07.03.03 Grounding

Grounding shall be according to OPSS 609.

631.07.03.04 Mechanical Concrete Anchors

Mechanical concrete anchors shall be installed in accordance with the manufacturer's recommendations.

631.07.04 Quality Control

631.07.04.01 Submission of Certificate of Conformance

A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Quality Verification Engineer shall affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:

- a) Work
- b) Material and installations
- c) Inspection, testing, and test results

The Certificate of Conformance shall include that:

- a) The excavation was carried out without causing instability to the base and walls of the excavation.
- b) The base of the caisson or shallow concrete foundation was cleaned of loosened or softened material or both prior to placing concrete.
- c) The anchorage assemblies, sleeves, and ducts were properly placed in the centre of the concrete footings within a 15 mm tolerance.
- d) The placement of concrete was completed according to OPSS 904.

631.07.05 Management of Excess Material

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

631.09 MEASUREMENT FOR PAYMENT

631.09.01 Actual Measurement

631.09.01.01 Concrete Footings for High Mast Lighting Poles

For payment purposes, a count shall be made of the number of concrete footings for high mast lighting poles installed.

631.09.01.02 Maintenance Platform for High Mast Lighting Poles

For payment purposes, a count shall be made of the number of maintenance platforms for high mast lighting poles installed.

631.09.02 Plan Quantity Measurement

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

631.10 BASIS OF PAYMENT

**631.10.01 Concrete Footings for High Mast Lighting Poles - Item
Maintenance Platform for High Mast Lighting Poles - Item**

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

631.10.02 Rock Excavation for Electrical Installation

Payment for rock excavation for electrical installation shall be according to OPSS 603.

Appendix 631-A, November 2015 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Pole base excavation lines and grades. (631.07.02.01)
- Caisson pile requirements. (631.07.02.02)
- Anchorage assembly size, diameter, length, and type. (631.07.02.04)
- Number of sleeves into the pole bases. (631.07.02.05)
- Minimum concrete strength for pole installation. (631.07.02.06)
- Grading around pole footing requirements. (631.07.02.09)
- Maintenance platform requirements. (631.07.03)

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

Related Ontario Provincial Standard Drawings

OPSD 2210.030	High Mast Lighting Pole, Apron
OPSD 2218.010	High Mast Lighting Pole Anchorage Assembly Placement
OPSD 2456.010	High Mast Lighting Pole Anchorage Assembly Details for Double Base Plate
OPSD 2456.011	High Mast Lighting Pole Anchorage Assembly Details



CONSTRUCTION SPECIFICATION FOR WATERMAIN INSTALLATION IN OPEN CUT

References to OPSS 701 shall be deemed to mean
OPSS 441, Construction Specification for
Watermain Installation in Open Cut

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 441:

- The technical content **has not** changed.
- Only the specification designation, publication date, and references to other renumbered specifications have been changed.



**CONSTRUCTION SPECIFICATION FOR
CATHODIC PROTECTION OF NEW AND
EXISTING WATERMAINS**

References to OPSS 702 shall be deemed to mean
OPSS 442, Construction Specification for
Corrosion Protection of New and
Existing Watermains

The renumbered specification has been relocated to Division 4 of this OPS Volume.

OPS Users Please Note

For the relocated specification OPSS 442:

- The specification was reviewed by an OPS specialty committee, and some of the technical content has changed.
- The specification designation, publication date, and references to other renumbered specifications have been changed.



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

There is no PROV version.

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



CONSTRUCTION SPECIFICATION FOR POST MOUNTED DELINEATORS

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APPENDICES

704-A	Commentary

704.01 SCOPE

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

704.01.01 Specification Significance and Use

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

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

704.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

704.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Material

OPSS 2001 Signs

Ontario Ministry of Transportation Publications

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

ASTM International

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

704.05 MATERIALS

704.05.01 Delineator Posts

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

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

704.05.02 Hardware

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

704.05.03 Delineators

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

704.07 CONSTRUCTION

704.07.01 General

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

704.07.02 Delineators

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

704.07.03 Management of Excess Material

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

704.09 MEASUREMENT FOR PAYMENT

704.09.01 Actual Measurement

704.09.01.01 Post Mounted Delineators

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

704.09.02 Plan Quantity Measurement

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

704.10**BASIS OF PAYMENT****704.10.01****Post Mounted Delineators - Item**

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

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

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

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Post mounted delineator locations and spacing. (704.07.01)
- Type A or Type B post mounted delineators. (704.07.02)

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

Related Ontario Provincial Standard Drawings

OPSD 984.101 Post Mounted Delineator, Installation



CONSTRUCTION SPECIFICATION FOR FLEXIBLE DELINEATOR POSTS

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705.07	CONSTRUCTION
705.08	QUALITY ASSURANCE - Not Used
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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.



NOTICE TO USERS OF OPSS 706

CONSTRUCTION SPECIFICATION FOR TEMPORARY TRAFFIC CONTROL DEVICES

OPSS 706 has been removed from this
OPS volume

The provincial version of OPSS 706 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 706

The municipal version of OPSS 706 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 706

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



CONSTRUCTION SPECIFICATION FOR MODIFIED OVERHEAD SIGNBOARDS

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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.



CONSTRUCTION SPECIFICATION FOR PAVEMENT MARKING

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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.

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.

710.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Material

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

Ontario Ministry of Transportation Publications

Manual of Uniform Traffic Control Devices for Ontario, MUTCD

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Temporary Raised Pavement Markers: refer to raised reflective devices.

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

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

710.04 DESIGN AND SUBMISSION REQUIREMENTS

710.04.01 General

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

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

710.05 MATERIALS

710.05.01 Classification

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

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

710.05.02 Organic Solvent Based Traffic

Organic solvent based traffic paint shall conform to OPSS 1712.

710.05.03 Thermoplastic Pavement Marking Materials

Thermoplastic pavement marking materials shall conform to OPSS 1713.

710.05.04 Field Reacted Polymeric Pavement Marking Materials

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

710.05.05 Preformed Plastic Pavement Marking Tape

Preformed plastic pavement marking tape shall conform to OPSS 1715.

710.05.06 Water-Borne Traffic Paint

Water-borne traffic paint shall conform to OPSS 1716.

710.05.07 Special Considerations

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

710.06 EQUIPMENT

710.06.01 General

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

710.06.02 Spray Equipment

710.06.02.01 General

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

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

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

710.06.02.02 Thermoplastic Pavement Markings

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

710.06.03 Other Methods of Application

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

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

710.07 CONSTRUCTION

710.07.01 General

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

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

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

Where the pavement marking scheme is not shown in the contract drawings, it shall conform to the MUTCD or be provided by the Authority.

710.07.02 Surface Preparation

The pavement surface must be clean and dry. Contaminants such as dirt, loose asphalt particles and oily residue shall be removed prior to application of pavement marking.

710.07.03 Pavement Marking Obliterating

Durable markings and traffic paint shall be obliterated or removed using the method indicated in the contract at the location(s) specified.

710.07.04 Premarking

The Contractor shall provide the necessary measurements required to establish the position of all pavement markings.

710.07.05 Temporary Pavement Marking

Temporary markings shall include surface preparation, premarking and placement of temporary markings.

Temporary pavement marking shall be placed on temporary road surfaces prior to the opening to the general public, conforming to MUTCD or as specified in the contract.

710.07.06 Short Term Pavement Marking

Short term pavement marking is required when a paved roadway is to be opened to the general public prior to the application of permanent pavement markings.

As part of the work of pavement marking, the Contractor shall apply short term pavement markings for the centreline and lane lines.

Short term pavement markings shall be applied conforming to MUTCD and as amended by Table 1.

Short term pavement markings shall not conflict with permanent pavement markings.

Short term pavement markings placed on final surface course shall be of the removable type.

A temporary raised pavement marker may be used in place of one 0.3 m line.

710.07.07 Permanent Pavement Marking

Permanent pavement marking includes surface preparation, premarking, short term pavement marking, removal of short term pavement markings and placement of permanent pavement markings.

When permanent pavement markings cannot be placed prior to the opening to traffic, Freeways, Major and Minor Roadways must have short term pavement markings conforming to Division C of the MUTCD and as amended by Table 1.

Permanent pavement markings must be in place and maintained prior to any winter shut down.

TABLE 1
Short Term Pavement Markings

TYPE OF MARKING NOTE 1	TYPE OF ROADWAY	LENGTH OF LINES MIN.	LENGTH OF GAPS MAX.	LENGTH OF TIME BEFORE PERMANENT MARKINGS ARE PLACED MAX.
A	Freeway - six Lanes or Greater, Three Lanes per Direction	3 m Note 2	9 m Note 2	15 Working Days
B	Freeway - Four Lanes, Two Lanes per Direction	0.3 m	15 m	15 Working Days
C	Major Roadways- Six Lanes or Greater, Three Lanes per Direction	3 m Note 2	6 m Note 2	15 Working Days
D	Major Roadways - Four Lanes, or Less	0.3 m	15 m	15 Working Days
E	Minor Roadways	0.3 m	15 m	20 Working Days

Notes: 1. Type of marking as specified elsewhere in the contract.
2. Same as MUTCD.

710.07.08 Selection of Materials

When the item Pavement Marking, or Pavement Marking Symbols, is called for, the Contractor is restricted to traffic paint.

When the item Pavement Marking, Durable or Pavement Marking Symbols, Durable is called for, the Contractor's choice of material is restricted to:

- durable preformed plastic tape
- field reacted polymeric pavement marking material
- thermoplastic pavement marking material

When the item Pavement Marking, Temporary, or Pavement Marking Symbols, Temporary, is called for the Contractor may choose from all marking materials.

When the item Pavement Marking, Temporary Removable, or Pavement Marking Symbols, Temporary - Removable is called for, the Contractor's choice of material is restricted to temporary preformed, removable pavement marking tape.

Selection of pavement marking material for use on a particular type of pavement surface shall conform to the manufacturer's recommendations.

710.07.09 Application

710.07.09.01 General

All pavement markings shall be accurately spaced and present a clean-cut, uniform appearance during either the day or night.

The application of pavement marking materials shall conform to the following requirements and the manufacturer's recommendations.

710.07.09.02 Organic Solvent Based Traffic Paint

Paint shall be applied when the pavement surface temperature is 5°C and above, unless otherwise approved in writing by the Authority.

Paint shall be applied at a rate which results in a uniform thickness of 230 ± 25 microns dry film. Reflectorizing glass beads, conforming to OPSS 1750, shall be applied uniformly at a rate as shown below, immediately after paint application, to ensure embedment of the glass beads.

Overlay glass beads shall not be applied on to black paint which is used for obliterating previous markings.

Rate of Application for Overlay Glass Beads per litre of Traffic Paint	
% Volume Solids of Traffic Paint	Glass Beads Required in kg
40-56	0.7
57-70	0.8

The paint temperature shall be between 40°C and 70°C when applied to the pavement.

710.07.09.03 Water-Borne Traffic Paint

Paint shall be applied as specified in clause 710.07.09.02 except that the pavement surface temperature shall be 10°C and above.

710.07.09.04 Thermoplastic Pavement Marking Material

The material shall be applied when the pavement surface temperature is 5°C and above. The maximum relative humidity shall be 70%. At pavement surface temperatures below 5°C, the pavement shall be preheated immediately prior to material application.

Thermoplastics shall be applied at a rate which results in a uniform thickness of $1.90 \text{ mm} \pm 0.40 \text{ mm}$, measured dry. Markings shall not be applied over pavement joints.

Reflectorizing glass beads conforming to OPSS 1750 with the exception of the requirements for silicone coating shall be applied uniformly at a rate of $1.5 \text{ kg} \pm 0.10 \text{ kg}$ per 10 m^2 of marking immediately after marking material applications and before the material hardens.

710.07.09.05 Field Reacted Polymeric Pavement Marking Materials

Field reacted polymeric pavement marking materials which are recommended for screed application shall be applied at a rate which results in a uniform thickness of $1.90 \text{ mm} \pm .40 \text{ mm}$, measured dry. Markings shall not be applied over pavement joints.

The materials shall be applied when the pavement surface temperature is 5°C and above. The maximum surface temperature shall be 35°C. The maximum relative humidity shall be 70%.

Reflectorizing glass beads conforming to OPSS 1750 with the exception of the requirement for silicone coating, shall be applied uniformly at a rate of $1.5 \text{ kg} \pm 0.10 \text{ kg}$ per 10 m^2 of marking, immediately before the material hardens.

Field reacted polymeric pavement marking materials recommended for spray application shall be applied at a uniform thickness of $.30 \text{ mm} \pm .15 \text{ mm}$, unless otherwise approved in writing by the Authority.

710.07.09.06 Preformed Plastic Tape

The tape shall be applied when the pavement surface temperature is 21°C and above. The maximum relative humidity shall be 70%.

Joints of marking tape shall be butt joints without overlaps. Preformed markings shall not be applied over pavement joints.

710.07.09.07 Pavement Marking, Temporary Removable

Temporary removable pavement markings shall be applied conforming to the manufacturer's recommendation and shall be removed as indicated. Removed material shall be disposed of outside the right-of-way.

710.07.09.08 Raised Pavement Markers, Temporary

The Contractor shall supply and install temporary raised pavement markers conforming to the Authority's requirements and the manufacturer's recommendations. Markers used shall be capable of remaining in place for a period of one to six months as specified in the contract. Temporary raised pavement markers shall be removed as specified in the contract. Removed material shall be disposed of outside the right-of-way.

710.08 QUALITY ASSURANCE

710.08.01 General

Random sampling may be carried out by the Authority during material application to assess line quality.

710.08.02 Line Quality

Line width, thickness, the nature of the edges and uniformity in appearance will be assessed by the Authority. The dry film thickness will be measured by a paint inspection gauge or a coating thickness gauge.

Glass bead distribution will be inspected for evenness in distribution, degree of embedment and retroreflectance.

710.08.03 Measurement of Temperature and Humidity

The testing of ambient and surface temperature will be by thermometer, and surface thermometer, respectively. Humidity will be measured using recording hygrometer.

710.09 MEASUREMENT FOR PAYMENT

710.09.01 Actual Measurement

710.09.01.01 Pavement Marking Pavement Marking, Durable Pavement Marking, Temporary Pavement Marking, Temporary - Removable Pavement Marking Obliterating

Measurement for pavement marking is by the horizontal length in metres of 10 cm wide line excluding gaps. Wider lines are measured in 10 cm equivalents.

Each symbol to be obliterated will be approximately equated in area to a 10 cm wide line.

710.09.01.02 Pavement Marking Symbols
Pavement Marking Symbols, Durable
Pavement Marking Symbols, Temporary
Pavement Marking Symbols, Temporary - Removable
Raised Pavement Markers, Temporary

The unit of measurement is each.

710.09.02 Plan Quantity Measurement

710.09.02.01 Pavement Marking
Pavement Marking, Durable
Pavement Marking, Temporary
Pavement Marking, Temporary - Removable
Pavement Marking Obliterating

Measurement for Pavement Markings is by Plan Quantity, as may be revised by Adjusted Plan Quantity, of the horizontal length in metres of 10 cm wide line, excluding gaps. Wider lines are measured in 10 cm equivalents.

Each symbol to be obliterated will be approximately equated in area to a 10 cm wide line.

710.09.02.02 Pavement Marking Symbols
Pavement Marking Symbols, Durable
Pavement Marking Symbols, Temporary
Pavement Marking Symbols, Temporary - Removable
Raised Pavement Markers, Temporary

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity. The unit is each.

710.10 BASIS OF PAYMENT

710.10.01 Pavement Marking - Item
Pavement Marking Symbols - Item
Pavement Marking, Durable - Item
Pavement Marking Symbols, Durable - Item
Pavement Marking, Temporary - Item
Pavement Marking Symbols, Temporary - Item
Pavement Marking, Temporary Removable - Item
Pavement Marking Symbols, Temporary - Removable - Item
Raised Pavement Markers, Temporary - Item
Pavement Marking Obliterating - Item

Payment at the contract price for the above item(s) shall be full compensation for all labour, equipment and material required to do the work.

Appendix 710-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Method and locations of markings and paint obliteration and removal. (710.07.03)
- Temporary pavement marking requirements. (710.07.05)
- Type of markings. (710.07.07)

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

Related Ontario Provincial Standard Drawings

No information provided here.



NOTICE TO USERS OF OPSS 721

CONSTRUCTION SPECIFICATION FOR STEEL BEAM GUIDE RAIL AND CABLE GUIDE RAIL

OPSS 721 has been removed from this
OPS volume

The provincial version of OPSS 721 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 721

The municipal version of OPSS 721 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 721

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



NOTICE TO USERS OF OPSS 723

CONSTRUCTION SPECIFICATION FOR ENERGY ATTENUATORS

OPSS 723 has been removed from this
OPS volume

The provincial version of OPSS 723 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 723

The municipal version of OPSS 723 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 723

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



NOTICE TO USERS OF OPSS 732

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

OPSS 732 has been removed from this
OPS volume

The provincial version of OPSS 732 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 732

The municipal version of OPSS 732 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 732

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



CONSTRUCTION SPECIFICATION FOR CONCRETE BARRIERS

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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 as addressed in (b), shall not exceed 150 mm in diameter in either vertical or longitudinal directions.
- d. Individual areas of surface damage including concrete spalls shall not measure more than 150 mm in any direction and shall not exceed a 25 mm depth. (Max. 150 x 150 x 25 mm). The accumulated total surface damage on the traffic side of the unit shall not exceed 10% of the total surface area of the respective side.
- e. Other than as addressed by (d) there shall be no exposed coarse aggregate, such as honeycombing. The top and bottom surface of the precast unit are excluded from this condition.
- f. Cracks shall not extend through the precast unit.

740.09 MEASUREMENT FOR PAYMENT

740.09.01 Actual Measurement

**740.09.01.01 Concrete Barrier
Tall Wall Barrier
Asymmetric Concrete Barrier
Asymmetric Tall Wall Barrier**

Measurement will be made in metres along the centreline of the barrier, from end to end of installation, and shall include the length required for lighting pole footings and over-head sign structure footings.

Where two concrete barriers are constructed back to back, Type B or E1, they will be treated as a single installation and the length will be measured only once for payment purposes.

740.09.01.02 Granular

Measurement will conform to OPSS 314.

740.09.01.03 Asphaltic Concrete

Measurement will conform to OPSS 310.

740.09.01.04 Temporary Concrete Barrier

Measurement will be made along the centreline of the barrier in metres from end to end of the installation, including temporary end sections for the supply, installation and removal of the maximum length of barrier required to be in place at any one time during the life of the contract.

740.09.01.05 Temporary Concrete Barrier, Relocation

Measurement will be made along the centreline of the barrier, in metres from end to end including end sections for each relocation.

Barrier that is temporarily surplus for intermediate stages, but will be required for later stages, will be paid as one relocation for the combined moves into and out of on site storage, including any off site storage required due to space restrictions.

740.09.02 Plan Quantity Measurement

**740.09.02.01 Concrete Barrier
Tall Wall Barrier
Asymmetric Concrete Barrier
Asymmetric Tall Wall Barrier**

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity of the length in metres along the centreline of the barrier, from end to end of the installation, and shall include the length for lighting pole footings and overhead sign structure footings. Where two concrete barriers are constructed back to back, Type B or E1, they will be treated as a single installation for measurement and payment purposes.

740.09.02.02 Temporary Concrete Barrier

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity, of the length in metres along the centreline of the barrier from end to end of the installation, for the supply, installation and removal of the maximum length of barrier required to be in place at any one time during the life of the contract.

740.09.02.03 Temporary Concrete Barrier, Relocation

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity, of the length in metres along the centreline of the barrier from end to end of the installation for each relocation.

Barrier that is temporarily surplus for intermediate stages, but will be required for later stages, will be paid as one relocation for the combined moves into and out of on site storage, including any off site storage required due to space restrictions.

740.10 BASIS OF PAYMENT

**740.10.01 Concrete Barrier -Item
Tall Wall Barrier - Item
Asymmetric Concrete Barrier - Item
Asymmetric Tall Wall Barrier - Item**

Payment at the contract price for the above item(s) shall be full compensation for all labour, equipment and material required to construct the barriers, including any concrete backfill between Type B or E1 concrete barriers at the location of bridge piers or transitions.

When the Contractor installs precast units as a permanent concrete barrier, the contract price shall include full compensation for placing the concrete pad.

740.10.02 Granular

Granular material used as backfill between concrete barriers shall be paid for at the contract price for the appropriate granular items.

740.10.03 Asphaltic Concrete

Asphaltic concrete laid as a foundation or used as asphalt surface at bridge piers shall be paid for at the contract price for the appropriate hot mix item.

**740.10.04 Temporary Concrete Barrier - Item
Temporary Concrete Barrier, Relocation - Item**

Payment at the contract price for the above item(s) shall be full compensation for all labour, equipment and material required to do the work.

Appendix 740-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Horizontal alignment. (740.07.01.02)

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

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR TEMPORARY CONCRETE BARRIERS

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741-A	Commentary

741.01 SCOPE

This specification covers the requirements for the construction of temporary concrete barriers.

This specification also covers the requirements for installation of restraint systems for temporary concrete barrier, Type M connection only, by the following three methods: pinning to asphalt pavement, strapping to concrete, or bolting through concrete.

741.01.01 Specification Significance and Use

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

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

741.01.02 Appendices Significance and Use

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

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 W59-13	Rolled or Welded Structural Quality Steel/Structural Quality Steel Welded Steel Construction (Metal Arc Welding)

ASTM International

A 123/A 123M-13 D 4956-13	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products Retroreflective Sheeting for Traffic Control

741.05 MATERIALS

741.05.01 Concrete

Concrete shall be according to OPSS 1350, except that the restrictions on volume batching shall not apply. The Contractor shall assume the responsibility for the mix design. The following specific requirements shall apply:

- a) Class of concrete: Nominal minimum 28-Day compressive strength of 35 MPa
- b) Coarse aggregate: 19.0 mm nominal maximum size

741.05.02 Reinforcing Steel Bars

Reinforcing steel bars shall be according to OPSS 1440 and the Contract Documents.

741.05.03 Connection Assembly Components

Connection assembly components including steel shapes and hollow sections for the I-Lock connection shall be Grade 350W according to CSA G40.20/G40.21 and the Contract Documents. Connection assembly components for other non-proprietary temporary concrete barrier systems shall be according to the Contract Documents.

Connection assembly components for proprietary temporary concrete barrier systems shall be according to manufacturer's specifications and the Contract Documents.

741.05.04 Restraint Systems, Type M Connection Only

All materials required for the restraint systems shall be according to the Contract Documents.

741.05.05 Thrie Beam Guide Rails, Bolts, and Nuts

Thrie beam guide rails shall be fabricated according to OPSS 1504 and the Contract Documents. Bolts and nuts shall be according to OPSS 1504.

741.05.06 Steel Plates, Bolts, and Nuts

Steel plates shall be fabricated according to CSA G40.20/G40.21 and the Contract Documents. Steel plates shall have minimum yield strength of 345 MPa. All steel plates shall be hot dip galvanized after fabrication according to ASTM A 123. Bolts and nuts shall be according to OPSS 1504.

741.05.07 Wooden Block

Wooden blocks shall be according to OPSS 1601.

741.05.08 Delineators

Delineators shall be two-sided and each side shall have a minimum reflective surface of 100 x 100 mm; high intensity retroreflective sheeting according to ASTM D 4956, Type VIII; orange colour; and flexibility to bend 90° from vertical and self restore.

741.05.09 Marking

All temporary concrete barrier units manufactured before March 1, 2008 shall be permanently and legibly marked by the manufacturer on the top or sides of each temporary concrete barrier as follows:

- a) Name or trademark of the manufacturer.
- b) Identification of plant if manufacturer has more than one plant.
- c) The date of manufacture identifying at minimum the year of manufacture with two digits.
- d) Markings shall be stencilled in indelible ink, stencilled in paint, or embossed.

All temporary concrete barrier units manufactured on or after March 1, 2008 shall be permanently and legibly marked by the manufacturer on each temporary concrete barrier as follows:

- a) Name or trademark of manufacturer on file with Owner including identification of plant if manufacturer has more than one plant and year of manufacture embossed on top of each temporary concrete barrier at one end.
- b) Owner approved three digit code of manufacturer and plant identification, and six digit code for date of manufacture (Year Month Day, example January 15, 2008 is 080115) stencilled in minimum 50 mm high digits with indelible ink or paint on top of each temporary concrete barrier at opposite end of embossed markings.
- c) Duplicate three digit code of manufacturer and plant identification, and six digit code for date of manufacture, stencilled in minimum 50 mm high digits with indelible ink or paint on the vertical face of one end elevation of each temporary concrete barrier.
- d) Markings are not permitted on traffic faces of temporary concrete barrier.

741.07 CONSTRUCTION

741.07.01 Temporary Concrete Barrier

Temporary concrete barrier shall be installed at locations specified in the Contract Documents.

Construction of temporary concrete barrier shall be by use of precast concrete barrier units.

Temporary concrete barrier shall be installed with connections properly engaged.

It is acceptable to transition from one type of temporary concrete barrier to another type of temporary concrete barrier using the temporary concrete barrier transition detail according to the Contract Documents. The proportion of each type of approved temporary concrete barrier used for the Work shall be at the Contractor's discretion. However, a minimum continuous length of 100 m of any one type of temporary concrete barrier is required prior to transitioning to another type.

741.07.01.01 Restrictions on Use of Connections

Contractors shall use temporary concrete barriers with one of the following types of connections:

- a) Type J
- b) Type M
- c) Type T

Contractors shall be permitted to use temporary concrete barriers with I-Lock connections on roadways with posted speeds less than 70 km/h.

At locations where restrained temporary concrete barriers are specified in the Contract Documents, temporary concrete barriers with Type M connections shall be used.

741.07.01.02 Foundation Preparation

Temporary concrete barrier shall be installed on a solid foundation having a slope of up to 6% maximum measured perpendicular to the installation. Two Days shall be allowed between the placement of final asphalt surface and placement of temporary concrete barrier. Temporary concrete barrier shall be in place prior to the opening of traffic operations.

Drainage shall be maintained under the temporary concrete barrier.

741.07.01.03 Tolerances

The horizontal and vertical alignment at the junction of each barrier section shall be within 15 mm. The minimum radius on which the barrier may be placed shall be as specified for each type of connection.

741.07.01.04 Construction Markers

Construction markers shall be placed in advance of the temporary precast concrete barrier installation to assist in directing the traffic away from the flared approach end treatment. Taper length for full lane closures and the maximum distance between markers shall be according to OTM Book 7.

741.07.01.05 Quality Control

The Contractor is responsible to supply and install the temporary precast units and certify that they meet the acceptance criteria listed under the Acceptance Criteria for Temporary Precast Concrete Barrier clause. The Contractor shall do an initial inspection of the units prior to installation and a further inspection of the units after each installation. When the installed or relocated units do not meet the acceptance criteria, the Contractor shall remove such units and replace them with units that meet the acceptance criteria. Each installation and relocation of units shall be certified by submitting to the Contract Administrator a completed MTO Form PH-CC-876 Certification of Temporary Precast Concrete Barrier Installations within 24 hours of installation or relocation of the units. Certification shall be done by an authorized representative of the Contractor.

While in-service on the Contract and when units have been damaged or alignment discontinuity is beyond that allowable by the acceptance criteria, the affected units shall be reinstalled or replaced as necessary. The Contractor shall perform the repair within a 48 hour period, starting at the occurrence or first awareness.

Repaired precast concrete barrier units may be used provided that the structural integrity of the unit is maintained. An Engineer's seal and signature shall be affixed to documentation certifying that the repair method used shall not impact the structural integrity of the unit.

741.07.01.05.01 Acceptance Criteria for Temporary Precast Concrete Barrier

For all applications, any unit that fails one or more of the following acceptance criteria shall be rejected:

- a) Dimensions of each unit shall not deviate from those specified by more than the following tolerance:
 - i. Specified dimensions up to 300 mm $\pm$ 5 mm
 - ii. Specified dimensions greater than 300 mm $\pm$ 10 mm
- b) Steel elements of each connecting device shall be free of visible fracture, distortion, and perforation.
- c) Concrete within 200 mm of a connecting device shall be free of visible cracks that exceed 0.3 mm in width, measured at the widest point of the crack.
- d) All cracks wider than 0.3 mm, other than addressed in c), shall neither extend through the precast unit nor be longer than 300 mm.
- e) The unit shall be free of honeycombing.
- f) The end of any unit shall not be located further than 50 mm from the horizontal alignment of the installation.

In addition to the above criteria, when the precast units are used on facilities with a posted regulatory speed limit of 80 km/h or higher, any unit that fails one or more of the following acceptance criteria shall be rejected:

- a) Damage to edges shall not extend more than 100 mm onto any adjacent face. When edge damage extends more than 50 mm onto such a face, damage to the opposite side of that edge shall not extend more than 50 mm onto the opposite face.
- b) The total length of concrete breakout damage to edges flanking the connecting devices, whether repaired or not, shall not exceed 25% of the respective connecting device length on each side of each connecting device.
- c) The concrete damage in the area of the drainage recess shall not reach higher than one third of the lower sloped surface containing the recess.
- d) Concrete breakouts on the traffic faces or on the top of the precast unit other than addressed in a) to c) above shall not be greater than 150 mm in any direction measured on the surface, nor shall the breakout depth at any point exceed 25 mm measured perpendicularly to the face.
- e) Accumulated total concrete breakouts addressed in d) on the traffic sides of the unit shall not exceed 10% of the total surface area of the respective side.
- f) Drilled holes into the barrier shall not have diameter greater than 40 mm.
- g) The horizontal and vertical alignment discontinuity between adjacent units shall not exceed 20 mm, as measured with a 1 m straightedge.

741.07.02 Drainage Gaps for Temporary Concrete Barrier

Gaps for drainage shall be installed according to the Contract Documents and at locations specified in the Contract Documents.

741.07.03 Temporary Concrete Barrier Restraint Systems, Type M Connection Only

741.07.03.01 General

Type M temporary concrete barrier used for temporary concrete barrier restraint systems shall have been manufactured after October 2011, as verified by the markings.

Restraint systems shall be installed at locations specified in the Contract Documents.

Mechanical and adhesive anchoring systems shall be installed according to the manufacturer's specifications to the minimum embedment depth specified in the Contract Documents.

All welds shall be according to CSA W59.

741.07.03.02 Restoration of Asphalt and Concrete Surfaces

Restoration of asphalt and concrete disturbed during the installation and removal of restrained temporary concrete barrier shall be as specified in the Contract Documents.

741.07.03.03 Transitions

Transitions between restrained temporary concrete barrier and unrestrained temporary concrete barrier shall be as specified in the Contract Documents.

Transitions between unrestrained temporary concrete barrier and permanent concrete barrier shall be as specified in the Contract Documents.

741.07.04 Delineators

Delineators according to OTM Book 11 shall be installed at 4 m intervals.

Delineators shall be securely fastened to the top of the temporary concrete barrier with reflective surfaces clearly visible.

Delineators shall be maintained at all times.

741.07.05 Management of Excess Material

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

741.08 QUALITY ASSURANCE

741.08.01 General

The Owner may conduct random Quality Assurance checks on units that have been supplied and installed or relocated to verify the Contractor's ability to ensure compliance with the acceptance criteria. Units that are identified by the Owner's representative as not meeting the acceptance criteria or those units that have been repaired and do not have documentation certifying the method of repair must be removed and replaced with units that meet the acceptance criteria for temporary precast concrete barrier. This shall be done within a 48 hour period of notice to the Contractor, unless agreed otherwise in writing.

741.09 MEASUREMENT FOR PAYMENT

741.09.01 Actual Measurement

741.09.01.01 Temporary Concrete Barrier

Measurement of barriers shall be by length in metres along the centreline of the barrier, from end to end, including temporary end sections installed and removed, up to the maximum length of barriers required to be placed at any one time during the Contract.

741.09.01.02 Temporary Concrete Barrier, Relocation

Measurement of barriers shall be by length in metres along the centreline of the barrier, from end to end, including temporary end sections relocated.

Barriers that are temporarily surplus, but are required for future stages shall be paid for as one relocation for the combined moves into and out of storage, including any off-site storage required due to on-site restrictions.

741.09.01.03 Temporary Concrete Barrier, Drainage Gap

For measurement purposes, a count shall be made of the number of temporary concrete barrier drainage gaps delivered and accepted.

741.09.01.04 Temporary Concrete Barrier Restraint System, Pinned Temporary Concrete Barrier Restraint System, Strapped Temporary Concrete Barrier Restraint System, Bolted

Measurement of barrier restraint systems shall be by length in metres along the centreline of the barrier restraint system, from end to end, installed and removed. Transitions shall be included with the appropriate restraint system.

741.09.02 Plan Quantity Measurement

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

741.10

BASIS OF PAYMENT

741.10.01

Temporary Concrete Barrier - Item
Temporary Concrete Barrier, Relocation - Item
Temporary Concrete Barrier, Drainage Gap - Item
Temporary Concrete Barrier Restraint System, Pinned - Item
Temporary Concrete Barrier Restraint System, Strapped - Item
Temporary Concrete Barrier Restraint System, Bolted - Item

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

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

Appendix 741-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Locations where temporary concrete barriers are required. (741.07.01)
- Drainage gap locations. (741.07.02)
- Locations where temporary concrete barriers are restrained. Temporary concrete barrier restraint systems should be considered for use on a high speed roadway, typically with a posted speed of 70 km/h or more, when barrier protection is required within 0.5 m of an excavation, within 1.0 m of structures not designed for impacts (e.g., scaffolding), or within 1.0 m of the edge of a bridge deck. (741.07.03.01)
- Details should be provided to cover the method and payment for the restoration of asphalt and concrete surfaces that are disturbed during the installation and removal of temporary concrete barrier restraint systems. (741.07.03.02)
- Locations where transitions are required between unrestrained temporary concrete barrier and restrained temporary concrete barrier and between unrestrained temporary concrete barrier and permanent concrete barrier. (741.07.03.03)

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

Related Ontario Provincial Standard Drawings

OPSD 911.140 to OPSD 911.430 Guide Rail System, Concrete Barrier Drawings



CONSTRUCTION SPECIFICATION FOR CONNECTICUT IMPACT ATTENUATION SYSTEM (CIAS)

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753-A	Commentary

753.01	SCOPE

This specification covers the requirements for the installation of Connecticut Impact Attenuation Systems (CIAS).

753.01.01 Specification Significance and Use

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

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

753.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

753.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 314	Untreated Granular, Subbase, Base, Surface, Shoulder, and Stockpiling
OPSS 904	Concrete Structures

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete

CSA Standards

G40.20-04/G40.21-04	Rolled or Welded Structural Quality Steels
W47.1-03	Certification of Companies for Fusion Welding of Steel
W59-03	Welded Steel Construction (Metal Arc Welding)

ASTM International

A 53/A 53M-07	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A 123/A 123M-09	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 153/A 153M-03	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 307-07	Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

753.05 MATERIALS

753.05.01 Concrete

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

753.05.02 Granular Base

Granular base shall be Granular A according to OPSS 1010.

753.05.03 Reinforcing Steel Bars

Reinforcing steel bars for concrete backwall shall be according to OPSS 1440.

753.05.04 Fasteners

Bolts, nuts, washers, and spacers shall be according to ASTM A 307 and hot dip galvanized according to ASTM A 153.

753.05.05 Steel Cylinders

Cylinders shall be fabricated from steel according to CSA G40.21, Grade 300W, and hot dip galvanized after fabrication to provide a zinc coating not less than 610 g/m² according to ASTM A 123.

Cylinders shall be cut square and seamless or electric welded. The finished cylinder shall be within 15 mm of true round. Each cylinder shall be labelled at the top with the designated A to N alphabetical character.

All edges shall be machined and free of burrs and sharp edges.

753.05.06 Steel Rails

Steel rails shall be fabricated as specified in the Contract Documents from flat stock steel according to CSA G40.21, Grade 300W, and hot dip galvanized after fabrication to provide a zinc coating not less than 610 g/m² according to ASTM A 123.

753.05.07 Steel Straps, Lid Support Angles, and Lifting Devices

Steel straps, lid support angles, and lifting devices shall be steel according to CSA G40.21, Grade 300W. All straps shall be cut to the width and length and welded to the cylinder as specified in the Contract Documents.

753.05.08 Steel Pipes

Steel pipes shall be 48.3 mm OD, standard weight, Schedule 40 steel pipe according to ASTM A 53 and welded to one side of the cylinder as specified in the Contract Documents.

753.05.09 Steel Pipe Retainers

Steel pipe retainers shall be 50 mm by 32 mm OD, standard weight, Schedule 40 steel pipe according to ASTM A 53 and welded to the side of the cylinder as specified in the Contract Documents.

753.05.10 Lids

Lids shall be fabricated from low-density polyethylene composed of 25% recycled plastic materials. Lids shall be black in colour and UV stabilized to a minimum rating of UV8D. The lid shall be of sufficient strength to support a centred point load having a mass of 60 kg producing a maximum deflection of 100 mm.

Each lid shall have a steel restraining chain for attachment of the lid to the cylinder.

Associated metal hardware for the lids, such as washers, eye bolts, chains, and screws shall be hot dip galvanized according to ASTM A 153 or equivalent electroplated or anodized treated.

753.05.11 Welds

All welding shall be according to CSA W47.1 and CSA W59.

753.07 CONSTRUCTION

753.07.01 General

Connecticut Impact Attenuation Systems shall be installed according to and at locations specified in the Contract Documents.

753.07.02 Concrete Pads and Backwalls

Levelling and site preparation required for the existing granular base shall be performed prior to placing the concrete pad and backwall.

Concrete pads and backwalls shall be constructed as specified in the Contract Documents. Concrete shall be placed, cured, and finished according to OPSS 904. Cross fall of the concrete pad is desirably 6% or less and shall not exceed 10%. All exposed edges of the backwall shall have a 25 mm chamfer. Drilling of anchor holes shall commence a minimum of five days after concrete has been placed.

753.07.03 Granular Base

The granular base below the concrete pad shall be a minimum depth of 150 mm and shall be placed according to OPSS 314. The granular material shall be compacted to 95% of the maximum dry density.

753.07.04 Connection to Barriers

The concrete backwall shall be connected to the barrier as specified in the Contract Documents.

753.07.05 Delineation

Delineation shall be provided as specified in the Contract Documents.

753.07.06 Management of Excess Material

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

753.09 MEASUREMENT FOR PAYMENT

753.09.01 Actual Measurement

753.09.01.01 Connecticut Impact Attenuation System

For measurement purposes, a count shall be made of the number of complete Connecticut Impact Attenuation Systems installed.

753.09.02 Plan Quantity Measurement

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

753.10 BASIS OF PAYMENT

753.10.01 Connecticut Impact Attenuation System - Item

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

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

Appendix 753-A, November 2013 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Connecticut Impact Attenuation System locations. (753.07.01)

The designer should determine to which standard Connecticut Impact Attenuation Systems should be installed and specify it in the Contract Documents:

- a) The Connecticut Impact Attenuation System should only be installed at a 10° skew to the centreline of the roadway when the length of the median hazard and the median width can accommodate a Connecticut Impact Attenuation System at each end of the hazard within the limits specified in OPSD 923.245. In this case, the designer should specify that the system be installed according to OPSD 923.245.
- b) The Connecticut Impact Attenuation System should only be installed at a 0° skew to the centreline of the roadway when the length of the median hazard is too long and the median width is too narrow to accommodate a Connecticut Impact Attenuation System at each end of the hazard within the limits specified in OPSD 923.245. In this case, the designer should specify that the system be installed according to OPSD 923.244.

Wherever possible, the designer should eliminate the use of curb with gutter, in advance of and along the length of end treatments and crash cushions. See the MTO Roadside Safety Manual for additional information.

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

Related Ontario Provincial Standard Drawings

OPSD 923.201	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Component - Steel Cylinder
OPSD 923.202	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Component - Polyethylene Lid
OPSD 923.204	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Component - Concrete Backwall
OPSD 923.242	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Installation
OPSD 923.244	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Installation - Long Median Hazard
OPSD 923.245	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Installation - Short Median Hazard
OPSD 984.205	Energy Attenuator, Crash Cushion, Connecticut Impact Attenuation System, Delineation, Installation - Permanent



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 771

CONSTRUCTION SPECIFICATION FOR STANDARD HIGHWAY FENCE

OPSS 771 has been removed from this
OPS volume

The provincial version of OPSS 771 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 771

The municipal version of OPSS 771 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 771

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



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

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791-A	Commentary

791.01 SCOPE

This specification covers the requirements for the installation of expanded metal anti-glare screens on concrete barrier, steel beam guide rail, and chain-link fence.

791.01.01 Specification Significance and Use

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

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

791.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

791.02 REFERENCES

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

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

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

Canadian General Standards Board (CGSB)

138.2-96 Steel Framework for Chain Link Fence

CSA Standards

W59-13 Welded Steel Construction (Metal Arc Welding)

ASTM International

A 27/A 27M-13	Steel Castings, Carbon, for General Application
A 123/A 123M-13	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 153/A 153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 325-10	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
A 824-01 (2012)	Metallic-Coated Steel Marcellled Tension Wire for Use With Chain-Link Fence
A 1011/A 1011M-14	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
B 209-10	Aluminum and Aluminum-Alloy Sheet and Plate

791.05 MATERIALS**791.05.01 Mesh**

Steel mesh panels shall be fabricated from expanding quality hot rolled sheets according to ASTM A 1011M.

Aluminum mesh panels shall be fabricated from expanding utility grade 3003 H14 sheets or 1100 H14 rolls.

Mesh panels shall consist of regular 19 mm diamond shaped patterns formed by expanding 1.6 mm thick panels to provide panels 600 mm or 1,200 mm in width and a minimum of 2,400 mm plus one diamond width in length. The diamonds shall be according to the following:

- a) Width of diamond, centre to centre of strand shall be 22 mm.
- b) Length of diamond, centre to centre of strand shall be 50 mm.
- c) Width of strand shall be 5 mm.
- d) Cut-off angle shall be a minimum of 21 degrees.

Mesh panels installed on concrete barrier and steel beam guide rail shall be 600 mm in width.

Mesh panels installed on chain-link fence shall be 1,200 mm in width.

The size of the finished mesh panels shall not deviate more than 3 mm from the specified width and more than 12 mm from the specified length.

Mesh panels shall be levelled and wire brushed after the expanding operation.

Mesh panels fabricated from steel sheets shall be hot dip galvanized after fabrication to provide a mass of zinc coating not less than 610 g/m² of total surface.

791.05.02 Posts and Wire Fasteners

Posts shall be steel pipe and according to CAN/CGSB 138.2.

Posts installed on concrete barrier shall be fabricated with a welded steel base plate grade 300W, hot dip galvanized after fabrication according to ASTM A 123, and according to the Contract Documents. All welds shall be to a low hydrogen classification according to CSA W59. Manual electrodes shall be E7015, E7016, or E7018. All welds shall be continuous.

Wire fasteners for fastening the mesh panels to the line posts shall be made of aluminum, galvanized steel, or stainless steel.

791.05.03 Top Wires, Bottom Wires, Diagonal Brace Wires, and Tie Wires

Top wires, bottom wires, and diagonal brace wires shall be 4.5 mm diameter marcelled tension wire Type II according to ASTM A 824 with a minimum Class 5 galvanized coating.

Tie wires shall be 3.5 mm diameter aluminum or galvanized steel or 1.0 mm diameter stainless steel wire. Tie wires shall be made with the same type of material as the mesh panels or stainless steel.

791.05.04 Miscellaneous Hardware

Washers, nuts, and bolts shall be according to ASTM A 325. All hardware shall be galvanized according to ASTM A 153 and to provide a mass of zinc coating of not less than 305 g/m² of total surface.

Metal discs used to fasten mesh panels to the chain-link fence fabric shall be fabricated from 1.6 mm thick steel and hot dip galvanized after fabrication to provide a mass of zinc coating of not less than 610 g/m² of the total surface.

791.05.05 Post Caps

All posts shall be fitted with waterproof metal caps according to ASTM F 626 and in a colour matching the posts. Post caps shall be designed to fit and fasten securely over the posts. All line post caps shall carry the top wire as specified in the Contract Documents.

791.05.06 Turnbuckles

Turnbuckles shall be drop forged steel according to ASTM A 27 and shall be galvanized according to ASTM A 153.

The average overall length shall be approximately 300 mm with ends in the closed position. Bolt diameter shall be approximately 10 mm and capable of taking up a minimum of 150 mm slack.

791.07 CONSTRUCTION

791.07.01 General

Expanded metal anti-glare screens shall be installed at locations specified in the Contract Documents. Mesh panels shall be oriented as specified in the Contract Documents.

791.07.02 Expanded Metal Anti-Glare Screens on Concrete Barrier

Mesh panels and posts shall be fastened to the concrete barrier as specified in the Contract Documents.

791.07.03 Expanded Metal Anti-Glare Screens on Steel Beam Guide Rail

Tops of guide rail posts shall be cut to accommodate the mesh panels as specified in the Contract Documents. Exposed surfaces of the guide rail posts shall be field treated with two applications of a preservative compatible with that used for the pressure treatment of the post.

791.07.04 Expanded Metal Anti-Glare Screens on Chain-Link Fence

Mesh panels shall be fastened to the chain-link fence as specified in the Contract Documents.

791.07.05 Marking

Identification plates, provided by the material supplier, shall be securely attached to the completed expanded metal anti-glare screen installation at the following intervals:

- a) At the start and end of each expanded metal anti-glare screen installation.
- b) At a maximum interval of 300 m.

The expanded metal anti-glare screen identification plate shall be located within 300 mm of a terminal post with the top of the plate located approximately 300 mm from the top of the expanded metal anti-glare screen. The maximum dimensions of the plate shall be 200 by 200 mm. The plate shall be made from 0.81 mm thick anodized aluminum sheet according to ASTM B 209 series 1100 or 5005-H34.

Each expanded metal anti-glare screen identification plate shall be engraved with the following information:

- a) Contract number.
- b) Name or trademark of anti-glare screen Subcontractor.
- c) Name or trademark of anti-glare screen supplier (i.e., suppliers) of expanded metal anti-glare screen and posts).
- d) Date of completed installation (i.e., yyyy-mm).

The height of the letters and numerals shall be within the range of 6 to 32 mm.

791.07.06 Management of Excess Material

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

791.08 QUALITY ASSURANCE

791.08.01 Construction

The Contract Administrator may perform a spot visual inspection to determine conformance with the workmanship, design, and dimensional requirements of this specification.

Failure to conform to the specifications may result in a partial or complete inspection of the installation and removal and replacement of all defective workmanship or materials.

791.09 MEASUREMENT FOR PAYMENT

791.09.01 Actual Measurement

791.09.01.01 Expanded Metal Anti-Glare Screen

Measurement of expanded metal anti-glare screen shall be by length in metres along the length of concrete barrier, steel beam guide rail, or chain-link fence for the actual length of screen installed.

791.09.02 Plan Quantity Measurement

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

791.10 BASIS OF PAYMENT

791.10.01 Expanded Metal Anti-Glare Screen - Item

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

Appendix 791-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Locations of expanded metal anti-glare screens. (791.07.01)

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

Related Ontario Provincial Standard Drawings

OPSD 991.130	Expanded Metal Anti-Glare Screen, Installation - Concrete Barrier
OPSD 991.131	Expanded Metal Anti-Glare Screen, Installation - Steel Beam Guide Rail with Wooden Post
OPSD 991.132	Expanded Metal Anti-Glare Screen, Installation - Chain-Link Fence



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**



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS 802
NOVEMBER 2010**
(Formerly OPSS 570, November 2007)

**CONSTRUCTION SPECIFICATION FOR
TOPSOIL**

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802.01 SCOPE

This specification covers the requirements for stockpiling, supplying, and placing topsoil.

802.01.01 Specification Significance and Use

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

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

802.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

802.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 206 Grading

802.05 MATERIALS

802.05.01 Topsoil

Topsoil shall be a fertile loam material that is free of roots, vegetation, or other debris of a size and quantity that prevents proper placement of the topsoil. The topsoil shall not contain material greater than 25 mm in size, such as stones and clods.

Imported topsoil shall not have contaminants that adversely affect plant growth.

Soil from swamps or muskeg areas may be used in place of topsoil, when approved by the Contract Administrator.

802.07 CONSTRUCTION

802.07.01 Stockpiling Topsoil

Topsoil shall be removed, stockpiled, and managed according to the Contract Documents. Stockpiles shall be constructed neatly with uniform surfaces. When required, the top surface shall be dished.

802.07.02 Preparation for Topsoil

Areas where topsoil is to be placed shall be fine graded to a uniform surface according to OPSS 206. The surface shall be loosened to a depth of 25 mm. It shall be free of all vegetation, debris, and stones which would not be covered by the depth of topsoil specified in the Placement of Topsoil subsection.

These areas shall be maintained in the condition described above until the topsoil is placed.

802.07.03 Placement of Topsoil

Topsoil shall be placed to a uniform depth of 50 mm on areas specified in the Contract Documents and up to the subgrade elevation on the roadway front slope.

Soil from swamps or muskeg areas, when used in place of topsoil, shall be placed according to the Contract Documents to a uniform depth of 75 mm, with no woody material protruding more than 50 mm above the surface.

802.07.04 Management of Excess Material

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

802.09 MEASUREMENT FOR PAYMENT

802.09.01 Actual Measurement

802.09.01.01 Topsoil from Stockpiles

Measurement shall be by volume in cubic metres of topsoil placed from a stockpile.

802.09.01.02 Topsoil, Imported

Measurement shall be by volume in cubic metres of topsoil imported and placed.

802.10 BASIS OF PAYMENT

802.10.01 Preparation for Topsoil - Item

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

Payment for this item shall be on surfaces graded under a previous Contract that require preparation for topsoil.

There is no payment for this item on surfaces constructed on this Contract.

802.10.02 Topsoil from Stockpiles - Item

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

802.10.03 Topsoil, Imported - Item

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

Appendix 802-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Topsoil removal and stockpiling areas. (802.07.01)
- Topsoil placement areas. (802.07.03)

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

Related Ontario Provincial Standard Drawings

No information provided here.



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 804

CONSTRUCTION SPECIFICATION FOR SEED AND COVER

OPSS 804 has been removed from this
OPS volume

The provincial version of OPSS 804 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 804

The municipal version of OPSS 804 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 804

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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

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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

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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

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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
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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
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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

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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
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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
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CONSTRUCTION SPECIFICATION FOR EXCAVATING AND BACKFILLING - STRUCTURES

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902-B	Supplemental Requirements for Using OPSS 902 in Municipal Contracts

902.01 SCOPE

This specification covers the requirements for excavating and backfilling for structures, including dewatering.

902.01.01 Specification Significance and Use

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

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

902.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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.

902.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 501	Compacting
OPSS 510	Removal
OPSS 518	Control of Water from Dewatering Operations
OPSS 539	Temporary Protection Systems

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1205	Clay Seal
OPSS 1860	Geotextiles

902.03

DEFINITIONS

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

Bedding means granular material to be placed in areas so designated in the Contract Documents.

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

Channel means a natural or artificial watercourse.

Culvert means a structure that provides an opening through an embankment and to which roadway loads are distributed through fill or that is designated as a culvert in the Contract Documents.

Designated Payment Surface means the original ground surface shown in the Contract Documents, unless a specially designated payment surface is shown either by elevation or by profile. The specially designated payment surface is horizontal in the transverse direction.

For rock excavation the designated payment surface shall be the existing rock surface as established in the field before rock excavation begins, unless another designated payment surface is specified.

Earth means all soils except those defined as rock, and excludes stone masonry, concrete and other manufactured materials.

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

Foundation means that portion of the ground below the structure base or footings that supports the structure or that portion of the ground supporting the pile caps.

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

Rock means natural beds or massive fragments, of the hard, stable, cemented part of the earth's crust, igneous, metamorphic, or sedimentary in origin, which may or may not be weathered, and includes boulders having a volume of 1 cubic m or greater.

Soil means all loose or moderately cohesive organic or inorganic deposits of the earth's crust such as silt, sand, gravel, or clay or any of their mixtures.

Structure means any bridge, tunnel, concrete culvert, retaining wall, dock, guideway, or sign support.

902.04

DESIGN AND SUBMISSION REQUIREMENTS

902.04.01

Design Requirements

902.04.01.01

Dewatering

Where dewatering is required, the Contractor shall be responsible for the design of the dewatering scheme for the intended purpose.

902.04.02 Submission Requirements

902.04.02.01 Preconstruction Survey

Prior to commencing the work, a condition survey of property and structures that may be affected by the work shall be submitted to the Contract Administrator. The survey shall include the locations and conditions of adjacent properties; buildings; underground structures; Utility services; and structures, such as walls abutting the site.

902.04.02.02 Milestone Inspections

The Quality Verification Engineer shall witness the following Interim Inspections of the work:

- a) Dewatering of excavation for structure.
- b) Completion of excavation for foundation.
- c) Excavation for backfill and frost tapers.
- d) Backfilling.

A copy of the written permission to proceed shall be submitted to the Contract Administrator prior to commencement of the successive operation.

902.05 MATERIALS

902.05.01 Granular

Granular material to be used for backfill, bedding, and frost tapers shall be according to OPSS 1010.

The 19.0 mm clear stone to be used for wall drains shall be according to OPSS 1004.

902.05.02 Native Backfill

Native and imported material shall be approved by the Contract Administrator. All material shall be free from frozen lumps, cinders, ashes, refuse, vegetable or organic matter, rocks and boulders over 150 mm in any dimension, and other deleterious material.

902.05.03 Clay Seal

Clay seal shall be according to OPSS 1205.

902.05.04 Geotextile

Geotextile shall be according to OPSS 1860 and be of the type, class, and filtration opening size (FOS) range specified in the Contract Documents.

902.06 EQUIPMENT

902.06.01 Compaction Equipment

Compaction equipment shall be according to OPSS 501.

902.07 CONSTRUCTION

902.07.01 Removals

Removals shall be according to OPSS 510.

902.07.02 Removal of Ice and Snow

All ice and snow shall be removed from all portions of the work area before any excavation and backfill operations proceed. Frozen materials shall not be incorporated into the work. Material shall not be placed over frozen ground, ice, or snow.

902.07.03 Protection Systems

Protection systems shall be according to OPSS 539.

Protection systems shall be installed:

- a) Where the stability, safety, or function of an existing structure, roadway, railway, or other facility can be impaired by an excavation or temporary slope.
- b) To permit excavation where there is a necessity to retain the sidewalls of an excavation and to permit dewatering by restricting water flow and facilitating safe execution of the work.

902.07.04 Dewatering Structure Excavation

Until backfilling has been completed and to permit the placing of concrete in the dry, the Contractor shall carry out all work necessary to control the flow of water into the excavation and to prevent disturbance of the founding material.

Control of water shall be according to OPSS 518.

All temporary dewatering shall remain the property of the Contractor and shall be removed from the right-of-way when they are no longer required.

902.07.05 Excavation

902.07.05.01 General

Deterioration of the foundation soil or rock, surface water from entering and eroding the face of the excavation, and build up of hydrostatic pressures that may have harmful effects upon the temporary or permanent structures shall be prevented.

902.07.05.02 Excavation for Foundations

Excavation for footings, working slabs, and granular pads shall be to the neat lines specified in the Contract Documents.

The bottom of the excavation on which the footing, working slab, or granular pad is to rest shall not be disturbed. In soft conditions, construction of the footing or structural slab shall commence immediately after the final removal of material to the foundation level has been completed.

In the case of concrete culverts of the open footing type, no excavation shall be made between the footings below the level of the stream bed or the top of the footings, whichever elevation is lower, unless authorized in writing by the Contract Administrator.

The elevation of the bottom of the footing, working slab, or granular pad shall not be changed without the approval of the Contract Administrator.

Overexcavated areas shall be restored to their original conditions. Overexcavated areas shall be backfilled with a material suitable for the particular application and approved by the Contract Administrator. Concrete fill shall be used for overexcavation in rock. Where material other than concrete is used, the material shall be compacted to the dry density specified in OPSS 501.

When authorized by the Contract Administrator, additional excavation, as may be required, shall be carried out.

902.07.05.03 Excavation for Backfill and Frost Tapers

Excavation for backfill and frost tapers shall be to the neat lines specified in the Contract Documents.

Overexcavated areas shall be restored with material approved by the Contract Administrator. The material shall be compacted to the dry density specified in OPSS 501.

902.07.05.04 Preservation of Channel

Where a channel cross-section is altered, it shall be restored to its original condition.

902.07.06 Backfilling

902.07.06.01 General

Frozen materials shall not be incorporated into the work.

Footings shall be protected against frost action.

Other than the backfill placed to the tops of the footings, no fill shall be placed against an abutment, wingwall, retaining wall, or concrete culvert until the concrete has reached 70% of its design strength.

Backfilling around culverts, arches, rigid frames, and piers shall proceed simultaneously and evenly on both sides of the structure. The differential in surface elevation of the backfill material on each side of the structure and individual component shall not be greater than 500 mm.

All voids around abutments, piers, or other permanent work shall be backfilled to the level of the surrounding ground or to the grade specified in the Contract Documents, whichever is the lower before the general backfilling commences.

When rock fill is to be placed around a structure the structure shall be protected to prevent damage from the rock fill.

The minimum height of fill specified in the Contract Documents shall be placed before traffic or construction equipment shall pass over the culvert.

Granular material shall be placed within the lines and grades specified in the Contract Documents.

Wall drains shall have a 0.05 m³ pocket of 19 mm minimum size clear stone wrapped in geotextile placed over the opening of the wall drain at the backfilled side of the wall.

902.07.06.02 Compaction

Backfill shall be placed according to OPSS 206 and compacted according to OPSS 501.

Only hand operated vibratory type compaction equipment shall be used for compaction of fill material within the restricted zone behind all earth retaining structures.

902.07.07 Clay Seal

When specified in the Contract Documents, clay seals shall be placed to the dimensions shown.

902.07.08 Certificate of Conformance

A completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Qualification Verification Engineer's seal and signature shall be affixed on the completed Certificate of Conformance confirming that the work has been carried out in general conformance with the Contract Documents.

902.07.09 Management of Excess Material

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

902.09 MEASUREMENT FOR PAYMENT

902.09.01 Actual Measurement

902.09.01.01 Excavation for Structure

Measurement of earth or rock excavation for structure shall be by volume in cubic metres.

Measurement of excavation for footings shall be based on the neat horizontal dimensions of the footing to the depth of the bottom of the footing, working slab, or granular pad.

Except as noted below, the quantity of excavation shall include only the quantities below the designated payment surface within the neat lines specified in the Contract Documents.

The above measurement also includes:

- a) Removal of asphalt pavement, except where there is a separate tender item for pavement removal that includes pavement overlapping the area of structure excavation.
- b) The excavation quantities, below the designated payment surface, required for placing granular backfill and granular frost tapers.
- c) For open footing culverts, the excavation quantities as measured below the designated payment surface but between the plan areas of the footings and above the stream bed or the tops of the footings, whichever is higher.

Where the structure excavation overlaps excavation required for other work, the measurement shall be made as specified in the Contract Documents with no deductions for overlap.

The volume of boulders in an excavation shall be calculated from the three maximum rectilinear dimensions. The following provisions shall apply:

- a) Only the amount removed shall be considered for payment.
- b) The volume of the boulders removed shall be deducted from the volume of excavation as calculated above.

The measurement of the total volume of materials considered for payment shall not exceed the calculated volume of excavation within the theoretical lines.

902.09.01.02 Granular Backfill

Measurement for payment of granular backfill shall be by volume in cubic metres or tonnes as specified in the Contract Documents.

The quantity of granular backfill and granular bedding shall include only those quantities measured below the subgrade and as measured within the theoretical line and grades specified in the Contract Documents.

Where the Contractor has excavated beyond the limits specified in the Contract Documents, the conversion factor of 2 t/m³ shall be used in measurement of the excess volume when it is replaced with granular on a tonne basis.

The weighing of granular material supplied on a tonnage basis shall be according to the Contract Documents.

902.09.02 Plan Quantity Measurement

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

902.10 BASIS OF PAYMENT

902.10.01 Earth Excavation for Structure - Item Rock Excavation for Structure - Item

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

When the Contract Administrator requests excavation for concrete working slabs, granular working pads, or granular bedding, payment shall be at the Contract price for the type of excavation required.

902.10.02 Dewatering Structure Excavations - Item

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

902.10.03 Granular Backfill to Structure - Item

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

When the Contract Documents do not include a separate item for granular backfill to structure, the Contract price for the items directly associated with the granular backfill to structure shall be full compensation for all labour, Equipment, and Material required to do the work.

902.10.04 Clay Seal - Item

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

902.10.05 Overexcavation

Payment shall not be made for overexcavation that has not been approved by the Contract Administrator or for backfill restoration of such overexcavation.

Appendix 902-A, November 2010 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Geotextile requirements. (902.05.04)
- Neat lines of excavations for footings, working slabs, and granular pads. (902.07.05.02)
- Neat lines of excavation for backfill and frost tapers. (902.07.05.03)
- Grade of backfill around abutments, piers, and other permanent work. (902.06.01)
- Lines and grades for granular materials. (902.06.01)
- Measurement units for granular material. (902.09.01.02)

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

- Clay seals and dimensions for clay seals. (902.07.07)

OPSS 902 contains information written for provincial contracts. To ensure completeness of municipal Contract Documents, the designer should invoke Appendix 902-B. The appendix contains supplemental requirements that modify OPSS 902 so it can be used by a municipality in its contracts.

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

Related Ontario Provincial Standard Drawings

OPSD 3090.100	Foundation, Frost Penetration Depths for Northern Ontario
OPSD 3090.101	Foundation, Frost Penetration Depths for Southern Ontario
OPSD 3101.150	Walls, Abutment, Backfill, Minimum Granular Requirement
OPSD 3101.200	Walls, Abutment, Backfill, Rock
OPSD 3102.100	Walls, Abutment, Backfill Drain
OPSD 3120.100	Walls, Retaining, Concrete Toe Wall
OPSD 3121.150	Walls, Retaining, Backfill, Minimum Granular Requirement
OPSD 3190.100	Walls, Retaining and Abutment, Wall Drain

Appendix 902-B, November 2010

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

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

Supplemental Requirements for Using OPSS 902 in Municipal Contracts

OPSS 902 Excavation and Backfilling - Structures, is amended as follows:

902.03 Definitions

Section 902.03 is amended by the deletion of the definitions for Certificate of Conformance and for Quality Verification Engineer.

902.04.02.02 Milestone Inspections

Clause 902.04.02.02 is deleted in its entirety and replaced with the following:

The Contract Administrator shall witness the following interim inspections of the work:

- a) Dewatering of excavation for structure.
- b) Completion of excavation for foundation.
- c) Excavation for backfill and frost tapers.
- d) Backfilling.

The next operation shall not proceed until the Contract Administrator has examined the excavation and given approval in writing to perform subsequent work.

902.07.04 Dewatering Structure Excavation

The third paragraph of clause 902.07.04 is deleted in its entirety and replaced with the following:

After the dewatering, the excavation shall be inspected and accepted by the Contract Administrator prior to construction of the footing. The Contractor shall not proceed with subsequent work until the Contract Administrator has given permission in writing.

902.07.08 Certificate of Conformance

Subsection 902.07.08 is deleted in its entirety.



NOTICE TO USERS OF OPSS 903

CONSTRUCTION SPECIFICATION FOR DEEP FOUNDATIONS

OPSS 903 has been removed from this
OPS volume

The provincial version of OPSS 903 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 903

The municipal version of OPSS 903 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 903

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



NOTICE TO USERS OF OPSS 904

CONSTRUCTION SPECIFICATION FOR CONCRETE STRUCTURES

OPSS 904 has been removed from this
OPS volume

The provincial version of OPSS 904 is now in:

OPS Volume 5,
Provincial-Oriented
MTO General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.PROV 904

The municipal version of OPSS 904 is now in:

OPS Volume 7,
Municipal-Oriented
OPS General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.MUNI 904

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



NOTICE TO USERS OF OPSS 905

CONSTRUCTION SPECIFICATION FOR STEEL REINFORCEMENT FOR CONCRETE

OPSS 905 has been removed from this
OPS volume

The provincial version of OPSS 905 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 905

The municipal version of OPSS 905 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 905

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



CONSTRUCTION SPECIFICATION FOR STRUCTURAL STEEL FOR BRIDGES

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906.01 SCOPE

This specification covers the construction requirements for the fabrication, delivery, and erection of structural steel for highway bridges.

906.01.01 Specification Significance and Use

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

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

906.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

906.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 911	Coating Structural Steel
OPSS 919	Formwork and Falsework
OPSS 922	Installation of Bearings

Ontario Provincial Standard Specifications, Materials

OPSS 1202	Bearings-Elastomeric Plain and Steel Laminated
OPSS 1203	Bearings-Rotational and Sliding Surface

Ontario Ministry of Transportation Publications

Structural Manual

CSA Standards

G40.20/40.21-04 (R2009)	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
S16-09	Design of Steel Structures
W47.1-09	Certification of Companies for Fusion Welding of Steel
W48-06 (R2011)	Filler Metals and Allied Materials for Metal Arc Welding
W59-03 (R2008)	Welded Steel Construction (Metal Arc Welding)
W178.1-08	Certification of Welding Inspection Organizations
W178.2-08	Certification of Welding Inspectors
S6-06	Canadian Highway Bridge Design Code

ASTM International

A 325M-09	Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength [Metric]
A 490M-09	Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
A 563M-07	Carbon and Alloy Steel Nuts
A 588/ A 588M-10	High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, With Atmospheric Corrosion Resistance
F 436M-11	Hardened Steel Washers

American Society of Mechanical Engineers (ASME)

B46.1-09	Surface Texture (Surface Roughness, Waviness, and Lay)

International Organization for Standardization/International Electrotechnical Commission (ISO/IEC)

17025-2005	General Requirements for the Competence of the Testing and Calibration Laboratories

Joint Publications of the Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE)

SSPC-SP6/NACE No. 3-2007	Commercial Blast Cleaning

906.03 DEFINITIONS

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

Bearing Contact Area means two planes that are in contact or have a separation between them not exceeding 0.12 mm.

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

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

Erection Diagrams means drawings showing the dimensioned layout of the steel structure, from which shop details are made, and that correlate the fabricator's piece markings with the location in the structure.

Faying Surface means the mating surface of a member that is in contact with another member to which it is to be joined.

Flush means a profile of weld reinforcement in which there is a smooth gradual transition between the base and weld metal involving grinding where necessary. Weld reinforcement not exceeding 1 mm in height may remain on each surface, unless the weld is part of a faying surface when all reinforcement is removed.

Fracture Critical Member means a member, including attachments, in a single load path structure that is subject to tensile stress and whose failure could lead to collapse of the structure.

Inspector means an individual who is a Canadian Welding Bureau (CWB) certified Level II or Level III inspector according to the requirements of CSA W178.2 and has documented evidence of professional knowledge, skill, and experience in the inspection of fabrication and erection of steel bridges.

New Steel means structural steel that has not previously been used.

Non-Destructive Testing Technician means an individual who has documented evidence of training, professional knowledge, skill, and experience in non-destructive testing of structural steel welds and material, and has a valid certificate showing qualification to a Level II or III according to CAN/CGSB 48.9712 and the CWB for the non-destructive testing specified.

Primary Tension Member means a member including attachments that are subject to tension stress.

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

Smooth means a profile of weld reinforcement, in which the surface finish or weld reinforcement has sufficient smooth gradual transition, involving grinding where necessary. Weld reinforcement not exceeding the following limits, may remain on each surface:

- 2 mm for plate thickness $\leq$ 50 mm
- 3 mm for plate thickness $>$ 50 mm

Snug Tight means the tightness attained by a few impacts of an impact wrench or the full effort of a person using a spud wrench.

906.04 DESIGN AND SUBMISSION REQUIREMENTS

906.04.01 Design Requirements

906.04.01.01 General

Design shall be according to CAN/CSA S6 and the Structural Manual.

906.04.01.02 Welding

Welding design shall be according to CSA W59.

Welding procedures shall be according to CSA W47.1 and CSA W59, except where modified by CAN/CSA-S6, Clause 10.24.5.

Symbols for welding and non-destructive testing shall be according to CSA W59.

906.04.02 Submissions

906.04.02.01 General

When other authorities are involved in the approval of the design or construction of a highway structure, submissions shall be made at least 5 weeks prior to commencement of work and one additional copy of the submission shall be provided for each authority.

The requirements of each authority shall be satisfied prior to commencement of fabrication.

906.04.02.02 Shop Details and Welding Procedures

The Contractor shall submit 3 sets of the shop details and welding procedures to the Contract Administrator at least 7 Days prior to commencement of fabrication, for information purposes only. Prior to making a submission, an Engineer's seal and signature shall be affixed on the shop details and welding procedures verifying that the details and procedures are consistent with the Contract Documents.

The shop details shall include at least the following:

- a) Full detail dimensions and sizes of all component parts of the structure. These dimensions shall make allowance for changes in shape due to weld shrinkage, camber, and any other effects that cause finished dimensions to differ from initial dimensions.
- b) Erection marks.
- c) All necessary specifications for the materials to be used.
- d) Identification of areas requiring special surface treatment.
- e) Identification of fracture-critical and primary tension members and component parts. Attachments having a length of more than 100 mm in the direction of tension and welded to the tension zone of a fracture-critical or primary tension member shall be treated as part of that member.
- f) Bolt installation requirements, including number of fitting up bolts required at each connection and oversize and slotted holes.
- g) Details of all welds.
- h) Identification of material and welds requiring non-destructive testing, including the limits of the weld undergoing testing and the frequency and type of testing.
- i) Temporary welds.
- j) Location of shop and field splices.

The fabricator shall not commence fabrication until he has received one set of shop detail drawings and welding procedures sealed and signed by an Engineer.

The fabricator shall have a copy of the shop detail drawings and welding procedures at the manufacturing plant during fabrication.

906.04.02.03 Erection Diagrams and Erection Procedure Drawings and Calculations

The Contractor shall submit 3 sets of the erection diagrams and erection procedure drawings and calculations to the Contract Administrator at least 7 Days prior to commencement of erection, for information purposes only. Prior to making a submission, an Engineer's seal and signature shall be

affixed on the erection diagrams and erection procedure drawings and calculations verifying that the erection diagrams and erection procedure drawings and calculations are consistent with the Contract Documents.

Erection diagrams and erection procedure drawings shall include at least the following:

- a) Principal dimensions of the bridge.
- b) Erection marks.
- c) Sizes of all members.
- d) Field welding requirements, including identification of welds requiring non-destructive testing.
- e) Size and type of bolts.
- f) Bolt installation requirements, including the number of fitting up bolts required at each connection and identification of oversize and slotted holes.
- g) Bracing during erection of structural steel.
- h) Treatment at faying surfaces for joints designed as slip critical.

The Contractor shall not commence erection until he has received one set of erection diagrams and erection procedure drawings and calculations sealed and signed by an Engineer.

The Contractor shall have a copy of the erection diagrams and the erection procedure drawings and calculations at the site during erection.

906.04.02.04 Mill Test Certificates

Prior to the use of any material in fabrication, 2 copies of the mill test certificates for that material shall be submitted to the Contract Administrator, confirming that the material is according to the Contract Documents.

Copies of the mill test certificates for all material to be used in the fabrication shall be available for review at the fabricating plant during fabrication. The certificates shall show that the material is according to the Contract Documents.

If the material cannot be identified by mill test certificates, coupons shall be taken and tested and these test certificates shall be made available.

When mill test certificates originate from a mill outside of Canada or the United States of America, the Contractor shall have the information on the mill test certificate verified by testing at a Canadian laboratory. This laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian laboratory and appropriate wording stating that the material is according to the specified Contract requirements. The stamp shall include the appropriate material specification number, testing date (i.e., yyyy-mm-dd), and the signature of an authorized officer of the Canadian laboratory.

906.04.02.05 Test Reports for Fasteners

Proof that the bolts, nuts, and washers meet the chemical composition, mechanical properties, dimensions, workmanship, and head burst as required by ASTM A 325M, ASTM A 490M, ASTM A 563M,

or ASTM F 436M shall be submitted to the Contract Administrator. Verification of the acceptability of assemblage of zinc-coated bolts, nuts, and washers delivered to the job site shall also be submitted to the Contract Administrator.

For bolts, nuts, and washers supplied from a manufacturer outside Canada or the United States of America, the above information shall be verified by testing at a Canadian laboratory as outlined in the Mill Test Certificates clause.

906.04.03 Interim Inspection after Fabrication of Components

Upon completion of fabrication of the components, and prior to erection, the Quality Verification Engineer shall conduct an interim inspection of the work to verify that the fabrication of components has been carried out in general conformance with the shop details, welding procedures, and Contract Documents and issue the fabricator written permission to proceed with the work.

906.05 MATERIALS

906.05.01 Steel

Structural steel shall be new and of the grade and category specified in the Contract Documents and shall be according to CAN/CSA G40.21.

ASTM A 588 may be substituted when either of the following steel grades have been specified:

- a) CAN/CSA G40.21, Grade 350A.
- b) CAN/CSA G40.21, Grade 350AT, when the Charpy impact energy requirements are verified by the submission of test documentation.

Substitution of other material for size and grade is not permitted unless approved by the Contract Administrator.

The steel shall be identified as specified in the Control of Material clause.

906.05.02 High Strength Bolts, Nuts, and Washers

High strength bolts shall be according to ASTM A 325M or ASTM A 490M.

High strength nuts, and hardened washers shall be suitable for use with the types of bolts being specified and shall be according to ASTM A 563M and ASTM F 436M.

The nuts, bolts, and washers shall be supplied and shipped together as an assembly from the same manufacturer.

High strength bolts, nuts, and washers for use with unpainted corrosion-resistant steel shall be Type 3. Bolts, nuts, and washers used with steel specified in the Contract Documents to receive a paint coating or galvanizing shall be Type 1 and shall be galvanized. High strength ASTM A 490M bolts shall not be galvanized or plated.

906.05.03 Electrodes

Welding electrodes, electrode and flux or electrode and gas combinations shall be low hydrogen (level H16 or less) and shall be according to CSA W47.1, CSA W48, and Section 12 of CSA W59.

The weld filler metal in fracture-critical and primary tension members shall meet the Charpy V notch impact energy requirements of CAN/CSA-S6, Table 10.14.

Weld metal used with corrosion resistant steels shall have similar corrosion resistance and colour to the base metal and shall be according to CSA W59.

906.05.04 Shear Connectors

Material requirements for stud shear connectors shall be according to CSA W59, Appendix H. Only studs of Type B shall be used.

906.05.05 Pins and Rollers

Pins and rollers more than 175 mm in diameter shall be forged and annealed or forged and normalized. Pins and rollers 175 mm or less in diameter shall be forged and annealed, forged and normalized, or cold-finished carbon-steel shafting.

906.05.06 Bearings

Bearings shall be according to OPSS 1202 or OPSS 1203 or both.

906.07 CONSTRUCTION

906.07.01 Fabrication

906.07.01.01 General

The fabrication shall be according to CAN/CSA-S6, Clause 10.24.4.

All Atmospheric Corrosion Resistant (ACR) steel components shall be abrasive blast-cleaned according to SSPC-SP6/NACE No. 3 to completely remove mill scale, rust, coating, oxides, corrosion products, oil, grease, dust, dirt, and other foreign matter.

906.07.01.02 Plate Edges

Plasma arc cutting of plates up to and including 20 mm in thickness is permitted. Plasma arc cutting of plates thicker than 20 mm shall not be permitted unless approval is received in writing from the Contract Administrator. When permitted, plasma arc cutting of plates shall use oxygen as the cutting gas and all edges shall be free of dross.

Inspection and repair of planar discontinuities shall be according to CSA W59.

Corners of oxygen cut girder flanges shall be chamfered 1.5 to 2.0 mm by grinding.

906.07.01.03 Straightening Material

Material with sharp kinks shall be rejected. Straightening of bends shall only be done using mechanical means or by the application of controlled heating according to CSA W59. Details of the straightening procedure including testing requirements, signed and sealed by an Engineer shall be submitted to the Contract Administrator prior to the straightening, for information purposes only.

Straightening shall only be carried out in the presence of the Owner's inspector.

If necessary, the Contract Administrator shall specify additional testing to be performed by the Contractor. If evidence of damage is discovered, the material shall be rejected and the cost of testing shall be at the expense of the Contractor.

The Contract Administrator shall be given 7 Days prior notice to arrange for the inspection.

906.07.01.04 Cambering

When rolled sections are heat cambered, the details of the heat cambering procedure, signed and sealed by an Engineer, shall be submitted to the Contract Administrator 7 Days prior to cambering, for information purposes only.

Plate girders shall have the required camber cut into the web with suitable allowance for camber loss due to cutting and welding.

Steel box girders fabricated with webs in an upright position shall have the fabricated camber verified by subtracting ordinates for deflections for girder segments from the relaxed camber diagram ordinates.

The use of heat to alter the camber of fracture critical or primary tension members shall be subject to approval by the Contract Administrator prior to the application of heat.

The ends of cambered girders shall be vertical under full dead load.

906.07.01.05 Horizontally Curved Girders

906.07.01.05.01 Heat Curving of Rolled Beams and Welded Girders

Girders shall be cambered before heat curving.

A detailed procedure for the heat curving operation, signed and sealed by an Engineer, shall be submitted to the Contract Administrator 14 Days prior to heat curving, for information purposes only.

906.07.01.06 Identification Marking for Erection

Each member shall carry an erection mark for identification.

Permanent marking shall be affixed in an area not exposed to view in the finished structure.

906.07.01.07 Welded Construction

906.07.01.07.01 General

All welded construction shall be according to CSA W59 and Clause 10.24.5 of CAN/CSA-S6.

All welding shall be carried out by welders having a CSA W47.1 identification card valid for the type of welding to be done and for the duration of the welding work.

The fabrication weld metal requirements, base metal repairs, and repairs of weld in fracture critical and primary tension members shall be according to CAN/CSA-S6, Clause 10.23.5.

Any company undertaking welded fabrication or erection or both shall be certified according to CSA W47.1, Division 1 or 2.

906.07.01.07.02 Altering the Sweep of Fracture-Critical and Primary Tension Members

The use of heat to alter the sweep of fracture critical or primary tension members shall be subject to approval by the Contract Administrator, prior to the application of heat.

906.07.01.07.03 Submissions of Repair Procedures

Canadian Welding Bureau (CWB) accepted welding procedure specifications, data-sheets, and repair procedures for prequalification, signed and sealed by an Engineer, shall be submitted for approval to the Contract Administrator 14 Days prior to commencement of work.

906.07.01.07.04 Assembly for Welding

Assembly for welding shall be according to CSA W59 and the following:

- a) Bearing stiffeners shall be vertical under full dead load.
- b) Intermediate stiffeners shall be either true vertical or perpendicular to the horizontal work lines used to layout the girder.
- c) Bearing stiffeners fitted to bear shall have a minimum bearing contact area of 75% and a maximum separation of 1 mm over the remaining area.
- d) Fitted intermediate stiffeners shall have a minimum bearing contact area of 25% and a maximum separation of 2 mm.

906.07.01.07.05 Temporary Welds

Temporary welds shall not be used on fracture-critical and primary tension members.

Temporary welds shall not be used on flange material in compression, unless approved by the Contract Administrator.

906.07.01.07.06 Preheat, Interpass Temperature, and Heat Input Control

When making welding repairs to fracture-critical and primary tension members, the preheat requirements shall be according to CAN/CSA-S6, Table 10.15.

906.07.01.07.07 Profile of Welds

Profile of welds shall be according to CSA W59 and the Structural Manual.

906.07.01.07.08 Corrections

Welding corrections and repairs to fracture-critical and primary tension members shall be according to CAN/CSA S6, Clause 10.23.5.

Any steel members subjected to shape corrections or straightening shall be allowed to cool in still air.

906.07.01.07.09 Peening

Peening, when required, shall be subject to approval by the Contract Administrator.

906.07.01.07.10 Stress Relief-Heat Treatment

Stress relief-heat treatment temperatures shall be recorded using thermo-couples or other methods acceptable to the Contract Administrator. A record showing temperature and time data of the heat treating operation shall be maintained and be made available to the Contract Administrator upon request.

906.07.01.07.11 Welding Inspection

906.07.01.07.11.01 General

All welding inspection shall be according to CSA W59.

906.07.01.07.11.02 Identification Cards - Canadian Welding Bureau

Prior to commencement of welding, the Contractor shall make available to the Contract Administrator the Canadian Welding Bureau's transferable or non-transferable identification cards for each tacker, welder, or welding operator to be employed on the work. Such identification cards shall be currently valid and shall indicate the welding processes and the welding positions at which the personnel are qualified to weld.

906.07.01.07.11.03 Certification of the Independent Testing Organization

The independent organization undertaking welding testing under the Quality Control subsection shall be certified for testing bridges according to CSA W178.1. The certification shall encompass at least the following methods: radiographic, ultrasonic, and magnetic particle.

906.07.01.07.11.04 Certification of the Non-Destructive Testing Technician

The independent organization's non-destructive testing technician undertaking non-destructive testing of welds under the Quality Control subsection shall be certified for testing bridges according to CSA W178.2. Certification shall be to either Level II or III for the methods used, as required by CAN/CGSB 48.9712.

906.07.01.07.12 Welding Corrections and Repairs for Fracture-Critical and Primary Tension Members

906.07.01.07.12.01 General

All repair procedures requiring approval shall be submitted to the Contract Administrator at least 14 Days prior to commencement of the work.

Repair procedures shall be according to CAN/CSA-S6, Clause 10.23.5.

906.07.01.07.12.02 Approval for Non-Critical Repairs

Non-critical repairs are those listed in CAN/CSA-S6, Clause 10.23.5.

Repair procedures shall be prepared and submitted to the Contract Administrator. Work on the repair shall not commence until the Contract Administrator has given written approval to proceed.

906.07.01.07.12.03 Approval for Critical Repairs

Repair procedures that are more severe than those described in CAN/CSA-S6, Subclause 10.23.5.4 are considered critical and shall be individually approved by the Contract Administrator before repair welding proceeds.

Critical repairs include those listed in CAN/CSA-S6, Clause 10.23.5.

906.07.01.07.13 Non-Destructive Testing of Fracture Critical Members

The fabricator shall maintain documentation of all visual and non-destructive testing for review and confirmation by the Contract Administrator. Documentation shall be submitted to the Contract Administrator upon completion of the project.

906.07.01.07.14 Repair of Welds

Any section of weld that does not meet the acceptance standards shall be removed, re-welded, and re-examined.

906.07.01.07.15 Bolted Construction

906.07.01.07.15.01 General

Bolted construction shall be according to CAN/CSA-S6, Clause 10.24.6.

Bolts shall be sufficiently long to exclude threads from the shear plane.

906.07.01.07.15.02 Plasma Arc Cutting of Holes

Plasma arc cutting of holes shall only be permitted in plates up to and including 20 mm in thickness. Plasma arc cut holes shall be produced by mechanically guided means and the diameter of the holes shall be greater than or equal to the thickness of the plate. When plasma arc cutting of holes is permitted, the cutting gas as well as the shielding gas shall be oxygen and the surface roughness shall not exceed 13 microns (500 micro-inches) as defined in ASME B46.1. Occasional gouges not more than 1.5 mm in depth are permitted. Thermally cut holes shall be 2 mm larger than the nominal diameter of the bolt and the taper shall not exceed 0.5 degrees.

906.07.01.07.15.03 Holes Drilled Using Numerically Controlled Machines

As an alternative to the shop trial assembly requirements of CAN/CSA-S6 when numerically controlled machines have prepared the boltholes, a check assembly consisting of the first components of each type of bolthole pattern to be made shall be undertaken to adequately demonstrate the accuracy of the drilling. If the check assembly is satisfactory, further assemblies of like components are not required. If the check assembly is unsatisfactory, the work shall be redone or repaired in a manner acceptable to the Contract Administrator.

906.07.01.07.15.04 Inspection

Inspection shall be according to CAN/CSA-S6 as required.

906.07.01.07.16 Tolerances

906.07.01.07.16.01 Dimensional and Workmanship Tolerances

Dimensional and workmanship tolerances shall be according to CSA W59 and Clause 10.24.7 of CAN/CSA-S6.

906.07.02 Transportation, Delivery, and Storage

The Contractor shall perform all work necessary to ensure safe loading, delivery, unloading, and storage of structural steel.

The work shall consist of loading the members, transporting them, and unloading at the site and shall include temporary works for access.

Structural steel shall be loaded for shipping in such a manner that it can be transported and unloaded at its destination without being excessively stressed, deformed, or otherwise damaged. Plate girders shall be transported with their webs in a vertical plane. When girders cannot be shipped with their webs in the vertical plane, static and dynamic forces during handling, transportation, and storage shall be determined using a dynamic load allowance of 100%. Computed stresses shall be according to CAN/CSA-S6, Clause 10.10 and the maximum cyclic stress range shall not exceed the constant amplitude fatigue threshold for the appropriate fatigue categories specified in CAN/CSA-S6, Table 10.4. All the calculations and associated sketches, including reasons why the girders cannot be shipped with the webs in the vertical plane, shall be submitted by the Contractor to the Contract Administrator for approval 7 Days prior to shipping. The calculations and sketches shall be signed and sealed by an Engineer.

Structural steel shall be stockpiled to avoid excessive stress deformation or other damage while stored.

The delivery schedule shall be provided to the Contract Administrator not less than 5 Days before any shipping begins.

Advertising by means of removable signing is permitted on elements only while in transit to the specified site. Painting of advertisements directly on elements is not permitted.

906.07.03 Erection

906.07.03.01 General

Erection shall be according to CAN/CSA-S6, Clause 10.24.10. Additional permanent material may be provided to ensure that the member capacities are not exceeded during erection, if approved by the Contract Administrator. The additional material shall be shown in the erection diagram.

The Contract Administrator shall be notified in writing of the starting erection date at least 14 Days prior to the commencement of field operations.

Repairs to erected material shall only be permitted after the Contract Administrator has approved the repair procedure.

Welding shall not be used to fill misplaced holes.

Hammering that can damage or distort the members is not permitted.

906.07.03.02 Falsework

Falsework shall be according to OPSS 919.

906.07.03.03 Connections

Holes made in the field shall be drilled or sub-drilled and reamed.

Any error that prevents the proper assembly and fitting of parts shall be reported and the proposed method of correction shall be submitted to the Contract Administrator. Corrective measures shall not commence until the submitted proposal is accepted.

Bolt heads shall be located on the outside faces of the exterior girders.

Bolt heads in field splices for box girders shall be located on the exterior surfaces.

906.07.03.04 Maintaining Alignment and Camber

The bridge shall be erected to the alignment and elevations specified in the Contract Documents.

906.07.03.05 Bearings

The installation of bearings shall be according to OPSS 922.

906.07.03.06 Coatings

Coating of new structural steel shall be according to OPSS 911.

906.07.04 Quality Control

906.07.04.01 General

Quality control shall be according to CAN/CSA-S6, Clause 10.24.8. The acceptance standards of CSA W59 for dynamically loaded structures shall also apply.

In addition to quality control measures instituted by the Contractor, the Contractor shall be responsible for the quality control procedures specified herein.

906.07.04.02 Control of Material

A record for each component shall be kept to identify the material as to heat number, corresponding mill test certificate, and colour coding or other identifying markings.

906.07.04.03 Visual Inspection

The Contractor's inspector shall carry out full visual inspection.

906.07.04.04 Non-Destructive Testing

906.07.04.04.01 General

An independent testing organization shall carry out all non-destructive testing of the welds for bridge structures by using radiographic, ultrasonic, magnetic particle, and liquid penetrant test methods.

A non-destructive testing technician shall do the testing.

Neither the technician nor the independent testing organization shall be changed without the approval of the Contract Administrator.

906.07.04.04.02 Notification of Testing

The independent testing organization shall be given at least 5 Days notice of when the work is ready for testing. Such notice shall include the type and quantity of work to be tested.

906.07.04.04.03 Testing of Welds

Radiographic, ultrasonic, or magnetic particle testing shall be carried out using procedures according to CSA W59.

The amount and location of welding to be tested shall not be less than:

- a) Visual inspection of all welds.

- b) Radiographic or ultrasonic inspection of groove welds in flanges and webs of built-up girders:
 - i. Flange splices in tension or stress reversal zones: 100% of all welds.
 - ii. Flange splices in compression zones: 100% of the weld of 1 in 4 splices.
 - iii. Web splices for 1/2 the depth from the tension flange: 100% of the weld length for each weld.
 - iv. Web splices for 1/2 the depth from the compression flange: 100% of the weld length of 1 in 4 splices.

If defects are found during testing of compression zones, two additional zones shall be tested for each zone exhibiting defects.

- c) Magnetic particle inspection of web-to-flange fillet welds:
 - i. Submerged-arc welds - 25% of length of each weld.
 - ii. Semi-automatic welds - 50% of length of each weld.
 - iii. Manual welds - 100% of length of each weld.
- d) Magnetic particle inspection of fillet welds in connection plates and stiffeners to which diaphragms or cross bracing are attached:
 - i. For 1/2 the depth from the tension flange: 100% of weld length of each weld.
 - ii. Transverse welds on tension flanges: 100% of weld length of each weld.
- e) Arc strikes shall be lightly ground and checked for cracks by magnetic particle inspection.

Radiographic and ultrasonic testing shall be performed prior to the assembly of the flanges to the webs.

906.07.05 Repair of Welds

The section of weld that does not meet the acceptance standards shall be removed, re-welded, and re-examined.

906.07.06 Inspection Reports

Inspection reports shall bear the seal and signature of an Engineer.

Copies of all inspection reports shall be submitted to the Contract Administrator.

906.07.07 Erected Girder Elevations

The top of flange elevations and top of splice plate elevations specified in the Contract Documents shall be checked and the elevations recorded and submitted to the Contract Administrator.

906.07.08 Certificate of Conformance Upon Completion of the Work

Upon completion of erection, the Contractor shall submit to the Contract Administrator a Certificate of Conformance sealed and signed by a Quality Verification Engineer. The Certificate shall state that the Work has been carried out in general conformance with the signed and sealed shop details, welding procedures, erection diagrams, erection procedure drawings, and Contract Documents.

906.07.09 Management of Excess Material

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

906.08 QUALITY ASSURANCE

906.08.01 General

Visual inspection, non-destructive testing, and sampling shall be done in the fabricating shop and in the field by an Owner's inspector to confirm the material supplied, fabrication, and erection has been done as specified in the Contract Documents.

The Contractor shall supply electric power, scaffolding, protection from the weather, and free access for inspection and testing of material, to all aspects of the fabrication, delivery, and erection of the structural steel.

906.10 BASIS OF PAYMENT

906.10.01 Fabrication of Structural Steel - Item

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

Structural steel that is stored at the fabricator's premises or some other location away from the Working Area shall be paid for when the Contractor obtains a lease from the property owner that names the Owner as the tenant. The Owner shall provide the form of lease for this purpose that specifies payment of \$10.00 for the term of the lease. The Contractor shall retain full responsibility for the members.

**906.10.02 Delivery of Structural Steel - Item
Erection of Structural Steel - Item**

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

906.10.03 Shop and Field Inspection and Testing

The supply of electric power, scaffolding, protection from the weather, and access for material testing and inspection shall be the Contractor's responsibility at no extra cost to the Owner.

906.10.04 Bearings

Payment for the supply and installation of bearings shall be according to OPSS 922.

When the Contract does not contain a separate item for bearings and bearings are not paid as part of any concrete tender item according to OPSS 904, the Contract price for the erection of structural steel shall include full compensation for all labour, Equipment, and Material to supply and install the bearings.

Appendix 906-A, November 2012
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Grade and category of structural steel. (906.05.01)
- Bridge alignment and elevation. (906.07.03.04)
- Girder top flange and top splice plate elevations. (906.07.07)

OPSS 906 contains information written for provincial contracts. To ensure completeness of municipal Contract Documents, the designer should invoke Appendix 906-B. The appendix contains supplemental requirements that modify OPSS 906 so it can be used by a municipality in its contracts.

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

Related Ontario Provincial Standard Drawings

OPSD 3311.100	Deck Girders, Steel, Method of Obtaining Screed Elevations
OPSD 3311.900	Deck Girders, Steel Box, Access Hatch

Appendix 906-B, November 2012

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

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

Supplemental Requirements for Using OPSS 906 in Municipal Contracts

OPSS 906, Structural Steel for Bridges, is amended as follows:

906.03 Definitions

Section 906.03 is amended by the deletion of the definitions for Certificate of Conformance and for Quality Verification Engineer.

Section 906.03 is amended by the addition of the following:

Certificate of Fabrication and Installation means a document issued by the design Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

906.04.02.02 Shop Details and Welding Procedures

The first paragraph of clause 906.04.02.02 is deleted in its entirety and replaced by the following:

The Contractor shall submit 5 sets of shop details and welding procedures to the Contract Administrator at least 14 Days prior to commencement of fabrication, for review. Prior to making a submission, the seal and signature of an Engineer shall be affixed on the shop details and welding procedures verifying that the details and procedures are consistent with the Contract Documents.

The second to last paragraph of clause 906.04.02.02 is deleted in its entirety.

906.04.02.03 Erection Diagrams and Erection Procedure Drawings and Calculations

The first paragraph of clause 906.04.02.03 is deleted in its entirety and replaced by the following:

The Contractor shall submit 5 sets of the erection diagrams and erection procedure drawings and calculations to the Contract Administrator at least 14 Days prior to commencement of erection, for review. Prior to making a submission, the seal and signature of an Engineer shall be affixed on the erection diagrams and erection procedure drawings and calculations verifying that the erection diagrams and erection procedure drawings and calculations are consistent with the Contract Documents.

The second to last paragraph of clause 906.04.02.03 is deleted in its entirety.

Appendix 906-B

906.04.02 Submissions

Subsection 906.04.02 is amended by the addition of the following:

906.04.02.06 Return of Submissions

Two copies of each submission shall be returned as one of the following:

- a) Stamped with the wording that allows for permission to construct. In this case, work can commence on receipt of the drawings by the Contractor.
- b) Stamped with the wording that allows for permission to construct as noted. In this case, work can commence on receipt of the drawings by the Contractor. The drawings shall be updated as noted and shall be sealed and signed by an Engineer stating the drawings have been revised according to the noted comments.
- c) Showing only required changes. In this case, the drawings shall be updated as required and the submission process repeated.

906.04.03 Interim Inspection after Fabrication of Components

Clause 906.04.03 is deleted in its entirety and replaced by the following:

Upon completion of fabrication of the components, and prior to erection, an Engineer shall conduct an interim inspection of the work to verify that the fabrication of components has been carried out in general conformance with the shop details, welding procedures, and Contract Documents and issue the fabricator written permission to proceed with the work.

906.07.03.01 General

The second paragraph of clause 906.07.03.01 is deleted in its entirety and replaced by the following:

The Contract Administrator shall be notified in writing of the erection starting date at least 3 weeks prior to the commencement of field operations.

906.07.03.03 Connections

The second paragraph of clause 906.07.03.03 is deleted in its entirety and replaced by the following:

Fabrication errors that prevent the proper assembly and fitting of parts shall be reported immediately to the Contract Administrator. The proposed method of correction shall be submitted to the Contract Administrator for review. Corrective measures shall not commence until written approval to proceed is issued by the Contract Administrator.

Appendix 906-B

906.07.08 Certificate of Conformance

Clause 906.07.08 is deleted in its entirety and replaced by the following:

906.07.08 Certificate of Fabrication and Installation

A certificate shall be submitted for all fabrication and installation work for which Working Drawings are submitted.

A completed certificate of fabrication and installation shall be submitted to the Contract Administrator upon completion of the structure erection. An Engineer's seal and signature shall be affixed on the completed certificate of fabrication and installation confirming that the work has been carried out in general conformance with the shop details, welding procedures, erection diagrams, erection procedure drawings, and Contract Documents.



CONSTRUCTION SPECIFICATION FOR STRUCTURAL WOOD SYSTEMS

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907.01 SCOPE

This specification covers the requirements for structural wood systems.

907.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

907.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

907.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 501	Compacting
OPSS 902	Excavating and Backfilling - Structures
OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete
OPSS 910	Stressing Systems for Post-Tensioning

Ontario Provincial Standard Specifications, Material

OPSS 1010	Granular - Base, Subbase, Selected Subgrade and Backfill Material
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1601	Wood - Material, Preservative Treatment and Shop Fabrication
OPSS 1860	Geotextiles

Ontario Ministry of Transportation Publications

Structural Manual

CSA Standards

B111-1974 (R2003)	Wire Nails, Spikes and Staple
G40.20-04/G40.21-04 (R2009)	General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
O86-09	Consolidation, Engineering Design in Wood
S6-06	Canadian Highway Bridge Design Code

ASTM International

A 47/A 47M-99 (2009)	Ferritic Malleable Iron Castings
A 307-10	Carbon Steel Bolts and Studs, 60000 psi Tensile Strength
A 653/A 653M-10	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process
A 722/A 722M-07	Uncoated High-Strength Steel Bar for Prestressed Concrete

907.03 DEFINITIONS

For the purpose of this specification, definitions in OPSS 1601 and the following definitions apply:

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Fastener means hardware used to connect wood members or components.

Girders means generally very large size beams and stringers or glued-laminated member for use in bending with load applied to the narrow face.

Groove and Dap means the wood base of a wood-concrete composite deck using alternating height laminations where the higher laminate is grooved and dapped according to CAN/CSA-S6.

Laminated Wood Deck means dimension lumber placed side by side on its narrow face to form a wood slab.

Lamination means dimension lumber sizes when used in a laminated wood deck.

Longitudinally Laminated Deck means a deck where the wood laminations are placed on edge and oriented parallel to the longitudinal centreline of the deck.

Notch and Spike means the wood base of a wood-concrete composite deck using uniform height laminations, where all laminations have square notches reinforced with spikes according to CAN/CSA-S6.

Reinforcing Spike means a common nail used to reinforce the shear key in notch and spike wood-concrete composite decks.

Stress-Laminated Wood Deck means a laminated wood deck, which is held together by pressure applied perpendicular to the laminations using high-strength bars according to CAN/CSA-S6.

Stringers means sawn wood that has a minimum thickness of 114 mm and a width at least 51 mm greater than the thickness for use in bending with load applied to the narrow face.

Transversely Laminated Deck means a deck in which the wood laminations are placed on edge and oriented transversely to the longitudinal centre line of the deck.

Truss Plates means a sheet of steel that has been punched by a special die, where the displaced material forms sharp teeth, used to connect laminations at butt joints in wood-concrete composite decks.

Wood-Concrete Composite Deck means a deck that has a laminated wood base made composite with a reinforced concrete overlay.

907.04 DESIGN AND SUBMISSION REQUIREMENTS

907.04.01 Submission Requirements

907.04.01.01 General

All Working Drawings, stressing details, and calculations shall bear the seal and signature of an Engineer.

At least 14 Days prior to commencement of work, 5 copies of any proposal shall be submitted to the Contract Administrator.

When other authorities are involved in the approval of the design or construction of a highway structure, the submission shall be made at least 5 weeks prior to commencement of the work. One additional set is required to be submitted for each authority.

907.04.01.02 Submission of Working Drawings for Fabrication and Fastening Details

At least 4 weeks before the commencement of fabrication, the Contractor shall submit 5 complete sets of the Working Drawings to the Contract Administrator.

Fabrication details shall include the following:

- a) The grade and species of all wood components and all necessary specifications.
- b) The type of preservative treatments to be used for all wood components, including the penetration, and retention required.
- c) Details of shop fabrication.
- d) Details of all fabrication to be performed in the field.
- e) Details of all field cuts and field boring.
- f) Special handling or protection details required in the shop, during shipping, or in the field.
- g) The field installation details of any temporary attachments such as running planks, barricades, and railings.
- h) Protective treatment of heat-treated alloy components.
- i) Fastening details.

907.04.01.03 Submission of Erection Procedures

Erection procedures shall bear the seal and signature of an Engineer.

At least 4 weeks before commencement of erection, the Contractor shall submit to the Contract Administrator, 5 complete sets of the erection procedures, including lifting point locations, details of all temporary supports, and prestressing procedures.

907.04.01.04 Return of Submissions

Two copies of each submission to be returned shall be marked as one of the following:

- a) Stamped with wording that allows for permission to construct.

In this case, work can commence upon the Contractor's receipt of the Working Drawings. A copy of the Working Drawings shall be available at the site prior to and during construction.

- b) Stamped with wording that allows for permission to construct as noted.

In this case, work can start upon the Contractor's receipt of the Working Drawings. The Working Drawings shall be updated as noted and shall have a stamp affixed that is signed by an Engineer stating that the Working Drawings have been revised according to the noted comments. A copy of the stamped updated Working Drawings shall be available at the site prior to and during construction.

- c) Showing only required changes.

In this case, the Working Drawings shall be updated as required and the submission process repeated.

907.05 MATERIALS

907.05.01 Wood

Wood shall be according to OPSS 1601.

907.05.02 Preservatives

The preservatives shall be according to OPSS 1601.

For wood structural systems in bridges, preservatives shall also be according to the CAN/CSA-S6 and the Structural Manual.

907.05.03 Fasteners and Hardware

907.05.03.01 Bolts, Rods, and Lag Screws

Bolts, rods, and lag screws shall be according to ASTM A 307 or CSA G40.20/G40.21.

907.05.03.02 Truss Plates

Sheet steel for manufacturing truss plates shall be according to ASTM A 653, Type A or Type B.

907.05.03.03 Split Ring and Shear Plate Connectors

Split ring and shear plate connectors shall be according to CSA O86.

907.05.03.04 Glulam Rivets

Glulam rivets shall be according to CSA O86.

907.05.03.05 Nails and Spikes

Nails and spikes shall be according to CSA B111.

907.05.03.06 Drift Pins

Steel used for drift pins shall have minimum yield strength of 280 MPa and shall be according to CSA G40.20/G40.21.

907.05.03.07 Washers

Steel washers shall be according to CSA G40.20/G40.21. Malleable iron casting washers shall be according to ASTM A 47M.

907.05.03.08 High-Strength Bars

High-strength bars shall be according to ASTM A 722M.

907.05.03.09 Galvanizing

All fasteners and hardware shall be hot dip galvanized according to CSA G164, after manufacture.

Heat-treated alloy components shall be galvanized according to the manufacturers specifications.

907.05.04 Granular Materials

Granular materials shall be according to OPSS 1010.

907.05.05 Geotextile

Geotextile shall be non-woven, Class II according to OPSS 1860, Table 1, with an FOS of 75-150 µm.

907.05.06 Concrete

Concrete shall be according to OPSS 1350 with a minimum 28-Day specified compressive strength of 30 MPa.

907.05.07 Steel Reinforcement

Steel reinforcement for concrete shall be according to OPSS 1440.

907.06 EQUIPMENT

907.06.01 Hydraulic and Mechanical Press

Hydraulic or mechanical presses capable of applying uniform pressure over the whole area of truss plates shall be used for the installation of all truss plates.

907.06.02 Hydraulic Jack System Stress-Laminated Wood Decks

The stressing equipment shall be according to OPSS 910.

The hydraulic jack system shall be capable of stressing a minimum of six post-tensioning locations at a time. For longitudinally laminated decks, the number of jacks shall not be less than those required to stress a length of deck equal to one half the width of the deck at the same time.

907.07 CONSTRUCTION

907.07.01 Handling and Storage of Wood

All wood shall be handled, stacked, and protected according to OPSS 1601.

907.07.02 Shop Fabrication

Shop preparation and fabrication shall be according to OPSS 1601.

907.07.03 Field Fabrication

Field fabrication shall only be permitted when specified in the Contract Documents.

Field cut portions of treated wood members shall not be buried or placed in contact with the ground.

Cutting and boring shall not puncture the internal voids of bridge decks containing the post-tensioning bars.

Field cuts, abrasions, and boreholes made in fabricated wood after preservative treatment shall be trimmed and treated to be according to OPSS 1601.

907.07.04 Fasteners

907.07.04.01 Bolts, Rods, and Lag Screws

Holes shall be prebored as specified in the Contract Documents. Holes shall be aligned and the bolts and rods shall be driven, with a hammer not larger than 0.5 kg, in order to make the connection. Lag screws shall be turned into the wood, not driven.

Holes for smooth dowels and drift pins shall be 1.5 mm less in diameter than the dowels or pins. Holes for galvanized bolts shall be bored with a bit 1.5 mm larger in diameter than the bolt.

Holes for lag screws shall have the same diameter and depth as the shank of the screw, plus a lead hole for the threaded portion with the diameter approximately 75% of the shank diameter.

Washers shall be placed under all bolt heads and nuts. Excess bolt lengths of more than 50 mm shall be cut off to a level where at least 5 threads are still extending beyond the nut. The cut ends of galvanized bolts shall receive 2 coats of zinc rich paint. After final tightening, all nuts shall be checked and threads burred effectively with a pointing tool to prevent loosening. Field cuts or damaged surfaces shall be touched-up with a zinc rich paint within 10 hours of exposure.

907.07.04.02 Nailing for Laminated Decks

Gauge lines for horizontal nailing shall be followed. Nails in the upper gauge line shall be inclined slightly downward and those in the lower gauge line inclined slightly upward. The nailheads shall be flush and well set so that they do not protrude from the surface. Power nailing devices shall be permitted for stress-laminated wood decks according to the CAN/CSA-S6.

907.07.05 Wood in Cribs

Excavation shall be according to OPSS 902.

Cribs shall be erected to the dimensions shown in the Contract Documents with each layer horizontal before placing the next. Wood with the least surface oils shall be located in or nearest to the water. Wood, which appears to be more heavily treated, shall be placed at the back of the crib against the ground.

The cribs shall be filled to 1 m below the top of the crib with boulder or rock fragments having dimensions in the range 200 to 600 mm. The top metre of the cribs shall be filled with Granular A or B. The granular material shall be protected against migration into the rock layer by the placement of geotextile fabric between the rock and the granular layers. The geotextile shall be placed uniformly, free of tears and as specified in the Contract Documents. All seams shall have a minimum overlap of 500 mm and the geotextile shall be fixed to prevent movement. Filling of the cribs shall be such that distortion is avoided. Fill material shall be placed in even horizontal layers and shall be compacted according to the requirements of OPSS 501.

907.07.06 Placement of Members

907.07.06.01 Stringers and Girders

Stringers and girders shall be placed and adjusted when necessary so that full and accurate bearing is achieved on the supports. Sawn wood members shall be oriented so that elevation differences between adjacent members, due to natural curvatures along their lengths, are minimized.

907.07.06.02 Laminated Wood Deck

Each lamination shall be placed in the bridge so that initially, full and accurate bearing is achieved. Subsequently the alignment of predrilled holes in stress-laminated decks or slots in composite wood-concrete decks shall be achieved. Finally, the laminations shall be brought to position by nailing.

907.07.07 Stress-Laminated Wood Decks

907.07.07.01 Stressing

Hydraulic jacks shall be used for stressing the stress-laminated wood decks. For transversely laminated decks, all tendons shall be uniformly stressed at the same time.

High-strength bars shall be stressed to the forces shown in the Contract Documents. The tensioning shall be performed in the following sequence:

- a) Initial stressing - at time of construction of deck.

The initial stressing shall consist of two stressing operations not less than 12 hours apart.

- b) 1st restressing - not less than 2 weeks after completion of the initial stressing.
- c) 2nd Restressing - not less than 4 weeks after the 1st restressing.

The allowable variation of prestressing force in each bar shall be 5%.

The Contract Administrator may increase the time periods between restressings, when the ambient temperature is below 0 °C.

907.07.07.02 Securing of Deck

The deck shall not be secured to the supporting members, except as specified in the Segmental Construction clause, until after the 1st restressing. When a deck requires restraint against buckling during stressing, the restraint shall not inhibit free movement of the deck perpendicular to the laminates.

907.07.07.03 Segmental Construction

When a deck is to be constructed in segments, each segment shall undergo all restressings as specified in the Stressing clause before being installed. The method of installation of the segments shall be such that the final assembled deck is continuous.

When the method of installation requires the temporary release of stressing in a segment in order to facilitate installation, that segment shall then be stressed twice before any segments are attached to it. The first stressing shall be at the time of installation of that segment. The second stressing shall be performed no sooner than 4 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 908

CONSTRUCTION SPECIFICATION FOR METAL TRAFFIC BARRIERS AND METAL RAILINGS FOR STRUCTURES

OPSS 908 has been removed from this
OPS volume

The provincial version of OPSS 908 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 908

The municipal version of OPSS 908 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 908

USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS



NOTICE TO USERS OF OPSS 909

CONSTRUCTION SPECIFICATION FOR PRESTRESSED CONCRETE – PRECAST GIRDERS

OPSS 909 has been removed from this
OPS volume

The provincial version of OPSS 909 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 909

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OPS Volume 7,
Municipal-Oriented
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NOTICE TO USERS OF OPSS 910

CONSTRUCTION SPECIFICATION FOR STRESSING SYSTEMS FOR POST-TENSIONING

OPSS 910 has been removed from this
OPS volume

The provincial version of OPSS 910 is now in:

OPS Volume 5,
Provincial-Oriented
MTO General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.PROV 910

The municipal version of OPSS 910 is now in:

OPS Volume 7,
Municipal-Oriented
OPS General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.MUNI 910

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NOTICE TO USERS OF OPSS 911

CONSTRUCTION SPECIFICATION FOR COATING STRUCTURAL STEEL SYSTEMS

OPSS 911 has been removed from this
OPS volume

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OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 911

The municipal version of OPSS 911 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 911

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NOTICE TO USERS OF OPSS 913

CONSTRUCTION SPECIFICATION FOR EMBEDDED WORK IN STRUCTURES FOR ELECTRICAL SYSTEMS

OPSS 913 has been removed from this
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The provincial version of OPSS 913 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
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OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 913

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NOTICE TO USERS OF OPSS 914

CONSTRUCTION SPECIFICATION FOR WATERPROOFING BRIDGE DECKS WITH HOT APPLIED ASPHALT MEMBRANE

OPSS 914 has been removed from this
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The provincial version of OPSS 914 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 914

The municipal version of OPSS 914 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 914

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NOTICE TO USERS OF OPSS 915

CONSTRUCTION SPECIFICATION FOR SIGN SUPPORT STRUCTURES

OPSS 915 has been removed from this
OPS volume

The provincial version of OPSS 915 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 915

The municipal version of OPSS 915 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 915

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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

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CONSTRUCTION SPECIFICATION FOR FORMWORK AND FALSEWORK

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919.01 SCOPE

This specification covers the design and construction requirements for formwork, falsework, and temporary supports used in the construction and rehabilitation of structures.

919.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

919.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

919.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 501	Compacting
OPSS 903	Deep Foundations
OPSS 906	Structural Steel

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase, Selected Subgrade, and Backfill Material
OPSS 1350	Concrete - Materials and Production
OPSS 1801	Corrugated Steel Pipe Products

CSA Standards

A23.3-04	Design of Concrete Structures
G40.20-04/40.21-04	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
G164-M92	Hot Dip Galvanizing of Irregularly Shaped Articles
O86-M84 (R1992)	Engineering Design in Wood
O121-08	Douglas Fir Plywood
O122-06	Structural Glued-Laminated Timber
S16-1969	Steel Structures for Buildings
S157/S157.1-05	Strength Design in Aluminum/Commentary on CSA S157-05, Strength Design in Aluminum
S269.1-1975 (R2003)	Falsework for Construction Purposes
S269.3-M92 (R2008)	Concrete Formwork

National Research Council (NRC)

National Building Code of Canada-2005

919.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Bulkhead means the vertical form that supports the end width of a deck pour of concrete.

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Culvert means a structure that provides an opening through an embankment and in which roadway loads are distributed to the structure through fill or that is designated as a culvert in the Contract Documents.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Exposed Surface means all external formed surfaces not to be covered by backfill material.

Falsework means any temporary structural support, including bracing, used to support all or part of the formwork or of the structure during its construction or rehabilitation until it becomes self-supporting.

Formwork means the mould into which the fresh concrete is placed.

Foundation means the ground immediately below the mudsills that supports the falsework or that portion of ground supporting the falsework piles.

Grade means:

- a) For steel, the designation of the quality of the steel that can be determined by referring to the appropriate CSA standard or by specimen testing.
- b) For wood, the designation of the quality of a piece of wood that can be determined by referring to the appropriate CSA Standard.

Hardwood means wood with a degree of hardness at least equal to a species, such as hard maple, oak, or beech.

Joist means one of a series of horizontal members, usually with narrow face up, to which form material is fastened.

Ledger means a horizontal flexural member usually supporting joists and resting on vertical supports.

Mudsill means a mat of timbers or a small footing on the ground used as a base from which the remainder of the falsework structure is erected.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Shoring means a system of vertical or inclined supports for forms or structure components. Shoring may be wood or metal posts, scaffold-type frames, or various patented members or other system of falsework.

Stay-in-Place Forms means forms that are not removed.

Structure means any bridge, culvert, tunnel, retaining wall, wharf, dock, or guideway.

Stud means one of a series of usually vertical members used in framing to support the plywood or formwork fastened to it.

Timber means felled trees or logs suitable for conversion by sawing or otherwise or a piece of sawn lumber having a minimum nominal dimension greater than or equal to 125 mm.

Wood means lumber and timber.

919.04 DESIGN AND SUBMISSION REQUIREMENTS

919.04.01 Design Requirements

919.04.01.01 Formwork Design

Formwork design shall be according to CAN/CSA S269.3.

919.04.01.02 Falsework Design

Falsework design shall be according to CSA S269.1 and as specified herein.

The allowable stresses for wood design shall be according to CSA/CAN3-086.

The allowable stresses for structural steel design shall be according to CSA S16, except the stresses allowed may be increased by 15% for temporary loading.

Deflection of beams shall be limited to $L/270$, where L is the span. The loading for deflection shall be the weight of concrete and formwork.

When deflection of a beam is 10 mm or more, provision shall be made to compensate for deflection. When provision is made to compensate for deflection, the deflection of the beams shall be limited to $L/240$, where L is the span. The tolerance shall be ± 5 mm.

Aluminum components shall be designed according to CAN3-S157.

Concrete components shall be designed according to CSA A23.3.

Where scaffolding, fabricated shoring, or patented accessories are used, the design shall be according to the manufacturer's recommendations.

Where another authority is involved, any additional requirements specified by the authority shall also be satisfied.

919.04.01.03 Vertical Loadings

Vertical loading shall be:

- a) The weight of the concrete being supported or 2.50 kN/m^2 on the horizontal projected area of the formwork, whichever is the greater.
- b) The weight of normal concrete, as it is placed, shall be considered as a liquid having a weight of 24.00 kN/m^3 .
- c) The weight of the formwork supported by the falsework or 0.50 kN/m^2 of the horizontal projected area, whichever is greater.
- d) The weight of workers, equipment, and tools that is to be supported during the concrete placing and finishing operations or 2.00 kN/m^2 of horizontal projected area of formwork whichever is greater. When motorized placing equipment is used this minimum load shall be increased to 3.00 kN/m^2 .
- e) Load due to any special conditions of construction likely to occur.
- f) Loads for temporary supports as specified.

919.04.01.04 Horizontal Loading

The horizontal loadings shall include the effects of environmental factors, such as wind; the rate of placing of concrete; the temperature of the concrete; the effect of vibration of the concrete; the consistency of the mix; and other pertinent factors.

Wind pressures shall be based on those listed in the National Building Code of Canada using 1/30 probability for falsework and 1/10 probability for formwork with a gust factor of 2 and a minimum wind pressure of 0.8 kPa.

Notwithstanding the above, a minimum transverse and longitudinal force of 2% of vertical loading or 1.50 kN/m of deck edge applied at the mid-depth of the deck, whichever is greater, shall be used.

919.04.01.05 Tower Leg Loads

The vertical loads on the tower legs may be based on simple span assumptions. The loads supported by a tower leg may be assumed to be those loads applied to the area immediately above the tower leg that is bounded by lines located one half way between each of the bays adjacent to the tower leg being considered.

When locating towers, the following criteria shall apply:

The maximum design load on one leg of a frame shall not exceed four times the design load on the other leg under full or partial loading conditions.

The maximum design load on one of the two frames making up a tower shall not exceed four times the design load on the opposite frame under any loading condition.

The minimum bracing requirements are as follows:

a) Connections Between Joists and Ledgers

Every fourth joist shall be connected to a ledger.

Ledgers on top of frames shall be axially continuous across the shoring system to evenly distribute horizontal forces to individual scaffold towers below. Ledgers with a splice designed to take the axial load are considered axially continuous.

b) Bracing in the Transverse Direction

When the shoring height is composed of three frames or the shoring height is more than three times the tower width or the total shoring height is more than 5 m, one horizontal brace made continuous shall be installed on one face of each tower.

The brace shall be located at the mid-height of a two-frame tower and at the top of the second frame for a three-frame tower.

When shoring towers are adequately braced against transverse movement by tying to an adjacent structure or adjacent tower, the above height-to-width restriction applies only to the tower grouping.

When the shoring height is composed of more than three frames, at least one horizontal brace made continuous and one diagonal brace made continuous shall be attached to one transverse face of each tower for every three frames of shoring height. In addition, the maximum spacing of the horizontal brace shall be three times the tower width. The horizontal brace shall be located near the top of a frame. Diagonal braces on adjacent towers shall be installed in opposite directions.

When superelevation is 4% or greater, a horizontal transverse brace shall be attached to one tower face of the top frame in addition to the bracing required by the preceding paragraph.

When the shoring height is greater than 20 m, guy wires shall be installed. The spacing of the guy wires shall not be greater than 15 m horizontally.

c) Bracing in the Longitudinal Direction

When the shoring height is composed of three frames or the total height is more than 5 m, one horizontal brace made continuous shall be installed spaced horizontally not more than 6 m apart. The brace shall be located at the top of the first frame of a two-frame tower and the top of the second frame of a three-frame tower.

When the shoring height is composed of four frames or more, horizontal braces and diagonal braces made continuous shall be attached on a tower and spaced horizontally not more than 6 m apart. The lowest brace shall be located no higher than the third frame and additional braces shall be spaced vertically at the top of every third frame thereafter.

When the bridge is on a longitudinal grade of 4% or greater, braces parallel to the grade shall be attached to one tower face of the top frame and spaced not more than 6 m apart horizontally.

d) Tie Back Bracing - Falsework Opening Towers

The falsework opening towers shall be longitudinally braced to two rows of scaffold towers behind them according to the Bracing in the Longitudinal Direction requirements above, regardless of the height, and shall be continuously braced transversely.

919.04.01.07 Mudsills

The mudsills shall be designed such that the settlement of mudsills shall not exceed 12 mm.

919.04.02 Submission Requirements

919.04.02.01 Working Drawings

919.04.02.01.01 General

Working Drawings shall be submitted for all falsework used in the construction or rehabilitation of structures, except for culverts less than 3 m in span.

Working Drawings are required for the following formwork:

- a) Inside forms for post-tensioned decks;
- b) Bulkheads in post-tensioned decks 2.0 m or greater in height;
- c) All columns and walls, 2.4 m or greater in height, of abutments, piers, and retaining walls.

Working Drawings for other formwork shall only be submitted, when specified in the Contract Documents.

Formwork and falsework shall not be supported by, braced to, or come in contact with another structure unless written permission is received from the owner of the other structure. In order to obtain written permission, 3 copies of Working Drawings shall be submitted to the owner of the other structure showing the support locations and imposed loads as they are applied to that structure and certify that the structure can safely support all the imposed loads from the Contractor's method of construction. Prior to a submission, an Engineer's seal and signature shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

During formwork and falsework construction, the Contractor shall have a copy of the Working Drawings at the site.

919.04.02.01.02 Falsework

The Contractor shall submit 3 sets of falsework Working Drawings to the Contract Administrator at least 1 Day prior to commencement of erection of falsework, for information purposes only. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

Where multi-discipline engineering work is depicted on the same Working Drawing and the design or design-checking Engineer or both are unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be sealed and signed by as many additional design and design-checking Engineers as necessary.

When other authorities are involved, 1 set of Working Drawings shall be submitted for each authority at least 5 weeks prior to the commencement of falsework construction.

The Working Drawings for the falsework for each structure shall include all details of all falsework to be erected.

Falsework Working Drawings shall include at least the following:

- a) Longitudinal, lateral, vertical, live, impact, and anticipated construction loads used in the design.
- b) Allowable bearing capacity of the soil beneath the mudsills.
- c) Maximum column loads.
- d) Deflection diagrams for beams having a deflection of 10 mm or more.
- e) The grade and actual size of all structural materials.
- f) Posts, connections, bracing and welding sufficiently detailed to demonstrate compliance with the structural analysis and erection requirements.
- g) Fully detailed frame shoring.
- h) Type and mass of moving or stationary equipment to be supported by the falsework.
- i) Sequence, method, and rate of concrete placement.
- j) All proprietary equipment sufficiently identified to demonstrate compliance with the structural analysis and erection requirements.
- k) Full details and locations of all splices.
- l) Method of maintaining rotational and lateral stability of bridge girders.
- m) Vertical stiffening details and lateral restraint for ledgers and subledgers.
- n) Lateral restraint details for falsework supporting beams spanning openings.
- o) Fluid concrete loads, assumed for design purposes.
- p) Location of screed rail supports and design load.
- q) Anticipated settlement of falsework, including settlement of mudsill.

919.04.02.01.03 Formwork

The Contractor shall submit 3 sets of formwork Working Drawings to the Contract Administrator at least 1 Day prior to commencement of erection of formwork, for information purposes only. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents and sound engineering practices.

Where multi-discipline engineering work is depicted on the same Working Drawing and the design or design-checking Engineer or both are unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be sealed and signed by as many additional design and design-checking Engineers as necessary.

When other authorities are involved, 1 set of Working Drawings shall be submitted for each authority at least 5 weeks prior to the commencement of falsework construction.

The Working Drawings shall show all necessary design and construction details, including the grade and size of materials used and the pressure diagrams used in the design.

919.04.02.02 Foundation Information

919.04.02.02.01 Falsework Foundation Design Report

Three copies of a Falsework Foundation Design Report shall be submitted to the Contract Administrator. The report shall bear the seal and signature of an Engineer, shall include the rationale used to determine the soil bearing capacity, and shall include the following information:

- a) The soil bearing capacity.
- b) Site preparation details.

A Falsework Foundation Design Report is not required when the mudsill bears on mass concrete poured directly on bedrock or when the mudsill bears on compacted Granular A of depth 1.0 m or less placed directly on bedrock.

919.04.02.02.02 Interim Inspection after Construction of Falsework Foundation

Upon completion of the falsework foundation and prior to installation of falsework, the Quality Verification Engineer shall conduct an interim inspection of the work to verify that the falsework foundation has been constructed according to the Falsework Foundation Design Report and issue the Contractor written permission to proceed with the work.

919.04.02.03 Proprietary Shoring, Forms, and Accessories

When proprietary shoring, forms, and accessories are used, the manufacturers' allowable loads with supporting test data shall be submitted with the Working Drawings.

919.04.02.04 Splices for Stay-In-Place Forms

Details of the method of joining round stay-in-place forms shall be shown on the Working Drawings.

919.04.02.05 Revised Submissions

When falsework design considerations or field conditions necessitate amendments to the falsework, revisions shall be resubmitted according to the Working Drawings clause.

919.05 MATERIALS

919.05.01 General

Forms and falsework shall be constructed of wood, metal, or concrete.

919.05.02 Wood

Wood shall be according to CSA/CAN3-O86.

919.05.03 Plywood

Plywood for formwork shall be 7 ply, 17 mm minimum thickness exterior grade Douglas Fir Plywood according to CSA O121.

For exposed surfaces, the finish side shall be medium density overlay plywood; however, this finish is not required in the following locations:

- a) The underside of a deck between girders.
- b) The ends of decks.
- c) The face of ballast walls.
- d) The internal faces of a culvert.

919.05.04 Structural Glued-Laminated Timber

Structural glued-laminated timber shall be exterior grade according to CAN/CSA O122.

919.05.05 Metal

Structural steel shall be according to CAN/CSA G40.20/G40.21 and be of the grade shown on the Working Drawings.

Aluminum shall be according to CSA-S157 and be of the alloy and temper shown on the Working Drawings.

Used metal shall be in good condition. All previous fabrication, adversely affecting the required strength, shall be corrected.

919.05.06 Concrete

Concrete shall be according to OPSS 1350.

919.05.07 Accessories

All accessories used shall comply with the details shown on the Working Drawings or with the recommendations of the manufacturer of the specified accessory.

Deck hangers and hardware left in place, either exposed or embedded in concrete within 20 mm of its surface, shall be hot dip galvanized.

All form ties left in place in barrier and parapet walls shall be hot dip galvanized, coated with an approved material, or non-corrodible. Where stainless steel reinforcement is used within the form, all form ties left in place in barrier and parapet walls shall be of stainless steel type 304.

The maximum diameter of plastic cones for form ties shall be 30 mm.

Hot dip galvanizing shall be according to CAN/CSA G164-M.

919.05.08 Void Tubes

Corrugated steel pipe shall be according to OPSS 1801 and need not be coated.

The thickness of the plate in the corrugated pipe shall be as follows:

- a) Diameters equal to or less than 900 mm - 0.9 mm thick.
- b) Diameters over 900 mm to 1200 mm - 1.1 mm thick.

Steel void forms shall have an outside diameter, top of corrugation to top of corrugation, equal to the diameter of the voids shown on the Working Drawings.

Paper fibre tubes shall be coated, spiral wound, wood fibre paperboard manufactured with waterproof glue.

919.05.09 Granular A

Granular A shall be according to OPSS 1010.

919.07 CONSTRUCTION

919.07.01 Formwork

919.07.01.01 General

Forms shall be smooth; clean; free from warps, splits, holes, and bulges; and constructed and maintained to be mortar tight.

919.07.01.02 Exposed Surfaces

Forms for exposed surfaces shall be new, except that forms may be re-used for exposed surfaces providing their condition is such as to produce a surface equal to one that would be attained using new materials. Where possible, plywood used on exposed surfaces shall be in full sheets and, except when used to form the underside of deck slabs for slab-on-girder construction, shall be so arranged that the face grain is perpendicular to the studs or joists.

919.07.01.03 Studs, Joists, and Decking

Studs and joists shall be spaced not more than 400 mm on centres. Edges of abutting sheets shall be nailed to the same stud or joist with 50 mm nails at not more than 200 mm centres. When used to form the underside of deck slabs in post-tensioned slab and rigid frame bridges, the joints between sheets abutting over joists shall be staggered a minimum of 400 mm. When prefabricated form panels are used, adjacent panels shall be placed such that the joints are maintained flush.

919.07.01.04 Form Release Oil

Non-staining form release oil shall be applied to the faces of forms against which concrete is to be placed. The form release oil shall be applied before placing reinforcement.

919.07.01.05 Ties

When internal form ties are used, concrete cover to any metal left upon removal of the forms shall be 20 mm minimum.

All ties, securing stay-in-place forms in position and extending below the deck soffit shall be loosened before any stressing commences.

Holes left in the deck soffit after removal of hanger coil rods shall be left open.

919.07.01.06 Exposed Corners

All exposed corners on concrete work and the edges of the box void slabs on the soffit of the structure shall be chamfered. The chamfer shall have a vertical and horizontal dimension of 20 mm.

919.07.01.07 Stay-in-Place Forms

Stay-in-place forms shall only be used when specified in the Contract Documents or under the following conditions:

- a) Round void tubes of metal in cast-in-place hollow prestressed concrete decks and round void tubes of metal or paper fibre in precast prestressed hollow slab deck units.

Where round voids are used, individual lengths shall be joined by an inner or outer sleeve or other method. Details of the method of joining shall be submitted to the Contract Administrator, for information purposes only.

- b) Box voids in precast concrete box girder deck units less than 1.2 m in depth.

919.07.02 Falsework

919.07.02.01 General

Sound adjustable falsework shall be built such that the structure remains true to line and grade after anticipated settlement.

Mudsills shall not be placed until the Contractor has a set of falsework Working Drawings on site.

The use of tack welds for hangers or other attachments to structural steel is not allowed, except that tack welds may be used on shear studs where it is not detrimental to the connection between the stud and the structural steel.

All welding of structural steel shall be according to OPSS 906.

919.07.02.02 Foundation Work

The falsework structure shall be supported on mudsills, structure footings, or piles.

Where the existing ground is unable to take the applied loads, piles driven according to OPSS 903 shall be used to support the falsework.

Where a timber pile in a falsework bent is too short, the Contractor shall cut off all the piling in the bent to the same elevation and cap the bent. An extension bent shall then be constructed. A pile splice shall only be used with the approval of the Contract Administrator.

Where steel piles are used in a falsework bent, a splice designed and fabricated for 100% of the pile section may be used to make up the required length of any pile.

All caps shall be continuous for the entire length of the bent or sliced as approved by the Contract Administrator. When splices in caps are approved, they shall be located at the centreline of a pile.

For traffic openings, a minimum horizontal space of 1.0 m shall be provided between the back face of the concrete barrier and the front edge of the mudsill.

A levelling pad consisting of a minimum of 100 mm of Granular A, compacted according to OPSS 501, or of poured in place concrete shall be placed under mudsills on bedrock to provide a level surface.

Where the ground is sloped and the Contractor elects to excavate steps, the slopes between the horizontal steps shall not be steeper than 1H:1V. A minimum horizontal width of 300 mm shall be provided between the mudsill and the top edge of slope.

Reduction of the bearing capacity of existing ground or compacted fill, due to water or ice, shall be prevented by suitable drainage or protection.

919.07.02.03 Wooden Shoring

All wooden posts shall be solid, not built up. Where splicing is necessary, the posts shall be cut square and the two pieces shall be in full contact over the splice. Scabbing shall be provided on all four faces of a post to be spliced. Each post shall be braced in two directions both above and below the splice immediately adjacent to the scabbing. Splices on adjacent posts shall be staggered.

Splicing of round posts shall not be permitted.

Bracing material shall be at least 38 x 89 mm lumber except for cross bracing for side forms where 19 x 138 mm lumber may be used. Bracing shall be nailed to each post with at least two 100 mm nails for 38 x 89 mm lumber and two 75 mm nails for 19 x 138 mm lumber. Splicing of bracing shall not be permitted.

Wedges used for purposes of falsework adjustment or to facilitate removal shall be hardwood.

919.07.02.04 Metal Shoring

Erection of metal frame shoring shall be according to CSA S269.1.

The maximum extension of jacks shall not exceed the lesser of the manufacturer's recommendations or 600 mm.

Shims used for levelling mudsills shall be fir plywood or solid lumber.

Wedges used to provide full bearing in U-heads shall be hardwood.

919.07.03 Temporary Supports

The construction of temporary supports shall be as specified in the Contract Documents.

919.07.04 Screed Rail Supports in Slab on Girder Construction

In slab-on-girder construction, screed rail supports shall not be located outside the centreline of the web of the outside girders.

When screed rail supports are not located over the webs of girders, a system of support shall be installed such that the deflection of the system under the load of the screed machine shall not exceed 5 mm.

919.07.05 Certificate of Conformance

Certificates of Conformance shall be submitted for all formwork and falsework for which Working Drawings are submitted.

A completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of formwork and falsework installation and before any concreting takes place. The Qualification Verification Engineer's seal and signature shall be affixed on the completed Certificate of Conformance confirming that the formwork and falsework have been installed in general conformance with the Working Drawings and Contract Documents.

919.07.06 Removal of Formwork, Falsework, and Temporary Supports

All formwork and falsework shall be removed. When authorized by the Contract Administrator, piles used for falsework may be left in place provided the top is 1.2 m below the finished grade or ground level or is at least 0.6 m below a streambed.

The method and sequence of removal of the formwork and falsework shall be such that it permits the concrete to take up the stresses gradually.

Falsework shall not be removed from post-tensioned structures until the post-tensioning is completed.

When a component is not post-tensioned, falsework may be removed after the concrete has attained a minimum strength of 20 MPa.

Formwork shall not be removed until the concrete has attained a minimum strength of 20 MPa; however, formwork for cast-in-place barrier walls and parapet walls may be removed 24 hours after completion of the placement.

Where insulation is used, the side forms may be slackened off 24 hours after concrete placement to help control temperature.

Removal of temporary supports shall be as specified in the Contract Documents.

919.07.07 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

919.10 BASIS OF PAYMENT

919.10.01 Formwork and Falsework

The Contract price for the concrete tender item directly associated with formwork and falsework shall include full compensation for all labour, Equipment, and Material to do the work.

919.10.02 Temporary Support - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the Work.

Appendix 919-A, November 2011 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Stay-in-place forms. (919.07.01.07)
- Construction of temporary supports. (919.07.03)
- Removal of temporary supports. (919.07.06)

The design should determine if the following is required and, if so, it should be specified in the Contract Documents:

- Submissions of other formwork Working Drawings. (919.04.02.01.01)

OPSS 919 contains information written for provincial contracts. To ensure completeness of municipal Contract Documents, the designer should invoke Appendix 919-B. The appendix contains supplemental requirements that modify OPSS 919 so it can be used by a municipality in its contracts.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 3310.100	Deck, Girders, Concrete, Method of Obtaining Screed Elevations
OPSD 3311.100	Deck, Girders, Steel, Method of Obtaining Screed Elevations
OPSD 3332.100	Deck, Round Voids, Form Supports and Tie Downs
OPSD 3333.100	Deck, Round Voids, Drains
OPSD 3333.101	Deck, Trapezoid Voids, Drains
OPSD 3390.100	Deck, Drip Channel
OPSD 3390.150	Falsework Clearance to Traffic Lanes
OPSD 3940.150	Figures In Concrete, Warning Message, Layout
OPSD 3940.151	Figures In Concrete, Warning Message Letters
OPSD 3940.200	Figures In Concrete, Site Number and Date Layout

Appendix 919-B, November 2009

FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

Supplemental Requirements for Using OPSS 919 in Municipal Contracts

OPSS 919, Formwork and Falsework, is amended as follows:

919.03 Definitions

Section 919.03 is amended by the deletion of the definitions for Certificate of Conformance and for Quality Verification Engineer.

Section 919.03 is amended by the addition of the following:

Certificate of Installation means a document issued by the design Engineer or design-checking Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

919.04.02.01.02 Falsework

The first paragraph of clause 919.04.02.01.02 is deleted in its entirety and replaced by the following:

The Contractor shall submit 5 sets of Working Drawings to the Contract Administrator at least 14 Days prior to commencement of the erection of falsework. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

919.04.02.01.03 Formwork

The first paragraph of clause 919.04.02.01.03 is deleted in its entirety and replaced by the following:

The Contractor shall submit 5 sets of Working Drawings to the Contract Administrator at least 14 Days prior to commencement of the erection of formwork. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

919.04.02.02.02 Interim Inspection after Construction of Falsework

Clause 919.04.02.02.02 is deleted in its entirety and replaced by the following:

Upon completion of the falsework foundation and prior to installation of falsework, the design Engineer or the design-checking Engineer shall conduct an interim inspection of the work to verify that the falsework foundation has been constructed according to the Falsework Foundation Design Report and issue the Contractor written permission to proceed with the work.

Appendix 919-B

919.04.02 Submission Requirements

Subsection 919.04.02 is amended by the addition of the following:

919.04.02.06 Return of Submissions

Two copies of each submission shall be returned as one of the following:

- a) Stamped with the wording that allows for permission to construct. In this case, work can commence on receipt of the drawings by the Contractor.
- b) Stamped with the wording that allows for permission to construct as noted. In this case, work can start on receipt of the drawings by the Contractor. The drawings shall be updated as noted and shall be sealed and signed by the design Engineer and the design-checking Engineer stating the drawings have been revised according to the noted comments.
- c) Showing only required changes. In this case, the drawings shall be updated as required and the submission process repeated.

919.07.05 Certificate of Conformance

Clause 919.07.05 is deleted in its entirety and replaced by the following:

919.07.05 Certificate of Installation

Certificates of installation shall be submitted for all formwork and falsework for which Working Drawings are submitted.

A completed certificate of installation shall be submitted to the Contract Administrator upon completion of the formwork and falsework installation prior to the placement of concrete. The design Engineer or design-checking Engineer's seal and signature shall be affixed on the completed certificate of installation confirming that the formwork and falsework have been installed in general conformance with the Working Drawings and Contract Documents. The certificate of installation shall also certify that the interim milestone inspections have been completed as specified in the Contract Documents.



NOTICE TO USERS OF OPSS 920

CONSTRUCTION SPECIFICATION FOR DECK JOINT ASSEMBLIES, PREFORMED SEALS, JOINT FILLERS, JOINT SEALS, JOINT SEALING COMPOUNDS, AND WATERSTOPS - STRUCTURES

OPSS 920 has been removed from this
OPS volume

The provincial version of OPSS 920 is now in:

OPS Volume 5,
Provincial-Oriented
MTO General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.PROV 920

The municipal version of OPSS 920 is now in:

OPS Volume 7,
Municipal-Oriented
OPS General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.MUNI 920

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



NOTICE TO USERS OF OPSS 922

CONSTRUCTION SPECIFICATION FOR INSTALLATION OF BEARINGS

OPSS 922 has been removed from this
OPS volume

The provincial version of OPSS 922 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 922

The municipal version of OPSS 922 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 922

USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS



NOTICE TO USERS OF OPSS 928

CONSTRUCTION SPECIFICATION FOR STRUCTURE REHABILITATION - CONCRETE REMOVAL

OPSS 928 has been removed from this
OPS volume

The provincial version of OPSS 928 is now in:

OPS Volume 5,
Provincial-Oriented
MTO General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.PROV 928

The municipal version of OPSS 928 is now in:

OPS Volume 7,
Municipal-Oriented
OPS General Conditions of Contract and
General & Construction Specifications
and designated as OPSS.MUNI 928

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS**



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 930

CONSTRUCTION SPECIFICATION FOR STRUCTURE REHABILITATION - CONCRETE PATCHES AND OVERLAYS

OPSS 930 has been removed from this
OPS volume

The provincial version of OPSS 930 is now in:

OPS Volume 5,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 930

The municipal version of OPSS 930 is now in:

OPS Volume 7,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 930

USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
IN THE CONTRACT DOCUMENTS



CONSTRUCTION SPECIFICATION FOR STRUCTURE REHABILITATION - SHOTCRETE

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931-A	Commentary

931.01	SCOPE

This specification covers the requirements for concrete structure rehabilitation using normal and silica fume shotcrete.

931.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

931.02**REFERENCES**

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications.

Ontario Provincial Standard Specifications, Construction

OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete
OPSS 919	Formwork and Falsework
OPSS 928	Structure Rehabilitation - Concrete Removal
OPSS 929	Abrasive Blast Cleaning - Concrete Construction
OPSS 932	Crack Repair - Concrete

Ontario Provincial Standard Specifications, Material:

OPSS 1002	Aggregates - Concrete
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1306	Burlap
OPSS 1315	White Pigmented Curing Compounds for Concrete

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:
LS-430 Method of Test for Bond Strength by Tensile Load

CSA Standards

A23.2-14C- 09 Obtaining and Testing Drilled Cores for Compressive Strength Testing*

* [Part of A23.1-09/A23.2-09 Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]

ASTM International

A 123/A 123M-12 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 153/A 153M-09 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 185/A 185M-07 Steel Welded Wire Reinforcement, Plain, for Concrete
C 1202-10 Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

931.03 DEFINITIONS

For the purpose of this specification the following definitions apply:

Cold Weather means those conditions when the air temperature is at or below 10° C. It is also considered to exist when the air temperature is at or is likely to fall below 10° C within 96 hours after concrete placement. Temperature refers to shade air temperature.

Dry-Mix Shotcrete means shotcrete in which the mixing water is added at the nozzle.

Hot Weather means those conditions when the air temperature is at or above 28 °C. It is also considered to exist when the air temperature is at or is likely to rise above 28 °C within 24 hours after concrete placement. Temperature refers to shade air temperature.

Nozzle Operator means the worker on the shotcrete crew who manipulates the nozzle, controls consistency with the dry process, and controls final placement of the material.

Rehabilitation means any modification, alteration, or improvement to a structure or its components that is designed to correct defects or deficiencies.

Structure means any bridge, culvert, tunnel, retaining wall, wharf, dock, guide way, or any part thereof.

Wet-Mix Shotcrete means shotcrete in which all of the ingredients, including water, are mixed before introduction into the delivery hose. Compressed air is introduced to the material flow at the nozzle.

931.04 DESIGN AND SUBMISSION REQUIREMENTS

931.04.01 Submission Requirements

931.04.01.01 Mix Design

The mix proportions and the name of the supplier of the prebagged shotcrete mix shall be forwarded to the Contract Administrator for review at least 14 Days prior to the application of shotcrete.

In addition, the Contractor shall submit with the mix design the following:

- a) A certificate from the cement supplier stating that the cement is certified to be free from early stiffening tendencies according to the requirements of OPSS 1301.
- b) Performance test data from the manufacturer of the prebagged material, or test data from another contract, verifying that the material meets the requirements of this specification.

All supporting test data shall not be more than 12 months old at the time the mix design was submitted to the Contract Administrator.

931.04.01.02 Shotcrete Equipment

A list of equipment and accessories to be used, including the following information, shall be submitted to the Contract Administrator at least 14 Days prior to the application of shotcrete:

- a) Equipment type and capacity.
- b) Nozzle type and size.
- c) Continuous feed predampener details, only when the dry mix process is used.

931.04.01.03 Nozzle Operator

The names of the nozzle operators and proof of their qualification shall be submitted to the Contract Administrator at least 14 Days prior to the commencement of the shotcreting operation.

931.04.01.04 Cold Weather Protection

Details of the method to be used in the production of the shotcrete to control the shotcrete temperature shall be submitted to the Contract Administrator at least 14 Days prior to the commencement of the shotcreting operation in cold weather. The submission shall be accompanied by samples of insulation, if requested by the Contract Administrator, and shall contain the following information:

- a) Weather conditions for which the description applies.
- b) Type of insulation, metric "R" value, and number of layers to be used.
- c) Description of housing and heating.
- d) Method of withdrawal of protection to avoid sudden temperature change in the shotcrete.
- e) Method of ensuring cold weather protection measures are maintained and effective when work requiring adjustment to the protective measure is being performed.

931.04.01.05 Hot Weather Shotcreting

A description of the method to be used in the production of the shotcrete to control the shotcrete temperature shall be submitted to the Contract Administrator 14 Days prior to the application of shotcrete in hot weather.

931.04.01.06 Curing

A description of the methods to be used for fog-misting and curing, including equipment and procedures, shall be submitted to the Contract Administrator 14 Days prior to the application of shotcrete.

931.04.01.07 Return of Submissions

Two copies of each submission shall be returned as one of the following:

- a) Stamped with the wording: Reviewed. In this case, work can commence on receipt of the drawings by the Contractor.
- b) Stamped with the wording: Reviewed as Noted. In this case, work can start on receipt of the reviewed submission by the Contractor. The submission shall be updated as noted and shall be sealed and signed by the design Engineer and the design-checking Engineer stating the submission has been revised according to the noted comments.
- c) Showing only required changes. In this case, the submission shall be updated as required and the submission process repeated.

931.05 MATERIALS

931.05.01 Anchors

Anchors for the attachment of the welded steel wire fabric to the concrete surface shall be galvanized according to ASTM A 153/A 153M and be of adequate length and strength to resist a pull-out force of 1.0 kN.

931.05.02 Burlap

Burlap shall be according to OPSS 1306.

931.05.03 Cementing Material

Cementing material shall be according to OPSS 1301.

931.05.04 Curing Compound

Curing compound shall be according to OPSS 1315.

931.05.05 Fine Aggregate

Fine aggregate shall be according to OPSS 1002.

931.05.06 Formwork

Formwork shall be according to OPSS 919.

931.05.07 Proprietary Patching Materials

Proprietary patching materials shall be as specified in the Contract Documents.

931.05.08 Shotcrete

931.05.08.01 General

The shotcrete mix shall be supplied prebagged. The prebagged mix shall contain cementing materials and fine aggregate. The bags shall be maintained in a dry condition up to the time of its use and shall be stored within a temperature range of 5 to 30 °C. Any bags that contain lumps of pre-hydrated shotcrete or appear to be frozen or otherwise damaged shall not be used in the Contract.

Each bag shall be stamped with the name of the manufacturer, mix identification, and date of packaging. The prebagged mix shall be used within 3 months of packaging.

931.05.08.02 Normal Shotcrete

The shotcrete shall have a minimum 28-Day compressive strength of 30 MPa. The water to cement ratio, by mass, shall not be greater than 0.35 when the wet mix process is used.

931.05.08.03 Silica Fume Shotcrete

The silica fume shotcrete shall have a minimum 28-Day compressive strength of 35 MPa and maximum rapid chloride permeability at 28 Days of 1,000 coulombs. The shotcrete mix shall contain 8% silica fume by mass of total cementing materials.

931.05.09 Tie Wire

Coated tie wire according to OPSS 905 shall be used.

931.05.10 Water

Water shall be according to OPSS 1302.

931.05.11 Welded Steel Wire Fabric

Welded steel wire fabric shall be welded galvanized steel of 51 x 51 mm, MW 5.5 x MW 5.5, and shall be according to ASTM A 185/A 185M. Galvanizing shall be according to ASTM A 123/A 123M.

931.06 EQUIPMENT

931.06.01 Compressor - Air Blasting

The compressor for air blasting shall have a minimum capacity of 3.5 m³/min. The compressed air shall be free from oil and other contaminants.

931.06.02 Fog Misting Equipment

The Contractor shall provide fog misting equipment for curing of the shotcrete. Fog misting equipment shall include at least one hand held portable unit.

931.06.03 Hand Finishing Equipment

Where hand finishing is required, only magnesium, wood, or sponge rubber floats shall be used.

931.06.04 Mixers

931.06.04.01 Dry Mix Process

A continuous feed predampener shall be used. The predampening equipment shall be capable of bringing the dry bagged material to consistent and suitable moisture content and shall operate at sufficient capacity to allow work to proceed without delays.

The delivery equipment shall be capable of discharging the mixture into the delivery hose at a rate sufficient to ensure a continuous smooth stream of uniformly mixed shotcrete mixture being delivered to the nozzle, at the velocity required.

The discharge nozzle shall be equipped with a manually operated water injection system, for directing an even distribution of liquid through the mixture. The liquid valve shall be capable of ready adjustment to vary the quantity of liquid and shall be convenient for the nozzle operator. The nozzle shall be capable of delivering a conical discharge stream with uniform appearance throughout. The liquid pressure at the discharge nozzle shall be sufficiently greater than the operating air pressure to assure that the liquid is thoroughly mixed with the other materials. The liquid pressure shall be uniform.

931.06.04.02 Wet Mix Process

The mixing equipment shall be capable of thoroughly mixing the specified materials in sufficient quantity to maintain continuous placing. The delivery equipment shall be capable of delivering the pre-mixed materials accurately, uniformly, and continuously through the delivery hose.

The wet mix process shall not be used for silica fume shotcrete.

931.06.05 Straight Edge

The straight edge shall be 1.0 m long, commercially made, and metal.

931.07 CONSTRUCTION

931.07.01 General

Typical locations and areas of repair are as specified in the Contract Documents; however, the actual locations and extent of repair shall be as determined during the layout of the repair areas according to OPSS 928 and as directed by the Contract Administrator.

931.07.02 Operational Constraints

The Contract Administrator shall be notified of the intent to apply shotcrete 3 Business Days prior to the commencement of the shotcreting operation. The application of shotcrete shall not proceed until the concrete surface preparation has been completed according to this specification and verified by the Contract Administrator.

Prior to shotcreting, the Contractor shall demonstrate to the Contract Administrator that the substrate temperatures meet the requirements specified in the Contract Documents by measuring and recording the substrate temperatures using a contact thermometer or infrared thermometer.

Shotcreting shall not be carried out when the air temperature or existing concrete surface temperature is below 10 °C or is likely to fall below 10 °C, or is above 28 °C or likely to rise above 28 °C throughout the duration of the shotcreting operation, unless protection is provided in accordance with the Contractor's submitted plan.

The air in contact with the repaired surfaces shall be maintained at temperatures above 10 °C for at least 96 hours after the application of shotcrete. The use of unvented heaters shall be prohibited.

Shotcreting operations shall be suspended during adverse weather conditions, unless protection is provided.

Prior to seasonal shutdown, operations shall be scheduled in such a manner to ensure that the shotcreting operations are completed in all areas where concrete removal has commenced. No steel reinforcement shall be left exposed during seasonal shutdown.

931.07.03 Access to Work Areas, Work Platform, and Scaffolding

Adequate access shall be provided to facilitate inspection and measurement by the Contract Administrator.

931.07.04 Surface Preparation

All concrete surfaces against which shotcrete is to be placed shall be clean, solid, and free from loose or unsound fragments, coatings, and any other foreign substances or debris, and shall be sufficiently rough to ensure that a full bond is developed with the new shotcrete.

All existing concrete surfaces to be covered by shotcrete shall be uniformly roughened by means of scabbling, chipping, or bush hammering. A surface profile of 5 ± 2 mm shall be achieved by exposing the aggregates across the entire surface.

All concrete surfaces, including areas 50 mm beyond the perimeter of the removal area and existing steel reinforcement to receive shotcrete, shall be abrasive blast cleaned according to OPSS 929 prior to installation of welded steel wire fabric.

Abrasive blast cleaned areas shall have shotcrete applied within 36 hours or shall be reblasted. In areas requiring reblasting, the Contractor shall remove the welded steel wire fabric prior to abrasive blast cleaning and reinstall the wire fabric.

Immediately prior to wetting the concrete, all dust and loose material shall be removed from the prepared surface of the repair area by using compressed air.

The area to be shotcreted shall be maintained in a wet condition for a period of 2 hours prior to the application of the shotcrete. Prior to the shotcreting operation, excess water shall be removed from the surface using compressed air.

931.07.05 Placement of Welded Steel Wire Fabric

When welded steel wire fabric is specified in the Contract Documents, it shall not be installed until after the concrete surface and exposed steel reinforcement in the repair area have been abrasive blast cleaned. The wire fabric shall not be abrasive blast cleaned at any time.

The Contractor shall install wire fabric in all repair areas greater than 0.1 m^2 that have a minimum dimension of 200 mm. The wire fabric shall be securely fastened to the exposed steel reinforcement by ties placed no further than 300 mm apart in a grid pattern. When the exposed steel reinforcement is not capable of providing rigid support for the wire fabric, anchors shall be used to support the wire fabric.

When there is no exposed steel reinforcement, the wire fabric shall be fastened to the concrete with anchors placed no further than 300 mm apart in a grid pattern. The minimum clearance between the wire fabric and the existing concrete shall be 20 mm.

The wire fabric shall be installed flat, tight, and at locations shown in the Contract Documents using spacers and anchors. The edges of adjoining wire fabric sheets shall be overlapped by one wire spacing plus 50 mm. The wire fabric shall be kept clean of any substance that may reduce the bond of the shotcrete to the wire surface.

931.07.06 Approval of Nozzle Operator

Shotcreting shall be carried out by a nozzle operator who has been certified by participation in the MTO Shotcrete Nozzlemen Certification Program.

931.07.07**Placing**

Prior to the application of shotcrete, the Contractor shall protect all structural components not receiving shotcrete and appurtenances from the shotcreting operation. Repair areas being prepared to receive shotcrete shall also be protected.

When practical, shotcrete shall be placed without the use of formwork. When the requirements of this specification cannot otherwise be met, formwork may be used and shall be according to OPSS 919. Formwork shall be adequately braced against excessive vibration and constructed to permit the escape of air and rebound during the shotcreting operation.

During the application of shotcrete, a steady continuous flow of shotcrete shall be maintained. Any predampened mixture that is not used within one half hour, shall not be incorporated into the work.

Shotcrete shall be applied so that there is no sagging or separation of the material in place. All rebound material shall be removed from the repair area as the work proceeds. Rebound or waste material shall not be worked back into construction or salvaged and re-used.

The concrete surface surrounding the repair area shall be cleaned immediately after the application of shotcrete using suitable hand tools.

When shotcrete in a repair area cannot be applied in a single operation or delays are experienced, moist curing by means of continuous fog mist shall be applied according to the curing requirements of this specification. If the previous layer has hardened, the surface of the shotcrete shall be thoroughly cleaned of any laitance by wire brushing and wetted prior to application of an additional layer of shotcrete.

The shotcrete shall be placed level or slightly above the level of the original concrete surface to provide a minimum of 50 mm cover to the welded steel wire fabric or reinforcing steel, unless otherwise specified in the Contract Documents.

At the end of the shotcreting operation, the shotcrete shall be terminated at a 1H:1V slope. Before placing an adjacent section, this sloped portion shall be thoroughly cleaned by wire brushing any laitance and wetted.

The total required depth of shotcrete shall be placed within the same working day.

931.07.08**Finishing**

Unless otherwise specified in the Contract Documents, when the final layer of shotcrete has attained its initial set, the surface of the shotcrete shall be finished with hand finishing equipment.

When tested with a straight edge, the maximum gap between the straight edge and any point on the surface shall be 6 mm.

931.07.09**Curing**

Shotcrete shall be initially moist cured by continuous fog mist for a minimum period of 24 hours. The curing shall commence as soon as the fog mist can be applied without deforming the surface of the shotcrete. When an area of fresh shotcrete is exposed to direct sunlight or to wind, the curing shall be applied immediately after the final application of shotcrete in that area.

After the initial 24 hour fog misting period, moist curing shall continue for an additional period of 72 hours by means of fog mist or wet burlap.

When wet burlap is used, the burlap shall be placed in a manner to ensure that it is in full contact with the surface of the shotcrete for the full duration of the curing period. The curing with burlap and water shall be according to OPSS 904.

Immediately after removal of moist curing, the shotcrete surface shall be coated with a curing compound according to OPSS 904.

931.07.10 Cold Weather Protection

931.07.10.01 General

The Contractor shall protect the shotcrete during cold weather. The protection system shall be designed for the worst conditions that can be reasonably anticipated from local weather records, forecasts, site conditions and past experience for the time period during which the protection is required.

931.07.10.02 Control of Temperature

During cold weather, the Contractor shall for a minimum period of seven days following the shotcrete operation, monitor and control the temperature of the shotcrete to ensure that the temperature does not fall below 10 °C. The Contractor shall take measures to ensure that the shotcrete temperature remains within the acceptable limits.

The Contractor shall supply thermocouples, wires, and digital temperature indicators with an accuracy of $\pm 0.5^{\circ}\text{C}$ to monitor the shade air temperature and shotcrete temperature. The digital temperature indicators shall be left in place or provided upon request to the Contract Administrator to facilitate additional readings for verification purposes.

Thermocouples shall be embedded near the shotcrete surface at a minimum of two locations for each day of shotcreting, as directed by the Contract Administrator.

For cold weather conditions, protection of concrete shall at least be according to Table 1.

931.07.10.03 Temperature Records

The Contractor shall record the shade air temperature and shotcrete temperature at a minimum frequency of once every four hours for the first 24 hours after the shotcreting operation and then once every eight hours for the remainder of the curing and protection period and during the removal of the cold weather protection.

The Contractor shall provide the Contract Administrator with the necessary access to the location and equipment to verify temperature readings.

Temperature records shall be forwarded to the Contract Administrator at the end of every day. At the end of the cold weather protection period, the Contractor shall submit to the Contract Administrator a complete temperature record consisting of a summary of the recorded temperatures and a graphical plot of temperature vs. time.

931.07.11 Coring and Testing

931.07.11.01 General

The cores shall be obtained according to CSA A23.2-14C at random locations specified by the Contract Administrator. The Contractor shall locate all steel reinforcement in the area, prior to taking any cores, to avoid cutting steel reinforcement.

Testing shall not be required on a structure when the total measured vertical area of shotcrete on a structure is less than 20 m² or the total measured horizontal area of shotcrete on a structure is less than 20 m².

931.07.11.02 Lot and Sublot Size

A lot shall consist of the total quantity of normal shotcrete or silica fume shotcrete in the Contract Documents. Each lot shall be divided into sublots of approximately equal size and not greater than 100 m². Separate sublots are required for vertical and horizontal repairs. Separate sublots are required for individual structures.

The Contract Administrator shall determine the sublot size after discussion with the Contractor and prior to the commencement of the shotcreting operation.

931.07.11.03 Compressive Strength

The Contractor shall be responsible for all aspects of coring, storage, and transportation of cores to determine compressive strength.

For evaluation of compressive strength testing, the Contractor shall remove four cores from the hardened shotcrete when the shotcrete is between 7 to 10 Days of age, for each sublot. The cores shall be 75 mm in diameter and at least 100 mm long. Cores may contain wire fabric but shall not contain reinforcing steel.

The Contractor shall deliver the cores to the designated quality assurance laboratory as specified in the Contract Documents. The cores shall be tested according to CSA A23.2-14C at 28 Days of age. The forms on which the field data for the cores is recorded shall be submitted to the laboratory with the shotcrete cores. Test results shall be recorded on forms acceptable to the Owner and forwarded to the Contract Administrator within 4 Days from the date of testing.

931.07.11.04 Tensile Bond Strength

The minimum tensile bond strength of the shotcrete shall be 1.0 MPa.

The tensile bond strength testing shall be carried out by the Contractor, in the presence of the Contract Administrator, on 3 in-situ cores taken within one metre of each other for each sublot. The testing shall be carried out by technicians employed by a laboratory acceptable to the Owner.

The cores shall be 100 mm in diameter and extend into the parent concrete to the depth specified in MTO LS-430. The testing shall be according to MTO LS-430 and shall be carried out when the shotcrete is 7 to 10 Days of age. The equipment used to measure the tensile bond strength shall be equipped with a maximum load indicator.

The Contractor shall ensure that the epoxy adhesive is cured according to the manufacturer's recommendations prior to carrying out the test. If failure occurs in the epoxy adhesive and the specified strength of 1.0 MPa has not been reached, the test shall be repeated within 300 mm of the original core location. Retesting is not required when the specified strength of 1.0 MPa has been achieved.

After the tensile bond strength testing is completed, the cores shall be extracted for the full depth of the coring to demonstrate to the Contract Administrator that the depth of coring was adequate.

All individual tensile bond strength results obtained by the Contractor and average shall be recorded on forms acceptable to the Owner and forwarded to the Contract Administrator within 4 Business Days of the date of testing.

931.07.11.05**Rapid Chloride Permeability - Silica Fume Shotcrete**

For evaluation of rapid chloride permeability, the Contractor shall remove cores from the hardened silica fume-shotcrete and test cores according to ASTM C 1202. Testing shall be carried out by a laboratory that is acceptable to the Owner.

Two cores, 100 mm in diameter and at least 75 mm long, shall be removed from each subplot, when the silica fume shotcrete is 7 to 10 Days of age. The portion of the core to be tested shall contain no reinforcing steel, welded wire steel fabric, or other embedments.

Cores shall be delivered in a plastic bag sealed to avoid loss of moisture, to a laboratory acceptable to the Owner, within 24 hours of coring. The cores shall be stored at a temperature of 23 ± 2 °C in a moist condition until time of testing. A 10 mm thick slice shall be cut from the top of each core before testing. Testing shall be carried out according to ASTM C 1202 when the shotcrete is 28 to 32 Days of age.

Rapid chloride permeability results obtained by the Contractor shall be recorded and forwarded to the Contract Administrator within 37 Days of application of shotcrete. Rapid chloride permeability core samples and original test record shall be retained by the Contractor until final completion of the Contract and shall be provided to the Contract Administrator, upon request.

931.07.11.06**Filling of Core Holes**

All remnants of cores, including ones that remain in place, shall be completely removed and core holes filled immediately after coring. Prior to filling, the inside surfaces of each core hole shall be cleaned of laitance and other debris from the coring operation by wire brushing. The core holes shall be cleaned using compressed air, pre-wetted, and filled with a proprietary patching material. The patching material shall be comparable to the surrounding concrete in terms of strength and permeability. The patching material shall be mixed and cured according to the manufacturer's recommendations. The patch shall be finished flush with the surface of the concrete and all excess material removed.

931.07.12**Remedial Work**

If plastic shotcrete is rejected by the Contract Administrator, the Contractor shall stop the work and take all necessary measures to correct deficiencies while the shotcrete is in the plastic state.

The Contractor shall notify the Contract Administrator in writing immediately if any of the defects or conditions listed in the Quality Assurance section are present in the Work with an explanation of the cause and extent of the deficiencies. These areas shall be repaired by the Contractor.

A proposal for the remedial work for the above defects and conditions shall be submitted to the Contract Administrator for review. The Contractor shall not proceed with repairs until approval of the proposal has been received.

The Contractor shall repair all cracks greater than or equal to 0.3 mm after the curing period has elapsed. Repair of cracks shall be according to OPSS 932. If the linear measurement of cracks greater than or equal to 0.3 mm in width per square metre is 2 m or greater, the entire shotcrete in the repair area shall be removed and replaced.

931.07.13**Management of Excess Material**

Management of excess material shall be according to the Contract Documents.

931.08 QUALITY ASSURANCE

931.08.01 Inspection

931.08.01.01 During Shotcrete Application

The Contract Administrator shall inspect the plastic shotcrete during the application process and shall reject all or a portion of the work based on the presence of one or more of the defects identified below:

- a) Failure to properly control and remove build-up of overspray and rebound.
- b) Incomplete consolidation around steel reinforcement and anchors.
- c) Excessive shotcrete rebound.
- d) Incorporation of sand lenses, excessive voids, delaminations, sags, and sloughing.
- e) Failure to apply shotcrete to the required line, grade, and tolerance.

931.08.01.02 Completed Work

The Contract Administrator shall inspect the completed work to determine if the work contains any of the following:

- a) Debonding or hollow-sounding areas.
- b) Porous or rebound material visible in cores.
- c) Areas that have visibly sagged in cores.
- d) Cracks.

931.08.02 Acceptance or Rejection

The Contract Administrator shall have the authority to accept or reject shotcrete that does not conform to the Contract requirements, either during the shotcrete application process or on the basis of the completed work, or if any of the defects identified in the Inspection subsection are identified in any of the cores extracted.

931.08.02.01 Normal Shotcrete

For normal shotcrete, the Contract Administrator shall reject all or a portion of the lot based on the presence of one or more of the defects identified in the Inspection subsection or one or more of the following conditions:

- a) Average compressive strength less than 30 MPa.
- b) An individual compressive strength result more than 3.5 MPa below the specified strength.
- c) Average tensile bond strength less than 0.6 MPa.
- d) Any work that does not conform to the requirements of this specification.

931.08.02.02**Silica Fume Shotcrete**

For silica fume shotcrete, the Contract Administrator shall reject all or a portion of the lot based on the presence of one or more of the defects identified in the Inspection subsection or one or more of the following conditions:

- a) Average compressive strength less than 35 MPa.
- b) An individual compressive strength result more than 3.5 MPa below the specified strength.
- c) Average tensile bond strength less than 0.6 MPa.
- d) Average rapid chloride permeability greater than 2,500 coulombs.
- e) Any work that is not according to the requirements of this specification.

931.09**MEASUREMENT FOR PAYMENT****931.09.01****Actual Measurement****931.09.01.01****Normal Shotcrete
Silica Fume Shotcrete**

Measurement shall be by volume in cubic metres of the concrete removed according to the Measurement for Payment section of OPSS 928, except when the existing cover to steel reinforcement is less than 50 mm, the depth used in calculating the volume shall be adjusted by adding the difference between the 50 mm required and the existing cover.

No measurement shall be made for areas of shotcrete that were removed according to the Remedial Work subsection.

No measurement shall be made for shotcrete required to patch areas of concrete removal when the removal was not approved by the Contract Administrator.

931.10**BASIS OF PAYMENT****931.10.01****Normal Shotcrete - Item
Silica Fume Shotcrete - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work, including abrasive blast cleaning of the concrete surfaces.

Payment for the work of abrasive blast cleaning of steel reinforcement shall be according to OPSS 929.

When the Contract does not contain a separate tender item for providing access to the work, the Contract price for the shotcrete items requiring the access shall include full compensation for all labour, Equipment, and Material to do the work.

TABLE 1
Minimum Cold Weather Protective Measures

Anticipated Minimum Air Temperature °C	Protective Measure Thickness of New Shotcrete < 0.25 m
+10 to 0	PM2
-1 to -10	PM4
-11 to - 20	PM5
Less than - 20	PM5
Maximum Allowable Drop in Concrete Temperature/24 hours	15 °C

Notes:

A. Protective Measures:

PM2 - Cover concrete with insulation having an R-Value of 0.67.

PM3 - Cover concrete with insulation having an R-Value of 1.33.

PM4 - Cover concrete with insulation having an R-Value of 2.00.

PM5 - House and heat as specified in the Housing and Heating clause of OPSS 904.

B. All R-Values are metric.

C. The conversion factor from metric to imperial units is:

Metric R-Value x 5.678 = Imperial R-Value.

Appendix 931-A, November 2013
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Proprietary patching materials. (931.05.07)
- Location of the quality assurance laboratory. (931.07.11.03)

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- Welded steel wire fabric. (931.07.05)

The wire fabric shall not be used in repair areas on which a cathodic protection system is to be installed.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR CRACK REPAIR - CONCRETE

TABLE OF CONTENTS

932.01	SCOPE
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APPENDICES

932-A	Commentary

932.01	SCOPE

This specification covers the requirements for the pressure injection, routing, and sealing of cracks in concrete for the purpose of structural rehabilitation and water seepage control.

932.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

932.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

932.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

- OPSS 920 Deck Joint Assemblies, Preformed Seals, Joint Fillers, Joint Seals, Joint Sealing Compounds, and Waterstops - Structures
- OPSS 929 Abrasive Blast Cleaning - Concrete Construction

Ontario Provincial Standard Specifications, Material

- OPSS 1212 Hot Poured Rubberized Asphalt Joint Sealing Compound
- OPSS 1302 Water

ASTM International

- C 920-08 Elastomeric Joint Sealants
- D 4285-83 (2006) Test Method for Indicating Oil or Water in Compressed Air

932.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Active Crack means a crack in concrete with plane surfaces that are in a state of movement relative to each other.

Crack Depth means the distance that the crack extends from the injection surface into the concrete to the point where the crack is 0.10 mm wide.

Effective Pressure means the fluid grout pressure at point of entry at the injection port. This shall be calculated as gauge pressure minus head losses in injection system.

Engineer means a Professional Engineer licensed by the Professional Engineers Ontario to practice in the province of Ontario.

Flushing means removing debris from the crack section by means of air or a liquid under pressure.

Gauge Pressure means the actual fluid grout pressure reading on the pump gauge.

Injection Port means a mechanical device that is firmly connected into the crack section for the purpose of providing access into a crack for the grouting material.

Passive Crack means a concrete crack in concrete with plane surfaces that are not moving relative to each other.

Payment Adjustment Factor means a multiplier applied to the unit Contract price to determine the actual unit payment price.

Plural Component Pump means a grout pump that separately delivers the grout material components separately to a common static mixer.

Pot Life means the period of time during which the polyurethane or epoxy resin remains pumpable.

Refusal Criteria means zero flow of grout at the proposed effective pressure for a duration of 5 minutes.

Regulated Operating Pressure means the maximum pressure, measured at the pump discharge, that the pump is capable of producing.

932.04

DESIGN AND SUBMISSION REQUIREMENTS

932.04.01

Submissions

932.04.01.01

Crack Repair Work Plan

Four copies of the crack repair work plan shall be submitted to the Contract Administrator at least 3 weeks prior to the commencement of the work.

The crack repair work plan shall bear the seal and signature of an Engineer and include at least the following information.

a) A description of the method of repair, including the following minimum information:

- i. Basis of selection.
- ii. Proposed effective pressure.

- iii. Surface finishing.
 - iv. Location and size of injection ports.
 - v. Surface treatment of the concrete prior to surface sealing.
 - vi. Method of storing and handling grouts, cleaning solvents, and waste materials.
- b) A list of the materials to be used for crack preparation and repair, including the following minimum information:
- i. Material specifications.
 - ii. Product data sheets with test data.
 - iii. Material safety data sheets.
 - iv. Pot life of the components to be used based on a sample size of 200 ml at 5 °C and 20 °C.
- c) A certificate from the material supplier shall be submitted stating the material is suitable for the intended use in this Contract.
- d) A list of the equipment and accessories to be used including the following minimum information:
- i. The operating pressure of each component.
 - ii. The type of injection port and means of closure.

932.04.02 Return of Submissions

Two copies of each submission shall be returned marked as one of the following:

- a) Stamped with the wording that allows for permission to construct.

In this case, work can commence upon receipt of the submission by the Contractor. A copy of the submission shall be available at the site prior to and during construction.

- b) Stamped with the wording that allows for permission to construct as noted.

In this case, work can start upon receipt of the submission by the Contractor. The submission shall be updated as noted and shall have a stamp affixed that is signed by an Engineer stating the submission has been revised according to the noted comments. A copy of the stamped updated submission shall be available at the site prior to and during construction.

- c) Showing only required changes.

In this case, the submission shall be updated as required and the submission process repeated.

932.05 MATERIALS

932.05.01 Grout

932.05.01.01 General

Material used for crack injection shall be polyurethane resins for active cracks and epoxy resins for passive cracks.

Polyurethane and epoxy grout shall prevent the penetration of water and shall have sufficient flowability to fill the crack at least 80% of the depth of the crack using the proposed equipment and method of repair at the ambient and substrate temperatures existing at the time of grouting.

932.05.01.02 Epoxy Resin

Epoxy resin shall be moisture insensitive and 100% solids.

932.05.01.03 Polyurethane Resin

Polyurethane resin shall be 100% solids.

932.05.02 Joint Sealing Compounds

932.05.02.01 Hot-Poured Rubberized Joint Sealing Compound

The hot-poured rubberized joint sealing compound shall be according to OPSS 1212.

932.05.02.02 Cold-Applied Joint Sealing Compound

Cold-applied joint sealing compound shall be according to ASTM C 920, Type S, Grade NS, Class 25, Use TM. Type M sealant shall be used where the depth of a chase exceeds 15 mm or the manufacturer's recommended depth for Type S sealant, whichever is less. Where the cold sealing compound is visible after completion of the work a grey colour material shall be used.

932.05.03 Water

Water shall be according to OPSS 1302.

932.06 EQUIPMENT

932.06.01 Gauges

In addition to the calibrated gauges required for use with the pumps and with the injection hose, additional gauges shall be available on site to replace those that malfunction.

Certificates of calibration, from an organization accredited by the Standards Council of Canada shall be supplied for each gauge certifying that the gauges are capable of measuring the pressure within a tolerance of ± 5 kPa.

932.06.02 Pumps

Equipment used for pressure injection shall be suitable for the intended use and compatible with the grout.

Pumps shall be positive displacement type and shall be capable of delivering a minimum of two litres of grout per minute.

Pumps shall be capable of developing a maximum regulated operating pressure at least equal to twice the effective pressure.

Pumps shall be equipped with a calibrated gauge and shall be capable of accurately maintaining an effective operating pressure of 50 kPa or less.

Plural component pumps shall be used when multicomponent solution grouts are used.

Hand cartridge pumps shall not be used unless the volume of crack repair is less than one litre of resin for 100 m² of gross repair area.

932.06.03 Mixers

932.06.03.01 Static In-Line Mixers

Static in-line mixers shall produce a homogeneous grout and shall be sized to accommodate the minimum and maximum anticipated flow rates.

Static mixers shall have the manufacturer's plate attached showing the following mixer information:

- a) Size.
- b) Type.
- c) Maximum operating pressure.

932.06.03.02 Agitating Mixer

Agitating mixers shall have a power driven paddle mixing head and produce a homogeneous component.

The speed of the mixers shall be variable to a maximum of 500 rpm.

932.06.04 Injection Hoses

Injection hoses shall have a rated working pressure equal to or greater than the maximum pump operating pressure and shall be equipped with a calibrated gauge at the injection port end.

932.06.05 Injection Ports

Injection ports shall be removable or non-metallic insert type units. The pressure capacity of the injection ports shall be at least equal to the maximum operating pressure of the pump. All injection ports shall be equipped with a shut-off valve or other mechanical means of closure under pressure.

Surface mounted injection ports shall not be used.

932.06.06 Air Compressor

Compressed air shall be free from oil and water when tested according to ASTM D 4285.

932.06.07 Drills

Drilling of the injection holes shall be performed using a rotary percussion or rotary diamond type drill.

Percussion drilling equipment shall not be used for drilling holes greater than 26 mm diameter and holes within 150 mm of any edge of concrete.

Only holes 26 mm or less in diameter shall be drilled within 50 mm of any free edge of concrete.

932.06.08 Routing Equipment

Routing equipment shall be any of the following:

- a) Concrete router.
- b) Hand-held grinding wheel or a multi-bladed cut-off saw equipped with abrasive or diamond blades.
- c) Multi-bladed floor saw cutting equipment equipped with diamond blades.

932.07 CONSTRUCTION

932.07.01 General

Installation of all accessories and material shall be according to the manufacturer's recommendations and as specified in the submitted work plan.

Work shall only proceed when the temperature of the concrete is 5 °C or greater.

932.07.02 Access

Adequate access shall be provided to facilitate:

- a) Performance of work.
- b) Inspection and measurement of the work by the Contract Administrator.

932.07.03 Crack Identification

Prior to commencement of the work, the cracks requiring repair, as identified by the Contract Administrator, shall be numbered, physically marked as to their extent, and measured in the presence of the Contract Administrator.

This information shall be recorded and a copy submitted to the Contract Administrator.

932.07.04 Crack Injection

932.07.04.01 Drilling for Injection Ports

Injection holes shall be drilled, on each side of the crack, at a 45° angle to the surface of the concrete. The holes shall be located such that they intersect the crack section at approximately the midpoint and they shall extend through the crack section. The holes shall be sized to accommodate the injection ports. The spacing of the holes shall not exceed the depth of the crack or 200 mm, and the holes shall be alternated from one side of the crack to the other.

Prior to installation of the injection ports each hole shall be individually cleaned of all deleterious material by an air-water blast to completely remove all drill cuttings from the hole.

Injection ports shall be inserted into the holes and sealed. The inserted end of the injection port shall not extend beyond the point at which the drilled hole intersects the crack.

932.07.04.02 Cleaning and Flushing

After the injection ports have been inserted, cracks shall be flushed with an air-water mixture or an alternating water and air flush to remove all deleterious material prior to the injection of grout. The flushing material shall be injected through the injection port and continued until it exudes from the adjacent injection port and the crack is thoroughly cleaned. This flushing shall proceed from one end of the crack to the other.

A final flush shall be made with air only to remove all of the free water.

932.07.04.03 Surface Preparation and Sealing

Surface opening of the cracks shall be sealed prior to injection.

The surface of the concrete shall be mechanically cleaned for a distance of 25 mm each side of the crack sections to prepare a clean substrate for bonding of the surface sealing compound. The surface preparation and sealing shall be as recommended by the manufacturer of the surface sealing material.

The surface sealing material shall completely confine the injection grout to the crack section with only the injection ports providing access. The surface sealing material shall withstand the maximum injection pressure without developing leakage along the crack section.

Surface sealing of passive cracks shall not commence until at least one hour after the final air flush.

932.07.04.04 Injection of Grout

932.07.04.04.01 General

Injection of grout shall proceed from the injection port at the lowest elevation of the crack and continue upwards along the crack on an injection port to injection port basis without interruption to the other end of the crack. The injection nozzle shall not be moved to the adjacent injection port until grout is showing at the next higher adjacent injection port or refusal criteria is developed.

While under pressure, each injection port shall be sealed immediately after completion of injection at that injection port.

When a maximum operating pressure greater than 3 MPa is required to inject the grout, the injection operation shall cease until the Contractor determines why this operating pressure is required.

932.07.04.04.02 Monitoring

The volume of grout used within each five metres of crack length shall be recorded. The pump gauge pressure shall be recorded every 10 minutes. The volume of grout and pump pressure shall be related to the crack location.

The records shall indicate crack location and number, injection port spacing and confirmation of grout showing or refusal. A copy of the recorded information shall be submitted to the Contract Administrator at the end of each Day.

932.07.04.04.03 Effective Pressure

When calculating the effective pressure, the head losses shall be determined prior to commencement of injection.

Head losses shall be determined in the presence of the Contract Administrator by performing a pressure flow test, through the equipment, for each equipment configuration used.

932.07.04.04.04 Ratio Test

Plural component injection equipment proportioning shall be verified in the presence of the Contract Administrator by measuring the volume output of material in the pressure lines at least once for each two hours of operation.

When deviation from the manufacturer's specified proportioning ratio exceeds 5%, immediate adjustment or replacement of the equipment is required.

932.07.04.04.05 Pot Life Determination

Prior to commencing the grouting operation, a sample shall be taken from the material containers on site and manually proportioned to the specified component ratio in the presence of the Contract Administrator. The total sample size shall be 200 ml, and the same size container shall be used for each sample taken.

The temperature of the material at the time of mixing and the pot life of the mixed material shall be recorded.

The proportions of materials and pot life shall conform to those specified in the original submissions.

An additional sample shall be taken from the end of the injection hose and a further pot life determination performed.

During grouting material samples shall be taken on a frequency of at least one per hour of operation and the pot life recorded.

Deviation from the proportions and pot life specified shall result in immediate discontinuance of use of the material.

All records shall be submitted to the Contract Administrator at the end of each working day.

932.07.04.05 Surface Finishing

Surface finishing shall not proceed until the curing period, as specified by the material supplier, has elapsed. Surface finishing shall consist of removal of the injection ports and the surface sealant flush with the original concrete surface. Core holes and holes left after the removal of injection ports shall be filled with a cement-based non-shrink grout after the surface sealant has been removed.

Where the crack is not completely filled to the injection surface, the crack shall be filled with a compatible material acceptable to the Contract Administrator. The material shall be applied according to the manufacturer's recommendations.

932.07.04.06 Coring

A 75 mm diameter test core shall be taken for each completed ten-metre increment of injected crack for the full depth of the crack, within 1½ to 2 hours after injection, at locations specified by the Contract Administrator. The ten-metre increment is the length of a continuous crack or a cumulative measurement of cracks of lesser length. The cores shall be submitted to the Contract Administrator. Similar coring shall be done to check remedial work.

932.07.04.07 Filling of Core Holes

Following the extraction of cores all slurry and other debris shall be removed from the core holes. The holes shall be blasted with compressed air and filled with non-shrink grout flush with the surface of the concrete.

Surface preparation, mixing, installation, and curing shall be according to the manufacturer's recommendations.

932.07.05 Routing and Sealing Cracks

Cracks shall be routed to create a chase and then filled with a sealant.

The depth to width ratio of the chase shall be 1H:1V with the crack located within the middle third of the chase. The width of the chase shall be 15 mm ± 5 mm.

The chase shall be abrasive blast cleaned according to OPSS 929. Abrasive blast cleaned areas shall have the subsequent treatment applied within 36 hours or shall be reblasted.

Immediately prior to placing the bond breaker, the chase shall be blasted with compressed air to remove all dust, dirt, and loose material.

A bond breaker compatible with the joint sealing compound and concrete shall be placed at the bottom of the chase.

Joint sealing compound shall be placed in the chase flush with the adjacent concrete surface unless it is subjected to vehicular traffic, in which case, it shall be recessed $2 \text{ mm} \pm 1 \text{ mm}$.

Hot-poured rubberized joint sealing compounds shall only be used on horizontal surfaces. Cold-applied joint sealing compounds shall only be used on vertical surfaces or on horizontal surfaces that are not to be waterproofed. Cold-applied joint sealing compound shall be installed according to the manufacturer's recommendations. Hot-poured rubberized joint sealing compound shall be installed according to OPSS 920.

932.07.06 Remedial Action

The failure of the test cores to meet the requirements specified in the Quality Assurance section shall be sufficient cause for immediate review and adjustment of the method of injection. The ten-metre increments represented by the failed test cores shall be repaired such that at least 80% of the crack depth is filled. The method of repair shall be submitted to the Contract Administrator prior to the commencement of the work.

932.07.07 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

932.08 QUALITY ASSURANCE

932.08.01 General

When the repair operation is complete, the Contract Administrator shall inspect the work to determine if the completed work contains defects.

932.08.02 Crack Injection

The 75 mm diameter test cores shall be examined for the percentage of the crack depth filled.

932.08.03 Ratio Test

The proportioning ratio of the injection material shall not deviate more than 5% from the manufacturer's specified proportioning ratio stated in the work plan.

932.08.04 Pot Life

The proportion of material and pot life shall not deviate from that specified by the manufacturer in the work plan.

932.08.05 Acceptance or Rejection

The Contract Administrator shall accept or reject material on the basis of the ratio testing and pot life determination results.

Crack injection shall be accepted or rejected on the basis of the percentage of crack depth filled as determined by evaluating the test core taken in each ten-metre increment of length.

Rejection of the ten-metre increment of crack shall be applied during the entire grouting operation.

Where 90% or more of the crack depth is filled in the test core, the ten-metre increment of crack length represented by the core shall be accepted.

Where 80 to 89% of the crack depth is filled in the test core, the work shall be accepted and a payment adjustment shall be applied to the ten-metre increment length of crack represented by that core.

Where less than 80% of the crack depth is filled in the test core, the ten-metre increment of crack length represented by the core shall be rejected.

932.09 MEASUREMENT FOR PAYMENT

932.09.01 Actual Measurement

932.09.01.01 Crack Injection

Measurement of crack injection shall be by length in metres of the accepted injected cracks. The total length shall be the sum of individual increments represented by the accepted test cores taken within each increment. Cracks filled to less than 80% of the crack depth shall not be measured for payment.

932.09.01.02 Routing and Sealing

Measurement of routing and sealing shall be by length in metres.

932.10 BASIS OF PAYMENT

932.10.01 Crack Injection - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

There shall be 100% payment of the Contract price where 90% or more of the crack depth is filled.

There shall be no payment where less than 80% of the crack depth is filled.

There shall be a payment adjustment of the unit Contract price for each ten-metre increment of crack filled to between 80% and 89% of the crack depth.

$$Pa = [100 - (89 - D) \times 2] \div 100$$

Where: Pa = payment adjustment factor

D = percentage of the crack depth filled, rounded to the nearest 0.1%.

and: $89 \geq D \geq 80$

932.10.02

**Routing and Sealing-Hot-Poured Rubberized Joint Sealing Compound-Item
Routing and Sealing-Cold-Applied Joint Sealing Compound-Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 932-A, November 2009
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.



CONSTRUCTION SPECIFICATION FOR PRESTRESSED SOIL AND ROCK ANCHORS

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942.01 SCOPE

This specification covers the requirements for the design, installation, and testing of prestressed anchors in soil and rock.

942.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

942.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

942.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following specifications, standards, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 903	Deep Foundations
OPSS 904	Concrete Structures
OPSS 906	Structural Steel for Bridges

Ontario Provincial Standard Specifications, Material

OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete

CSA Standards

A23.1-04/A23.2-04	Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete
A283-06	Qualification Code for Concrete Testing Laboratories
G40.20-04/G40.21-04	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels

ASTM International

A 53/A 53M-07	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
A 416/A 416M-06	Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
A 500/A 500M-07	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
A 722/A 722M-07	Uncoated High-Strength Steel Bars for Prestressing Concrete
D 1143/D 1143M-07	Standard Test Method for Deep Foundations Under Static Axial Compressive Load
D 1248-05	Polyethylene Plastics Extrusion Materials for Wire and Cable
D 1784-08	Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
D 3350-08	Polyethylene Plastics Pipe and Fittings Materials
D 4101-08	Polypropylene Injection and Extrusion Materials

International Organization for Standardization/International Electrotechnical Commission (ISO/IEC)

17025 General Requirements for the Competence of the Testing and Calibration Laboratories

American Petroleum Institute (API)

13A Drilling Fluid Materials, 18th Edition, 01.10.06
RP 13B-1 Standard Procedure for Field Testing Water Based Drilling Fluids, 4th Edition

Post Tensioning Institute (PTI)

Recommendations for Prestressed Rock and Soil Anchors

942.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Alignment Load means a nominal minimum load applied to an anchor during testing to keep the testing equipment positioned correctly.

Anchor means a system used to transfer tensile loads to soil or rock that includes the prestressing steel, anchorage, corrosion protection, sheathings, spacers, centralizers, and grout.

Anchorage means the combined system of anchor head, bearing plate, trumpet, and anchorage corrosion protection that is used to transmit the prestressing force from the prestressing steel to the surface of the ground or the supported structure.

Anchor Head means the device by which the prestressing force is permanently transmitted from the prestressing steel to the bearing plate.

Apparent Free Length means the length of tendon or bar that is apparently not bonded to the surrounding ground or grout, as calculated from the elastic movement measured during the load test.

Bond Length means the length of the tendon that is bonded to the primary grout and capable of transmitting the applied tensile load to the surrounding soil or rock.

Centralizer means a device to support and position the tendon and sleeves in the drill hole throughout the bond length of the tendon so that a minimum grout cover is achieved.

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in General Conformance with the requirements of the Contract Documents.

Coupler means the method by which the prestressing force can be transmitted from one partial length of prestressing tendon to another.

Design Load means the anticipated final maximum effective load in the anchor after allowance for time-dependent losses or gains. The design load includes appropriate load factors to ensure that the overall structure has adequate capacity for its intended use.

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Free Stressing Length means the designed length of the tendon that is not bonded to the surrounding ground or grout during stressing.

Lift-Off means checking the load in the tendon at any specified time with the use of a hydraulic jack at the moment of lifting of the anchor head off the bearing plate.

Lock-Off Load means the prestressing force in an anchor immediately after transferring the load from the jack to the stressing anchorage.

Log Time Cycle means one rotation of a log cycle of a semilogarithmic plot for the purpose of recording the measurement of movement and time.

Permanent Anchor means a prestressed anchor intended for permanent use.

Performance Test means cyclic and incremental loading and unloading of an anchor, while recording the total movement of the pulling head in each cycle at each increment, including the residual movement at alignment load.

Post-Grouting means regrouting an anchor after the primary grout has set.

Pre-Production Test Anchor means an anchor installed and then loaded to verify the design parameters, prior to the installation of the production anchors.

Prestressing Steel means strands, a group of strands combined to form a tendon, or a high strength steel bar.

Primary Grout means Portland cement based grout that is injected into the anchor hole prior to or after the installation of the anchor tendon to provide for the force transfer to the surrounding ground along the bond length of the tendon.

Production Anchor means an anchor installed and loaded that forms part of the final foundation support system.

Production Test Anchor means an anchor installed and then loaded to verify the design parameters, prior to the installation of the production anchors.

Proof Test means incremental loading of an anchor and recording the total movement of the anchor at each increment.

Quality Verification Engineer means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Residual Movement means the non-recoverable movement of the pulling head measured at alignment load.

Temporary Anchor means a prestressed anchor intended for temporary use.

Test Load (TL) means the maximum load that the anchor is subjected during testing.

Total Movement means the total movement of the pulling head measured at maximum load in each cycle.

942.04 DESIGN AND SUBMISSION REQUIREMENTS

942.04.01 Design Requirements

942.04.01.01 General

Except for Owner designed anchors, the Contractor shall be responsible for the detailed design of the anchor, including the determination of the applied loads, design assumptions, and installation procedures. The Contractor shall also be responsible for the design of the anchor testing equipment and reaction system.

The anchors shall be designed to safely withstand the applied loads specified in the Pre-Production Test Anchor clause and fulfill the acceptance criteria specified in the Production Anchor clause and perform satisfactorily at the design load through the required service life.

The design assumptions shall accurately represent the subsurface conditions prevalent at the site.

Temporary anchors in a corrosive environment shall be designed as permanent anchors.

Except as specified in this specification, the anchors shall be designed according to the design recommendation of the Recommendations for Prestressed Rock and Soil Anchors publication.

942.04.02 Submission Requirements

942.04.02.01 Working Drawings

The Contractor shall submit 5 sets of Working Drawings to the Contract Administrator at least 3 weeks prior to the commencement of the work of prestressed rock and soil anchors, for information purposes only. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

Where multi-discipline engineering work is depicted on the same Working Drawing and the design or design-checking Engineer or both are unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be sealed and signed by as many additional design and design-checking Engineers as necessary.

Information to be shown on the Working Drawings shall describe and illustrate the complete details of the anchor system, anchor testing equipment, and reaction system for the production anchors and, when specified in the Contract Documents, pre-production test anchors. This information shall include as a minimum:

a) Plans, Elevations, and Sections

- i. Anchor spacing.
- ii. Orientation.
- iii. Minimum total anchor length.
- iv. Free stressing length.
- v. Design load.

- vi. A unique identification number for each anchor.
- vii. Anchor components and details.

b) Installation

- i. Construction methods.
- ii. Work restrictions.
- iii. Schedule.
- iv. Sequence and coordination of work.
- v. Monitoring.
- vi. Type and number of tests
- vii. Evaluation of test results.

c) Materials

- i. Physical properties of monobar and multistrand anchors.
- ii. Primary grout materials and mix proportions.
- iii. Post grouting materials and mix proportions.
- iv. Free stressing length materials and mix proportions.
- v. Corrosion protection material physical and mechanical properties.

d) Anchor Hole Construction

- i. Method of constructing the anchor holes and maintaining the stability of the holes during the anchor installation. The drilling equipment and materials including drill bit or auger diameter and lengths, casing diameter and lengths, and slurry material used to facilitate the construction of the anchor hole. The method of verifying the hole length shall also be identified.
- ii. Details for assembling the anchor in the anchor hole.
- iii. Method of placing and centring the anchor tendons, including the method used to maintain them in the centre of the hole over the design bond length.
- iv. Bond zone primary grout placement. Grout mixing procedure and the method of installation, including grout pressures. The method to determine the surface of the hardened bond length grout shall be identified.
- v. Bond zone post grout placement. Grout mixing procedure and the method of installation, including grout pressures.
- vi. Free stressing zone grout placement. Grout mixing procedure and the method of installation, including grout pressures.
- vii. Waterproofing of holes drilled in rock for permanent anchors. Details of water tightness tests, including setup, water pressure, method of applying pressure, details of consolidation, grouting, redrilling, and retesting.

e) Stressing Information

- i. Anchor stressing schedule that includes the working loads and test loads.
- ii. Anchor stressing equipment, and the method for testing the stressing of pre-production and production test anchors and production anchors. Details of the reaction system used to support the applied loads.
- iii. Equipment, including the calibration records of the gauges and jacks, and procedure to monitor the applied loads and movements during anchor testing.
- iv. Details of the reference system and equipment to monitor the movement.

f) All design assumptions, loads, parameters, and bond stresses used for pre-production and production test anchors and production anchors.

g) Testing records when testing has been done to determine bond stress.

h) Details of destressing and removal of temporary anchors.

942.04.02.02**Slurry**

At least 14 Days prior to commencement of the work, the following information for the slurry shall be submitted to the Contract Administrator, for information purposes only:

- a) The type, source, and physical and chemical properties of the bentonite or polymer.
- b) The source of water.
- c) Method of mixing slurry.
- d) The water solids ratio and the mass and volumes of the constituent parts, including any chemical admixtures or physical treatment employed to produce slurry with the required physical properties.
- e) Details of procedure to be used for monitoring the quality of the slurry.
- f) A test report showing the properties of the slurry and certifying that the slurry meets the requirements of API 13A.
- g) Method of disposal of the slurry.

942.04.02.03**Couplers**

At least 14 Days prior to commencement of the work, a copy of the following shall be submitted to the Contract Administrator:

- a) Manufacturer's catalogue giving the complete data on the coupler material and installation procedures.
- b) Test reports from the manufacturer certifying strength and fatigue requirements.

942.04.02.04**Prestressing Steel****942.04.02.04.01****Mill Certificates**

One copy of the mill test certificates, indicating that the steel meets the requirements of the Contract Documents, shall be submitted to the Contract Administrator at the time the prestressing steel is delivered to the job site.

Identification on the anchor tendon shall allow tracing of the prestressing steel to its heat or reel number.

Where mill test certificates originate from a mill outside Canada or the United States of America the Contractor shall have the information on the mill certificate verified by testing by a Canadian testing laboratory. The laboratory shall be accredited by the Standards Council of Canada as complying with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian testing laboratory and appropriate wording stating that the material is according to the Contract Documents. The stamp shall include the appropriate material specification number, testing date (i.e., yyyy-mm-dd), and signature of an authorized officer of the testing laboratory.

One copy of the stress-strain curves that are representative of the lots to be used shall be submitted to the Contract Administrator together with the mill certificates specified detailed in OPSS 1440.

942.04.02.04.02 Prestressing Steel Bond Capacity

If not available from the prestressing steel manufacturer, a prestressing strand bond capacity test shall be conducted on the strand according to Appendix A of the Recommendations for Prestressed Rock and Soil Anchors publication. The test information shall be submitted to the Contract Administrator prior to commencement of work.

942.04.02.05 Milestone Inspections

The Quality Verification Engineer shall witness the following interim inspections of the work:

- a) Construction of anchor holes.
- b) Anchor installation.
- c) Primary grouting.
- d) Post grouting.
- e) Placement of slurry in free stressing length.
- f) Anchorage installation.
- g) Pre-production anchor testing.
- h) Production anchor testing.

A written request for permission to proceed shall be submitted to the Contract Administrator prior to commencement of the successive operation.

942.05 MATERIALS

942.05.01 Permanent Anchors

942.05.01.01 General

Tendons shall be manufactured from steel bars or strand either in single or multiple element tendons.

The permanent anchors shall be Dywidag Threadbar Anchors, BBR Cona Multi-Strand Anchors, VSL Multi-Strand Anchors, or other approved equivalent anchors.

942.05.01.02 Anchorages

The components of the anchorage shall be capable of developing at least 100% of the guaranteed minimum ultimate capacity of the tendon or bar.

The anchor head shall be wedges for prestressing strands and anchor nuts for prestressing bars. The wedges shall be designed to uniformly engage the strand with no notch or pinching effects.

The bearing plate shall be fabricated from steel according to CSA G40.20/G40.21.

The trumpet shall be fabricated from steel pipe according to ASTM A 53M or tubing according to ASTM A 500M. The trumpet shall have a minimum wall thickness of 3 mm for diameters up to and including 100 mm and 5 mm for larger diameters. The joint between the trumpet and the bearing plate and the joint between the trumpet and sheath shall be watertight. The trumpet shall overlap the free stressing length corrosion protection by at least 100 mm. The trumpet shall be long enough to accommodate movements of the structure and the tendon during stressing and testing.

The anchorage covers shall completely encapsulate the anchor head with a watertight seal between the cover and the bearing plate.

942.05.01.03 Prestressing Steel

Prestressing steel shall be according to ASTM A 416M and ASTM A 722M.

Bars shall be high-tensile strength bars grade 1,030 MPa, 1,100 MPa, or 1,230 MPa.

Strand shall be seven-wire, uncoated, stress relieved and low relaxation strand grade 1,720 MPa, 1,760 MPa, or 1,860 MPa.

The strand and bar shall meet the bond capacity test specified in the Prestressing Steel Bond Capacity subsection.

942.05.01.04 Couplers

Couplers for bars shall be as specified by the supplier of the anchor and shall develop at least 100% of the guaranteed minimum ultimate strength of the tendon. Strand tendons shall not be coupled.

942.05.01.05 Cement

Cement shall be according to OPSS 1301 and shall be certified free of false set.

942.05.01.06 Water

Water shall be according to OPSS 1302.

942.05.01.07 Sheathing

Plastic sheathing shall be high density polyethylene according to ASTM D 1248, Type III, or polyvinyl chloride (PVC) according to ASTM D 1784, Class 13464-B or equal. The plastic sheathing shall be such that a bond of 5 MPa is developed when grout with a compressive strength of 30 MPa is used.

Hot melt extruded plastic tubing made from polyethylene according to ASTM D 3350 and ASTM D 1248 shall have an average minimum wall thickness of 1.5 mm. Hot melt extruded plastic tubing from polypropylene according to ASTM D 4101 shall have an average minimum wall thickness of 1.5 mm. Steel tubing or pipe shall have an average minimum wall thickness of 5.0 mm.

The materials for the sheathing accessories such as end caps, grouting caps, grout tubes, and sealing caps shall have properties equal to the plastic sheathing.

942.05.01.08 Heat Shrinkable Sleeves

Heat shrinkable sleeves shall be fabricated from a radiation cross-linked polyolefin tube internally coated with an adhesive sealant.

942.05.01.09 Grout Tubes

Grout tubes shall have an adequate inside diameter to enable the grout to be pumped to the bottom of the drill hole. They shall be able to withstand 1 MPa pressure.

Post-grout tubes shall be strong enough to withstand the post-grouting pressure.

942.05.01.10 Bond Breaker

The bond breaker shall be fabricated from plastic tube or pipe made from medium to high density polyethylene according to ASTM D 1248 or from polyvinyl chloride according to ASTM D 1784, Class 13464-B or equivalent, with a minimum wall thickness of 1 mm.

942.05.01.11 Centralizers and Spacers

Centralizers and spacers shall be steel or plastic.

942.05.01.12 Grout

The grout cube for high early strength grout shall be at least 20 MPa at 7 Days and 30 MPa at 28 Days. The type of cement used shall be suitable for the required use of the grout. Accelerators shall not be used. The grout shall bleed less than 2% when allowed to stand for 1 hour.

942.05.01.13 Corrosion Inhibiting Compound

The corrosion inhibiting compound placed in either the free stressing length or the anchorage area shall be an organic compound, grease, or wax with appropriate polar moisture displacing and self-healing properties and corrosion inhibiting additives. The compound shall permanently stay viscous and be chemically stable and non-reactive with the prestressing steel, sheathing material, and anchor grout.

942.05.01.14 Corrosion Protection

The anchor shall be provided with Class I, encapsulated tendon, double corrosion protection according to the Recommendation for Prestressed Rock and Soil Anchors publication.

The tendon shall be fully encased within a corrugated PVC sheathing that is, in turn, encased within a smooth PVC sheathing over the length of the free stressing zone and protected with grout having the 7- and 28-Day compressive strengths.

942.05.02 Temporary Anchors

The material for temporary anchors shall be the same as specified for the permanent anchors except the double protection system is not required.

942.05.03 Pre-Production Test Anchors

The material for the pre-production test anchors shall be the same as specified for the production anchor being evaluated.

942.05.04 Bentonite Cement Slurry

Bentonite and polymers shall meet the requirements of API 13A.

The bentonite cement slurry shall consist of a stable mixture of cement and a colloidal suspension of pulverized solids or polymers thoroughly mixed with water. The density, viscosity, sand content, and pH of the slurry while being used during excavation shall be according to API RP13B-1.

942.05.05 Concrete

Concrete shall be according to OPSS 1350 with a nominal 28-Day compressive strength of 30 MPa.

The slump shall be 150 to 180 mm.

942.06 EQUIPMENT

942.06.01 General

All equipment for the installation of the anchor, anchor stressing, anchor testing, and monitoring of the anchor test shall be suitable for the intended purposes and capable of working on the site under the prevailing access and clearance conditions.

The equipment used shall not cause damage to the anchor tendon, corrosion protection, or retained structural members.

The equipment used shall be in according to those listed in the required submissions.

942.06.02 Grouting Equipment

Mixers and pumps shall be of an adequate capacity and hoses shall be sized to allow continuous grouting of an individual anchor within one hour. A colloidal mixer with a gauge to measure the water shall be used.

942.06.03 Temporary Anchor Concrete Placement Equipment

Continuous flight augers shall be used for the placement of concrete for temporary anchors up to a maximum ratio of hole diameter to length of 1:35. Open hole concrete placement shall be limited to a minimum hole diameter of 600 mm and a maximum ratio of hole diameter to length of 1:15.

942.06.04 Anchor Testing Equipment

The rated capacity of the equipment shall not be exceeded when stressing the tendon to the maximum specified test load. The pump shall be capable of applying each load increment in less than 60 seconds.

The equipment shall permit the tendon to be stressed in increments so that the load in the tendon can be increased or decreased according to the test specifications and to allow the anchor to be lift-off tested to confirm the lock-off load.

Dial gauges shall have at least a 75 mm travel. Longer gauge stems or sufficient gauge blocks shall be provided to allow for greater travel where required. Gauges shall have precision of at least 0.02 mm.

Dial gauges shall permit the measurement of total tendon movement to the nearest 0.02 mm at every load increment. The gauge shall have sufficient travel to record the total anchor movement at test load without the need to reset at an interim point.

Jacks used for stressing tendons shall have a minimum ram extension of 150 mm.

Stressing equipment shall be calibrated within an accuracy of $\pm 2\%$ immediately prior to use.

Current calibration curves bearing the seal and signature of an Engineer shall be provided for all gauges and jacks.

942.07 CONSTRUCTION

942.07.01 General

The Contractor shall be responsible for the material, fabrication, installation, testing, and monitoring of pre-production and production test anchors and production anchors.

In addition, for non-Owner designed anchors, the Contractor shall be responsible for the preparation of a soils report, the determination of design parameters, and the design of the anchors.

The anchor system shall be according to this specification and the Working Drawings.

Concrete placement according to the Concrete clause of the Caisson Piles subsection of OPSS 903 may be used for temporary anchors inclined a minimum of 30 degrees below the horizontal and having a minimum hole diameter of 450 mm.

942.07.02 Structural Steel

Structural steel components shall be fabricated according to OPSS 906.

942.07.03 Anchor Fabrication

Anchors shall be either shop or field fabricated according to the Working Drawings and schedules by personnel trained and qualified for this work.

Prestressing steel shall be cut with an abrasive saw or, when approved by the prestressing steel supplier, an oxyacetylene torch may be used.

All of the bond length shall be free of dirt, manufacturers' lubricants, corrosion-inhibiting coatings, or other deleterious substances that may significantly affect the grout-to-tendon bond or the service life of the anchor.

When encapsulated anchors are pregouted, they shall be done on an inclined, rigid frame or bed by injecting the grout from the low end of the tendon.

Joints in the protection system shall be made watertight by use of an epoxy bonding agent.

942.07.04 Storage and Handling

Upon delivery, the fabricated anchors and the prestressing steel for fabrication of the tendons and all hardware shall be stored and handled in a manner that avoids mechanical damage, corrosion, and contamination with dirt or deleterious substances.

Handling of the tendons shall not cause mechanical damage or contamination to the prestressing steel, the corrosion protection, or the epoxy coating.

Rope or nylon slings shall be used.

Cement and additives for grout shall be stored under cover and protected against moisture.

Lifting of any pregouted tendons shall not cause excessive bending that may debond the prestressing steel from the surrounding grout.

942.07.05 Corrosion Protection

942.07.05.01 Anchorage Protection

The corrosion protection of the tendon in the vicinity of the anchorage shall ensure proper protection.

All stressing anchorages permanently exposed to the atmosphere or that has a concrete cover less than 50 mm shall be covered with a corrosion inhibiting compound-filled or grout-filled cover.

On strand tendons, the trumpet shall be long enough to enable the tendon to make a transition from the diameter of the tendon along the free stressing length to the diameter of the tendon at the wedge plate without damaging the encapsulation.

The trumpet shall be completely filled with a corrosion inhibiting compound or grout. Compounds may be placed any time during construction. Grout shall be placed after the anchor has been tested and stressed to the lock-off load.

Corrosion inhibiting compound-filled trumpets shall have a permanent seal between the trumpet and the free stressing length corrosion protection.

Trumpets filled with grout shall have either a temporary seal between the trumpet and the free stressing length corrosion protection or the trumpet shall fit tightly over the free stressing length corrosion protection for a minimum of 0.3 m.

942.07.05.02 Free Stressing Length Protection

The tendon shall be fully encased within a corrugated PVC sheathing that is in turn encased within a smooth PVC sheathing over the length of the free stressing zone and protected with grout.

Corrosion protection of the free stressing length shall be provided by a sheath filled with a corrosion inhibiting compound or grout or a heat shrinkable tube internally coated with a mastic compound. The corrosion inhibiting compound shall completely coat the tendon elements, fill the void between them and the sheath, and fill the interstices between the wires of 7-wire strands. Provisions shall be made to retain the compound within the sheath.

The corrosion protective sheath surrounding the free stressing length of the tendon shall be long enough to extend into the trumpet but shall not come into contact with the stressing anchorage during testing.

For pregrouted encapsulations, a separate bond breaker shall be provided to prevent the tendon from bonding to the grout surrounding the free stressing length.

Fusion bonded epoxy may be used to provide an additional layer of protection to the prestressing steel.

942.07.05.03 Free Stressing Length and Bond Length Transition

The transition between the corrosion protection for the bonded and free stressing lengths shall be designed and fabricated to ensure continuous protection from corrosion.

The corrosion protection surrounding the free stressing length of the tendon shall not contact the bearing plate or anchor head.

942.07.05.04 Coupler Protection

On encapsulated bar tendons, the coupler and any exposed bar section next to it shall be covered with a corrosion proof compound or wax impregnated cloth tape. The coupler area shall be covered by a smooth plastic tube overlapping the adjacent sheathed tendon by at least 25 mm. The two joints shall be sealed each by a coated heat shrink sleeve of at least 150 mm length or approved equivalent. The corrosion proof compound shall completely fill the space inside the cover tube.

942.07.06 Construction of Anchor Holes

942.07.06.01 General

The anchor holes shall be constructed to the diameter, orientation, and length specified in the Contract Documents and detailed on the Working Drawings. A drilling method that establishes a stable anchor hole within the tolerances specified in the Contract Documents shall be used.

The sides and end of the completed anchor holes shall be maintained in a stable condition.

The anchor hole entry shall be located within 300 mm of its plan location. The deviation of the anchor hole entry angle from its inclination as specified the Contract Documents shall be no greater than ± 3 degrees.

Open anchor holes and drilled casings shall be cleaned upon completion of drilling.

Anchor holes open for longer than eight hours shall be recleaned prior to insertion of the tendon and primary grouting.

The following information shall be recorded for each anchor hole and submitted to the Contract Administrator:

- a) Identification number.
- b) Anchor hole diameter.
- c) Anchor hole length.
- d) Drilling procedure.
- e) Soil, rock, and ground water conditions encountered.
- f) Time required to drill the anchor hole.
- g) Problems encountered.

942.07.06.02 Waterproofing Anchor Holes

Waterproofing of anchor holes shall be done when specified in the Contract Documents and according to the Working Drawings, procedures, and equipment.

If during the water tightness test, the leakage from an anchor hole over a ten-minute period exceeds 9.5 L, the anchor hole shall be consolidation grouted, redrilled, and retested.

Redrilling shall be done when the grout strength is considerably less than the strength of the surrounding rock.

942.07.07 Anchor Installation

The anchors shall be installed as specified in this specification and detailed on the Working Drawings.

Care shall be taken to ensure the sheathing, corrosion protection, and grout tubes are not damaged during installation of the anchors.

Damaged anchors that cannot be repaired to the satisfaction of the Contract Administrator shall be replaced.

Method of repair shall be submitted to the Contract Administrator for approval.

The prestressing steel in the tendon bond length shall be protected with a grout filled corrugated plastic encapsulation. Centralizers shall be used to ensure a grout cover of at least 12 mm over the encapsulation.

The centralizers shall be maintained in position during installation.

The centralizer shall support the tendon in the drill hole and position the tendon so a minimum grout cover of 12 mm is achieved. Centralizers used inside a sheath shall provide a nominal grout cover of 5 mm over the prestressing steel. All centralizers shall be designed to permit grout to flow freely around the tendon and up the drill hole.

The Contractor shall determine the number of centralizers required; however, one unit shall be placed within 1 m of the bottom of the hole and another at the bond length and free stressing length interface. The centralizers shall not interfere with the placement of grout.

Spacers shall be used in multiple element tendons to separate the strands or bars individually or into small groups.

942.07.08 Primary Grouting of Anchors

The grout shall be placed as specified in this specification and as detailed on the Working Drawings.

The grout shall entirely fill the annular space between the anchor and the borehole wall in the bond length.

Anchors shall be grouted as soon as practical after installation. The stressing tails of prestressing steel strands shall be aligned prior to initial set of the grout.

After grouting, the anchor shall remain undisturbed until the grout has reached the strength specified in the Contract Documents.

The following information shall be recorded for each anchor and submitted to the Contract Administrator:

- a) Identification number.
- b) Type of grout.
- c) Grout pressure.
- d) Volume of grout used.
- e) Location of the top of the bond length grout.

942.07.09 Post-Grouting of Bond Length

When specified in the Contract Documents, post-grouting of the bond length shall be done according to the submitted procedures and equipment.

The information required to be recorded for primary grouting shall be recorded for post grouting.

Ground movement shall be monitored and, if excess movement is observed, the grouting shall be terminated and the situation reported to the Contract Administrator.

The Contract Administrator shall be notified prior to the commencement of post-grouting of both permanent and temporary anchors.

942.07.10 Placing of the Cement Bentonite Slurry in the Free-Stressing Length

The method of placing the cement bentonite slurry shall be as specified in this specification and as detailed on the Working Drawings.

The cement bentonite slurry for the free stressing length shall completely fill the annular space between the prestressing steel and the borehole wall and shall prevent any transfer of the anchor load to the free stressing zone.

942.07.11 Installation of Anchorage

The anchor bearing plate and the anchor head or nut shall be installed perpendicular to the tendon within ± 3 degrees and centred on the bearing plate, without bending or kinking of the prestressing steel elements. Wedge holes and wedges shall be free of rust, grout, and dirt. Special care shall be exercised to obtain the continuity of corrosion protection in the vicinity of the anchorage as described in the Corrosion Protection subsection. The stressing tail shall be cleaned and protected from damage until final testing and lock-off.

The tendon stressing tail shall be cut to its final length according to the tendon manufacturer's recommendations after the anchor is accepted by the Contract Administrator.

Anchorage permanently exposed to the atmosphere shall be covered with a corrosion inhibiting compound filled or grout filled cover

942.07.12 Testing

942.07.12.01 General

Testing shall be carried out as detailed on the Working Drawings and as specified in this specification.

The maximum anchor load shall not exceed 80% of the guaranteed minimum ultimate strength of the tendon.

Stressing shall not commence until the grout has reached its 28-Day strength.

Anchor tests shall be conducted at a time mutually acceptable to the Contractor and Contract Administrator. The Quality Verification Engineer shall witness the testing.

942.07.12.02 Reaction System

The reaction system shall be installed as detailed on the Working Drawings.

942.07.12.03 Reference System and Testing Equipment

The layout of the reference systems and testing equipment required for testing shall be as detailed on the Working Drawings and as specified in this specification.

All reference beams shall be independently supported with the support firmly embedded in the ground at a distance of not less than 2.5 m from the anchor. Reference beams and their supports shall be sufficiently rigid to support instrumentation and to prevent movement relative to the test anchor as a result of stressing or other construction activity during testing.

Dial gauges shall bear on the pulling head of the jack and their stems shall be co-axial with the tendon direction.

The jacks shall be secured with chains to provide adequate protection to personnel in the event of breakage of the anchor or stressing system.

942.07.12.04 Reference System Enclosures

Suitable enclosures shall be constructed to provide complete protection for personnel, equipment, and instruments from variations in the weather conditions and disturbances during the test program.

These provisions shall meet the approval of the Contract Administrator and include the following specific requirements:

- a) The test enclosures shall be weatherproof and adequately lighted and have consistent and controllable heat in order to eliminate temperature variations.
- b) The test enclosure shall be provided with a level dry floor.
- c) A field office equipped with tables, chairs, heating, and lighting shall be provided adjacent to the test anchors.

942.07.12.05 Pre-Production Test Anchors

942.07.12.05.01 General

Pre-production tests shall be conducted to determine the bond stress when:

- a) A bond stress is not specified in the Contract Documents.
- b) A higher bond stress than specified in the Contract Documents is used in the design.
- c) To establish the adequacy of other components of the anchor in advance of the production anchors.

For Contractor designed anchors, at least one pre-production test anchor shall be installed and tested in each significantly different ground condition.

For Owner designed anchors, the number of pre-production test anchors shall be as specified in the Contract Documents. The test anchor shall be constructed using the materials, methods, and procedures specified in this specification and as detailed on the Working Drawings.

Pre-production test anchors shall not be incorporated into the permanent or temporary work unless approved by the Contract Administrator.

942.07.12.05.02 Pre-Production Test Procedures and Measurements

The pre-production anchor test shall be carried out generally in accordance with the prevailing requirements of ASTM D 1143M superseded where applicable by the procedure specified in this specification.

When the pre-production test anchor is to be incorporated into the work, the load in the anchor shall be adjusted to lock-off load in the final cycle.

The pre-production test shall be conducted by cyclically and incrementally loading and unloading the anchor according to the schedule below or until the anchor fails.

AL, 0.25 DL, AL
AL, 0.25 DL, 0.50 DL, AL,
AL, 0.25 DL, 0.50 DL, 0.75 DL, AL
AL, 0.25 DL, 0.50 DL, 0.75 DL, 1.00 DL, AL,
AL, 0.25 DL, 0.50 DL, 0.75 DL, 1.00 DL, 1.25 DL, AL,
AL, 0.25 DL, 0.50 DL, 0.75 DL, 1.00 DL, 1.25 DL, 1.50 DL, AL
AL, 0.25 DL, 0.50 DL, 0.75 DL, 1.00 DL, 1.25 DL, 1.50 DL, 1.75 DL, AL,
AL, 0.25 DL, 0.50 DL, 0.75 DL, 1.00 DL, 1.25 DL, 1.50 DL, 1.75 DL, 2.00 DL*, AL
AL, 0.00 DL

Where:

AL = alignment load
DL = design load of anchor

* At 2.00 DL, the load shall be maintained for 24 hours.

Each load shall be maintained for a minimum of 15 minutes or until the rate of displacement is not greater than 0.25 mm per hour.

Vertical and horizontal movement of the reaction system and tendon elongation shall be recorded with respect to an independent fixed reference point. A record of the test enclosure temperature is also required.

During the load hold periods, the anchor load shall not be allowed to deviate from the test pressure by more than 0.35 MPa.

When required, repumping back to test load shall be done to compensate for small movements, hydraulic oil seepage, and changes in temperature of the hydraulic oil.

The load shall always be returned to the specified test load prior to taking the movement reading at the specified interval. The test load shall not be exceeded during the period of observation.

942.07.12.05.03 Removal of Pre-Production Test Anchors

The test anchors not approved to be incorporated into the work shall be removed flush with the surrounding ground and the test site restored to its pretest conditions.

The test anchorages shall not be removed until the Contract Administrator has given permission in writing to remove them.

942.07.12.06 Production Anchors

942.07.12.06.01 General

Every temporary and permanent anchor shall be tested according to the Proof Test - Permanent Anchors or Proof Test - Temporary Anchors clause, as appropriate.

942.07.12.06.02 Proof Test - Permanent Anchors

The following proof test shall be applied to the anchorages:

After preloading the anchor to 1.5 DL for 30 minutes, the proof test shall be conducted by incrementally loading and unloading the anchor according to the following schedule or until the anchorage fails, as determined by the Contract Administrator. The acceptance criteria apply to only the peak loading.

Loads shall be applied as follows:

0.25 DL, 1.00 DL, 1.50 DL, 1.00 DL, 0.25 DL

Where:

DL = specified working load of anchorage

At 1.50 DL, the load shall be maintained for a minimum of 30 minutes. Measurement shall be recorded according to the following time increment schedule.

0 min, 1 min, 2 min, 3 min, 6 min, 9 min, 12 min, 15 min, 18 min, 30 min.

If the acceptance criteria as specified herein are met, the anchorage shall be prestressed to 1.50 DL, then shall be locked-off at the transfer load of 1.10 DL.

If the acceptance criteria as specified herein are not met in the 30-minute period the test shall be extended as required, with readings at 30-minute increments, up to 180 minutes.

If the acceptance criteria as specified herein are not met, the provisions of the Unacceptable Stressing Results clause shall apply.

942.07.12.06.03 Proof Test - Temporary Anchors

The proof test shall be conducted by incrementally loading the anchor according to the following schedule:

AL, 0.25 DL, 0.50 DL, 0.75 DL, 1.00 DL, 1.20 DL, 1.33 DL, AL, and adjust to lock-off load

Where:

AL = alignment load

DL = specified working load of anchorage

At the test load of 1.33 DL, the load shall remain constant for 10 minutes and the total movement shall be recorded at 1, 2, 3, 4, 5, 6, and 10 minutes. If the difference between the total movements at 1 minute and 10 minutes exceeds 1 mm, the test load shall be maintained for an additional 50 minutes, and the movements readings shall be recorded at 20, 30, 40, 50, and 60 minutes. The anchor shall be returned to AL after holding the load at test load for 50 minutes and the residual movement recorded.

The hydraulic pressure during the load hold period shall not deviate by more than 0.35 MPa and the load shall be returned to the test load prior to taking the movement reading. The total movements at each load increment shall be recorded.

942.07.12.06.04 Lock-Off Procedure

After testing has been completed, the load in the tendon shall be such that, after seating losses (wedge seating), the specified lock-off load has been applied to the anchor tendon.

The magnitude of the lock-off load shall be 1.10 DL or as specified by the Contract Administrator and shall not exceed 70% of the ultimate load of the tendon or bar (F_{pu}).

The wedges shall be seated at a minimum load of 50% of F_{pu} . If the lock-off load is less than 50%, shims shall be used under the wedge plate and the wedges seated at 50% of F_{pu} . The shims shall then be removed to reduce the load in the tendon to the desired lock-off load. Bar tendons may be locked off at any load less than 70% of F_{pu} .

942.07.12.06.05 Lift-Off Tests

A minimum of three lift-off tests shall be conducted at each site. The location of the anchor to be tested and the time of test shall be as determined by the Quality Verification Engineer. The lift-off test shall not be performed until 48 hours has elapsed after transferring the lock-off load. The method of testing shall be as detailed on the Working Drawings.

The lift-off test shall be performed after transferring the load to the anchor and prior to removing the jack from its location. The lift-off load shall be determined by re-applying the load to the tendon or bar to lift off the wedge plate or anchor nut without unseating the wedges or turning the anchor nut.

942.07.12.07 Acceptance Criteria

An anchor shall be considered acceptable when all three of the following acceptance test criteria are satisfied:

- a) The total creep movement at test load during the last log time cycle is less than 1.5 mm.
- b) The apparent free stressing length based on the elastic movement at the test load is not less than 80% of the designed free stressing length.
- c) The load measured during the lift-off test is within 10% of the designed lock-off load.

942.07.12.08 Unacceptable Stressing Results

For the anchorages that do not meet the acceptance criteria for the performance test or the proof test, the Contractor shall submit one of the following alternatives as a proposal to the Contract Administrator for approval:

- a) Abandon the deficient anchor and install a new anchor.
- b) Lock-off the anchors at no more than 50% of the accepted test load sustained during test or as determined by the Contract Administrator and install an additional anchor to compensate for the deficiency.
- c) Post grout the anchor at a grouting pressure not exceeding 3.6 MPa or as recommended by the Contract Administrator and then conduct a proof test and apply the acceptance criteria to the test results. The post grouting shall be terminated immediately if any distress on the ground surface is observed during grouting.
- d) Readjust the transfer load to 1.10 DL for an anchor that does not meet the lift-off criteria and repeat the test after a minimum of 48 hours. If the anchor does not meet the lift-off test criteria after completing this procedure, it shall be considered unacceptable.

942.07.13 Quality Control

942.07.13.01 General

In addition to the quality control procedures initiated by the Contractor, the following work shall also be done.

942.07.13.02 Quality of Grout Mixture

942.07.13.02.01 General

The Contractor shall be responsible for testing of bleeding, preparation and initial storage of grout cubes for determination of compressive strength, and delivery of the grout cubes to a testing laboratory designated by the Owner.

The Contractor shall employ staff from a testing company certified according to CSA A283, Certification for Additional Tests 1B, by an organization accredited by the Standards Council of Canada to carry out testing for bleeding, making, and curing of grout cubes and early strength determination.

Grout cubes for compressive strength test and testing of bleeding shall be made on a level, vibration free surface.

942.07.13.02.02 Testing for Bleeding

The testing for bleeding of the grout shall be according to CSA A23.2-1B.

Prior to the grouting operation, in the presence of the Contract Administrator, a trial batch shall be mixed and the grout tested for bleeding to ensure that the grout meets the requirements of this specification. The trial batch of grout shall not be used in the actual grouting operation.

During the grouting operation, bleeding measurements shall be performed on the grout sampled at the mixer. The measurements shall be performed at least once a day and as requested by the Contract Administrator.

The bleeding test results shall be submitted to the Contract Administrator in writing. The test results that indicate the grout is not meeting the requirements of the Contract Documents shall be reported immediately to the Contract Administrator and the grouting operation halted until the cause of the problem is identified and corrected.

942.07.13.02.03 Making, Curing, and Transportation of Cubes for Compressive Strength Tests

Grout cubes shall be prepared as follows on site from the grout pumped into the anchor body:

- a) One set of grout cubes, consisting of three cubes, shall be made each day the grouting operations are carried out.
- b) The grout cubes shall be prepared according to CSA A23.2-1B and stored at a temperature between 15 and 25 °C and shall not be moved prior to demoulding.
- c) The grout cubes shall be demoulded and transported to the laboratory designated by the Owner within 24 hours.
- d) The grout cubes shall be transported in a sealed white opaque plastic bag containing at least 250 mL of water and maintained at a temperature between 15 and 25 °C.

942.07.13.02.04 Early Strength Determination

The Contractor shall prepare and test additional grout cubes to determine when the grout has attained a strength of 20 MPa.

The laboratory conducting the test shall be certified as specified in this specification.

942.07.13.03 Certificate of Conformance

A completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the anchor installation and stressing operations. The Qualification Verification Engineer's seal and signature shall be affixed on the completed Certificate of Conformance confirming that the anchors have been supplied, installed, and stressed in general conformance with the Working Drawings. The Certificate of Conformance shall also certify that the interim milestone inspections have been completed as specified.

942.07.14 Management of Excess Materials

Management of excess material shall be as specified in the Contract Documents.

942.09 MEASUREMENT FOR PAYMENT

942.09.01 Actual Measurement

942.09.01.01 Pre-Production Test Anchors and Production Anchors

Measurement of pre-production test anchors and production anchors shall be by length in metres along the actual length of the anchor from the anchor plate to the tip.

942.09.01.02 Post-Grouting of Bond Length

Measurement of post-grouting of bond length shall be by mass in kilograms of mixed grout used.

942.10 BASIS OF PAYMENT

**942.10.01 Pre-Production Test Anchors - Item
Production Anchor - Item
Post-Grouting of Bond Length - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 942-A, November 2009 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Anchor hole diameter, orientation, and length tolerances and inclination. (942.07.06.01)
- Grout strength. (942.07.08)
- Number of pre-production test anchors for Owner designed systems. (942.07.12.05.01)
- Grout testing laboratory. (942.07.13.02.01)

The designer should determine if the following are required and, if so, they should be specify in the Contract Documents:

- Waterproofing anchor holes. (942.07.06.02)
- Post-grouting of bond length of anchors. (942.07.09)
- Bond stress. (942.07.12.05.01)

OPSS 942 contains information written for provincial contracts. To ensure completeness of municipal Contract Documents, the designer should invoke Appendix 942-B. The appendix contains supplemental requirements that modify OPSS 942 so it can be used by a municipality in its contracts.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.

Appendix 942-B, November 2009

FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

Supplemental Requirements for Using OPSS 942 in Municipal Contracts

OPSS 942, Prestressed Soil and Rock Anchors, is amended as follows:

942.03 Definitions

Section 942.03 is amended by the deletion of the definitions for Certificate of Conformance and for Quality Verification Engineer.

Section 942.03 is amended by the addition of the following:

Certificate of Installation means a document issued by the design Engineer or design-checking Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

942.04.02.01 Working Drawings

The first paragraph of clause 942.04.02.01 is deleted in its entirety and replaced by the following:

The Contractor shall submit 5 sets of Working Drawings to the Contract Administrator at least 3 weeks prior to commencement of the work for the prestressed soil and rock anchor installation. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

Clause 942.04.02.01 is amended by the addition of the following:

942.04.02.01.01 Return of Submissions

Two copies of each submission shall be returned as one of the following:

- a) Stamped with the wording that allows for permission to construct. In this case, work can commence on receipt of the drawings by the Contractor.
- b) Stamped with the wording that allows for permission to construct as noted. In this case, work can start on receipt of the drawings by the Contractor. The drawings shall be updated as noted and shall be sealed and signed by the design Engineer and the design-checking Engineer stating the drawings have been revised according to the noted comments.
- c) Showing only required changes. In this case, the drawings shall be updated as required and the submission process repeated.

The Contractor shall have a copy of the stamped updated or accepted drawings at the site prior to the commencement of the work of the prestressed soil and rock anchors.

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942.04.02.02 Slurry

The first sentence of clause 942.04.02.02 is deleted in its entirety and replaced by the following:

At least 14 Days prior to the commencement of the work, the following information for the slurry shall be submitted to the Contract Administrator.

942.04.02.05 Milestone Inspections

The first sentence of clause 942.04.02.05 is deleted in its entirety and replaced by the following:

The design Engineer or the design-checking Engineer shall witness interim inspections of the following work:

942.07.12.01 General

The last paragraph of clause 942.07.12.01 is deleted in its entirety and replaced by the following:

Anchor tests shall be conducted at a time mutually acceptable to the Contractor and Contract Administrator. The design Engineer or the design-checking Engineer shall witness the testing.

942.07.12.06.05 Lift-Off Tests

The first paragraph of clause 942.07.12.06.05 is deleted in its entirety and replaced by the following:

A minimum of three lift-off tests shall be conducted at each site. The location of the anchor to be tested and the time of test shall be as determined by the design Engineer or design-checking Engineer. The lift-off test shall not be performed until 48 hours has elapsed after transferring the lock-off load. The method of testing shall be as detailed on the Working Drawings.

942.07.13.03 Certificate of Conformance

Clause 942.07.13.03 is deleted in its entirety and replaced by the following:

942.07.13.03 Certificate of Installation

A completed certificate of installation shall be submitted to the Contract Administrator upon completion of the anchor installation and stressing operations. The design Engineer or design-checking Engineer's seal and signature shall be affixed on the completed certificate of installation confirming that the anchors have been supplied, installed, and stressed in general conformance with the Working Drawings. The certificate of installation shall also certify that the interim milestone inspections have been completed as specified.

942.07 Construction

Section 942.07 is amended by the addition of the following:

942.07.15 As Built Drawings

As built drawings shall be prepared by the Contractor for the soil and rock anchor installations as follows:

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a) For all work incorporated in the completed structure that required the submission of Working Drawings.

For all changes to the original Contract Document requirements.

The as built drawings shall be submitted to the Contract Administrator, prior to the final acceptance of the work, in a reproducible format specified by the Owner.

The submission of as built drawings shall be accompanied by a letter bearing the seal and signature of an Engineer stating the as built drawings contain all the changes to the work.

The as built drawings shall bear the seal and signature of an Engineer.