

Ontario Provincial Standards for Roads and Public Works



- Volume 2 -

MUNICIPAL AND PROVINCIAL COMMON MATERIAL SPECIFICATIONS



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MANUAL REVISION RECORD

Municipal and Provincial Common

Volume 2 – Material 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
32	APRIL 2005	Included in new manuals	57	APRIL 2019	Included in new manuals
33	NOV 2005	Included in new manuals	58		
34	APRIL 2006	Included in new manuals	59		
35	NOV 2006	Included in new manuals	60		
36	APRIL 2007	Included in new manuals	61		
37	NOV 2007	Included in new manuals	62		
38	NOV 2008	Included in new manuals	63		
39	NOV 2009	Included in new manuals	64		
40	APRIL 2010	Included in new manuals	65		
41	NOV 2010	Included in new manuals	66		
42	APRIL 2011	Included in new manuals	67		
43	NOV 2011	Included in new manuals	68		
44	APRIL 2012	Included in new manuals	69		
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46	APRIL 2013	Included in new manuals	71		
47	NOV 2013	Included in new manuals	72		
48	APRIL 2014	Included in new manuals	73		
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54	NOV 2017	Included in new manuals	79		
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REVISION INFORMATION SHEET

ONTARIO PROVINCIAL STANDARDS FOR ROADS AND PUBLIC WORKS

VOLUME 2 MUNICIPAL AND PROVINCIAL COMMON MATERIAL SPECIFICATIONS

MANUAL REVISION #57

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for use of Ontario Provincial Standards; therefore, manual holders are cautioned about immediately discarding superseded and cancelled standards.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 2

Remove the entire index and replace with the attached revised index.

Standard Specifications Volume 2

Superseded/Cancelled (Remove)		Revised/New (Insert)		Remarks
OPSS	Dated	OPSS	Dated	
1305	Nov 2008	1305	Apr 2019 Notice to Users of OPSS 1305	“MATERIAL SPECIFICATION FOR MOISTURE VAPOUR BARRIERS” Superseded by OPSS.PROV 1305 in OPS Volume 6 and OPSS.MUNI 1305 in OPS Volume 8.
1306	Nov 2011	1306	Apr 2019 Notice to Users of OPSS 1306	“MATERIAL SPECIFICATION FOR BURLAP” Superseded by OPSS.PROV 1306 in OPS Volume 6 and OPSS.MUNI 1306 in OPS Volume 8.
2476	Nov 2010	2476	Apr 2019 Notice to Users of OPSS 2476	“MATERIAL SPECIFICATION FOR RAISING AND LOWERING EQUIPMENT FOR HIGH MAST LIGHTING POLES” Superseded by OPSS.PROV 2476 in OPS Volume 6 and OPSS.MUNI 2476 in OPS Volume 8.



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APR 2013	1002	Notice to Users of OPSS 1002 (Aggregates - Concrete)
APR 2013	1003	Notice to Users of OPSS 1003 (Aggregates - Hot Mix Asphalt)
NOV 2012	1004	Notice to Users of OPSS 1004 (Aggregates - Miscellaneous)
APR 2017	1005	Notice to Users of 1005 (Aggregates - Streambed Material)
APR 2013	1006	Notice to Users of 1006 (Aggregates - Surface Treatment)
APR 2013	1010	Notice to Users of OPSS 1010 (Aggregates - Base, Subbase, Select Subgrade, and Backfill Material)
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NOV 2018	1150	Notice to Users of OPSS 1150 (Hot Mix Asphalt)
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NOV 2016	1152	Notice to Users of OPSS 1152 (SC-800 Patching Material)
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NOV 2003	1204	Polyvinyl Chloride Waterstops
APR 2015	1205	Notice to Users of OPSS 1205 (Clay Seal)
NOV 2014	1210	Notice to Users of OPSS 1210 (Deck Joint Assemblies)
NOV 2003	1212	Hot Poured Rubberized Asphalt Joint Sealing Compound
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SEPT 1996	1302	Water
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NOV 2018	1842	Notice to Users of OPSS 1820 (Pressure Polyethylene Pipe Products)
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CURRENTLY NO SPECIFICATIONS

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NOTICE TO USERS OF OPSS 1001

MATERIAL SPECIFICATION FOR AGGREGATES - GENERAL

OPSS 1001 has been removed from this
OPS volume

The provincial version of OPSS 1001 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1001

The municipal version of OPSS 1001 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1001

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NOTICE TO USERS OF OPSS 1002

MATERIAL SPECIFICATION FOR AGGREGATES - CONCRETE

OPSS 1002 has been removed from this
OPS volume

The provincial version of OPSS 1002 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1002

The municipal version of OPSS 1002 is now in:

OPS Volume 8,
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Material Specifications
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NOTICE TO USERS OF OPSS 1003

MATERIAL SPECIFICATION FOR AGGREGATES - HOT MIX ASPHALT

OPSS 1003 has been removed from this
OPS volume

The provincial version of OPSS 1003 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1003

The municipal version of OPSS 1003 is now in:

OPS Volume 8,
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Material Specifications
and designated as OPSS.MUNI 1003

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NOTICE TO USERS OF OPSS 1004

MATERIAL SPECIFICATION FOR AGGREGATES - MISCELLANEOUS

OPSS 1004 has been removed from this
OPS volume

The provincial version of OPSS 1004 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1004

The municipal version of OPSS 1004 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1004

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NOTICE TO USERS OF OPSS 1005

MATERIAL SPECIFICATION FOR AGGREGATES – STREAMBED MATERIAL

OPSS 1005 has been removed from this
OPS volume

The provincial version of OPSS 1005 is now in:

OPS Volume 6,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 1005

The municipal version of OPSS 1005 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 1005

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NOTICE TO USERS OF OPSS 1006

MATERIAL SPECIFICATION FOR AGGREGATES - SURFACE TREATMENT

OPSS 1006 has been removed from this
OPS volume

The provincial version of OPSS 1006 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1006

The municipal version of OPSS 1006 is now in:

OPS Volume 8,
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Material Specifications
and designated as OPSS.MUNI 1006

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NOTICE TO USERS OF OPSS 1010

MATERIAL SPECIFICATION FOR AGGREGATES - BASE, SUBBASE, SELECT SUBGRADE, AND BACKFILL MATERIAL

OPSS 1010 has been removed from this
OPS volume

The provincial version of OPSS 1010 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1010

The municipal version of OPSS 1010 is now in:

OPS Volume 8,
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Material Specifications
and designated as OPSS.MUNI 1010

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NOTICE TO USERS OF OPSS 1101

MATERIAL SPECIFICATION FOR PERFORMANCE GRADED ASPHALT CEMENT

OPSS 1101 has been removed from this
OPS volume

The provincial version of OPSS 1101 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1101

The municipal version of OPSS 1101 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1101

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NOTICE TO USERS OF OPSS 1102

MATERIAL SPECIFICATION FOR LIQUID ASPHALT USED IN SPRAYING, SEALING AND PRIMING APPLICATIONS

OPSS 1102 has been removed from this
OPS volume

The provincial version of OPSS 1102 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1102

The municipal version of OPSS 1102 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1102

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NOTICE TO USERS OF OPSS 1103

MATERIAL SPECIFICATION FOR EMULSIFIED ASPHALT

OPSS 1103 has been removed from this
OPS volume

The provincial version of OPSS 1103 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1103

The municipal version of OPSS 1103 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1103

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NOTICE TO USERS OF OPSS 1150

MATERIAL SPECIFICATION FOR HOT MIX ASPHALT

OPSS 1150 has been removed from this
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The municipal version of OPSS 1150 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1150

There is no PROV version.

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NOTICE TO USERS OF OPSS 1151

MATERIAL SPECIFICATION FOR SUPERPAVE AND STONE MASTIC ASPHALT MIXTURES

OPSS 1151 has been removed from this
OPS volume

The provincial version of OPSS 1151 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1151

The municipal version of OPSS 1151 is now in:

OPS Volume 8,
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Material Specifications
and designated as OPSS.MUNI 1151

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NOTICE TO USERS OF OPSS 1152

MATERIAL SPECIFICATION FOR SC-800 PATCHING MATERIAL

OPSS 1152 has been removed from this
OPS volume

The provincial version of OPSS 1152 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1152

The municipal version of OPSS 1152 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1152

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NOTICE TO USERS OF OPSS 1153

MATERIAL SPECIFICATION FOR EMULSIFIED ASPHALT PATCHING MATERIAL

OPSS 1153 has been removed from this
OPS volume

The provincial version of OPSS 1153 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1153

The municipal version of OPSS 1153 is now in:

OPS Volume 8,
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Material Specifications
and designated as OPSS.MUNI 1153

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NOTICE TO USERS OF OPSS 1202

MATERIAL SPECIFICATION FOR BEARINGS – ELASTOMERIC PLAIN AND STEEL LAMINATED

OPSS 1202 has been removed from this
OPS volume

The provincial version of OPSS 1202 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1202

The municipal version of OPSS 1202 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1202

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NOTICE TO USERS OF OPSS 1203

MATERIAL SPECIFICATION FOR BEARINGS – ROTATIONAL AND SLIDING SURFACE

OPSS 1203 has been removed from this
OPS volume

The provincial version of OPSS 1203 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1203

The municipal version of OPSS 1203 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1203

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MATERIAL SPECIFICATION FOR POLYVINYL CHLORIDE WATERSTOPS

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1204.03	DEFINITIONS - Not Used
1204.04	SUBMISSION AND DESIGN REQUIREMENTS - Not Used
1204.05	MATERIALS
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1204.07	PRODUCTION
1204.08	QUALITY ASSURANCE
1204.09	OWNER PURCHASE OF MATERIAL

APPENDICES

1204-A	Commentary

1204.01	SCOPE

This specification covers the polyvinyl chloride waterstops for joints in concrete structures.

1204.01.01	Significance and use of Appendices

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

Appendix 1204-A is a commentary appendix to provide designers with information on the use of this specification in a Contract.

1204.02**REFERENCES**

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

ASTM International

- D 412-98a Standard Test Methods for Vulcanised Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
- D 624-98 Standard Test for Tear Strength of Conventional Vulcanised Rubber and Thermoplastic Elastomers
- D 2240-97el Standard Test Method for Rubber Property - Durometer Hardness

1204.05**MATERIALS****1204.05.01****General Requirements**

The waterstops shall be extruded from a polyvinyl chloride compound to meet the performance requirements given in this specification. Reworked polyvinyl chloride may be used but reclaimed polyvinyl chloride will not be permitted.

1204.05.02**Physical Requirements**

The waterstop shall meet the requirements specified in Table 1. All tests shall be made on specimens prepared from the extruded waterstops.

When required, the thickness of specimens shall be reduced to between 1.5 and 3.0 mm by buffing, or slicing.

The extruded material shall be dense, homogeneous, of smooth surface, and free from porosity and other imperfections.

1204.07**PRODUCTION****1204.07.01****General**

The waterstops shall be of the shape and dimensions specified in the Contract Documents. The cross-section of the waterstop shall be uniform along its length and shall be symmetrical transversely so that the thickness at any given distance from either edge of the waterstop will be uniform.

All splices in the waterstop shall be watertight.

1204.07.02**Quality Control****1204.07.02.01****Testing Procedures****1204.07.02.01.01****General**

Testing procedures shall be according to the relevant ASTM standards indicated in Table 1, except that modulus of elasticity, effect of alkali, accelerated extraction, cold bend, and low temperature impact resistance shall be determined according to the procedures described in the following clauses.

1204.07.02.01.02 Modulus of Elasticity

Conformance shall be determined on the average of the results from tests on 3 specimens. Testing shall be carried out according to the following:

- a) Each specimen shall be 25 mm in length and of the full cross-section of the finished waterstop.
- b) The specimen shall be clamped in the testing machine in such a manner as to form a cantilever beam with the 25 mm dimension as the beam width.
- c) The specimen shall be held between the bulb and the nearest rib on either side of the bulb.
- d) The load shall be applied at the rib farthest from the clamp, across the full width of the specimen by a rigid blade type loading head of 0.8 mm contact edge radius.
- e) With the load value being that obtained for a deflection rate of 5 mm/min the modulus of elasticity of the material shall be calculated from the following formula.

$$E = \frac{4PxL^3}{\Delta xbt^3}$$

Where

- E = modulus of elasticity, kilopascals
- P = applied load, kilonewtons
- L = span length, millimetre
- Δ = deflection under applied load, millimetres
- b = width of the specimen 25 mm
- t = average thickness of the specimen, millimetres

1204.07.02.01.03 Effect of Alkali

Testing shall be carried out according to the following:

- a) Three specimens shall be cut from the waterstop, each having a mass of 75 grams.
- b) The specimens shall be washed in tap water, rinsed with distilled water, wiped with a clean cloth, and allowed to dry in laboratory air for approximately 1 hour.
- c) The mass of each specimen shall be recorded to the nearest 0.001 gram.
- d) Using a Shore durometer, Type A, a durometer reading shall be taken according to ASTM D 2240.
- e) The specimens shall be completely immersed in a freshly made solution containing 5.0 grams of chemically pure sodium hydroxide and 5.0 grams of chemically pure potassium hydroxide in one litre of distilled water kept at 21 to 24°C. The solution shall be replaced every 7 Days.
- f) At the end of 7 Days and at the end of 28 Days the specimens shall be removed, rinsed with distilled water, the surfaces wiped with a clean cloth, and allowed to dry in laboratory air for approximately 1 hour.
- g) The mass shall be measured and recorded at the end of 7 Days and at the end of 28 Days. The durometer hardness shall be measured and recorded at the end of 7 Days. Mass changes shall be recorded as a percentage of the original mass and the hardness change in durometer units.

1204.07.02.01.04 Accelerated Extraction

Testing shall be carried out according to the following:

- a) Five tensile test specimens according to ASTM D 412 Die C, each weighed to the nearest 0.001 gram, shall be placed in a one litre tall form beaker with spout.
- b) The beaker shall be filled to within 50 mm of the top, with a solution made by dissolving 5.0 grams of chemically pure potassium hydroxide in one litre of distilled water. The specimens shall be completely immersed and the top of the beaker covered with a watch glass.
- c) The beaker shall then be placed in a constant temperature bath and the temperature of the solution maintained between 60 and 65°C. The solution shall be changed every 24 hours, with the new solution being warmed to 65°C before replacing the old.
- d) A 6 mm diameter glass tube shall be inserted in the spout of the beaker to within 12 mm of the bottom of the beaker. Air shall then be gently bubbled through the solution at the rate of about one bubble per second.
- e) Once daily each of the five specimens shall be removed from the beaker, rinsed lightly with distilled water, and then superficially dried with a clean cloth. Ten minutes after the specimens have been thus dried, the group of five specimens shall be weighed and mass recorded.
- f) The sequence of testing shall be carried out continuously for a period of not less than 14 Days.
- g) After the 14 Day period, provided the specimens have reached constant mass, they shall be tested for tensile strength and elongation. Constant mass is assumed to have been achieved when the masses of the group of specimens on three successive weighings do not differ from each other by more than 0.05% of the original mass. Prior to being tested for tensile strength and elongation, the specimens shall be removed, rinsed, stored for 10 minutes and weighed. If the tests for tensile strength and elongation cannot be made within 1 hour after completion of the weighings indicating the achievement of constant mass, the specimens shall be stored immersed in a fresh alkali solution at room temperature. Tensile strength shall be calculated from the total load at failure, the nominal width, and the thickness as determined prior to the extraction test. The tensile strength and elongation shall be determined not more than 72 hours after the weighings which demonstrated that constant mass had been achieved.
- h) If constant mass has not been achieved after 90 Days, the exposure shall be terminated, the specimen tested for tensile strength and elongation, and a note added to the report indicating the mass losses between the last successive weighings and the fact that constant mass, as here defined, was not achieved.

1204.07.02.01.05 Cold Bend

Three specimens, each between 1.5 and 3.0 mm thick, 25 mm wide, and 150 mm long shall be cooled to 10°C then immediately bent through 180 degrees around a 6 mm diameter mandrel. Any cracking shall constitute a failure.

1204.07.02.01.06 Low Temperature Impact Resistance

Testing shall be carried out according to the following:

- a) Three specimens from a finished waterstop, each 100 to 150 mm long and of full cross-section, shall be rigidly clamped in a horizontal position in such a manner as to form a cantilever beam of length equal to the cross-sectional width. There shall be a minimum of 125 mm vertical clearance below the unsupported section of the beam.

- b) The test assembly and specimens shall be cooled to a temperature of -35°C.
- c) At that temperature the unsupported section shall be struck centrally with a 3.6 kg steel ball dropped freely through 1.5 m.

Any cracking or chipping of the specimen shall constitute failure

1204.07.03 Test Certificates

Two certified copies of the manufacturer's test results for the lot numbers shall be provided for all shipments to the Contract or storage depots. One copy shall be included with the shipment and a second copy shall be sent to the Contract Administrator.

1204.07.04 Acceptance or Rejection

All waterstops failing to meet any of the requirements of this specification shall be rejected. Rejected materials shall be expeditiously removed and replaced with acceptable materials at no additional expense to the Owner.

1204.07.05 Marking

All waterstops shall be identified as to the manufacturer by means of a colour. These colours shall be registered with the Owner and shall be used in all waterstops produced by the respective manufacturer.

The waterstop shall be marked with the lot number.

1204.07.06 Packaging

The waterstop shall be packaged as coils in containers so constructed as to ensure safe delivery. The inside diameter of the coil shall be at least 300 mm.

The waterstop in the coil shall be of continuous length.

The waterstop shall be clearly identified by affixing labels to the coils and containers. The labels shall indicate the following:

- a) Manufacturer's name.
- b) Trade name.
- c) Lot number.
- d) Coil number.
- e) Length of the waterstop in the coil.
- f) Size.

1204.08 QUALITY ASSURANCE

The Owner may perform such inspection, sampling, and testing at such times and locations deemed necessary to determine the acceptability of the waterstops.

1204.09 OWNER PURCHASE OF MATERIAL

1204.09.01 Measurement and Payment

Payment at the price specified in the purchasing order, in metres along the length of the waterstops for the type specified, shall be full compensation for all labour, Equipment, and Material to supply the waterstops to the destination at the time specified.

Where material is sampled by the Owner's representative after packaging, measurement shall be made of the original quantity as packed.

Table 1
Physical Requirements for Waterstops

Property	Physical Requirements	Test Procedure
Tensile Strength, Mpa	minimum 10 average of 5 specimens	ASTM D 412 Die C
Ultimate Elongation, %	minimum 275 average of 5 specimens	ASTM D 412 Die C
Tear Resistance, N/mm	minimum 44 average of 3 specimens	ASTM D 624 Die B
Modulus of Elasticity, MPa	minimum 24	See Modulus of Elasticity clause
Effect of Alkali 7 Day - mass increase, % - mass decrease, % - hardness change, points 28 Day - mass increase, % - mass decrease, %	maximum 0.25 maximum 0.10 ± 5 maximum 0.40 maximum 0.30	See Effect of Alkali clause.
Accelerated Extraction Tensile Strength, MPa Ultimate Elongation, %	minimum 90 minimum 250	See Accelerated Extraction clause
Cold Bend	Pass	See Cold Bend clause
Low Temperature Impact Resistance	Pass	See Low Temperature Impact Resistance clause

Appendix 1204-A, Commentary for OPSS 1204, November 2003

Note: This appendix does not form part of the standard specification. It is intended to provide information to the designer on the use of this specification in a Contract.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Waterstop shape and dimensions. (1204.07.01)

Related Ontario Provincial Standard Drawing

OPSD 4670.000 Construction and Expansion Joint In Concrete



NOTICE TO USERS OF OPSS 1205

MATERIAL SPECIFICATION FOR CLAY SEAL

OPSS 1205 has been removed from this
OPS volume

The provincial version of OPSS 1205 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1205

The municipal version of OPSS 1205 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1205

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



NOTICE TO USERS OF OPSS 1210

MATERIAL SPECIFICATION FOR DECK JOINT ASSEMBLIES

OPSS 1210 has been removed from this
OPS volume

The provincial version of OPSS 1210 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1210

The municipal version of OPSS 1210 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1210

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



**MATERIAL SPECIFICATION FOR
HOT POURED RUBBERIZED ASPHALT JOINT SEALING COMPOUND**

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1212-A	Commentary

1212.01	SCOPE

This specification covers hot poured rubberized asphalt joint sealing compounds for sealing joints in concrete or asphaltic concrete with a small amount of movement.

1212.01.01	Significance and Use of Appendices

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

Appendix 1212-A is a commentary appendix to provide designers with information on the use of this specification in a Contract.

1212.02**REFERENCES**

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

ASTM International

- D 6690-01 Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
- D 5329 (1996) Test Methods for Sealants and Fillers, Hot-Applied, For Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements
- D 5 (1997) Standard Test Method for Penetration of Bituminous Materials

Ministry of Transportation, Ontario, Laboratory Testing Manual

- LS-262 Method of Test for Bulk Relative Density of Compacted Bituminous Mixtures

National Standard Specifications

- CAN/CGSB 37.50-M89 Hot Applied Rubberized Asphalt for Roofing and Waterproofing

1212.05**MATERIAL****1212.05.01 Joint Sealing Compound**

Except as modified herein, the joint sealing compound shall be according to ASTM D 6690 and as specified in the Contract Documents.

1212.07**PRODUCTION****1212.07.01****General**

Pouring point shall be at least 10°C lower than the safe heating temperature recommended by the manufacturer.

1212.07.02**Quality Control****1212.07.02.01****Test Procedures**

Where required by the Contract Administrator, the hot poured rubberized asphalt joint sealing compound shall be sampled and tested for cone penetration, flow, resilience, bond, toughness, and relative density as follows:

- a) Sample preparation shall be according to CAN/CGSB 37.50-M.
- b) Cone penetration, resilience, and bond testing shall be carried out according to ASTM D 5329.
- c) Flow testing shall be carried out according to ASTM D 5329 and ASTM D 5.
- d) Toughness testing shall be carried out according to CAN/CGSB 37.50-M.
- e) Relative density determination shall be carried out according to LS-262.

Pouring point shall be the lowest temperature to which the material is heated and at which it is suitable for filling a 12.5 mm wide and 40 mm deep groove formed between two blocks of concrete without inclusions of large air voids or discontinuities and without damage to the material.

1212.07.02.02 Test Specimens

All bond test specimens shall not crack or separate in the sealing compound or between the sealing compound and sawn Portland cement or asphaltic concrete block.

1212.07.03 Acceptance or Rejection

Notwithstanding the Owner's initial approval of the product, shipments of joint sealing compound represented by samples which fail in any respect to meet the requirements of this specification shall be rejected.

1212.07.04 Packaging and Marking

The sealing compound shall be packaged in 22 kg or smaller units. It shall be contained in a polyethylene bag in a metal container. Each container shall be legibly marked with the following information:

- a) Designated trade name of the compound.
- b) Manufacturer's name.
- c) Batch number.
- d) Date of manufacture.
- e) Quantity contained.

1212.08 QUALITY ASSURANCE

1212.08.01 Sampling

Samples of material for quality assurance testing shall be taken by the Owner from material delivered to the Working Area.

1212.09 OWNER PURCHASE OF MATERIAL

1212.09.01 Measurement and Payment

Payment at the price specified in the purchasing order in kilograms, shall be full compensation for all labour, Equipment, and Materials required to supply and deliver the hot poured rubberized asphalt joint sealing compound to the destination at the time specified. No deduction in mass will be made for Owner samples.

The cost of all testing, except that performed in the Owner's laboratory shall be included in the price.

Appendix 1212-A, Commentary for OPSS 1212, November 2003

Note: This appendix does not form part of the standard specification. It is intended to provide information to the designer on the use of this specification in a Contract.

Designer Action/Considerations

The designer is to specify the following in the Contract Documents:

- Joint sealing compound type. (1212.05.01)

Related Ontario Provincial Standard Drawings

None.



**MATERIAL SPECIFICATION FOR
HOT APPLIED RUBBERIZED ASPHALT WATERPROOFING MEMBRANE**

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.03	Cone Penetration Test Procedure
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1213.01 SCOPE

This specification covers the requirements for hot applied rubberized asphalt waterproofing membrane for bridge decks.

1213.02 REFERENCES

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

Ontario Provincial Standard Specifications, Construction:

OPSS 914 Waterproofing Bridge Decks with Hot Applied Asphalt Membrane

National Standards of Canada:

CAN/CGSB-37.50 M89 - Hot-Applied Rubberized Asphalt for Roofing and Waterproofing

American Society for Testing and Materials:

ASTM D 5329-92 - Test Methods for Sealants and Fillers, Hot Applied, for Joints and Cracks in Asphalt and Portland Cement Concrete Pavements

Ministry of Transportation Publications:

MTO Field Guide, For the Acceptance of Hot Mix and Bridge Deck Waterproofing

1213.05 MATERIALS

1213.05.01 General

Under no circumstances shall this product be changed without the prior approval of the Contract Administrator.

1213.05.02 Composition

The composition and general properties of the waterproofing membrane shall meet the requirements of CAN/CGSB-37.50 except that:

- a. the cone penetration at 50°C shall not be greater than 160, when tested according to ASTM D 5329.
- b. the specimens for Oven Aged Low Temperature Flexibility shall not show any cracking.
- c. the exception to the test result listed in "a." above for cone penetration shall apply to testing for heat stability.

1213.08 QUALITY ASSURANCE

1213.08.01 Sampling and Testing

Sampling and testing of the waterproofing membrane will be according to the CAN/CGSB-37.50 except as modified herein.

1213.08.02 Required Testing

The following properties will be tested:

Cone Penetration @ 25°C
Cone Penetration @ 50°C
Flow @ 60°C
Low Temperature Flexibility @ -25°C
Oven Aged Low Temperature Flexibility
Toughness
Toughness/Peak Force
Mass Density
Heat Stability

1213.08.03 Sample Preparation Variation from CAN/CGSB-37.50

1213.08.03.01 Low Temperature Flexibility Test and Oven Aged Low Temperature Flexibility

One large sample will be made on a 3 to 5 mm thick aluminum panel that has been treated with a releasing agent. The area of the film will be large enough to permit cutting out ten specimens, 25 mm by 150 mm, for testing.

1213.08.04 Testing Variation from CAN/CGSB-37.50

1213.08.04.01 Low Temperature Flexibility Test

The bend test on the five specimens will be applied solely to the film.

1213.08.04.02 Oven Aged Low Temperature Flexibility Test Procedure

The procedure for testing for oven aged low temperature flexibility will be the same as that used for the low temperature flexibility testing except that the five specimens will be oven aged at $70^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for seven days after the initial 16 to 72 h conditioning and shall again be conditioned for 16 to 72 h after the oven aging prior to placing in the cold chamber.

1213.08.04.03 Cone Penetration Test Procedure

The testing will be according to ASTM D 5329.

1213.08.04.04 Heat Stability

The testing variations listed above for low temperature flexibility and cone penetration apply to testing for heat stability.

There will be no testing for viscosity.

1213.08.05 Field Sampling

Field sampling will be done according to OPSS 914 and the MTO Field Guide, for Acceptance of Hot Mix and Bridge Deck Waterproofing. Testing for heat stability will not be done.

The oven aged low temperature flexibility test and the heat stability test will not be conducted on the field samples.



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS 1215
MARCH 1998**

MATERIAL SPECIFICATION FOR PROTECTION BOARD

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1215.08.05 Water Absorption Test

**1215.08.05.01 Sample Preparation
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1215.09 Not Used

1215.10 Not Used

1215.01 SCOPE

This specification covers the material requirements for protection board for use with hot applied rubberized asphalt bridge deck waterproofing membranes.

1215.02 REFERENCES

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

Ontario Provincial Standards Specifications, Construction:

OPSS 904 Concrete Structures
OPSS 914 Waterproofing Bridge Decks with Hot Applied Asphalt Membrane

Ontario Provincial Standards Specifications, Material:

OPSS 1103 Emulsified Asphalt
OPSS 1149 Hot Mix and Hot Laid Asphaltic Concrete, Including Recycled and Specialty Mixes
OPSS 1213 Hot Applied Rubberized Asphalt Waterproofing Membrane

American Society for Testing and Materials, Standards:

ASTM C 403-95 - The Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

ASTM D 3202-94 - Practice for Preparation of Bituminous Mixture Beam Specimens by Means of the California Kneading Compactor

1215.05 MATERIAL

1215.05.01 Composition

Protection board shall be formed of asphalt and fillers between two sheet materials.

1215.05.02 Properties

The board shall remain stable and free from perforations when placed according to OPSS 914.

1215.05.03 Indentation/Puncture

When tested according to the Quality Assurance section, the boards shall show no punctures. Indentations shall be local at least 0.25 mm and no greater than 0.9 mm deep.

1215.05.04 Compatibility

When tested according to the Quality Assurance section, the board shall show no evidence of puncture, delamination, pumping, stripping of the aggregates, or any signs of incompatibility between the boards and the asphaltic concrete or the waterproofing membrane.

1215.05.05 Weather Simulation and Bond

When tested according to the Quality Assurance section, the edge of the upper board shall not curl up more than 5 mm from the original horizontal position, and shall not delaminate within itself or debond from the waterproofing membrane.

1215.05.06 Water Absorption

When tested according to the Quality Assurance section, the specimens shall have a water absorption of no greater than 5% and shall show no deterioration such as stripping emulsification or loss of mass.

1215.07 PRODUCTION**1215.07.01 General**

Under no circumstances shall the protection board or the board separating material placed on the top surface of the board, be changed, without the prior approval of the Owner.

1215.07.02 Size

The thickness shall be 3.6 mm $\pm$ 0.4 mm. The width of the board shall be 1100 mm $\pm$ 200 mm and the length of the board shall be 1500 mm $\pm$ 200 mm. The board shall have straight edges, square corners, and edges free of burrs and breakaways.

Notwithstanding the size tolerance above, all sheets in a shipment shall be of the same length and width within a tolerance of $\pm$ 5 mm and of uniform thickness within a tolerance of $\pm$ 0.25 mm.

1215.07.03 Shipment and Delivery

The following information shall be clearly shown on each bundle of protection board:

- a. Brand Name
- b. Name of Manufacturer
- c. Date of Manufacture
- d. Instructions on handling, storage and application.

The material shall be so packaged as to permit shipping, handling, and storage without damage to the contents.

1215.08 QUALITY ASSURANCE

1215.08.01 Size Measurements

Thickness measurements will be made at ten locations on the board and these locations will be determined by the Owner.

1215.08.02 Indentation/Puncture Test

1215.08.02.01 Apparatus

Apparatus will be according to ASTM C 403.

The needle used in the test will be flat ended and 9.1 mm in diameter. A steel base plate with a circular hole 5 mm larger than the diameter of the needle will be positioned in the testing apparatus so that the hole is centred under the needle.

1215.08.02.02 Specimen Preparation

Three 100 mm x 100 mm specimens will be cut from the board and conditioned along with the base plate for two hours at $94^{\circ}\text{C} \pm 2^{\circ}\text{C}$.

1215.08.02.03 Procedure

Immediately after conditioning, the base plate will be placed into the apparatus and the specimen will be centred on the plate and a load of 89 N will be applied for five seconds with the needle. This procedure will be repeated for three specimens.

1215.08.03 Compatibility

1215.08.03.01 Specimen Preparation

Two specimens will be prepared. A 5 ± 1 mm, layer of waterproofing membrane, according to OPSS 1213, will be applied to one of the larger faces of each of two 381 mm x 83 mm x 50 mm concrete bases cured according to OPSS 904.

Immediately after the application of the membrane, two pieces of protection board 196 mm x 83 mm will be applied to each base to provide a 12 mm overlap at the centre of the base.

A coating layer of SS-1 emulsion according to OPSS 1103 will be applied to the surface of the board and allowed to set according to OPSS 914.

40 mm of loose hot mix HL4 mm according to OPSS 1149 will be compacted in one lift over each specimen by applying 180 tamps to each from a California Kneading Compactor according to ASTM D 3202.

The temperature of the asphalt during compaction will be $120^{\circ} \pm 5^{\circ}\text{C}$. The foot pressures shall be as follows:

40 tamps @ 517 kPa
40 tamps @ 689 kPa
40 tamps @ 1380 kPa
60 tamps @ 2070 kPa

Immediately after compaction a static load will be applied to each specimen by a compression machine. The load will be applied at a rate of 6.4 mm per minute until the maximum applied load of 2760 kPa is reached. The load will be maintained at that level for one minute, then slowly released.

When the specimens are cooled to room temperature and removed from their moulds, they will be placed, concrete face down, on a smooth flat surface.

Both specimens will be cured for seven days at room temperature. One specimen will be oven aged for an additional 24 hours at $60^{\circ} \pm 2^{\circ}\text{C}$ and then cooled to $23^{\circ} \pm 2^{\circ}\text{C}$.

1215.08.03.02 Procedure

After the conditioning period the composite samples will be examined for compatibility requirements specified in the Materials section.

1215.08.04 Weather Simulation and Bond Tests

1215.08.04.01 Sample Preparation

A layer of hot poured rubberized asphalt waterproofing membrane 5 ± 1 mm thick will be applied to a 300 x 300 x 75 mm concrete base according to OPSS 914.

Two pieces of protection board cut 159 mm x 300 mm to provide an 18 mm overlap at the centre of the concrete base will be applied immediately after the application of the membrane and allowed to condition at $23^{\circ} \pm 2^{\circ}\text{C}$ for a minimum of 30 minutes.

1215.08.04.02 Procedure

The board will be ponded with water to a depth of 6 mm above the top surface for 30 minutes then drained and dried under a 250 watt heat lamp centrally located above the specimen at a height of 400 ± 5 mm for 2 hours.

The procedure will be repeated a second time on the same day and an additional time the following day.

Following the third cycle, two parallel cuts 100 ± 5 mm long will be made near the centre of the sample, 25 mm apart through the upper protection board from the overlapped edge with a sharp knife. The cuts will be perpendicular to the edge and down to the concrete surface. The parallel cuts shall be made no sooner than 4 h nor later than 24 h after removal of the heat lamp. The sample shall be maintained at a temperature of $23^{\circ} \pm 2^{\circ}\text{C}$ during the test.

The board shall not separate from the waterproofing when a peeling force of 0.6 N/mm is applied to the exposed edge of the overlap of the 25 mm wide strip.

1215.08.05 Water Absorption Test

1215.08.05.01 Sample Preparation

Two specimens of protection board 150 mm x 50 mm will be cut.

1215.08.05.02**Procedure**

The specimens will be oven dried to a constant mass at $60^{\circ} \pm 1.1^{\circ}\text{C}$. The mass of the specimens before and after drying will be recorded. The specimens will then be submerged horizontally under 25 mm of water three times as follows:

First Immersion:

The water temperature will be $23^{\circ} \pm 2^{\circ}\text{C}$ and the duration of the immersion will be 4 hours.

Second Immersion:

The water temperature will be $23^{\circ} \pm 2^{\circ}\text{C}$ and the duration of the immersion will be 20 hours.

Third Immersion:

The water temperature will be $60^{\circ} \pm 2^{\circ}\text{C}$ and the duration of the immersion will be 80 hours.

After each immersion the specimens will be towel dried and the mass recorded.

The percent mass loss or gain from the original oven dry mass will be recorded.



NOTICE TO USERS OF OPSS 1301

MATERIAL SPECIFICATION FOR CEMENTING MATERIALS

OPSS 1301 has been removed from this
OPS volume

The municipal version of OPSS 1301 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1301

There is no PROV version.

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



MATERIAL SPECIFICATION FOR WATER

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1302.09	Not Used
1302.10	Not Used

1302.01 SCOPE

This specification covers the requirements for water used in the mixing and curing of concrete and mortar.

1302.02 REFERENCES

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

Canadian Standards Association Standards:

CSA-A23.1-M94	Concrete Materials and Methods of Concrete Construction
CSA-A5/A8/A362-93	Portland Cement/Masonry Cement/Blended Hydraulic Cement

1302.04**SUBMISSION AND DESIGN REQUIREMENTS**

Except for water approved by the Ministry of Health, prior to its use in the work, a certificate from an independent test laboratory shall be submitted, to the Contract Administrator, stating the water is according to this specification.

1302.05**MATERIALS**

The water shall be according to CSA-A23.1 and shall not change the initial setting time of the test concrete by more than one hour when compared to a reference concrete prepared with water approved by the Ministry of Health.

Water shall be clean and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances.

The testing shall be performed by an organization certified by the Standard Council of Canada.

1302.08**QUALITY ASSURANCE****1302.08.01****Sampling and Testing**

Except for water approved by the Ministry of Health which may be used without testing, the water will be tested according to CSA-A23.1 and CSA-A5 Setting Time by Vicat Method.

1302.08.02**Acceptance or Rejection**

Any indication of unsoundness, marked change in time-of-setting, or a reduction of more than ten percent in strength from test results obtained with mixtures containing water of satisfactory quality shall be sufficient cause for rejection of the water under test.



NOTICE TO USERS OF OPSS 1303

MATERIAL SPECIFICATION FOR ADMIXTURES FOR CONCRETE

OPSS 1303 has been removed from this
OPS volume

The provincial version of OPSS 1303 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1303

The municipal version of OPSS 1303 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1303

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



**MATERIAL SPECIFICATION FOR
PACKAGED SILICA FUME DRY GROUT MIXTURE
FOR POST TENSIONING**

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1304-A	Commentary

1304.01	SCOPE

This specification covers the requirements for packaged silica fume dry grout mixture for use in post-tensioning of ducts.

1304.01.01 Significance and Use of Appendices

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

Appendix 1304-A is a commentary appendix to provide designers with information on the use of this specification in a Contract.

1304.02**REFERENCES**

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

Ontario Provincial Standard Specifications, Construction

OPSS 910 Stressing Systems for Post Tensioning

Ontario Provincial Standard Specifications, Material

OPSS 1301 Cementing Materials

OPSS 1302 Water

Canadian Standards Association

A23.2-1B Viscosity, Bleeding, Expansion, and Compressive Strength of Flowable Grout [Part of
CSA A23.1-04/A23.2-04, Concrete Materials and Methods of Concrete
Construction/Methods of Test and Standard Practices for Concrete]

A283-00(R2003) Qualification Code for Concrete Testing Laboratories

A3000-03 Cementitious Materials Compendium

ASTM International

D 962-81(2003) Aluminum Powder and Paste Pigments for Paints

1304.03**DEFINITIONS**

For the purpose of this specification, the following definition applies:

Cementing Materials means Type GU Portland cement and silica fume.

1304.05**MATERIALS****1304.05.01****Cementing Materials**

Cementing materials shall consist of Type GU Portland cement and silica fume. The cement shall be according to OPSS 1301 and certified to be free from early stiffening tendency when tested according to CAN/CSA A3000. Silica fume shall be according to CAN/CSA A3000 and in an uncompacted form. Silica fume shall constitute a 6% replacement by mass of cement in the dry grout mixture.

1304.05.02**Superplasticizer**

Superplasticizer shall be a non-retarding naphthalene sulphonate in powdered form. Superplasticizer shall constitute 1.5% by mass of cementing materials in the dry grout mixture.

1304.05.03**Aluminum Powder**

Aluminum powder shall be according to ASTM D 962 Type 1, Class C, and coated with 2.5 to 3.0% stearic acid. Aluminum powder shall be used in a quantity sufficient to provide the expansion specified herein.

1304.05.04**Water**

Water for testing grout mixture shall be according to OPSS 1302.

1304.07 PRODUCTION

1304.07.01 Dry Grout Mixture

The dry grout mixture shall consist of cementing materials, superplasticizer, and aluminum powder as specified herein.

1304.07.01.01 Grout Properties

The grout and grout cubes, when tested by the manufacturer as specified in the Testing for Certificate of Compliance clause, shall exhibit the following properties:

- a) The grout shall not bleed or segregate when allowed to stand for 1 hour immediately after mixing.
- b) The grout shall expand by $6\% \pm 2\%$ of its original volume when measured at 1 hour after mixing.
- c) The time for the grout to flow through the flow cone shall be between 11 and 25 seconds when the measurements are performed immediately after the grout is removed from the mixer and shall remain between 11 and 25 seconds, when measured 30 minutes after mixing.
- d) Cubes made from the grout shall have a minimum specified 28-Day compressive strength of 60 MPa.

1304.07.01.02 Compressive Strength Development Curve

The manufacturer shall establish a compressive strength development curve for the grout to demonstrate that the early compressive strength provided in the certificate of compliance meets the strength development curve developed for that type of grout. A minimum of 3 different batches, each representing a different grout production day, shall be prepared and compressive strength cubes made and tested at 3, 7, 14, and 28 Days to generate the compressive strength development curve. A minimum of 6 cubes shall be tested for each compressive strength determination.

The manufacturer shall establish a new compressive strength development curve every twelve months or sooner or every time the material sources change, whichever is more frequent.

1304.07.02 Packaging, Handling, and Delivery

The dry ingredients of the grout shall be thoroughly mixed and packaged in bags, with a maximum bag size of 30 kg. The bag shall be of sufficient strength and waterproof to withstand handling and to protect the grout from moisture and contamination.

The packaged bags shall have the following information printed on the outside:

- a) Name of manufacturer.
- b) Maximum water to cementing materials ratio to be used in mixing.
- c) Maximum amount of water to be used per bag of dry grout mixture.
- d) Date packaged.

The packaged dry grout mixture shall be supplied on skids and covered with polyethylene sheeting.

The packaged dry grout mixture shall be stored in a dry condition up to the time of shipment and suitably protected against the weather during delivery.

1304.07.03 Certificate of Compliance

A certificate of compliance prepared by a testing laboratory certified according to the Testing for Certificate of Compliance clause and signed by the manufacturer's representative of the dry grout mixture shall be submitted to the Contract Administrator with each shipment. The certificate shall include the following information:

- a) A strength development curve prepared according to the Production section. The strength development curve shall be not more than 12 months old at the time of submission.
- b) A statement that grout representing the shipment, meets the grout properties a, b, and c as specified in the Production section, when tested according to the Production section.
- c) Early compressive strength test results determined according to the Production section that show compliance with the attached strength development curve.
- d) The water to cementing materials ratio to achieve the grout properties specified in a, b, c, and d of the Production section.

1304.07.03.01 Testing for Certificate of Compliance

1304.07.03.01.01 Qualification of the Testing Laboratory

The testing laboratory shall be certified by an organization accredited by the Standards Council of Canada according to CSA A283 for Additional Tests according to CSA A23.2-1B.

1304.07.03.01.02 Batch Preparation

The batch shall be prepared from the dry grout mixture and water using the equipment specified in OPSS 910 or using a 1200 to 2000 rpm laboratory colloidal mixer.

The mixing procedure for the batch of grout shall be as follows:

- a) The amount of water less than or equal to that specified by the manufacturer shall be added by means of the calibrated measuring device attached to the mixer or manually if the mixing is done in a laboratory colloidal mixer. No further water shall be added to the grout.
- b) The packaged dry grout mixture shall be added to the mixer with the mixer running.
- c) The grout shall be mixed for at least 1 minute after the dry grout mixture is added and until the grout is mixed thoroughly and uniformly.

1304.07.03.01.03 Sampling and Testing

1304.07.03.01.03.01 General

Tests shall be according to CSA A23.2-1B and as specified herein.

Viscosity, bleeding, and expansion measurements and preparation of grout cubes for compressive strength tests shall be done on a level, vibration free surface.

Fluid grout shall be sampled from the mixer or holding tank of the mixer immediately following completion of mixing.

1304.07.03.01.03.02 Viscosity

The grout used for the first set of viscosity measurements shall be discarded after testing and shall not be used for the 30-minute measurement. The grout used for the 30-minute viscosity measurement shall be left undisturbed in a clean container, covered with a lid, until the measurement is performed.

1304.07.03.01.03.03 Compressive Strength Tests

Compressive strength test cubes, 50 mm in size, shall be prepared from the grout sample. A minimum of three sets of six cubes each shall be made. Two sets shall be tested for the certificate of compliance, each set at a different age from the other at either 3, 7, or 14 Days. The remaining set shall be used for 28-Day compressive strength test. The test results of the 28-Day compressive strength test shall be forwarded to the Contract Administrator within 7 Days of the testing.

The cubes shall be demoulded and stored according to CSA A23.2-1B.

If the cubes are to be transported to a certified laboratory, the cubes shall be removed from the moulds, placed in a sealed white opaque plastic bag containing at least 250 ml of water and maintained at a temperature between 15 and 25°C during transportation.

1304.08 QUALITY ASSURANCE

1304.08.01 General

The Owner may carry out sampling and testing for viscosity, bleeding, expansion, and compressive strength using material from a batch of fluid grout prepared from the packaged dry grout mixture and water using the equipment specified in OPSS 910.

Sampling and testing will be done randomly using the packaged dry grout mixture delivered to the Working Area.

1304.08.02 Acceptance, Rejection

When notified by the Owner as to the uncertainty of the quality of any dry grout mixture, it shall be rejected and no additional dry grout mixture shipped until the manufacturer has performed additional testing and notice of acceptance has been received from the Owner.

Appendix 1304-A, Commentary for OPSS 1304, November 2005

Note: This appendix does not form part of the standard specification. It is intended to provide information to the designer on the use of this specification in a Contract.

Designer Action/Considerations

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

Related Ontario Provincial Standard Drawings

None



NOTICE TO USERS OF OPSS 1305

MATERIAL SPECIFICATION FOR MOISTURE VAPOUR BARRIERS

OPSS 1305 has been removed from this
OPS volume

The provincial version of OPSS 1305 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1305

The municipal version of OPSS 1305 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1305

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



NOTICE TO USERS OF OPSS 1306

MATERIAL SPECIFICATION FOR BURLAP

OPSS 1306 has been removed from this
OPS volume

The provincial version of OPSS 1306 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1306

The municipal version of OPSS 1306 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1306

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



MATERIAL SPECIFICATION FOR JOINT FILLER IN CONCRETE

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1308.05	MATERIALS
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1308.07	PRODUCTION
1308.08	QUALITY ASSURANCE
1308.09	OWNER PURCHASE OF MATERIAL

APPENDICES

1308-A	Commentary

1308.01 SCOPE

This specification covers preformed expansion joint fillers for joints in concrete.

1308.01.01 Significance and Use of Appendices

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

Appendix 1308-A is a commentary appendix to provide designers with information on the use of this specification in a Contract.

1308.02**REFERENCES**

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

ASTM International

D 1751(99)	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
D 1752-84(1996)e1	Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

1308.05**MATERIALS****1308.05.01****Joint Filler**

The joint filler shall be according to ASTM D 1751 for Type A or ASTM D 1752 for Type B.

The type of material supplied shall be as specified in the Contract Documents.

1308.07**PRODUCTION****1308.07.01****Cutting and Tolerance**

The joint filler shall be cut neatly, free from burrs to the sizes specified in the Contract Documents.

Holes for dowel bars in the joint filler shall be neatly punched in the exact position specified and shall be free from loose fibres.

Pieces of the joint filler shall be according to the dimensions in the Contract Documents with the following tolerances:

Thickness	0 to 1.5 mm
Depth	± 3 mm
Length	± 3 mm

1308.07.02**Packaging and Marking**

Each shipment of joint filler shall be provided with an itemized statement of the number and dimensions of the pieces. The brand name and the thickness of the material shall be clearly stamped on the pieces or on a label attached securely to each bundle.

Each piece of self-expanding cork filler shall be individually wrapped in waterproof material and shall be sealed in a manner that will prevent the entrance of moisture.

The material shall be suitably packaged to permit shipping, handling, and storage without damage.

1308.08 QUALITY ASSURANCE

1308.08.01 Sampling and Testing

Samples of the material for quality assurance testing shall be available to the Owner from deliveries to the site for testing according to ASTM D 1751 and D 1752.

1308.09 OWNER PURCHASE OF MATERIAL

1308.09.01 Measurement and Payment

Payment at the price specified in the purchasing order, by either linear metres for strips, or by a count for other shapes, shall be full compensation for all labour, Equipment, and Material required for the supply and delivery of the joint filler to the destination and at the time specified.

The cost of the samples for testing and the cost of all testing except that performed by the Owner shall be included in the price.

Appendix 1308-A, Commentary for OPSS 1308, November 2003

Note: This appendix does not form part of the standard specification. It is intended to provide information to the designer on the use of this specification in a Contract.

Designer Action/Considerations

The following shall be specified in the Contract Documents:

- Type and size of material to be supplied.

Related Ontario Provincial Standard Drawings

OPSD 4670.000 Construction and Expansion Joint In Concrete



MATERIAL SPECIFICATION FOR LATEX MODIFIERS FOR USE IN CONCRETE

TABLE OF CONTENTS

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1312.06	EQUIPMENT - Not Used
1312.07	PRODUCTION - Not Used
1312.08	QUALITY ASSURANCE
1312.09	OWNER PURCHASE OF MATERIALS - Not Used

APPENDICES

1312-A	Commentary

1312.01 SCOPE

This material specification covers the requirements for latex modifiers for use in concrete.

1312.01.01 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.

1312.01.02 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.

1312.02 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

Laboratory Testing Manual:

LS-413 Method of Test for Non-Volatile Content of Chemical Admixtures, Latex Admixtures and Curing Compounds

LS-419 Method of Test for Evaluation of Latex Modifiers for Use in Concrete

ASTM International

C 494/C 494M-05a Chemical Admixtures for Concrete

E 70-07 Test Method for pH of Aqueous Solutions with the Glass Electrode

Federal Highway Administration (FHWA)

Report No. FHWA-RD-78-35 "Styrene Butadiene Latex Modifiers for Bridge Deck Overlay Concrete", K.C. Clear and B.H. Collar, April 1975

1312.03 DEFINITIONS

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

Latex Modifier means a dispersion of polymeric particles in water which, when added to concrete, decreases its permeability without significantly adversely affecting its other properties.

1312.04 DESIGN AND SUBMISSION REQUIREMENTS

1312.04.01 Submission Requirements

1312.04.01.01 Product Data

Use of this product shall not commence until acceptance of the product has been received in writing from the Owner.

The following product data shall be submitted to the Owner for acceptance prior to its use.

- a) Trade name of product.
- b) Name of manufacturer and supplier.
- c) Generic description of the latex.
- d) Infrared spectra of the latex modifier determined according to the method described in Report No. FHWA-RD-78-35, Section VI.3.
- e) A list of all monomers and polymers charged during emulsion manufacture.
- f) Non-volatile content, pH, relative density, and viscosity of the latex together with the production tolerances.
- g) Test data and a test certificate from a certified laboratory showing compliance of the latex emulsion with the requirements of this specification.
- h) Manufacturer's Safety Data Sheets.

1312.07 PRODUCTION

1312.07.01 Quality Control

The acceptability of the latex modifier shall be determined by comparing the properties of a test concrete containing the latex modifier, to the properties of a reference concrete according to LS-419.

The testing shall be performed by a laboratory certified by an organization accredited by the Standards Council of Canada or by a laboratory participating in the Cement and Concrete Reference Laboratory at the National Institute of Standards and Technology correlation and inspection programs. When the certified laboratory is the manufacturer's laboratory, an Engineer employed by an independent certified laboratory shall witness the testing and affix their Engineer's seal and stamp to the test report verifying in writing the testing was performed according to this specification.

1312.08 QUALITY ASSURANCE

1312.08.01 Sampling

The Contractor shall supply a 1 litre sample of the latex emulsion to the Contract Administrator when requested. Samples shall be taken in the presence of the Contract Administrator.

The Contractor shall supply the sample containers. The containers shall be sufficiently strong and securely fastened.

All containers used for samples of materials controlled under WHMIS shall be appropriate for the materials being shipped and shall be labelled and accompanied with the relevant Material Safety Data Sheets.

Sample containers shall be triple-tight, leak-proof cans or pails that are inert to the material being sampled or suitable plastic containers of similar capacity that can be closed to prevent any leakage.

When labelling and identification requirements are not specified in the Contract Documents, the following minimum sample identification shall accompany the sample. Steps shall be taken to ensure the samples and the sample identification are not separated during transporting.

- a) Contract number.
- b) Name of Contractor and a contact person's name and telephone and fax numbers.
- c) Contract Administrator's name and telephone and fax numbers.
- d) Quantity and type of sample. When a sample consists of more than one item, each item shall be individually identified.
- e) Date sampled (i.e., yyyy-mm-dd).
- f) Date shipped (i.e., yyyy-mm-dd).
- g) Sample location.

1312.08.02 Chemical and Physical Tests

Testing for non-volatile content shall be according to LS-413.

Testing for relative density shall be according to ASTM C 494M, Section 18.4.

Testing for pH value, shall be according to ASTM E 70.

1312.08.03 Acceptance or Rejection

The material properties shall be according to the product data information submitted to the Owner at the time of the initial evaluation.

The non-volatile content shall be within $\pm 1.0\%$ of the approved latex emulsion.

The relative density shall be within ± 0.005 of the approved latex emulsion.

The pH shall be within ± 1.0 pH units of the pH of the approved latex emulsion.

Material represented by a quality assurance sample failing to meet the requirements of this specification shall be rejected.

Appendix 1312-A, November 2008
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should 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.



MATERIAL SPECIFICATION FOR WHITE PIGMENTED CURING COMPOUNDS FOR CONCRETE

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1315.09	OWNER PURCHASE OF MATERIALS - Not Used

APPENDICES

1315-A	Commentary

1315.01 SCOPE

This specification covers membrane forming compounds for curing concrete.

1315.01.01 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.

1315.01.02 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.

1315.02 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

Laboratory Testing Manual:

- LS-413 Method of Test for Non-Volatile Content of Chemical Admixtures, Latex Admixtures and Curing Compounds
- LS-416 Method of Test for Settling Rates-Curing Compounds

ASTM International

- C 156-05 Standard Test Method for Water Retention by Liquid Membrane-Forming Curing Compounds for Concrete
- C 309-07 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- D 244-04 Standard Test Methods and Practices for Emulsified Asphalts

1315.04 DESIGN AND SUBMISSION REQUIREMENTS

1315.04.01 Submission Requirements

1315.04.01.01 Product Data

Use of this product shall not commence until acceptance of the product has been received in writing from the Owner.

The following product data shall be submitted to Owner for acceptance prior to its use.

- a) Trade name of the compound.
- b) Name of manufacturer and supplier.
- c) A test certificate, from an independent laboratory, containing test results for the tests performed on the designated compound required by this specification.
- d) Infrared spectra of the curing compound.
- e) A statement as to the type of solids, type of solvents, pigment content, total solids content, specific gravity and viscosity of the designated compound.
- f) Production tolerances for solids content and specific gravity.
- g) Manufacturer's Safety Data Sheet.

1315.05 MATERIALS

1315.05.01 Requirements

The curing compound shall be white pigmented Type 2 Class B curing compound according to ASTM C 309 and this specification.

1315.07 PRODUCTION

1315.07.01 Quality Control

The curing compound shall restrict the loss of water present in the test specimen at the time of application of the compound to not more than 300 g/m² of treated surface, when tested according to ASTM C 156.

The curing compound shall not react deleteriously with concrete.

The compound shall have a rate of settling that the uniformly white portion, as visible to the eye, is not less than 145 ml at 2 hours and not less than 125 ml at 24 hours after filling the cylinder, when tested according to LS-416.

The testing shall be performed by a laboratory certified by an organization accredited by the Standards Council of Canada or by a laboratory participating in the Cement and Concrete Reference Laboratory at the National Institute of Standards and Technology correlation and inspection programs. When the certified laboratory is the manufacturer's laboratory, an Engineer employed by an independent certified laboratory shall witness the testing and affix their Engineer's seal and stamp to the test report verifying in writing the testing was performed according to this specification.

1315.08 QUALITY ASSURANCE

1315.08.01 Sampling

The Contractor shall supply a 1 litre sample of the curing compound to the Contract Administrator when requested. Samples shall be taken in the presence of the Contract Administrator.

The Contractor shall supply the sample containers. The containers shall be sufficiently strong and securely fastened.

All containers used for samples of materials controlled under WHMIS shall be appropriate for the materials being shipped and shall be labelled and accompanied with the relevant Material Safety Data Sheets.

Sample containers shall be triple-tight, leak-proof cans or pails that are inert to the material being sampled or suitable plastic containers of similar capacity that can be closed to prevent any leakage.

When labelling and identification requirements are not specified in the Contract Documents, the following minimum sample identification shall accompany the sample. Steps shall be taken to ensure the samples and the sample identification are not separated during transporting.

- a) Contract number.
- b) Name of Contractor and a contact person's name and telephone and fax numbers.
- c) Contract Administrator's name and telephone and fax numbers.
- d) Quantity and type of sample. When a sample consists of more than one item, each item shall be individually identified.
- e) Date sampled (i.e., yyyy-mm-dd).
- f) Date shipped (i.e., yyyy-mm-dd).
- g) Sample location.

1315.08.02 Physical Tests

Testing for the non-volatile content shall be according to LS-413.

Testing for relative density shall be according to ASTM D 244.

Test for settling rate shall be according to LS-416.

1315.08.03 Acceptance or Rejection

The material properties shall be according to the product data information submitted to the Owner at the time of the initial evaluation.

The non-volatile content shall be within $\pm 2.5\%$ of the approved curing compound.

The relative density shall be within ± 0.01 of the approved curing compound.

The rate of settlement shall be not less than 145 ml at 2 hours and not less than 125 ml at 24 hours.

Material represented by a quality assurance sample failing to meet the requirements of this specification shall be rejected.

Appendix 1315-A, November 2008
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should 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 1350

MATERIAL SPECIFICATION FOR CONCRETE - MATERIALS AND PRODUCTION

OPSS 1350 has been removed from this
OPS volume

The provincial version of OPSS 1350 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1350

The municipal version of OPSS 1350 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1350

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



**MATERIAL SPECIFICATION FOR
PRECAST REINFORCED CONCRETE COMPONENTS
FOR MAINTENANCE HOLES, CATCH BASINS,
DITCH INLETS, AND VALVE CHAMBERS**

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1351.09	OWNER PURCHASE OF MATERIAL

APPENDICES

1351-A	Commentary

1351.01 SCOPE

This specification covers the requirements for precast reinforced concrete components for the construction of maintenance holes, catch basins, ditch inlets, and valve chambers, maintenance hole steps, and aluminum safety platforms.

1351.01.01 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.

1351.01.02 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.

1351.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Materials

OPSS 1002	Aggregates - Concrete
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1303	Admixtures for Concrete
OPSS 1315	White Pigmented Curing Compounds for Concrete
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:
LS-412 Scaling Resistance of Concrete Surfaces Exposed to De-icing Chemicals

Structural Manual

CSA Standards

A23.1-09	Concrete Materials and Methods of Concrete Construction [Part of CAN/CSA-A23.1-09/ A23.2-09, Concrete Materials and Methods of Concrete Construction / Methods of Test for Concrete]
A257.3-09	Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections, and Fittings Using Rubber Gaskets [Part of A257 Series-09, Standards for Concrete Pipe and Manhole Sections]
A257.4-09	Precast Reinforced Circular Concrete Manhole Sections, Catch Basins, and Fittings [Part of A257 Series-09, Standards for Concrete Pipe and Manhole Sections]
A3000-13	Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004, and A3005)
S6-06	Canadian Highway Bridge Design Code
S157-05	Strength Design in Aluminum / Commentary on CSA S157-05, Strength Design in Aluminum

ASTM International

B 221-13	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
C 990-09 (2014)	Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

Canadian Food and Drug Regulations

Division 23 Food Packaging Materials

United States Federal Specifications

United States Code of Federal Regulations
Section 177.1520, Olefin Polymers

Plant Prequalification Program Publication

Prequalification Requirements for Precast Concrete Drainage Products

1351.03 DEFINITIONS

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

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

Hoop Steel means a continuous ring of steel wire reinforcement.

1351.04 DESIGN AND SUBMISSION REQUIREMENTS

1351.04.01 Design Requirements

1351.04.01.01 Circular Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

Circular precast concrete components shall be designed according to CAN/CSA A257.4, CAN/CSA S6, and the Structural Manual.

1351.04.01.02 Square or Rectangular Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

Square or rectangular precast maintenance holes, catch basins, ditch inlets, and valve chambers shall be designed according to CAN/CSA S6 and the Structural Manual.

1351.04.01.03 Precast Concrete Adjustment Units

Precast concrete adjustment units shall be designed according to CAN/CSA A257.4.

1351.04.01.04 Steps

Steps that are cast, mortared, or attached by mechanical means into the walls of risers or tapered top sections shall be designed according to CAN/CSA A257.4, except that:

- a) The steps shall be evenly spaced at a distance of 300 mm centre to centre.
- b) The steps shall be located a minimum of 150 mm from the ends of the sections.
- c) The clearance between the wall face and the centre of the inside surface of the step shall not be less than 150 mm.

1351.04.01.05 Aluminum Safety Platforms

Aluminum safety platforms shall be designed according to CAN/CSA S157.

1351.04.01.06 Joints

Joints shall be designed as to be formed by a spigot end of a precast concrete section joining with a bell end on the adjoining section.

All joints of precast concrete sanitary sewer maintenance holes and valve chambers shall be provided with a joint seal system that shall be the sole element depended upon to make the joint watertight.

Joints shall be designed so that when joined they shall withstand, without cracking and fracturing, the forces caused by the compression of the joint seal system and any stresses resulting from the hydrostatic test specified in this specification.

1351.04.01.07 Precast Base Slabs and Monolithic Base Sections

Structural design, including minimum steel reinforcement requirements, shall be based on worst condition installation for standard precast maintenance hole bases. Live load, dead load, hydrostatic uplift, and other possible forces shall be considered for a burial depth of 10 m. Depth of bury shall be measured from grate elevation at the top of the precast maintenance hole to the bottom of its base. When greater depth of bury is required, a specially designed base slab shall be used.

1351.04.01.08 Precast Transition Slabs

Structural design, including minimum steel reinforcement requirements, shall be based on worst condition installation for standard precast maintenance hole transition slabs. Live load, dead load, hydrostatic uplift, and other possible forces shall be considered for a burial depth of 8.0 m for tapered transition slabs and transition slabs 1,500 mm and larger in diameter. Depth of bury for the transition slab shall be measured from grate elevation at the top of the precast maintenance hole to the top of its transition slab. When greater depths of bury are required, a specially designed transition slab shall be used.

1351.04.02 Submission Requirements

1351.04.02.01 Special Design Drawings

When the Contract Documents do not include Drawings for precast concrete components, the Contractor shall submit 2 sets of detailed structural design drawings of the components to the Contract Administrator 2 weeks prior to the commencement of work, 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 detailed structural design drawings verifying that the drawings are consistent with the Contract Documents.

When multi-discipline engineering work is depicted on the same detailed structural design drawings and the design or design-checking Engineer or both are unable to seal and sign the detailed structural design drawings for all aspects of the work, the drawings shall be sealed and signed by as many additional design and design-checking Engineers, as necessary.

Details of precast concrete adjustment units and maintenance hole steps, including the name of the step manufacturer, shall also be included on the Drawings.

1351.05 MATERIALS

1351.05.01 Aggregates

Aggregates shall be according to OPSS 1002, except that the requirement for gradation need not apply.

1351.05.02 Cement

Cement shall be Portland cement or a commercial blend of Portland cement and blast furnace slag or fly ash, or both. Ground granulated blast-furnace slag or fly ash may also be added separately to Portland cement. Whether added separately or in the form of blended cement, ground granulated blast-furnace slag shall constitute not more than 70% by mass of the total cementing materials and fly ash shall constitute not more than 40% by mass of the total cementing materials.

Portland cement, blended cement, ground granulated blast furnace slag, and fly ash shall be according to CAN/CSA A3000.

1351.05.03 Water

Water for concrete shall be according to OPSS 1302.

1351.05.04 Chemical and Air Entraining Admixtures

Chemical and air entraining admixtures shall be according to OPSS 1303.

1351.05.05 Steel Reinforcement

Steel reinforcement shall be according to OPSS 1440 and as specified in the Contract Documents.

Steel reinforcement for precast concrete components shall be:

- a) Steel bars, 400 MPa minimum yield strength.
- b) Welded steel wire, 500 MPa minimum yield strength.
- c) Welded deformed steel wire, 500 MPa minimum yield strength.

d) Hoop steel, cold drawn steel wire, 500 MPa minimum yield strength.

Steel reinforcement for precast concrete adjustment units shall be according to CSA A257.4.

1351.05.06 Steps

Steps shall be made of stainless steel, plastic encased steel, or plastic encased or unencased aluminum. Aluminum steps shall be according to ASTM B 221, Alloy 6351, Temper T6. Stainless steel steps shall be made of stainless steel, Type 304.

For plastic encased steps, the casing shall be of a solid, low-density virgin polyethylene material that has been deemed non-objectionable by the Health Protection Branch of Health and Welfare Canada based on the Canadian Food and Drug Act and Regulations, Division 23. In addition, the polyethylene material shall be in compliance with Title 21 of the United States Code of Federal Regulations, Section 177.1520, Olefin Polymers.

The minimum thickness of the polyethylene material shall be 3 mm along the top wearing surface of the step, excluding anchor portion. The bottom part of the step and the entire anchor portion shall have a minimum polyethylene coating thickness of 2 mm.

1351.05.07 Concrete

Concrete for precast concrete components, including circular valve chambers and all adjustment units shall be according to OPSS 1350 with a nominal 28-Day compressive strength of 30 MPa, except that the nominal 28-Day compressive strength for precast rectangular valve chambers shall be 40 MPa.

1351.05.08 Aluminum Safety Platforms

Aluminum safety platforms shall be according to ASTM B 221, Alloy 6351, Temper T6.

1351.05.09 Joint Seal System

Joint seal system for circular precast components for maintenance holes, catch basins, ditch inlets, and valve chambers shall be a dense homogeneous rubber according to CAN/CSA A257.3, Clauses 8 and 9.

Joint seal system for square or rectangular precast components for maintenance holes, catch basins, ditch inlets, and valve chambers shall comply with one of the following requirements:

- a) A dense homogeneous rubber according to CAN/CSA A257.3, Clauses 8 and 9.
- b) A flexible preformed gasket according to ASTM C 990.

1351.05.10 Membrane Curing Compound

Membrane curing compound shall be according to OPSS 1315.

1351.07 PRODUCTION

1351.07.01 General

A manufacturer producing precast reinforced concrete components for maintenance holes, catch basins, and ditch inlets shall possess a current Prequalification Certificate issued under the Plant Prequalification Program as outlined in the publication Prequalification Requirements for Precast Concrete Drainage Products.

1351.07.02 Production Method

Production of all precast reinforced concrete components shall be according to CAN/CSA A257.4.

1351.07.03 Marking

Markings shall be according to CAN/CSA A257.4 and be permanently marked on all precast components in a position readily visible for inspection. The following information shall also be marked on maintenance hole, catch basin, and ditch inlet components:

- a) The term *HOOP* on precast concrete riser sections using hoop steel reinforcement.
- b) The prequalification stamp as shown in Figure 1.

1351.08 QUALITY ASSURANCE

1351.08.01 General

Acceptance of the precast reinforced concrete components shall be based on the results of the step testing; concrete testing; hydrostatic testing, when specified in the Contract Documents; and salt scaling acceptance test for dry-cast concrete or air voids testing for wet-cast concrete.

Precast reinforced concrete components, equipment, other material, and labour used to perform the testing shall be supplied by the component manufacturer without any charge to the Owner.

When specified in the Contract Documents, the Owner shall be notified in writing at least 72 hours before testing is carried out. In the event that the Owner is unable to be present during the test, the manufacturer shall provide an affidavit affirming the actual recorded test results.

1351.08.02 Step Testing

1351.08.02.01 Horizontal Load Testing

The horizontal load testing of steps shall be according to CAN/CSA A257.4, except that a load of 1.3 kN shall be applied on the tread over the width of 90 mm, next to the point the step turns into the wall to form the anchorage. If the step sustains a permanent set of 6 mm or less after application of the horizontal load, the test is then acceptable.

1351.08.02.02 Vertical Load Testing

The vertical load testing of steps shall be according to CAN/CSA A257.4. If the step sustains a permanent set of 13 mm or less after application of the vertical load, the test is then acceptable.

1351.08.02.03 Integrity of Plastic Encased Steps to be Installed in New Maintenance Holes and Valve Chambers

This test applies only to steps to be installed in new concrete, less than 1 hour old for dry cast and less than 12 hours old for wet cast. Three steps of the same type shall be tested for integrity of the plastic coating in the following manner:

- a) The steps shall be maintained at $-23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 24 hours.
- b) The steps shall then be left at $20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 24 hours.

- c) The steps shall then be cut in half, vertically, at the midpoint of the tread and the coating removed at the cut end of each step half to expose approximately 10 mm of metal.
- d) A water solution shall be prepared containing sodium chloride, 3% by mass, and a wetting agent (e.g., liquid detergent), 0.25% by volume.
- e) A wire shall be connected from an anode in the salt and detergent solution to an ohm meter.
- f) Each step half shall then be tested separately for integrity of the plastic coating by connecting the exposed end to the ohm meter and placing the sample in the salt and detergent solution to within 50 mm of the exposed metal end for at least 5 minutes.

For acceptance of the steps, the following criteria shall apply:

- a) There shall be no cracking, fracturing, or openings through the plastic encasement. An unacceptable casing shall be indicated by a resistance of less than 1 megaohm after 5 minutes in the salt and detergent solution. An acceptable coating shall be indicated by a near infinite resistance greater than 1 megaohm after 5 minutes in the salt and detergent solution.
- b) If any single step half of the three complete steps tested proves to be unacceptable, three additional complete steps of the same type shall then be tested according to the above procedures. If any of these additional steps do not meet the requirements of this specification, the product shall then be deemed to be unacceptable.

1351.08.02.04 Integrity of Plastic Encased Steps to be Installed in Existing Maintenance Holes and Valve Chambers

This test applies only to steps to be installed in existing concrete, older than 1 hour for dry cast and older than 12 hours for wet cast. Three steps of the same type shall be tested for integrity of the plastic coating in the following manner:

- a) The steps shall be maintained in a cold room at $-23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 24 hours.
- b) Within 5 minutes of removing them from the cold room, the steps shall be driven into 25 mm diameter holes drilled in 30 MPa concrete using a standard 1.45 kg rubber mallet. The concrete shall have been cured at least 28 Days.
- c) Taking care to avoid damage to the casing, the concrete shall be chipped away from around the steps and the steps maintained at room temperature at $20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 24 hours.
- d) The steps shall be cut in half vertically at the midpoint of the tread and the coating removed at the cut end of each step half to expose approximately 10 mm of metal.
- e) A water solution shall be prepared containing sodium chloride, 3% by mass, and a wetting agent (e.g., liquid detergent), 0.25% by volume.
- f) A wire shall be placed from an anode in the salt and detergent solution to an ohm meter.
- g) Each step half shall then be tested separately for integrity of the plastic coating by connecting the exposed end to the ohm meter and placing the sample in the salt and detergent solution to within 50 mm of the exposed metal end for at least 5 minutes.

For acceptance of the steps, the following criteria shall apply:

- a) There shall be no cracking, fracturing, or openings through the plastic encasement. An unacceptable casing shall be indicated by a resistance of less than 1 megaohm after 5 minutes in the salt and detergent solution. An acceptable coating shall be indicated by a near infinite resistance, greater than 1 megaohm after 5 minutes in the salt and detergent solution.
- b) If any single step half of the three complete steps tested proves to be unacceptable, three additional complete steps of the same type shall then be tested according to the above procedures. If any of these additional steps do not meet the requirements of this specification, the product shall then be deemed to be unacceptable.

1351.08.03 Concrete Testing

1351.08.03.01 Concrete Compressive Strength

Concrete compressive strength shall be according to CAN/CSA A257.4, except cylinders shall be cast and tested monthly.

If the specified strength requirement of the concrete has not been reached after 28 Days, two cores shall be taken from a component at locations approved by the Owner. Cores shall be moisture conditioned and tested according to CAN/CSA A23.1. Repairs to the core holes shall be to the satisfaction of the Owner.

1351.08.03.02 Salt Scaling Acceptance Test

The Salt Scaling Acceptance Test shall be according to LS-412, except as noted below.

Compliance with the test requirement is based upon a loss of mass of not more than 0.8 kg/m^2 from the surface after 50 cycles of freezing and thawing. If the specimens fail the salt scale resistance test, the manufacturer shall submit proposals of remedial action to the Owner for consideration.

Salt scale resistance testing shall be done at least once a year per mix design. If any mix design components or component suppliers change or component mix design proportions change by more than 10%, the mix design shall then be considered new.

Specimens, at least 300 x 300 mm in size, shall be selected from finished and cured product. Specimens shall be representative of the manufacturer's production. Test specimens supplied from the finished and cured product are considered fully cured, and salt scale resistance testing can start immediately on these specimens. Specimens do not need to be saturated with moisture before testing.

A dyke may be made of any material that shall adhere to the specimen and serve to maintain the salt solution on the surface of the specimen throughout the period of the test. The dyke shall be applied during the dry period. The dyke shall not affect the test results. If a dyke is a precast mortar dyke, an air entrained paste shall be applied to the edges around the perimeter of the test specimen and any excess paste shall be removed. After allowing the paste to harden for 24 hours, epoxy sealant shall be applied to the inside, top, and outside of the dyke extending the outside surface epoxy treatment to 25 mm below the joint.

1351.08.03.03 Air Voids Testing

Air voids testing in hardened concrete shall be done at least once a year per mix design according to OPSS 1350.

1351.08.03.04 Hydrostatic Testing

When specified in the Contract Documents, hydrostatic tests shall be carried out on any of the sizes of precast sections or bases to be supplied for the Contract. Such tests shall be carried out by the precast maintenance hole supplier in the presence of the Owner's representative according to the following requirements:

- a) A minimum of two maintenance hole riser sections shall be assembled according to the manufacturer's instructions.
- b) When testing is performed in such a manner that the joint is closed, the restraining force exerted on the joint shall not exceed the force represented by the weight of a precast maintenance hole 9 m in height of the size being tested.
- c) The ends of the test sections shall be bulkheaded and the section filled with water.
- d) The maintenance hole sections shall be subjected to an internal hydrostatic pressure of 60 kPa for a period of ten minutes.
- e) All joints shall be tested. When only two maintenance hole riser sections are tested, the bulkhead joints shall also be tested.
- f) There shall be no leakage through the maintenance hole joints or walls. Damp spots and beads of moisture adhering to the walls of the sections shall not be considered as leakage.
- g) As an option, the 2 test riser sections may be allowed to soak for a period of 24 hours prior to proceeding with the hydrostatic test.
- h) Up to 1.0% of the number of each size included in the Contract shall be tested, but in no case shall less than 2 riser sections be tested for each maintenance hole size. Riser sections supplied for testing shall be sound full-size sections.

1351.08.04 Inspection and Testing

The Owner's representative shall be permitted free access to all portions of the plant engaged in the production of the precast maintenance hole, catch basin, and ditch inlet components, steps, and adjustment units and shall be provided with all reasonable facilities to secure the required samples and be satisfied that the components supplied are according to this specification.

1351.09 OWNER PURCHASE OF MATERIAL

1351.09.01 Measurement and Payment

For measurement purposes, a count shall be made of the number of complete structures delivered and accepted.

For measurement purposes, a count shall be made of the number of concrete adjustment units delivered and accepted.

Payment at the price specified in the purchasing order shall be for supply of the complete structure, individual components, steps, concrete adjustment units, or safety platforms delivered to the destination on the date and time specified.

The cost of all testing, except that performed in the Owner's laboratory, shall be included in the price.



FIGURE 1
Prequalification Stamp

Appendix 1351-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:

- Precast reinforced concrete component drawings. (1351.04.01.01)

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

- If Owner wishes 72 hours notice prior to quality assurance testing being carried out. (1351.08.01)
- If the Owner requires hydrostatic testing. For deeper maintenance hole test sections, higher hydrostatic test pressures to 90 kPa may be requested. (1351.08.03.03)

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 404.010 to 404.022	Aluminum Safety Platforms
OPSD 405.010 to 405.020	Maintenance Hole Steps
OPSD 701.010 to 701.015	Precast Concrete Maintenance Holes, 1,200 to 3,600 mm Diameter
OPSD 701.021	Maintenance Hole Benching and Pipe Opening Alternatives
OPSD 701.030 to 701.081	Precast Concrete Maintenance Hole Components, 1,200 to 3,600 mm Diameter
OPSD 702.040	Precast Concrete Ditch Inlet Maintenance Hole Type A, 1,200 x 1,200 mm
OPSD 702.050	Precast Concrete Ditch Inlet Maintenance Hole Type B, 1,200 x 1,200 mm
OPSD 703.011 to 703.015	Precast Concrete Single Inlet Flat Cap, 1,500 to 3,600 mm Diameter
OPSD 703.021 to 703.024	Precast Concrete Twin Inlet Flat Cap, 1,500 to 3,600 mm Diameter
OPSD 704.010	Precast Concrete Adjustment Units for Maintenance Holes and Catch Basins
OPSD 705.010	Precast Concrete Catch Basin, 600 x 600 mm
OPSD 705.020	Precast Concrete Twin Inlet Catch Basin, 600 x 1,450 mm
OPSD 705.030	Precast Concrete Ditch Inlet, 600 x 600 mm
OPSD 705.040	Precast Concrete Ditch Inlet, 600 x 1,200 mm
OPSD 706.010 to 706.041	Precast Concrete Ditch Inlets 600 x 1,200 mm with 1,500 to 3,000 mm Diameter Flat Caps
OPSD 1101.010	Precast Valve Chamber, 1,200 mm and 1,500 mm Diameter
OPSD 1101.012 to 1101.015	Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 1,800 x 2,400 mm
OPSD 1101.016 to 1101.019	Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 2,400 x 3,000 mm
OPSD 1101.030 to 1101.033	Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 3,000 x 3,000 mm
OPSD 1101.040 to 1101.043	Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 3,600 x 3,600 mm



MATERIAL SPECIFICATION FOR PRECAST CONCRETE BARRIERS

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1352.01 SCOPE

This specification covers the requirements for precast concrete barriers.

1352.02 REFERENCES

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

Ontario Provincial Standard Specifications, Material:

OPSS 1301	Hydraulic Cementing Materials
OPSS 1350	Concrete (Materials and Production)
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1442	Epoxy Coated Steel Reinforcement (Concrete)
OPSS 1443	Organic Coatings for Steel Reinforcement (Concrete)

American National Standard Institute/American Society of Testing Materials:

ASTM C 672-84 - Test Method for Scaling Resistance of Concrete Specimens Subjected to Freezing

Canadian Standards Association:

CSA G164-M1981 - Hot Dip Galvanizing of Irregularly Shaped Articles

CSA G189-1966 - Sprayed Metal Coatings for (R1980) Atmospheric Corrosion Protection

1352.05 MATERIALS

1352.05.01 Concrete

Concrete shall conform to OPSS 1350 except that the restrictions on volume batching will not apply. The Contractor shall assume the responsibility for the mix design. The following specific requirements shall apply:

Class of Concrete	30 MPa at 28 d
Coarse Aggregate	19.0 mm nominal max. size
Maximum Slump	60 mm
Air Content	6% $\pm$ 1.5%

1352.05.02 Cement

Cement shall be Portland Cement, Portland Blast-Furnace Slag Cement (Type 10S or Type 10SM) or Portland Pozzolan Cement (Type 10P) conforming to OPSS 1301. Ground granulated blast-furnace slag, or fly ash may be used in conjunction with Normal Portland Cement (Type 10). Ground granulated blast-furnace slag shall conform to OPSS 1301 and it shall constitute not more than 70% by the mass of the total cementing material. Fly ash shall conform to OPSS 1301 (Type F or Type C) and it shall constitute not more than 40% by the mass of the total cementing material.

1352.05.03 Barrier Connections

The Precast Concrete Barrier connections shall be one of the following approved types:

Hook and Eye;
Concrete Key;
I-Lock Connection.

1352.05.04 Interlocking Components

All interlocking devices and exposed metal in the precast concrete barrier units shall be protected by using one of the following methods:

- a. hot dip galvanizing conforming to CSA G-164 providing a minimum zinc coating of 0.61 kg²
- b. zinc metallizing conforming to CSA G-189 providing a minimum metallized coating of 200 µm thickness;
- c. coating with an approved organic coating material conforming to OPSS 1443.

1352.05.05 Reinforcing Steel

All reinforcing steel in permanent precast concrete barriers shall be epoxy coated conforming to OPSS 1442. All reinforcing steel in temporary concrete barriers shall conform to OPSS 1440.

1352.07 PRODUCTION

1352.07.01 Curing Methods

Curing shall conform to the method as submitted and approved by the Authority.

1352.07.02 Marking

The following information shall be permanently marked on the top or sides of the precast sections:

1. Name or trade-mark of the manufacturer;
2. Identification of plant if manufacturer has more than one plant;
3. The date of manufacture.

1352.07.03 Quality Control

1352.07.03.01 Salt Scaling Test

For quality control purposes the Contractor may use a modified version of the "Salt Scaling Test" described in Section 1352.08. The modified version to be used is the visual evaluation of the surface deterioration conforming to ASTM C672.

1352.08 QUALITY ASSURANCE

1352.08.01 Salt Scaling Test

1352.08.01.01 General

The acceptance of permanent precast concrete barrier will be based on the results of the "Salt Scaling Test" as carried out by the Authority and as described in this specification.

This test determines the resistance of concrete specimens, with a salt solution ponded on the surface, to repeated cycles of freezing and thawing. Compliance with the test requirement is based upon a loss of mass of not more than 0.8 kg/m^2 from the surface after 50 cycles of freezing and thawing.

After 50 freeze-thaw cycles the test specimen shall not exhibit deterioration in the form of cracks, spalls, aggregate disintegration or other objectionable features.

1352.08.01.02 Apparatus

The freezing apparatus shall consist of a suitable cabinet or cold room capable of maintaining an air temperature of $-18 \pm 2^\circ\text{C}$.

The thawing and air drying apparatus shall consist of a suitable cabinet or room with controls to maintain an air temperature of $23 \pm 2^\circ\text{C}$ and a relative humidity of 50 ± 5 percent. The scales or balance shall have a minimum capacity of 5000 g with an accuracy of 0.1 g. The drying oven shall be capable of maintaining a temperature of $105 \pm 2^\circ\text{C}$.

1352.08.01.03 Freezing and Thawing Cycle

One freeze-thaw cycle shall be completed every 24 hours. The cycle shall consist of 16 hours ± 1 hour freezing followed by 8 hours ± 1 hours thawing. When, due to work schedules or other reasons a thaw period cannot commence at the specified time the specimens shall remain in the freezing cabinet at $-18 \pm 2^\circ\text{C}$.

1352.08.01.04 Test Specimens

For the purposes of the test, two specimens 75 mm thick and at least 300 x 300 mm or 300 mm in diameter will be selected from the finished product by the Authority's representative. Specimens shall be representative of the Contractor's production.

Upon receipt of the specimens in the laboratory an epoxy mortar dyke or other suitable dyke shall be cast around the edges of the test specimen to expose a surface 250 x 250 mm or 250 mm in diameter, as shown in Figure 1. The surface of the specimen ponded in this test will normally be the outside surface of the barrier.

The dyked surface shall be flooded with water, 6 mm deep for 3 days to check for possible leakage.

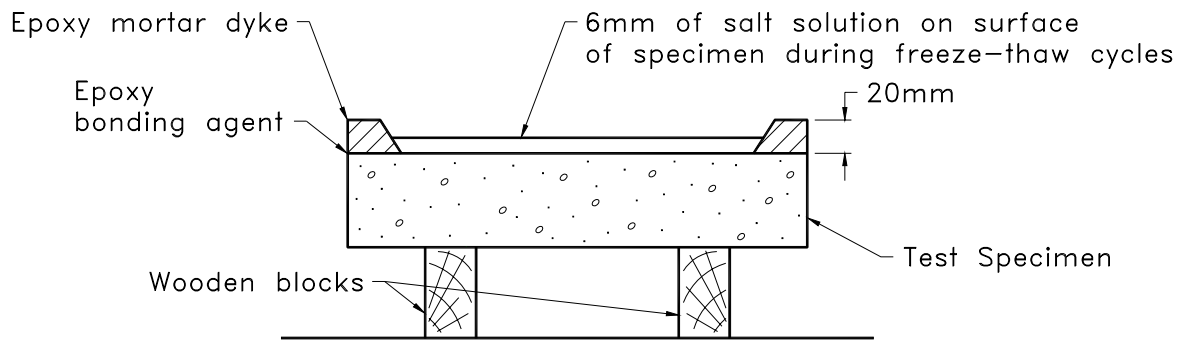


Figure 1

1352.08.01.05 Test Procedure

The water on the surface of the specimens shall be replaced by a solution of sodium chloride (concentration 3 percent by mass) to a depth of 6 mm.

The specimens shall then be subjected to continuous freeze-thaw cycles as specified in Clauses 1352.08.01.01 and 1352.08.01.03.

After each 5 cycles the salt solution and the particles of deteriorated concrete shall be removed from the slab and collected in a watertight container. The operation is best accomplished by tilting the slab into a funnel approximately 500 mm in diameter and washing the surface of the slab with a 3 percent sodium chloride solution. This washing should continue until all loose particles are removed from the concrete. The solution shall then be strained through a filter and the residue dried out at 105°C to a constant weight condition. The residue shall be cumulatively weighed after each 5 cycles. This residue shall be defined as the loss of mass and expressed in kilograms per square metre of exposed slab area.

The loss of mass shall be calculated to the nearest 0.1 kg/m².

After the washing of each slab a new solution of sodium chloride shall be placed on the surface.

The test shall continue until 50 freeze-thaw cycles have been completed.

During the test each specimen shall be positioned and supported to allow free air circulation under, around and over the test pieces.

The bottom of the specimens shall be supported on wooden blocks but not in a manner as to prevent movement of moisture through the test pieces.

1352.08.01.06 Report

The report shall include the following:

- (i) Identification;
- (ii) Photographs of the test specimens before and after the 50 cycle freeze-thaw test. Photographs at intermediate stages of the test are optional.

- (iii) A graph of the cumulative mass loss of each specimen plotted in kilograms per metre squared against the number of freeze-thaw cycles at 5 cycle intervals.

1352.09 AUTHORITY PURCHASE OF MATERIALS BY PURCHASE ORDER

1352.09.01 Measurement for Payment

The unit of measurement for payment will be for each precast concrete barrier unit delivered and accepted.

1352.09.02 Basis of Payment

Payment at the contract price for precast concrete barrier units shall be full compensation for all labour, equipment and materials for the supply and delivery of the units to the location and at the time specified.

1352.10 DESIGNATED SOURCES REQUIREMENTS

Manufacturers wishing approval to manufacture precast concrete barrier shall contact the Ministry of Transportation Purchasing and Supply Office.

Approval of the manufacturer's plant shall be based on the acceptability of the constituent materials, the degree of production control and uniformity, and whether the finished product meets the requirements of this specification. The manufacturer shall not change material type, sources, or production methods, without prior approval of the Authority.



NOTICE TO USERS OF OPSS 1359

MATERIAL SPECIFICATION FOR UNSHRINKABLE FILL

OPSS 1359 has been removed from this
OPS volume

The provincial version of OPSS 1359 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1359

The municipal version of OPSS 1359 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1359

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NOTICE TO USERS OF OPSS 1430

MATERIAL SPECIFICATION FOR GABION BASKETS AND MATS

OPSS 1430 has been removed from this
OPS volume

The provincial version of OPSS 1430 is now in:

OPS Volume 6,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 1430

The municipal version of OPSS 1430 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 1430

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NOTICE TO USERS OF OPSS 1440

MATERIAL SPECIFICATION FOR STEEL REINFORCEMENT FOR CONCRETE

OPSS 1440 has been removed from this
OPS volume

The provincial version of OPSS 1440 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1440

The municipal version of OPSS 1440 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1440

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NOTICE TO USERS OF OPSS 1441

MATERIAL SPECIFICATION FOR LOAD TRANSFER ASSEMBLIES

OPSS 1441 has been removed from this
OPS volume

The provincial version of OPSS 1441 is now in:

OPS Volume 6,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 1441

The municipal version of OPSS 1441 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 1441

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MATERIAL SPECIFICATION FOR EPOXY COATED REINFORCING STEEL BARS FOR CONCRETE

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1442-A	Commentary

1442.01 SCOPE

This specification covers the requirements for the production of reinforcing steel bars for concrete with protective epoxy coating applied by the electrostatic spray fusion bond method.

1442.01.01 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.

1442.01.02 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.

1442.02 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 1440	Steel Reinforcement for Concrete
OPSS 1443	Organic Coatings for Reinforcing Steel Bars for Concrete

Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-420	Cathodic Disbondment Test for Epoxy-Coated Reinforcing Bars
LS-421	Salt Spray Test for Epoxy-Coated Reinforcing Bars

ASTM International

A 775/A 775M-06	Epoxy Coated Steel Reinforcing Bars
D 3963/D 3963M-93	Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars

Concrete Reinforcing Steel Institute (CRSI)

Voluntary Certification Program for Fusion - Bonded Epoxy Coating Applicator Plants

1442.03 DEFINITIONS

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

Holidays means pinholes and voids in non-conductive coatings that allow an electrical current to pass through the protective coating to the metal base material. These discontinuities are such that they may not be visible to a person with normal vision.

Manufacturer means coating applicator or coater.

1442.05 MATERIALS

1442.05.01 Reinforcing Steel Bars

Reinforcing steel bars shall be according to OPSS 1440.

1442.05.02 Coating

Epoxy coating and patching material shall be according to OPSS 1443.

1442.07 PRODUCTION

1442.07.01 Surface Preparation and Application of Coating

All surfaces of the reinforcing steel bars shall be prepared and coated according to ASTM A 775M.

1442.07.02 Requirements

The requirements and the test methods for film thickness, continuity, flexibility, and adhesion shall be according to ASTM A 775M, ASTM D 3963M, and MTO test methods LS-420 and LS-421 except as modified as follows:

- a) The continuity of the coating shall be visually inspected after curing. The coating shall be free of holes, voids, blemishes, cracks, contaminations, and any damaged areas discernible to a person with normal vision. There shall be an average of no more than four holidays per linear metre of the bar when tested with a holiday detector.
- b) The flexibility of the coating shall be evaluated by bending test specimens around a mandrel with the appropriate bending pin diameter shown in Table 1. The bars shall be bent to 180 degrees, after rebound. The bend shall be made at a uniform rate and may take up to 5 seconds maximum to complete. The test shall be performed on test pieces having a uniform temperature of not less than 15 °C.

1442.07.03 Handling and Identification

Handling and identification of the coated reinforcing steel bars shall be according to ASTM A 775M and ASTM D 3963M except as follows:

- a) Coated reinforcing steel bars in the plant and at the Working Area shall be clearly labelled with the following information:
 - i. Name of manufacturer
 - ii. Coating system used
 - iii. Production date consisting of the month and year

- b) Unprotected storage of the coated reinforcing steel bars shall not exceed 30 Days. The total storage time shall not exceed 120 Days unless stored in such a manner as to protect them from the sun and moisture condensation.

1442.07.04 Fabrication

Fabrication of the reinforcing steel bars after application of the coating shall be according ASTM D 3963M.

1442.07.05 Repairs To Damaged Coating

Damage to the coating of the coated reinforcing steel bars caused during the fabrication and handling at the manufacturer's premises, including hairline cracks without bond loss and sheared bar ends, shall be repaired according to ASTM D 3963M. Repairs shall be completed before rusting and shipment occurs, with the following exceptions:

- a) Damage shall not exceed a surface area of 10 mm² in any linear metre of coated bar, not including sheared ends.
- b) There shall be no more than four defects per coated bar length.
- c) Bars containing hairline cracks that are associated with bond loss shall be rejected.

Coated reinforcing steel bars with damage exceeding the above shall be rejected.

1442.07.06 Quality Control

The manufacturer shall exercise quality control procedures to ensure the requirements of this specification are met.

Tested samples shall be retained by the manufacturer for 90 Days after testing and be identified with labels containing the following information:

- a) Date of manufacture
- b) Time of sampling
- c) Coating type
- d) Bar line

Tested samples shall be available at the manufacturer's premises for examination by the Contract Administrator.

Test results shall be submitted to the Contract Administrator. The submission shall include the Average Radial Disbondment for the Cathodic Disbondment Test and for the Salt Spray Test, calculated on the basis of three consecutive months' test results. The submission shall be signed by a qualified representative of the manufacturer verifying that results are included for all adhesion tests performed and that testing was according to LS-420 and LS-421. The submission shall include the name of the individuals who performed the testing.

Suppliers shall provide the purchaser with all testing records for each lot or part of lot to verify that the coated steel reinforcing bars supplied were produced and tested according to the appropriate specification requirements.

1442.07.06.01 Sampling and Frequency of Testing

Film thickness shall be determined according to ASTM D 3963M at the rate of one bar for every 25 coated bars or part thereof for each bar size produced on any one Day.

One bar sample, one metre in length, for every 1,500 m or part thereof for each coated bar size produced on any one day shall be taken and tested for flexibility.

One bar sample, 200 mm in length, for each bar size produced for every eight hours of production shall be taken for adhesion testing according to LS-420. The test samples shall be taken from each production line in rotation.

One bar sample, 200 mm in length, for every 24 hours of production shall be taken for adhesion testing according to LS-421. The test samples shall be taken from each production line in rotation and at least one sample representative of each bar size produced shall be tested for every seven Days of production.

1442.07.07 Certification of Manufacturer

The manufacturer shall meet the minimum quality criteria set forth by the CRSI Voluntary Certification Programme for Fusion-Bonded Epoxy Coating Applicator Plants and have a valid copy of this certificate available at their plant for review by the Contract Administrator.

1442.08 QUALITY ASSURANCE

1442.08.01 Inspection and Testing

The Owner reserves the right to inspect and test at such times as the Owner may consider necessary to ensure that the materials supplied are according to this specification.

The inspection and sampling of the coated reinforcing steel bars may be carried out at the coating plant, fabricating plant, or point of delivery to the Working Area.

Materials not meeting the requirements of this specification shall be rejected.

1442.08.02 Acceptance

Acceptance will be based on satisfactory test results that the coated reinforcing steel bar sample is according to this specification. Culling of rejected coated reinforcing steel bars is permitted. Rejected coated reinforcing steel bars are not to be used as uncoated reinforcing steel.

The average disbondment radius of the test site of coated reinforcing steel bar for cathodic disbondment according to LS-420 shall not exceed 2 mm, when measured from the edge of an intentional coating defect.

The average disbondment radius of six test sites of coated reinforcing steel bar for the Salt Spray, according to LS-421 shall not exceed 3 mm, and any individual test site shall not have greater than 5 mm disbondment radius average when measured from the edge of an intentional coating defect.

For film thickness acceptance purposes, at least 90% of the recorded thickness measurements shall be between 175 and 300 µm, excluding steel profile.

For adhesion of coating acceptance purposes, any coated reinforcing steel bars with cracking or cracking and disbonding of coating shall be rejected.

When inspected as delivered to the Working Area, the following criteria shall apply:

- a) Bars with coating damage greater than 1% of their surface area in any one metre length shall be rejected.
- b) Bars with coating damage of 1% or less of their surface area shall have all damaged areas of the bar coating repaired.
- c) If the additional required repairs result in a total bar surface area covered by patching material exceeding 5% of the bar surface area, the bar shall be rejected.

When the manufacturer is notified by the Owner of the uncertainty of the quality of the coated reinforcing steel bars, such bars shall be rejected and no additional coated reinforcing steel bars shall be shipped until the manufacturer has performed additional testing and notice of acceptance has been received from the Owner.

TABLE 1
Bending Pin Diameters

Bar Size, M	10	15	20	25	30	35	45	55
Bending Pin Diameter, mm	80	120	160	200	240	350	450	550

Appendix 1442-A, November 2007
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

Related Ontario Provincial Standard Drawings

None



NOTICE TO USERS OF OPSS 1504

MATERIAL SPECIFICATION FOR STEEL BEAM GUIDE RAIL

OPSS 1504 has been removed from this
OPS volume

The provincial version of OPSS 1504 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1504

The municipal version of OPSS 1504 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1504

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NOTICE TO USERS OF OPSS 1505

MATERIAL SPECIFICATION FOR CHANNEL COMPONENTS FOR STEEL BEAM GUIDE RAIL

OPSS 1505 has been removed from this
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The provincial version of OPSS 1505 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1505

The municipal version of OPSS 1505 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1505

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NOTICE TO USERS OF OPSS 1540

MATERIAL SPECIFICATION FOR STANDARD HIGHWAY FENCE COMPONENTS

OPSS 1540 has been removed from this
OPS volume

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OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1540

The municipal version of OPSS 1540 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
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NOTICE TO USERS OF OPSS 1541

MATERIAL SPECIFICATION FOR CHAIN-LINK FENCE COMPONENTS

OPSS 1541 has been removed from this
OPS volume

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OPS Volume 6,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 1541

The municipal version of OPSS 1541 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
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NOTICE TO USERS OF OPSS 1601

MATERIAL SPECIFICATION FOR WOOD, PRESERVATIVE TREATMENT, AND SHOP FABRICATION

OPSS 1601 has been removed from this
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The provincial version of OPSS 1601 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1601

The municipal version of OPSS 1601 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1601

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NOTICE TO USERS OF OPSS 1605

MATERIAL SPECIFICATION FOR EXTRUDED EXPANDED POLYSTYRENE PAVEMENT INSULATION

OPSS 1605 has been removed from this
OPS volume

The provincial version of OPSS 1605 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1605

The municipal version of OPSS 1605 is now in:

OPS Volume 8,
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Material Specifications
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NOTICE TO USERS OF OPSS 1704

MATERIAL SPECIFICATION FOR PAINT COATING SYSTEMS FOR STRUCTURAL STEEL

OPSS 1704 has been removed from this
OPS volume

The provincial version of OPSS 1704 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1704

The municipal version of OPSS 1704 is now in:

OPS Volume 8,
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Material Specifications
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**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS 1712
FEBRUARY 1991**

**MATERIAL SPECIFICATION FOR
ORGANIC SOLVENT BASED TRAFFIC PAINT**

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1712.01

SCOPE

This specification covers the requirements for organic solvent based traffic paint which is suitable for application onto concrete and bituminous pavements.

1712.02

REFERENCES

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

Ontario Provincial Standard Specifications, Material:

OPSS 1750 Traffic Paint Reflectorizing Glass Beads

Canadian General Standards Board:

CGSB-1-GP-12C-1983 - Standard Paint Colours

CGSB-1-GP-71-1983 - Testing Paints and Pigments:

American Society for Testing and Materials:

ASTM D185-84 - Coarse Particles in Pigments, Pastes and Paints

ASTM D562-81, (1985) - Consistency of Paints Using the Stormer Viscometer.

ASTM D711-84 - No Pick-Up Time of Traffic Paint

ASTM D713-87 - Conducting Road Service Tests on Traffic Paint

ASTM D868-85 - Evaluating Degree of Bleeding of Traffic Paint

ASTM D869-85 - Evaluating Degree of Settling of Traffic Paint

ASTM D969-85 - Degree of Bleeding of Traffic Paint

ASTM D2205-85 - Traffic Paints

ASTM D2244-85 - Calculation of Colour Differences from Instrumentally Measured Colour Coordinates

ASTM E97-82 (1987) - Test Method for 45-deg., 0-deg., Directional Reflectance Factor of Opaque Specimens by Broad-Band Filter

ASTM E303-83 - Measuring Surface Frictional Properties Using the British Pendulum Tester

United States Federal Standard:

U.S. FED-STD-595B - Colours Used in Government Dec. 15, 1989 Procurement

International Commission on Illumination:

CIE 1976 - L^* , a^* , b^* Uniform Colour Space and Colour Difference Equation.

1712.03

DEFINITIONS

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

Compliance Certification: refers to the procedure and requirements for establishing an approved source for materials.

Fingerprinting: refers to the testing of organic solvent based traffic paint by gas chromatographic and infrared spectroscopic techniques for verification purposes.

No Tracking Time: refers to the time required for a newly applied pavement marking line to show no visible deposition of the material to the pavement surface, outside the line when viewed from a distance of 15 metres, as determined by passing over the applied line at 60 km per hour in a simulated passing maneuver with a passenger car.

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 Marking Material: refers to a material formulated for application onto bituminous or concrete pavement in order to delineate vehicle operating limits.

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.

Service Test: refers to the evaluation of pavement marking materials on a test deck and performance rating prior to compliance certification.

Traffic Paint: refers to a paint specifically formulated for use as a pavement marking to delineate vehicle operating limits.

1712.05

MATERIALS

1712.05.01

General

Organic solvent based traffic paint shall be homogeneous, and shall be well ground to a uniform smooth consistency. It shall be free from skin, dirt and other foreign particles, and shall be capable of being sprayed at the temperature intended for application. The organic solvent based traffic paint shall flow evenly and smoothly and cover solidly when applied to pavements.

The materials used in the manufacture of the traffic paint shall be of high quality and consistency such that the appearance will not change in service to impair the colour or visibility of the delineation. The organic solvent based traffic paint film shall be flat in finish, and be visible under daylight and artificial light with the addition of the overlay glass beads.

1712.05.02

Colour

The organic solvent based traffic paint shall conform to the following colour requirements:

White - CGSB 1-GP-12C white 513-301.

Yellow - Shall match either the yellow traffic paint chip of the Ministry of Transportation, Ontario or U.S. FED-STD-595B, Yellow 33538.

Black - CGSB 1-GP-12C black 512-301.

The tolerance in colour allowed is as follows in CIE L^* , a^* , b^* Uniform Colour Space and Colour Difference Equation when calculated from instrumentally measured colour differences conforming to ASTM D 2244:

White $L^* = +2$ and -1.5 max
 $a^* = +1.5$ and -1 max
 $b^* = +4$ and -4 max

Yellow - MTO $L^* = +2$ and -1.5 max
 $a^* = +3$ and -1.5 max
 $b^* = +7$ and -1.5 max

Yellow - US $L^* = -2$ and $+4$ max
 $a^* = -6$ and $+4$ max
 $b^* = -9$ and $+10$ max

1712.05.03 Chemical Composition

The chemical composition of the organic solvent based traffic paint shall be at the discretion of the paint manufacturer, and shall be certified by the Authority.

1712.05.04 Reflectorization

The white and yellow organic solvent based traffic paints shall be used with overlay glass beads which are applied uniformly after application of the paint at a rate as shown below. The white and yellow organic solvent based traffic paints shall provide proper anchorage for overlay glass beads conforming to OPSS 1750.

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

Test samples of glass beads conforming to OPSS 1750 may be obtained from the Authority upon request.

1712.05.05 Physical Property Requirements

Organic solvent based traffic paints shall be supplied ready-mixed for use without any addition of solvents.

The handling and storage qualities must be acceptable with respect to degree of settling, uniform consistency, absence of skinning and thixotropic properties. The organic solvent based traffic paint shall be capable of being sufficiently atomized to produce an uniformly applied paint stripe without side splatter and overspray within the limitation imposed by conventional striping equipment.

The physical properties of the organic solvent based traffic paints submitted for compliance certification shall conform to Table 1.

Samples are required by the Authority for laboratory testing. The supplier shall submit with each test sample, complete data on physical properties, application procedure, and material safety for the organic solvent based traffic paint.

1712.05.06 Service Test

Organic solvent based traffic paint, conforming to 1712.05.05, and Table 1 shall be submitted for service test when requested by the Authority.

Organic solvent based traffic paints will be service tested, conforming to the following:

- a. Test deck location, time and procedure of application shall be as specified by the Authority.
- b. Test stripe shall be 10 cm in width and applied transversely across the lanes of the road. Application of the organic solvent based traffic paint to a dry thickness of 230 ± 25 microns on bituminous or concrete pavement with about 20,000 AADT and the subsequent application of overlay glass beads conforming to OPSS 1750, at the approved rate immediately over the yellow and white striped line.
- c. The ease and uniformity of application, severity of overspray, covering properties and drying time will be evaluated during application.
- d. The applied organic solvent based traffic paint will be inspected periodically and its service performance will be rated by the Authority, as outlined in Table 2.
- e. Approval will be given after one year of service rating, providing the material conforms to Table 2 and meets the conditions of 1712.09.02.

1712.07 PRODUCTION

1712.07.01 Plant Inspection

In order to qualify as a supplier of organic solvent based traffic paint(s), a manufacturer must satisfy the following minimum requirements:

- a. Adequate facilities to produce minimum batches of 3000 litres;
- b. A laboratory sufficiently equipped and staffed to provide a quality control program which will ensure compliance with this specification; and
- c. Properly documented production, sampling and testing procedures and methods.

1712.07.02 Quality Control

A manufacturer shall be responsible for carrying out a quality control program to ensure that the organic solvent based traffic paint(s) conform(s) to this specification.

1712.08 QUALITY ASSURANCE

1712.08.01 Acceptance Criteria

The Authority may request samples to be taken from the shipments of organic solvent based traffic paint(s) at any time for quality assurance testing. Samples shall be taken from each batch produced for delivery to the Authority. Criteria for accepting each production batch include the following requirements and manufacturing tolerances:

- a. Density shall be within 0.05 kg/l of the value established on the test sample, conforming to CGSB-1-GP-71 - Method 2.1.

- b. Viscosity shall be within ± 5 KU of the reference value.
- c. Colour Difference ΔE shall be within ± 1.5 of the value established on the reference sample.
- d. Composition shall not vary by more than $\pm 5\%$, based on fingerprinting and other tests, of the value of the reference sample.
- e. No pickup time of each production batch sample shall be within ± 1.5 minutes of the value established for the test sample, conforming to ASTM D-711.
- f. Hiding power with minimum value of $8.4 \text{ m}^2/\text{l}$.
- g. Bleeding with minimum value of 5.0.
- h. Directional reflectance with:
 - minimum value of 70% white
 - minimum value of 50% yellow

1712.08.02 Quality Control of Production Batches

A one litre sample from each production batch along with test results on density, viscosity at 25°C and no pickup time, shall be delivered to the Authority's laboratory within two days of manufacture of the respective batches.

Delivery records shall be kept, by the supplier, of the number of containers of each batch shipped to each delivery point and a list of such shipments during each calendar week shall be given to the Authority at the end of each week until the entire order is completed and shipped.

1712.08.03 Storage

The organic solvent based traffic paint shall conform to this specification after storage.

1712.09 AUTHORITY PURCHASE OF MATERIAL BY PURCHASE ORDER

1712.09.01 Trial Batch Application

A trial batch of organic solvent based traffic paint(s) conforming to this specification may be purchased by the Authority for evaluation of application properties using the Authority's painting equipment. The trial batch shall consist of a minimum quantity of 1,000 litres of organic solvent based traffic paint.

No tracking time will also be determined.

Those organic solvent based traffic paint(s) conforming to this specification which exhibit satisfactory loading and application properties when used with the Authority's painting equipment will be considered for purchase.

1712.09.02 Certificate of Compliance

The manufacturer shall submit a certificate of compliance, with tenders, indicating that the physical properties and chemical composition of all of the manufacturer's production batches of traffic paint, for the Authority, shall conform to this specification and shall not deviate from the allowable tolerances, unless approved by the Authority.

1712.09.03**Delivery and Packaging of Organic Solvent Based Traffic Paint**

The delivery schedule, delivery location, colour, type, and quantity shall be as specified on the Authority's Purchase Order.

The organic solvent based traffic paint shall be furnished in returnable drums with air tight liners.

Each drum shall be clearly marked on the side and the top with weather resistant markings to show the following information:

- a. manufacturer's name and address
- b. type of traffic paint
- c. colour
- d. manufacturer's code and batch numbers
- e. date of filling the drum
- f. volume of contents in litres

A small portion of the organic solvent based traffic paint may be required in twenty-litre containers. The quantity will be specified on the Purchase Order.

1712.09.04**Measurement and Payment**

The unit of measurement for organic solvent based traffic paint will be litres.

Payment for supplying the organic solvent based traffic paint shall be as specified on the Authority's Purchase Order.

1712.10**DESIGNATED SOURCES REQUIREMENTS**

In order for a Supplier to be considered for addition to the List of Designated Sources of the Ministry of Transportation, Ontario for organic solvent based traffic paint, the manufacturer shall supply a production sample of the organic solvent based traffic paint to the Ministry along with complete material data in a prescribed form PAV.M.1712, available at the Ministry of Transportation for conformance testing.

If the test sample conforms to this specification and the Ministry is satisfied that the Supplier has the equipment and ability to produce the material in bulk quantities, then the Ministry, upon written request to the Manager, Purchasing and Supply Office of the Ministry of Transportation, 1201 Wilson Avenue, Downsview, Ontario, M3M 1J8 will place the Supplier on the List of Designated Sources for Materials.

Subsequent changes in formulation, the inability to maintain quality production or to meet commitments, or failure to conform to this specification shall be cause for cancellation of approval and shall necessitate application for reapproval.

TABLE 1
PHYSICAL PROPERTY REQUIREMENTS
FOR ORGANIC SOLVENT BASED TRAFFIC PAINT

TEST AND PROPERTY	REQUIREMENTS		TEST METHODS		
	Min.	Max.	CGSB 1-GP-71	ASTM	OTHER
Water Content % by mass		0.5	24.1		
Settling 6 months	8.0			D869	
Hiding Power m ² /l	8.4				Pfund cyptometer with #3.5 wedge
Skinning 48 hours	nil	nil	10.1		
Bleeding	5.0			D969 & D868	
Viscosity KU @ 7°C @ 25°C	80.0	135.0 90.0	4.5	D562	
Coarse Particles # 60 sieve - 250 µm #100 sieve - 150 µm	nil	nil 0.01		D185 & D2205	
No Pickup Time, mins.		8.0*		D711	
Directional Reflectance % White Paint Yellow Paint	70.0 50.0			E97	
Skid Resistance BPN Units	**			E303	

* For coning type of traffic paints, this value can be higher.

** Values to be established.

TABLE 2
PERFORMANCE REQUIREMENTS FOR SERVICE TEST AT ABOUT 20,000 AADT
FOR ORGANIC SOLVENT BASED TRAFFIC PAINT

Property	Performance Requirements					Test Method
	Newly Installed Paints	Service Life Ratings of				
		3 mths	1 yr	1.5 yrs	2 yrs	
Directional Reflectance %						ASTM E-97*
White	≥ 70	≥ 70	≥ 50	≥ 50	≥ 50	
Yellow	≥ 50	≥ 50	≥ 35	≥ 35	≥ 35	
Black	≤ 12	≤ 12				
Retroreflectance						Instrument
mcd/m ² /lux						Mirolux
White	**	**	**	**	**	12
Yellow	**	**	**	**	**	
Black	**	**	**	**	**	
No Tracking Time, mins.	≤ 2					
Durability						
White and Yellow		≥ 90	≥ 85	≥ 75	≥ 70	MTO***
Black		≥ 90				
Appearance	10	≥ 8	≥ 7	≥ 6	≥ 5	ASTM D713 & MTO

* These values are based on markings placed on a typical asphalt surface.

** Values to be established.

*** Durability is calculated, first by estimating the % wear from the photographs/video images of stripes taken at test sites, and then deducting the value obtained from 100.

**** Rating 1-10; Perfect Score is 10.
Rating made on inspection of the markings by a panel of evaluators from the Authority.

Organic solvent based traffic paint DATA FORM

A. MANUFACTURER'S NAME _____
 ADDRESS _____

TELEPHONE NO. _____

B. SAMPLE IDENTIFICATION

Manufacturer's Code No. _____ Paint Batch No. _____
 Colour of Paint _____ Sample Date _____

C. TEST DATA

Density, kg/l	1-GP-71 M2.1	_____
Volatile Matter, %	1-GP-71 M17.1	_____
Water, %	1-GP-71 M24.1	_____
No Pickup Time, minutes	ASTM D711	_____
Hiding Power, m ² /l	Pfund Cryptometer	_____
	OPSS 1712 Table 1	_____
Bleeding, 1-10 rating	ASTM D868/D969	_____
Viscosity, KU	ASTM D562	_____
@ 7°C		_____
@ 25°C		_____

D. COMPOSITION OF PAINT

	% by Mass	% by Volume
Pigment and Fillers	_____	_____
Non-Volatile	_____	_____
Volatile	_____	_____

Composition of Pigment and Fillers	% by Mass

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

Type of Vehicle _____
 Type of Thinner _____
 Type of Driers _____

E. MATERIAL SAFETY DATA

F. APPLICATION PROCEDURES

Surface Preparation _____
 Minimum Pavement Temperature _____
 Paint Temperature _____ min °C _____ max °C
 Mode of Application _____
 Ambient Temperature _____ min °C Relative Humidity _____ max %

NOTE: Above form to be completed and forwarded with paint sample. Samples submitted without a completed Paint Data form will not be considered.



MATERIAL SPECIFICATION FOR THERMOPLASTIC PAVEMENT MARKING MATERIALS

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1713.01	SCOPE

This specification covers the requirements for reflectorized thermoplastic pavement marking material that is suitable for application onto bituminous and concrete pavements.

1713.02**REFERENCES**

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

Ontario Provincial Standard Specifications, Material:

OPSS 1750 - Traffic Paint Reflectorizing Glass Beads

Canadian General Standards Board:

CGSB 1-GP-12C-1983 - Standard Paint Colours

American Society for Testing and Materials:

ASTM D256-1988 Impact Resistance of Plastics and Electrical Insulating Materials

ASTM D570-81 (1988) Water Absorption of Plastics

ASTM D713-87 Conducting Road Service Tests on Traffic Paint

ASTM D1415-88 Rubber Property - International Hardness

ASTM D2240-86 Rubber Property - Durometer Hardness

ASTM D2244-85 Calculation of Colour Differences from Instrumentally Measured Colour Coordinates

ASTM E28-67(1982) Softening Point by Ring and Ball Apparatus

ASTM E97-82(1987) Test Method for 45-deg., 0-deg. Directional Reflectance Factor of Opaque Specimens by Broad-Band Filter

ASTM E303-83 Measuring Surface Frictional Properties Using the British Pendulum Tester

British Standards Institution:

BS 3262-1987 - Hot-Applied Thermoplastic Road Marking Materials.
Part 1, Specification for Constituent Materials and Mixtures
Part 2, Specification for Road Performance
Part 3, Specification for Application of Material to Road Surfaces

United States Federal Standard:

U.S. FED-STD-595B, Dec. 15, 1989 - Colours Used in Government Procurement

International Commission on Illumination:

CIE 1976 - L^*, a^*, b^* Uniform Colour Space and Colour Difference Equation

1713.03**DEFINITIONS**

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

Compliance Certification: refers to the procedure and requirements for establishing an approved source for materials.

Fingerprinting: refers to the testing of thermoplastic pavement marking materials by gas chromatographic, and infrared spectrophotometric techniques for verification purposes.

Hot Applied Thermoplastic Pavement Marking Material: refers to a thermoplastic material that is specifically formulated for hot spray or screed application onto bituminous or concrete pavements to delineate the vehicle operating limits.

No Tracking Time: refers to the time required for a newly applied pavement marking line to show no visible deposition of the material to the pavement surface, outside the line when viewed from a distance of 15 metres, as determined by passing over the applied line at 60 km per hour in a simulated passing manoeuvre with a passenger car.

Pavement Marking Material: refers to a material formulated for application onto bituminous or concrete pavement in order to delineate vehicle operating limits.

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.

Service Test: refers to the evaluation of pavement marking materials on a test deck and performance rating prior to compliance certification.

Thermoplastics: refers to a polymeric plastic material which softens, melts, and flows at elevated temperatures, but forms into a solid material at lower temperatures. This thermal behaviour, being reversible, is retained on repeated heating and cooling cycles.

1713.05 MATERIALS

1713.05.01 General

The thermoplastic pavement marking material shall not undergo any significant breakdown or deterioration when held at 170°C for four hours or during four one-hour reheatings to the plastic temperature. The softening point and viscosity characteristics of the plastic material shall remain constant through four reheatings and should be the same from batch to batch.

There shall be no significant change in the colour of the material as the result of up to four reheatings of one hour each, up to a temperature of 170°C. The material shall be environmentally safe during heating and application. The material shall not deteriorate by contact with sodium chloride, calcium chloride, or any other chemical used for ice control, or because of oil content of pavement materials or oil droppings from the traffic.

The ingredients used in the production of thermoplastic pavement marking materials shall be of high quality and consistency so that the appearance will not change in service to impair the colour or the visibility of the delineation.

1713.05.02 Colour

Thermoplastic pavement marking materials shall conform to the following colour requirements:

White Thermoplastic Pavement Marking Material - CGSB 1-GP-12C white 513-301

Yellow Thermoplastic Pavement marking Material shall match either the yellow colour chip of the Ministry of Transportation, Ontario or U.S. Federal 595B, Yellow 33538.

The tolerance in colour allowed is as follows in the CIE L^*, a^*, b^* Uniform Colour Space and Colour Difference Equation when calculated from instrumentally measured colour differences conforming to ASTM D2244.

White $L^* = +2$ and -1.5 max
 $a^* = +1.5$ and -1 max
 $b^* = +4$ and -4 max

Yellow - MTO $L^* = +2$ and -1.5 max
 $a^* = +3$ and -1.5 max
 $b^* = +7$ and -1.5 max

Yellow - U.S. $L^* = -2$ and $+4$ max
 $a^* = -6$ and $+4$ max
 $b^* = -9$ and $+10$ max

1713.05.03 Chemical Composition

The chemical composition of the thermoplastic material shall be at the discretion of the manufacturer and shall be certified by the Authority.

1713.05.04 Reflectorization

Thermoplastic material for screed application and preformed thermoplastic pavement marking material shall contain premixed glass beads. Overlay glass beads shall also be applied at a rate recommended by the manufacturer for reflectorization. Thermoplastic materials recommended for spray application shall be used with overlay glass beads for reflectorization. These materials shall provide proper anchorage for the glass beads which shall conform to OPSS 1750, with the exception of the requirement of silicone coating.

Test samples of glass beads conforming to the above requirements may be obtained from the Authority upon request.

1713.05.05 Physical Property Requirements

Physical properties of thermoplastic pavement marking material submitted for compliance certification shall conform to Table 1.

Samples are required by the Authority for laboratory testing. The supplier shall submit with each test sample, complete data on physical properties, application procedure, and material safety for the thermoplastic pavement marking material.

1713.05.06 Service Test

Thermoplastic pavement marking material, conforming to the qualifications of 1713.05 and Table 1, shall be supplied for service test when requested by the Authority.

Thermoplastic pavement marking material will be service tested conforming to the following:

- a. Test deck location and time for application shall be determined by the Authority.

- b. The test stripes shall be 10 cm in width and applied transversely across the lanes of the road. 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. The application will be made by the supplier/manufacturer or his approved agent, using the pieces of equipment recommended by the manufacturer of thermoplastic pavement marking material.
- c. Application of test stripes of hot applied or preformed thermoplastic pavement marking material on a bituminous or concrete pavement with about 20,000 AADT.
- d. Ease of application and quality and nature of the stripes, shape of the edges and uniformity in thickness will be evaluated.
- e. Thermoplastic pavement marking will be inspected periodically and its service performance will be rated by the Authority as specified in Table 2.
- f. Susceptibility to snow plow damage and chipping will be assessed.
- g. Approval will be given after 2 years of service rating, providing the material conforms to Table 2 and meets the conditions of 1713.05.05.

1713.07 PRODUCTION

1713.07.01 General

In order to qualify as a supplier, a manufacturer must satisfy the following minimum requirements:

- a. Adequate production facilities.
- b. A laboratory sufficiently equipped and staffed to provide a quality control program which will ensure compliance with this specification; and
- c. Properly documented production, sampling, and testing procedures and methods.

1713.07.02 Quality Control

A manufacturer shall be responsible for carrying out a quality control program to ensure that the thermoplastic pavement marking material(s) conform(s) to this specification.

1713.08 QUALITY ASSURANCE

1713.08.01 Acceptance Criteria

The Authority may request samples to be taken from the shipments at any time for quality assurance testing. Samples shall be taken from each batch produced for delivery to the Authority. Criteria for acceptance shall include the following requirements and manufacturing tolerances:

- a. Composition shall not vary by more than $\pm 5\%$, based on fingerprinting and other tests, of the values established for the reference sample.
- b. Softening point shall be within $\pm 3^\circ\text{C}$ from the value established for the reference sample.
- c. Colour difference ' ΔE ' shall be less than ± 1.5 provided the colour conforms to this specification.

d. Directional reflectance with:

minimum value of 70% white
minimum value of 45% yellow

1713.08.02 Quality Control of Production Batches

A 500 g sample of hot applied thermoplastic pavement marking material or one section of the preformed thermoplastic pavement marking material from each production batch along with test results on softening point, hardness, and material composition shall be supplied to the Authority for laboratory testing.

Delivery records shall be kept by the Supplier, of the number of containers of each batch shipped to each delivery point and a list of such shipments shall be given to the Authority.

1713.08.03 Storage

Thermoplastic pavement marking materials shall conform to this specification after storage.

1713.09 AUTHORITY PURCHASE OF MATERIAL BY PURCHASE ORDER

1713.09.01 Certificate of Compliance

The manufacturer shall submit a certificate of compliance, with tenders, indicating that the physical properties, material composition, and installation characteristics of all of the manufacturer's production batches of thermoplastic pavement marking material(s) for the Authority shall conform to this specification and shall not deviate from the allowable tolerances, unless approved by the Authority.

1713.09.02 Delivery and Packaging of Thermoplastic Pavement Marking Material

The delivery schedule, delivery location, colour, type, and quantity shall be as specified by the Authority. Thermoplastic pavement marking material supplied shall be packaged to commercially acceptable standards. Each package shall have a label or marking with the following information:

- a. manufacturer's name and address
- b. type and colour of thermoplastic pavement marking material
- c. manufacturer's code and batch numbers
- d. net weight in kilograms or in metres for preformed material
- e. date of manufacture

1713.09.03 Measurement and Payment

Thermoplastic pavement marking material will be measured in metres.

Payment for supplying thermoplastic pavement marking material shall be as specified on the Authority's purchase order.

1713.10 DESIGNATED SOURCES REQUIREMENTS

In order for a Supplier to be considered for addition to the List of Designated Sources of the Ministry of Transportation, Ontario, for thermoplastic pavement marking materials, the manufacturer shall supply a production sample of the thermoplastic pavement marking material to the Ministry along with complete material data in a prescribed form PAV.M.1713, available at the Ministry, for conformance testing.

If the test sample conforms to this specification and the Ministry is satisfied that the Supplier has the equipment and ability to produce the material in bulk quantities, then the Ministry, upon written request to the Manager, Purchasing and Supply Office of the Ministry of Transportation, 1201 Wilson Avenue, Downsview, Ontario, M3M 1J8, will place the Supplier on the List of Designated Sources for Materials.

Subsequent changes in formulation, the inability to maintain quality production or to meet commitments, or failure to conform to this specification shall be cause for cancellation of approval and shall necessitate application for reapproval.

TABLE 1
PHYSICAL PROPERTY REQUIREMENTS FOR
THERMOPLASTIC PAVEMENT MARKING MATERIAL

TEST AND PROPERTY	REQUIREMENTS		TEST METHODS ASTM
	Min.	Max.	
Directional Reflectance % White Yellow	70 45		E97
Softening Point °C	80		E28
Water Absorption %		0.5	D570
Impact Resistance Izod	**		D256*
Hardness at 25°C IRHD	90	98	D1415
Skid Resistance BPN Units	**		E303

* Material is cast into 3" x 1" x 0.9" bars for this test.

** Values to be established.

TABLE 2

**PERFORMANCE REQUIREMENTS FOR SERVICE TEST AT ABOUT 20,000 AADT
FOR THERMOPLASTIC PAVEMENT MARKING MATERIAL**

Property	Performance Requirements for Test Stripes						Test Method
	Newly Installed Thermo-Plastics	Service Life Ratings					
		1 yr	2 yrs	3 yrs	4 yrs	5 yrs	
Directional Reflectance %							
White	≥ 70	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	ASTM E97*
Yellow	≥ 45	≥ 35	≥ 35	≥ 35	≥ 35	≥ 35	
Retroreflectance							Instrument Mirolux 12
mcd/m ² /lux							
White	**	**	**	**	**	**	
Yellow	**	**	**	**	**	**	
No Tracking Time, mins.	≤ 2						MTO
Durability		≥ 95	≥90	≥ 80	≥ 75	≥ 70	MTO***
Appearance	10	≥ 8	≥ 7	≥ 6	≥ 5	≥ 5	ASTM D713 & MTO***

* These values are based on markings placed on a typical asphalt surface.

** Values to be established.

*** Durability is calculated, first by estimating the % wear from the photographs/video images of stripes taken at test sites, and then deducting the value obtained from 100.

**** Rating 1-10; Perfect score is 10.
Rating made on inspection of the markings by a panel of evaluators from the Authority.

THERMOPLASTIC PAVEMENT MARKING MATERIAL DATA FORM

A. MANUFACTURER'S NAME _____
ADDRESS _____

TELEPHONE NO. _____

B. SAMPLE IDENTIFICATION

Commercial Trade Name of Sample _____
Manufacturer's Code No. _____
Batch No. _____
Colour _____
Date of Manufacture _____

C. MATERIAL COMPOSITION

Resins and Conditioners wt % _____
Pigments and Fillers wt % _____
Glass Beads wt, % _____
Gradation of Beads _____

D. TEST DATA

Softening Point °C	ASTM E28	_____
Water Absorption %	ASTM D570	_____
Impact Resistance	ASTM D256*	_____
Hardness**, IRHD	ASTM D1415	_____
Shore A° or D°	ASTM D2240	_____

E. MATERIAL SAFETY DATA

* material is cast into 3" x 1" x 0.9" bars for this test
** hardness may also be measured conforming to ASTM D2240

F. PROCEDURE FOR OVERLAY AND INLAY APPLICATION

1. Pavement Surface Preparation Procedure _____

2. Pavement Temperature Range for Installation
Minimum °C _____
Maximum °C _____
3. Air Temperature
Minimum °C _____
4. Humidity Maximum % _____
5. Temperature Range of Hot Thermoplastic Material for Application
Minimum °C _____
Maximum °C _____
6. Types of Pavement *** where the application is not recommended.

7. Equipment for Application _____

8. Application Procedure for Glass Beads _____

9. Particulars regarding suitability of application onto partly worn existing pavement marking.
 - a. On solvent based traffic paint _____
 - b. On water-borne traffic paint _____
 - c. On thermoplastic pavement marking _____
 - d. On field reacted polymeric pavement marking _____
10. Any Other Relevant Information _____

*** refers to the age of pavement, the surface texture (e.g. OFC, DFC etc.) and whether it is asphalt or concrete pavement.

Note: This form must be completed in full and forwarded with material sample. Samples submitted without a completed data form will not be considered.



MATERIAL SPECIFICATION FOR FIELD REACTED POLYMERIC PAVEMENT MARKING MATERIALS

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1714.01	SCOPE

This specification covers the requirements for field reacted, two component polymeric pavement marking materials which are suitable for application onto concrete and bituminous pavements.

1714.02**REFERENCES**

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

Ontario Provincial Standard Specifications, Material:

OPSS 1750 Traffic Paint Reflectorizing Glass Beads

Canadian General Standards Board Specifications:

CGSB 1-GP-12C-1983 - Standard Paint Colours

American Society for Testing and Materials:

ASTM D 713-87	-	Conducting Road Service Tests on Traffic Paint
ASTM D 868-85	-	Degree of Bleeding of Traffic Paint
ASTM D 869-85	-	Degree of Settling of Traffic Paint
ASTM D 1415-88	-	Rubber Property - International Hardness
ASTM D 1644-88	-	Non-Volatile Content of Varnishes
ASTM D 1652-88	-	Epoxy Content of Epoxy Resins
ASTM D 2074-66(1987)-	-	Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D 2240-86	-	Rubber Property - Durometer Hardness
ASTM D 2244-85	-	Calculation of Colour Differences from Instrumentally Measured Colour Coordinates
ASTM D 4060-84	-	Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM E-97-82 (1987)	-	Test for 45-deg, 0-deg, Directional Reflectance Factor of Opaque Specimens by Broad Band Filter
ASTM E-298-84	-	Assay of Organic Peroxides
ASTM E-303-83	-	Measuring Surface Frictional Properties Using the British Pendulum Tester

United States Federal Standard:

U.S.-FED-STD-595B-Dec. 15, 1989 Colours Used in Government Procurement

International Commission on Illumination:

CIE 1976 - L^* , a^* , b^* Uniform Colour Space and Colour Difference Equation.

1714.03**DEFINITIONS**

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

Compliance Certification: refers to the procedure and requirements for establishing an approved Designated Sources of Materials.

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 and applied during the pot life of the mixture.

Fingerprinting: refers to the testing of field reacted polymeric pavement marking materials by infrared spectroscopy and other techniques for verification purposes.

No Tracking Time: refers to the time required for a newly installed beaded line to show no visible deposition of the material to the pavement surface, outside the line when viewed from a distance of 15 metres, as determined by passing over the applied pavement marking line at 60 km per hour, in a simulated passing maneuver at about 60 km per hour with a passenger car.

Pavement Marking Material: refers to a material formulated for application onto bituminous or concrete pavement in order to delineate vehicle operating limits.

Pot Life: refers to the length of time a material is usable after a curing agent or a polymerization catalyst has been mixed.

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.

Service Test: refers to the evaluation of pavement marking materials on a test deck and performance rating prior to compliance certification.

1714.05 MATERIALS

1714.05.01 General

The ingredients used in the production of the field reacted polymeric pavement marking materials shall be of high quality consistency such that the appearance will not change in service to impair the colour or visibility of the delineation.

1714.05.02 Colour

The field reacted polymeric pavement marking material shall conform to the following colour requirements after mixing at the recommended proportions and curing:

White - CGSB 1-GP-12C white 513-301.

Yellow - shall match either the yellow colour chip of the Ministry of Transportation, Ontario or U.S. Federal 595B, Yellow 33538.

Black - CGSB 1-GP-12C black 512-301.

The tolerance in colour allowed is as follows in the CIE $L^*a^*b^*$ Uniform Colour Space and Colour Difference.

Equation when calculated from instrumentally measured colour differences conforming to ASTM D 2244:

White $L^* = +2$ and -1.5 max
 $a^* = +1.5$ and -1 max
 $b^* = +4$ and -4 max

Yellow - MTO $L^* = +2$ and -1.5 max
 $a^* = +3$ and -1.5 max
 $b^* = +7$ and -1.5 max

Yellow - U.S. $L^* = -2$ and $+4$ max
 $a^* = -6$ and $+4$ max
 $b^* = -9$ and $+10$ max

1714.05.03 Chemical Composition

The chemical composition of the field reacted polymeric pavement marking material shall be at the discretion of the manufacturer and shall be certified by the Authority.

1714.05.04 Reflectorization

Field reacted polymeric pavement marking material recommended for screed application shall contain premixed glass beads and overlay glass beads shall also be applied at a rate recommended by the manufacturer for reflectorization of the pavement markings. Field reacted polymeric pavement marking materials recommended for spray application shall be used with overlay glass beads for reflectorization. These materials shall provide proper anchorage for the glass beads which shall conform to OPSS 1750, with the exception of the requirement of silicone coating.

Test samples of glass beads conforming to the above requirements may be obtained from the Authority.

1714.05.05 Physical Property Requirements

The physical properties of the field reacted polymeric pavement marking material submitted for compliance certification shall conform to Table 1.

Samples are required by the Authority for laboratory testing. The supplier shall submit with each test sample, complete data for both components and mixing ratios of the field reacted polymeric pavement marking material.

1714.05.06 Service Tests

Field reacted polymeric pavement marking materials, conforming to the qualifications of 1714.05, and Table 1 shall be submitted for service tests when requested by the Authority.

The field reacted polymeric pavement marking material will be service tested conforming to the following:

- a. Test deck location and time for application shall be determined by the Authority.
- b. The test stripes shall be 10 cm in width and applied transversely across the lanes of the road. The application will be made by the supplier or the manufacturer or his agent, as recommended by the manufacturer except that the thickness of screed applied material shall be $1.90 \text{ mm} \pm 0.40 \text{ mm}$.
- c. Application of test stripes of the field reacted polymeric material on a bituminous or concrete pavement with about 20,000 AADT.

- d. Ease of application, quality, and nature of the stripes, including the shape of the edges and uniformity in thickness will be assessed.
- e. The field reacted polymeric pavement marking will be inspected periodically and its service performance will be rated by the Authority as outlined in Table 2.
- f. Approval will be given after 2 years of service rating, providing the material conforms to Table 2 and meets the conditions of 1714.05.05.

1714.07 PRODUCTION

1714.07.01 General

In order to qualify as a supplier of field reacted polymeric pavement marking material(s), a manufacturer must satisfy the following minimum requirements.

- a. Adequate production facilities.
- b. A laboratory sufficiently equipped and staffed to provide a quality control program which will ensure compliance with this specification; and
- c. Properly documented production, sampling and testing procedures and methods.

1714.07.02 Quality Control

A manufacturer shall be responsible for carrying out a quality control program to ensure that the field reacted polymeric pavement marking material(s) conform(s) to this specification.

1714.08 QUALITY ASSURANCE

1714.08.01 Acceptance Criteria

The Authority may request samples to be taken from the shipments of field reacted polymeric pavement marking material(s) at any time for quality assurance testing. Samples shall be taken from each batch produced for delivery to the Authority. Criteria for accepting each production batch include the following requirements and manufacturing tolerances:

- a. Composition shall not vary by more than $\pm 5\%$ of the reference value, as determined by fingerprinting and other specific tests for the materials conforming to the applicable ASTM specification from ASTM D 1644, ASTM D 1652, ASTM D 2074 and ASTM E-298.
- b. Pot life shall not vary by more than ± 5 minutes of the value established for the reference sample, when tested at 25°C and 50% relative humidity.
- c. Directional reflectance with:
 - Minimum value of 70% white
 - Minimum value of 45% yellow

1714.08.02 Quality Control of Production Batches

A 500 g sample of the prepolymer or polymerizable component and an equivalent amount of curing agent or catalyst samples shall be supplied to the Authority for laboratory testing.

1714.08.03 Storage

The field reacted polymeric pavement marking materials shall conform to this specification after storage.

1714.09 AUTHORITY PURCHASE OF MATERIAL BY PURCHASE ORDER

1714.09.01 Certificate of Compliance

The manufacturer shall submit a certificate of compliance, with tenders, indicating the physical properties, material composition, and installation characteristics of all of the manufacturer's production batches of the field reacted polymeric pavement marking materials for the Authority shall conform to this specification and shall not deviate from the allowable tolerances, unless approved by the Authority.

1714.09.02 Delivery and Packaging of the Field Reacted Polymeric Pavement Marking Material

The delivery schedule, delivery location, colour, type, and quantity shall be as specified by the Authority. Both components of the field reacted polymeric pavement marking material supplied, shall be packaged to commercially acceptable standards. Each package shall have a label or marking with the following information:

- a. manufacturer's name and address
- b. type and colour of the field reacted polymeric pavement marking material
- c. manufacturer's code and batch numbers
- d. net weight in kilograms
- e. date of manufacture

1714.09.03 Measurement and Payment

The unit of measurement for the field reacted polymeric pavement marking material will be kilograms. Payment for supplying the field reacted polymeric pavement marking material shall be as specified on the Authority's purchase order.

1714.10 DESIGNATED SOURCES REQUIREMENTS

In order for a Supplier to be considered for addition to the List of Designated Sources of the Ministry of Transportation, Ontario for field reacted polymeric pavement marking material, the manufacturer shall supply a production sample of the pavement marking material to the Ministry along with complete material data in a prescribed form PAV.M.1714, available at the Ministry for conformance testing.

If the test sample conforms to this specification and the Ministry is satisfied that the Supplier has the equipment and ability to produce the material in bulk quantities, then the Ministry, upon written request to the Manager, Purchasing and Supply Office of the Ministry of Transportation, 1201 Wilson Avenue, Downsview, Ontario, M3M 1J8 will place the Supplier on the List of Designated Sources for Materials.

Subsequent changes in formulation, the inability to maintain quality production or to meet commitments, or failure to conform to this specification shall be cause for cancellation of approval and shall necessitate application for reapproval.

TABLE 1

**PHYSICAL PROPERTY REQUIREMENTS FOR FIELD REACTED
POLYMERIC PAVEMENT MARKING MATERIALS**

TEST AND PROPERTY	REQUIREMENTS		TEST METHODS	
	Min.	Max.	ASTM	OTHER
Settling, 6 months Component A Component B	6 6		D 869	MTO
Pot Life min. at 25°C		20		
Bleeding	5		D 868	
Directional Reflectance %			E 97	
White Paint	70			
Yellow Paint	45			
Black		12		
Hardness IRHD	90	98	D 1415	
Abrasion Resistance 1000 cycles/g	*		D 4060 CS-17	
Skid Resistance BPN Units	*		E 303	

* Values to be established

TABLE 2

**PERFORMANCE REQUIREMENTS FOR SERVICE TEST AT ABOUT 20,000 AADT
FOR FIELD REACTED POLYMERIC PAVEMENT MARKING MATERIALS**

Property	Performance Requirements							Test Method
	Newly Installed Marking	Service Life Ratings of						
		3 mths	1 yr	2 yr	3 yrs	4 yrs	5 yrs	
Directional Reflectance % White Yellow Black	≥ 70 ≥ 45 ≤ 12	≥ 50 ≥ 35	≥ 50 ≥ 35	≥ 50 ≥ 35	≥ 50 ≥ 35	≥ 50 ≥ 35	≥ 50 ≥ 35	ASTM E-97*
Retroreflectance mcd/m ² /lux White Yellow Black	** ** **	** ** **	** ** **	** ** **	** ** **	** ** **	** ** **	Instrument Mirolux
No Tracking Time, mins.	≤ 15							
Durability White & Yellow Black		≥ 95	≥ 90	≥ 80	≥ 75	≥ 70		MTO***
Appearance	10	≥ 9	≥ 8	≥ 7	≥ 6	≥ 5	≥ 5	ASTM D713 & MTO****

* These values are based on markings placed on a typical asphalt surface.

** Values to be established.

*** Durability is calculated, first by estimating the % wear from the photographs/video images of stripes taken at test sites, and then deducting the value obtained from 100.

**** Rating 1 - 10; Perfect Score is 10. Rating made on inspection of the markings by a panel of evaluators from the Authority.

FIELD REACTED POLYMERIC PAVEMENT MARKING MATERIAL DATA FORM

A. MANUFACTURER'S NAME _____
 ADDRESS _____

 TELEPHONE NO. _____

B. SAMPLE IDENTIFICATION	COMPONENT A	COMPONENT B
Commercial, Trade Name of Sample	_____	_____
Manufacturer's Code No.	_____	_____
Batch No.	_____	_____
Colour	_____	_____
Date of Manufacture	_____	_____

C. MATERIAL COMPOSITION	COMPONENT A	COMPONENT B
Resins and Conditions, wt %	_____	_____
Pigments and Fillers, wt %	_____	_____
% Active Polymerization	_____	_____
Catalyst, Curing Agent	_____	_____
Glass Beads, wt %	_____	_____
Gradation of Glass Beads	_____	_____
	_____	_____
	_____	_____

D. TEST DATA

Settling, 6 months	ASTM 869	_____
Component A		_____
Component B		_____
Bleeding, mixed material	ASTM D868	_____
Pot Life at 25°C min.	MTO	_____

Hardness*, IRHD	ASTM D 1415	_____
Shore A° or D°	ASTM D 2240	_____

Abrasion Resistance	ASTM D4060	
1000 cycles/g	CS-17	_____

E. MATERIAL SAFETY DATA FOR BOTH COMPONENTS

F. PROCEDURE FOR OVERLAY AND INLAY APPLICATION

1. Pavement Surface Preparation Procedure

2. Pavement Temperature Range for Application

Minimum °C

Maximum °C

3. Air Temperature

Minimum °C

Maximum °C

4. Humidity Maximum %

5. Mix Ratio of Component A & B

Mixing Procedure Quantities

Pot Life min. at 25°C

6. Types of Pavement ** where the application is not recommended

7. Equipment for Application

8. Application Procedure for Glass Beads Overlay

9. Particulars regarding suitability of application onto partly worn existing pavement marking.

a. on solvent based traffic paint

b. on water-borne traffic paint

c. on thermoplastic pavement marking

d. on field reacted polymeric pavement marking

10. Any Other Relevant Information

* Hardness may also be measured conforming to ASTM D 2240.

** Refers to the age of pavement, the surface texture, e.g. OFC, DFC, and whether it is asphalt or concrete pavement.

NOTE: This form must be completed in full and forwarded with test sample. Samples submitted without a completed Data Form will not be considered.



**MATERIAL SPECIFICATION FOR
PREFORMED PLASTIC PAVEMENT MARKING TAPE**

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1715.01	SCOPE

This specification covers the requirements for reflective and non-reflective preformed plastic pavement marking tapes which are suitable for use onto concrete and bituminous pavements.

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

Ontario Provincial Standard Specifications, Materials:

OPSS 1750 Traffic Paint Reflectorizing Glass Beads

Canadian General Standards Board:

CGSB 1-GP-12C-1983 - Standard Paint Colours

American Society for Testing and Materials:

- ASTM D523-89 - Method for Specular Gloss
- ASTM D638-87b - Tensile Properties of Plastics
- ASTM D713-87 - Conducting Road Service Tests on Traffic Paint
- ASTM D1000-88a - Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
- ASTM D4505-85 - Preformed Plastic Pavement Marking Tape for Extended Service Life
- ASTM D4592-86 - Preformed Plastic Pavement Marking Tape for Limited Service Life
- ASTM E97-82(1987) - Method for 45-deg., 0-deg. Directional Reflectance Factor of Opaque Specimens by Broad-Band Filter
- ASTM E303-83 - Measuring Surface Frictional Properties Using the British Pendulum Tester

United States Federal Standard:

U.S. FED-STD-595B Dec. 15, 1989 - Colours Used in Government Procurement

International Commission on Illumination:

CIE 1976 - L^*, a^*, b^* Uniform Colour Space and Colour Difference Equation.

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

Compliance Certification: refers to the procedure and requirements for establishing an approved Source of Materials.

Durable Preformed Plastic Pavement Marking Tape: refers to preformed plastic pavement marking tape with extended service life period, with a minimum service period of 2 years when placed conforming to the manufacturer's recommended procedures on pavement surfaces with an annual average daily traffic, AADT of about 20,000.

Fingerprinting: refers to the testing of preformed plastic pavement marking tape by Gas Chromatographic method and other techniques for verification purposes.

Preformed Plastic Pavement Marking Tape: refers to plastic material specifically designed and preformed into pliable rolls or ribbons of various lengths and width or into symbols either white, yellow, or black for use as pavement marking on concrete or bituminous pavement.

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.

Service Test: refers to the evaluation of pavement marking materials on a test deck and performance rating prior to compliance certification.

Temporary Preformed Plastic Pavement Marking Tape: refers to preformed plastic pavement marking tape with a limited service life, and a minimum service period of 3 months when placed in conformance with the manufacturer's recommended procedures on pavement surfaces with an annual average daily traffic, AADT of about 20,000.

1715.05 MATERIALS

1715.05.01 General

Only material properties which are necessary for proper installation and satisfactory performance of preformed plastic pavement marking tape are specified here. The material as supplied, shall be free of cracks, and have edges true, straight and unbroken conforming to ASTM D4505. Preformed plastic pavement marking tape of all types shall have a uniform width and thickness.

The material used in the manufacture of preformed plastic pavement marking tape shall be of high quality so that the appearance will not change in service to impair the colour or the visibility of the delineation.

1715.05.02 Colour

The preformed plastic pavement marking tape shall conform to the following colour requirements:

White - CGSB 1-GP-12C white 513-301.

Yellow - shall match either the yellow traffic paint chip of the Ministry of Transportation, Ontario or U.S. Federal 595B, Yellow 33538.

Black - CGSB 1-GP-12C black 512-301.

The tolerance in colour allowed is as follows in CIE L^* , a^* , b^* Uniform Colour Space and Colour Difference Equation when calculated from instrumentally measured colour differences conforming to ASTM D 2244:

White	$L^* = +2 \text{ and } -1.5 \text{ max}$
	$a^* = +1.5 \text{ and } -1 \text{ max}$
	$b^* = +4 \text{ and } -4 \text{ max}$

Yellow - MTO	$L^* = +2 \text{ and } -1.5 \text{ max}$
	$a^* = +3 \text{ and } -1.5 \text{ max}$
	$b^* = +7 \text{ and } -1.5 \text{ max}$

Yellow - U.S.	$L^* = -2 \text{ and } +4 \text{ max}$
	$a^* = -6 \text{ and } +4 \text{ max}$
	$b^* = -9 \text{ and } +10 \text{ max}$

1715.05.03 Adhesive

The preformed plastic pavement marking tape shall be either precoated with a factory applied adhesive at the base or supplied with a suitable adhesive and any other material such as a primer that is necessary for installation of the tape onto the pavement.

1715.05.04 Material Composition

The material composition of the preformed plastic pavement marking tape shall be at the discretion of the manufacturer and shall be certified by the Authority.

1715.05.05 Physical Property Requirements

The physical properties of the preformed plastic pavement marking tape submitted for compliance certification shall conform to Table 1.

Samples are required by the Authority for laboratory testing. The supplier shall submit with each test sample, one complete set of data on physical properties, application procedure, and material safety for Preformed Plastic Pavement Marking Tape.

1715.05.06 Service Test

Preformed plastic pavement marking tape conforming to 1715.05.06, Table 1 shall be submitted for service test when requested by the Authority.

Preformed plastic pavement marking tape for extended service, durable preformed plastic tape will be service tested conforming to the following:

- a. Test deck location and time for installation shall be determined by the Authority.
- b. The test strips shall be 10 cm in width and installed transversely across the lanes of the road. The installation of the preformed plastic pavement marking tape will be made by personnel from the supplier/manufacturer or his agent using the pieces of equipment recommended by the manufacturer for installation.
- c. A service test shall consist of installation of test stripes of pre-formed plastic pavement marking tape(s), onto bituminous or a concrete pavement with about 20,000 AADT.
- d. Ease of application and quality and nature of the stripes will be assessed.
- e. The installed tape will be inspected periodically and its service performance will be rated by the Authority as outlined in Table 2.
- f. Approval will be given after two years of service rating of durable preformed plastic pavement marking tape, providing the material conforms to Table 2 and meets the conditions of 1715.05.05.

Temporary preformed plastic pavement marking tape(s) of removable type shall conform to this specification and also to ASTM D 4592 except that the required minimum service life is 3 months at about 20,000 AADT.

1715.07 PRODUCTION

1715.07.01 General

In order to qualify as a supplier of preformed plastic marking tape, a manufacturer must satisfy the following minimum requirements:

- a. Adequate production facilities;
- b. A laboratory sufficiently equipped and staffed to provide a quality control program which will ensure compliance with this specification; and
- c. Properly documented production, sampling and testing procedures and methods.

1715.07.02 Quality Control

A manufacturer shall be responsible for carrying out a quality control program to ensure that the preformed plastic pavement marking tape(s) conform(s) to this specification.

1715.08 QUALITY ASSURANCE

1715.08.01 Acceptance Criteria

The Authority may request samples to be taken from the shipments of preformed plastic pavement marking tape for quality assurance testing. Samples shall be taken from each batch produced for delivery to the Authority. Criteria for accepting the preformed tape include the following requirements and tolerances:

- a. Composition as determined by fingerprinting and other tests shall not vary by more than $\pm 5\%$ from that of the reference sample.
- b. Colour difference, ΔE shall be within ± 1.5 of the value established on the reference sample.
- c. Directional Reflectance, Y shall not vary by more than ± 3 and have a minimum value of 65 and 45 for white and yellow tapes respectively.
- d. Retroreflectance shall not vary by more than $\pm 10 \text{ mcd/m}^2/\text{lux}$.

Viscosity and the infrared spectograph of any adhesive and/or primer shall match that obtained for the approved reference samples.

1715.08.02 Quality Control of Production Batches

- a. One metre sections of each type and colour of the tapes, and a section of legends and/or symbols shall be supplied to the Authority for laboratory testing from each production batch.
- b. 200 ml of primer or adhesive, if the use of such surface preparation material or adhesive is recommended by the manufacturer, from each production batch, to be supplied to the Authority.

1715.08.03 Storage

The preformed plastic pavement marking tape shall conform to this specification after storage.

1715.09 AUTHORITY PURCHASE OF MATERIAL BY PURCHASE ORDER

1715.09.01 Certificate of Compliance

The manufacturer shall submit a certificate of compliance, with tenders, indicating that the physical properties, material composition, and installation characteristics of all of the manufacturer's production batches of preformed plastic pavement marking tapes for the Authority shall conform to this specification and shall not deviate from the allowable tolerances, unless approved by the Authority.

1715.09.02**Delivery and Packaging of Preformed Plastic Pavement Marking Tape**

The delivery schedule, delivery location, colour, type, and quantity shall be as specified on the Authority's Purchase Order.

Each package of preformed plastic pavement marking tape shall be clearly identified with the following information:

- a. manufacturer's name and address
- b. types and colour of preformed plastic pavement marking tape
- c. manufacturer's code and batch numbers
- d. dimension and length or numbers of legends and symbols
- e. date of manufacture.

1715.09.03**Measurement and Payment**

The unit of measurement for preformed plastic pavement marking tapes will be in metres. All legends and symbols will be numerically counted.

Payment for supplying preformed plastic pavement marking tape shall as specified on the Authority's purchase order.

1715.10**DESIGNATED SOURCES REQUIREMENTS**

In order for a Supplier to be considered for addition to the List of Designated Sources of the Ministry of Transportation, Ontario, for preformed plastic pavement marking tape, the manufacturer shall supply a production sample of the preformed plastic pavement marking tape to the Ministry along with complete material data in a prescribed form PAV.M.1715, available at the Ministry for conformance testing.

If the test sample conforms to this specification and the Ministry is satisfied that the Supplier has the equipment and ability to produce the material in bulk quantities, then the Ministry, upon written request to the Manager, Purchasing and Supply Office of the Ministry of Transportation, 1201 Wilson Ave., Downsview, Ontario, M3M 1J8 will place the Supplier on the List of Designated Sources for Materials.

Subsequent changes in formulation, the inability to maintain quality production or to meet commitments, or failure to conform to this specification shall be cause for cancellation of approval and shall necessitate application for reapproval.

TABLE 1

**PHYSICAL PROPERTY REQUIREMENTS FOR
PREFORMED PLASTIC PAVEMENT MARKING TAPE**

Property	Durable Preformed Plastic Tape		Temp. Preformed Plastic Tape		Test Methods	
	Min.	Max.	Min.	Max.	ASTM	Others
Directional Reflectance %					E97	
White	65		65			
Yellow	45		45			
Black Temporary				12		
Retroreflectance mcd/m ² /lux						Instrument Mirolux 12
White	**		**			
Yellow	**		**			
Black Temporary				**		
Tensile Strength MPa			7.5*		D638	
Elongation at Break %		50		50	D638	
Adhesion at						
10°C	500		500		D1000	
24°C	500		500		D1000	
g/25.4 mm of width						
60° Gloss					D 523	
White		10		10		
Yellow		10		10		
Black Temporary				5		
Skid Resistance BPN Units	**		**		E-303	

* This requirement is applicable to temporary preformed tape of removable type.

** Values to be established.

TABLE 2

**PERFORMANCE REQUIREMENTS FOR SERVICE TEST AT ABOUT 20,000 AADT
FOR PREFORMED PLASTIC PAVEMENT MARKING TAPE**

Property	Performance Requirements						Test Method
	Temp. Tape 3 Mths	Durable Tape					
		1 yr	2 yr	3 yr	4 yr	5 yr	
Directional Reflectance %							E97
White	≥ 65	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	
Yellow	≥ 45	≥ 35	≥ 35	≥ 35	≥ 35	≥ 35	
Black Temporary	≤ 12						
Retroreflectance							Instrument Mirolux 12
mcd/m ² /lux							
White	*	*	*	*	*	*	
Yellow	*	*	*	*	*	*	
Black Temporary	*						
Durability %	≥ 95	≥ 95	≥ 90	≥ 80	≥ 75	≥ 70	MTO**
Appearance	≥ 8	≥ 8	≥ 7	≥ 6	≥ 5	≥ 5	D713 & MTO ***

* Values to be established.

** Durability is calculated, first by estimating the % wear from the photographs/video images of stripes taken at test sites, and then deducting the value obtained from 100.

*** Rating 1 - 10; Perfect Score is 10.
Rating made on inspection of the markings by a panel of evaluators from the Authority.

PREFORMED PLASTIC PAVEMENT MARKING TAPE MATERIAL DATA FORM

A. MANUFACTURER'S NAME _____
 ADDRESS _____

 TELEPHONE NO. _____

B. SAMPLE IDENTIFICATION
 Commercial/Trade Name of Sample _____
 Manufacturer's Code No. _____
 Batch No. _____
 Colour _____
 Width _____
 Thickness _____
 Date of Manufacture _____

C. MATERIAL COMPOSITION
 Resins and Conditioners wt % _____
 Pigments and Fillers wt % _____
 Beads wt, % _____

D. TEST DATA
 1. Preformed Tape
 a. Tensile strength, Mpa ASTM D638
 at 24°C 0.6 cm/min _____
 b. Elongation and Break % ASTM D638
 0.6 cm/min _____
 c. Adhesion at 10°C ASTM D1000
 g/25.4 mm at 24°C _____
 Softening Point °C ASTM E28 _____
 2. Adhesive and Primer, if used separately
 Viscosity 25°C ASTM D562 Primer Adhesive
 _____ _____

E. MATERIAL SAFETY DATA

F. PROCEDURE FOR OVERLAY AND INLAY APPLICATION/INSTALLATION

1. Pavement Surface Preparation Procedure _____

2. Pavement Temperature Range for Installation
Minimum °C _____
Maximum °C _____
3. Air Temperature
Minimum °C _____
4. Humidity Maximum % _____
5. Adhesive Application Procedure _____

6. Type of Pavement * where the application is recommended _____

7. Equipment for Installation _____

8. Any Other Relevant Information _____

* Refers to the age of the pavement, the surface texture, e.g. OFC, DFC, and whether it is asphalt or concrete.

NOTE: This form must be completed in full and forwarded with tape sample. Samples submitted without a completed Data Form will not be considered.



MATERIAL SPECIFICATIONS FOR WATER-BORNE TRAFFIC PAINT

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1716.01	SCOPE

This specification covers the requirements for water-borne traffic paint which is suitable for application onto concrete and bituminous pavements.

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

Ontario Provincial Standard Specifications, Material:

OPSS 1750 - Traffic Paint Reflectorizing Glass Beads

Canadian General Standards Board:

CGSB-1-GP-12C-1983 - Standard Paint Colours

CGSB-1-GP-71-1983 - Testing Paints and Pigments:

California Department of Transportation:

8010-61G-30 - Water Borne Traffic Paint

American Society for Testing and Materials:

- ASTM D185-84 - Coarse Particles in Pigments, Pastes and Paints
- ASTM D562-81(1985) - Consistency of Paints Using the Stormer Viscometer.
- ASTM D711-84 - No Pick-Up Time of Traffic Paint
- ASTM D713-87 - Conducting Road Service Tests on Traffic Paint
- ASTM D869-85 - Evaluating Degree of Settling of Traffic Paint
- ASTM D2205-85 - Traffic Paints
- ASTM D2243-82(1987) - Freeze-Thaw Resistance of Water-Borne Paints
- ASTM D2244-85 - Calculation of Colour Differences from Instrumentally Measured Colour Coordinates
- ASTM D2369-87 - Volatile Content of Coatings
- ASTM D3168-85 - Practice for Qualitative Identification of Polymers in Emulsion Paints
- ASTM D3960-87 - Determining Volatile Organic Content (VOC) of Paints and Related Coatings
- ASTM E70-77(1986) - Test Method for pH of Aqueous Solutions With the Glass Electrode
- ASTM E97-82(1987) - Test Method for 45-deg., 0-deg., Directional Reflectance Factor of Opaque Specimens by Broad-Band Filter
- ASTM E303-83 - Measuring Surface Frictional Properties Using the British Pendulum Tester

United States Federal Standard:

U.S. FED-STD-595B Dec. 15, 1989 - Colours Used in Government Procurement

International Commission on Illumination:

CIE 1976 - L^* , a^* , b^* Uniform Colour Space and Colour Difference Equation.

1716.03 DEFINITIONS

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

Compliance Certification: refers to the procedure and requirements for establishing an approved source for materials.

Fingerprinting: refers to testing of water-borne by gas chromatographic and infrared spectroscopic techniques for verification purposes.

No Tracking Time: refers to the time required for a newly applied pavement marking line to show no visible deposition of the material to the pavement surface, outside the line when viewed from a distance of 15 metres, as determined by passing over the applied line at 60 km per hour in a simulated passing manoeuvre with a passenger car.

Pavement Marking Material: refers to a material formulated for application onto bituminous or concrete pavement in order to delineate vehicle operating limits.

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.

Service Test: refers to the evaluation of pavement marking materials on a test deck and performance rating prior to compliance certification.

Traffic Paint: refers to a paint specifically formulated for use as a pavement marking to delineate vehicle operating limits.

Water-Borne Traffic Paint: refers to 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.

1716.05 MATERIALS

1716.05.01 General

Water-borne traffic paint shall be homogeneous, and shall be well ground to a uniform smooth consistency. It shall be free from skin, dirt and other foreign particles, and shall be capable of being sprayed at the temperature intended for the paint. The water-borne traffic paint shall flow evenly and smoothly and cover solidly when applied to pavements.

The materials used in the manufacture of the water-borne traffic paint shall be of high quality and consistency such that the appearance will not change in service to impair the colour or visibility of the delineation. The water-borne traffic paint film shall be flat in finish, and the white and yellow markings shall be visible under daylight and artificial light after the addition of the overlay glass beads.

1716.05.02 Colour

The water-borne traffic paint shall conform to the following colour requirements:

White - CGSB 1-GP-12C white 513-301

Yellow - shall match either the yellow traffic paint chip of the Ministry of Transportation, Ontario or U.S. Federal 595B, Yellow 33538.

Black - CGSB 1-GP-12C Black 512-301

The tolerance in colour allowed is as follows in the CIE L^* , a^* , b^* Uniform Colour Space and Colour Difference Equation when calculated from instrumentally measured colour differences conforming to ASTM D 2244:

White $L^* = +2$ and -1.5 max
 $a^* = +1.5$ and -1 max
 $b^* = +4$ and -4 max

Yellow - MTO $L^* = +2$ and -1.5 max
 $a^* = +3$ and -1.5 max
 $b^* = +7$ and -1.5 max

Yellow - U.S. $L^* = -2$ and $+4$ max
 $a^* = -6$ and $+4$ max
 $b^* = -9$ and $+10$ max

1716.05.03 Chemical Composition

The chemical composition of the water-borne traffic paint shall be at the discretion of the paint manufacturer and shall be certified by the Authority.

1716.05.04 Reflectorization

The white and yellow paints shall be used with overlay glass beads which are applied uniformly after application of the paint at a rate as shown below. The white and yellow paints shall provide proper anchorage for overlay glass beads conforming to OPSS 1750.

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

Test samples of glass beads conforming to OPSS 1750 may be obtained from the Authority upon request.

1716.05.05 Physical Property Requirements

Water-borne traffic paints shall be supplied ready-mixed for use without any addition of water.

The handling and storage qualities must be acceptable with respect to degree of settling, uniform consistency, absence of skinning and thixotropic properties. The water-borne traffic paint shall be capable of being sufficiently atomized to produce an uniformly applied paint stripe without side splatter and overspray within the limitation imposed by conventional striping equipment.

The physical properties of the water-borne traffic paints submitted for compliance certification shall conform to Table 1.

Samples are required by the Authority for laboratory testing. The Supplier shall submit with each test sample, complete data on physical properties, application procedure, and material safety for the water-borne traffic paint.

1716.05.06 Service Test

Water-borne traffic paint, conforming to 1716.05.05 and Table 1 shall be submitted for service test when requested by the Authority.

Water-borne traffic paints will be service tested, conforming to the following:

- a. Test deck location, time, and procedure of application shall be as specified by the Authority.
- b. Test stripe shall be 10 cm in width and applied transversely by across the lanes of the road. Application of the traffic paint to a dry thickness of 230 ± 25 microns on bituminous or concrete pavement with about 20,000 AADT and application of overlay glass beads conforming to OPSS 1750, at the approved rate immediately over the white and yellow striped line.
- c. The ease and uniformity of application, severity of overspray, covering properties, and drying time will be evaluated during application.
- d. The applied water-borne traffic paint will be inspected periodically and its service performance will be rated by the Authority, as outlined in Table 2.
- e. Approval will be given after one year of service rating, providing the material conforms to Table 2 and meets the conditions of 1716.09.02.

1716.07 PRODUCTION

1716.07.01 Plant Inspection

In order to qualify as a supplier of water-borne traffic paint(s), a manufacturer must satisfy the following minimum requirements:

- a. Adequate facilities to produce minimum batches of 3000 litres;
- b. A laboratory sufficiently equipped and staffed to provide a quality control program which will ensure compliance with this specification;
- c. Properly documented production, sampling and testing procedures and methods.

1716.07.02 Quality Control

A manufacturer shall be responsible for carrying out a quality control program to ensure that the water-borne traffic paint(s) conform(s) to this specification.

1716.08**QUALITY ASSURANCE****1716.08.01****Acceptance Criteria**

The Authority may request samples to be taken from the shipments of water-borne traffic paint(s) at any time for quality assurance testing. Samples shall be taken from each batch produced for delivery to the Authority. Criteria for accepting each production batch include the following requirements and manufacturing tolerances:

- a. Density shall be within 0.05 kg/l of the value established on the test sample, conforming to CGSB-1-GP-71 - Method 2.1.
- b. Viscosity shall be within ± 5 KU of the reference value.
- c. Colour Difference ΔE shall be within ± 1.5 of the value established on the reference sample.
- d. Composition shall not vary by more than $\pm 5\%$, based on fingerprinting and other tests, ASTM D3168, of the value of the reference sample.
- e. Total solids shall not vary by more than $\pm 2\%$ from the value of the reference sample.
- f. pH of the sample shall not vary by more than one unit from that of the value established for the reference sample.
- g. No pickup time of each production batch sample shall be within ± 2.5 minutes of the value established for the test sample, conforming to ASTM D-711.
- h. Directional Reflectance with:
 - minimum value of 70% white
 - minimum value of 50% yellow
- i. Hiding Power with minimum value of 8.4 m²/l.

1716.08.02**Quality Control of Production Batches**

A one litre sample from each production batch of water-borne traffic paint along with test results on density, viscosity at 25°C, pH, total solids, and no-pickup time shall be delivered to the Authority's laboratory within two days of manufacture of the respective batches.

Delivery records shall be kept, by the supplier, of the number of containers of each batch shipped to each delivery point and a list of such shipments during each calendar week shall be given to the Authority at the end of each week until the entire order is completed and shipped.

1716.08.03**Storage**

The water-borne traffic paint shall conform to this specification after storage.

1716.09 AUTHORITY PURCHASE OF MATERIAL BY PURCHASE ORDER

1716.09.01 Trial Batch Application

A trial batch of water-borne traffic paint(s) conforming to this specification may be purchased by the Authority for evaluation of application properties using the Authority's painting equipment. The trial batch shall consist of a minimum quantity of 1,000 litres of traffic paint.

No-tracking time will also be determined.

Those water-borne traffic paint(s) conforming to this specification which exhibit satisfactory loading and application properties when used with the Authority's traffic painting equipment will be considered for purchase.

1716.09.02 Certificate of Compliance

The manufacturer shall submit a certificate of compliance, with tenders, indicating that the physical properties and chemical composition of all of the manufacturer's production batches of traffic paint, for the Authority, shall conform to this specification and shall not deviate from the allowable tolerances, unless approved by the Purchaser.

1716.09.03 Delivery and Packaging of Water-Borne Traffic Paint

The delivery schedule, delivery location, colour, and quantity shall be as specified on the Authority's Purchase Order.

The water-borne traffic paint shall be furnished in returnable drums with air tight liners.

Each drum shall be clearly marked on the side and the top with weather resistant markings to show the following information:

- a. manufacturer's name and address
- b. type of traffic paint
- c. colour
- d. manufacturer's code and batch numbers date of filling the drum
- e. volume of contents in litres

A small portion of the water-borne traffic paint may be required in twenty litre containers. The quantity will be specified on the Purchase Order.

1716.09.04 Measurement and Payment

The unit of measurement for water-borne traffic paint will be litres. Payment for supplying the water-borne traffic paint shall be as specified on the Authority's Purchase Order.

1716.10 DESIGNATED SOURCES REQUIREMENTS

In order for a Supplier to be considered for addition to the List of Designated Sources of the Ministry of Transportation, Ontario for water borne traffic paint, the manufacturer shall supply a production sample of the water borne traffic paint to the Ministry along with complete material data in a prescribed form PAV.M.1716 available from the Ministry, for conformance testing.

If the test samples conform to this specification and the Ministry is satisfied that the Supplier has the equipment and ability to produce the material in bulk quantities, then the Ministry, upon written request to the Manager, Purchasing and Supply Office of the Ministry of Transportation, 1201 Wilson Ave., Downsview, Ontario, M3M 1J8 will place the Supplier on the List of Designated Sources for Materials.

Subsequent changes in formulations, the inability to maintain quality production or to meet commitments, or failure to conform to this specification shall be cause for cancellation of approval and shall necessitate application for reapproval.

TABLE 1
PHYSICAL PROPERTY REQUIREMENTS FOR WATER-BORNE TRAFFIC PAINT

TEST AND PROPERTY	REQUIREMENTS		TEST METHODS		
	Min.	Max.	CGSB 1-GP-71	ASTM	OTHER
Volatile Organic Content %		8.5		D3960	Pfund cyptometer with #3.5 wedge
Settling 6 months	8.0			D869	
Hiding Power m ² /l	8.4				
Skinning 48 hours	nil	nil	10.1		
Viscosity KU @ 7°C @ 25°C	85	135.0 110.0	4.5	D562	Caltrans 8010-61G-30
Viscosity Change after Heat-Shear Stability Test at 25°C KU		10.0			
Freeze-Thaw Stability	Pass			D2243	
Coarse Particles # 60 sieve - 250 µm #100 sieve - 150 µm	nil	nil 0.01		D185 & D2205	
No Pickup Time, mins.		8.0*		D711	
Directional Reflectance % White Paint Yellow Paint Black Paint	70.0 50.0	12		E97	
Skid Resistance BPN Units	**			E303	

* For coning type of traffic paints, this value can be higher.

** Values to be established.

TABLE 2

**PERFORMANCE REQUIREMENTS FOR SERVICE TEST
AT ABOUT 20,000 AADT FOR WATER-BORNE TRAFFIC PAINT**

Property	Performance Requirements					Test Method
	Newly Installed Paints	Service Life Ratings of				
		3 mths	1 yr	1.5 yrs	2 yrs	
Directional Reflectance %						ASTM E-97*
White	≥ 70	≥ 70	≥ 50	≥ 50	≥ 50	
Yellow	≥ 50	≥ 50	≥ 35	≥ 35	≥ 35	
Black	≤ 12	≤ 12				
Retroreflectance mcd/m ² /lux						Instrument Mirolux 12
White	**	**	**	**	**	
Yellow	**	**	**	**	**	
Black	**	**				
No Tracking Time, mins.	≤ 2					MTO
Durability						
White and Yellow		≥ 90	≥ 85	≥ 75	≥ 70	ASTM D913 & MTO***
Black		≥ 90				
Appearance	10	≥ 8	≥ 7	≥ 6	≥ 5	ASTM D713 & MTO****

* These values were obtained on a typical asphalt surface.

** Values to be established.

*** Durability is calculated, first by estimating the % wear from the photographs/video images of stripes taken at test sites, and then deducting the value obtained from 100.

**** Rating 1 - 10; perfect score is 10.

Rating made on inspection of the markings by a panel of evaluators from the Authority.

WATER-BORNE TRAFFIC PAINT DATA FORM

A. MANUFACTURER'S NAME _____
 ADDRESS _____

TELEPHONE NO. _____

B. SAMPLE IDENTIFICATION

Manufacturer's Code No. _____ Paint Batch No. _____
 Colour of Paint _____ Sample Date _____

C. TEST DATA

Density, kg/l	1-GP-71 M2.1	_____
Volatile Organic Content %	ASTM D 3960	_____
No Pickup Time, minutes	ASTM D711	_____
Hiding Power, m ² /l	Pfund Cryptometer	_____
	OPSS 1716, Table 1	_____
pH	ASTM E70	_____
Total Solids	ASTM D2369	_____
Freeze-Thaw Stability	ASTM D2243	_____
Viscosity Change after		_____
Heat-Shear Stability	OPSS 1716, Table 1	_____

D. COMPOSITION OF PAINT

	% by Mass	% by Volume
Pigment and Fillers	_____	_____
Binder	_____	_____
Water	_____	_____

Composition of Pigment
and Fillers % by Mass

1	_____
2	_____
3	_____
4	_____
5	_____
6	_____
7	_____
8	_____

Type of Binder _____

VOC individual components mg/litre

_____	_____
_____	_____
_____	_____
_____	_____

E. MATERIAL SAFETY DATA

F. APPLICATION PROCEDURE

Surface Preparation _____
Minimum Pavement Temperature _____
Paint Temperature _____ min °C _____ max °C
Mode of Application _____
Air Temperature _____ min °C Humidity _____ max %

NOTE: This form must be completed in full forwarded with paint sample. Samples submitted without a completed Paint Data form will not be considered.



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS 1750
DECEMBER 1983**

**MATERIAL SPECIFICATION FOR
TRAFFIC PAINT REFLECTORIZING GLASS BEADS**

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1750.01	SCOPE

This specification covers the requirements for glass beads for use with traffic paint and requirements for Authority purchase of reflectorizing glass beads.

1750.02 REFERENCES

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

ASTM Specifications

D1155-53 (1975) - Standard Test Method for Roundness of Glass Spheres

D1214-58 (1975) - Standard Method of Sieve Analysis of Glass Spheres

E11-81 - Wire Cloth Sieves for Testing purposes.

1750.05 MATERIALS

1750.05.01 Durability

The beads shall be manufactured from glass of a composition designed to be highly resistant to the effects of traffic wear and weathering.

1750.05.02 Colour

The glass shall be colourless to a degree that the resulting beads, when added to white paint, do not impart a noticeable hue.

1750.05.03 Bead Type and Grade

Beads shall be supplied in the OVERLAY type and MOISTURE PROOF grade. The beads shall be treated in such a manner as to overcome the effects of water, as vapour or liquid, on the beads before the beads are added to the paint stripe.

1750.07 PRODUCTION

1750.07.01 Roundness

At least 70% by mass of the glass beads shall be true spheres.

1750.07.02 Gradation

The glass beads shall meet the following gradation requirements when tested according to ASTM D1214.

US Standard ASTM E11 Sieve Series	Opening μm	Percentage Passing by Dry Mass
		Overlay Type
No. 20	850	100
No. 30	600	95 - 100
No. 40	425	45 - 70
No. 50	300	20 - 40
No. 70	212	5 - 20
No. 100	150	0 - 3

1750.07.03 Refractive Index

The index of refraction of the glass beads, when tested by the immersion method at 25°C under tungsten light, shall not be less than 1.50.

1750.07.04 Imperfections

The surface of the beads shall be smooth, lustrous and free from film, scratches and pits.

Not more than 25% by mass of the true spheres shall have imperfections such as milkiness, dark specks, incipient fractures, and air inclusions in the form of bubbles greater than 10% of the volume of the spheres.

1750.09 AUTHORITY PURCHASE OF MATERIAL BY PURCHASE ORDER

1750.09.01 Sampling and Testing

1750.09.01.01 General

A maximum of 10% but no less than 1% of the total number of packages in each batch will be taken at random for test purposes by the Authority. The contents of each random package will be riffled until a representative sample of approximately 1000 g (or 500 ml) of beads is obtained. The 1000 g samples will be combined to form a composite sample of about 4 kg (about 4 L in volume) representing a batch of 25,000 kg of beads. The composite sample will be riffled in the laboratory until about a 150 g sample is obtained for the following testing.

1750.09.01.02 Roundness Testing

The percentage true spheres shall be determined by one of the following methods:

(a) by counting the beads under 50X and 100X magnification as follows:

- Glass beads larger than #50 sieve size inclusive, shall be counted under 50X magnification (see gradation requirements).
- Glass beads smaller than #50 sieve size shall be counted under 100X magnification.
- Approximately 1,000 beads contained loosely in a culture dish shall be counted under reflected light for each sieve specified to determine the percentage by mass of perfectly round spheres.

(b) by ASTM D1155.

1750.09.01.03 Imperfections Testing

Imperfections shall be evaluated by observation under 50X and 100X magnification.

1750.09.01.04 Water Resistance Test

One hundred grams of glass beads will be placed in a 500 ml beaker and an equivalent volume of distilled water will be flowed into the beaker on top of the glass beads. The beaker will be permitted to stand for 5 min. At the end of this period, the water shall be poured off and the glass beads will be transferred to a clean, dry beaker and permitted to stand for 5 min. The spheres will then be introduced into a standard 125 mm diameter glass funnel having a stem of 125 mm length. The beads shall flow through the funnel without stoppage. (Slight initial agitation to start the flow through the funnel at the beginning of the test will be permissible.)

1750.09.02 **Packaging**

Beads in bags shall be free of clusters, lumps, moisture and foreign matter.

Glass beads shall be packaged in bags of 25 kg net capacity, and each bag shall be marked to show clearly the following information:

- 1) "Overlay Type Glass Beads"
- 2) "Moisture Proof Grade"
- 3) "MTC"
- 4) "Batch number" (marked in 25 mm
- 5) "Manufacturer's name" high letters)

Bags shall be paper-lined burlap with 50 µm polyethylene inserts. The burlap liner, all seams and top closures shall be waterproof and leakproof and shall be capable of maintaining these properties during transportation and numerous handlings.

Bags shall be approximately 0.35 m x 0.66 m with the 50 µm polyethylene insert being 0.35 m x 0.96 m.

All bags shall be subject to prior approval by the Authority and shall be or be equal in quality to either:

1. A Bemis Waterproof, Standard Type, single paper lined, cemented centre seam, taped bottom bag, produced by Bemis Bros. Bag Company, St. Louis, Missouri, U.S.A., or
2. A Lloyd jute bag with polyethylene liner, Code #1010, produced by Lloyd Bag Company Limited, 114, St. Clair Street, Chatham, Ontario.

1750.09.03 **Delivery**

Delivery details and scheduling shall be as stipulated on the Authority's Purchase Order.

1750.09.04 **Quality Assurance**

Any shipment or shipments of this material supplied to the Authority will be sampled and tested within a 30 day period immediately following the date of the delivery. Failure to meet the requirements of this specification shall constitute cause for rejection of the shipment. Upon rejection of the shipment, the letters "MTC" shall be made permanently illegible on each bag of the shipment. Rejected materials shall be expeditiously removed and replaced with acceptable materials at no additional cost to the Authority.

1750.09.05 Measurement for Payment

Measurement for payment will be in kilograms of beads delivered.

1750.09.06	Basis of Payment

Payment at the contract price per kilogram shall be full compensation for all labour, equipment and material to supply and deliver the beads as specified on the Authority's Purchase Order.



NOTICE TO USERS OF OPSS 1801

MATERIAL SPECIFICATION FOR CORRUGATED STEEL PIPE (CSP) PRODUCTS

OPSS 1801 has been removed from this
OPS volume

The provincial version of OPSS 1801 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1801

The municipal version of OPSS 1801 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1801

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



NOTICE TO USERS OF OPSS 1802

MATERIAL SPECIFICATION FOR SMOOTH WALLED STEEL PIPE

OPSS 1802 has been removed from this
OPS volume

The provincial version of OPSS 1802 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1801

The municipal version of OPSS 1802 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1802

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



NOTICE TO USERS OF OPSS 1820

MATERIAL SPECIFICATION FOR CIRCULAR AND ELLIPTICAL CONCRETE PIPE

OPSS 1820 has been removed from this
OPS volume

The provincial version of OPSS 1820 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1820

The municipal version of OPSS 1820 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1820

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



MATERIAL SPECIFICATION FOR PRECAST REINFORCED CONCRETE BOX CULVERTS

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APPENDICES

1821-A	Commentary

1821.01	SCOPE

This specification covers the requirements for materials, design and fabrication of single-cell precast reinforced concrete box culverts not exceeding 3 m in span.

1821.01.01 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.

1821.01.02 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.

1821.02 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 422	Precast Reinforced Concrete Box Culverts In Open Cut
OPSS 904	Concrete Structures

Ontario Provincial Standard Specifications, Materials

OPSS 1002	Aggregates - Concrete
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete

Ontario Ministry of Transportation Publications

Structural Manual, Division 1, Exceptions to the Canadian Highway Bridge Design Code

MTO Laboratory Testing Manual:

LS-412	Scaling Resistance of Concrete Surfaces Exposed to De-icing Chemicals

CSA Standards

A23.1/A23.2-00 Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete
S6-14 Canadian Highway Bridge Design Code

ASTM International

C457-98 Standard Test Method for Microscopical Determination of Parameters of the Air-Void System
in Hardened Concrete

Ontario Concrete Pipe Association

Prequalification Requirements for Precast Concrete Drainage Products

1821.03 DEFINITIONS

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

Box Unit means as defined in OPSS 422.

Distribution Slab means as defined in OPSS 422.

Dry Cast Concrete means concrete with a slump equal to or less than 20 mm at the time of placing.

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

Height of Fill means the smallest elevation difference, between the top slab of a box culvert and the top of pavement or finished grade, from edge of shoulder to edge of shoulder.

Joint Annular Space means the design clearance between the tapered surface of the bell and spigot ends of adjacent box units.

Longitudinal Steel means steel reinforcement aligned parallel to the longitudinal axis of the box unit.

Perimeter Steel means steel reinforcement aligned perpendicular to the longitudinal axis of the box unit.

Wet Cast Concrete means concrete with a slump greater than 20 mm at the time of placing.

1821.04 DESIGN AND SUBMISSION REQUIREMENTS

1821.04.01 Design Requirements

All box units shall be designed according to CSA S6 and the Structural Manual, Division 1. For box units reinforced with welded wire fabric (WWF), the manufacturer's Working Drawings shall be according to Table 1 and the Contract Documents.

Box culverts with a height of fill less than 0.60 m require additional reinforcing and shall include a distribution slab. When a distribution slab is required it shall cover the entire top of box unit. The distribution slab shall be as specified in the Contract Documents.

1821.04.02 Submission Requirements

The box unit manufacturer's Working Drawings shall be submitted to the Owner upon request. All Working Drawings shall bear the seal and signature of an Engineer certifying they are according to the Contract Documents.

1821.05 MATERIALS

1821.05.01 Concrete

1821.05.01.01 General

Concrete shall be according to OPSS 1350 except as specified herein.

1821.05.01.02 Strength

The concrete shall have a nominal 28-Day compressive strength of 35 MPa.

1821.05.01.03 Water-Cement Ratio

All concrete shall have a water-cement ratio not exceeding 0.40 by mass.

1821.05.01.04 Wet Cast Concrete

For wet cast concrete, the air void system of the hardened concrete, when tested according to ASTM C 457, shall be as follows:

- a) Air Content 3.0 % Minimum
- b) Spacing Factor 0.200 mm Maximum

1821.05.01.05 Dry Cast Concrete

For dry cast concrete, the salt scaling resistance when tested according to laboratory method LS-412 and this specification shall have a mass loss of not more than 0.8 kg/m².

1821.05.02 Aggregates

Aggregates shall be according to OPSS 1002.

1821.05.03 Steel Reinforcement

Steel reinforcement shall be according to OPSS 1440.

In addition, WWF shall achieve minimum 4% elongation at ultimate strength measured over a 100 mm gauge length that includes at least one cross wire.

1821.05.04 Associated Hardware

All support systems shall be capable of withstanding the loads to be placed on them. All embedded hardware within 35 mm of exposed faces shall be coated with an acceptable material or be of an acceptable non-metallic material.

Tie wire shall be 1.5 mm diameter annealed wire.

1821.07 PRODUCTION

1821.07.01 Prequalification Requirements for Box Units

Manufacturers producing box units must possess a current Prequalification Certificate, issued under the Plant Prequalification Program as outlined in the publication, Prequalification Requirements for Precast Concrete Drainage Products.

1821.07.02 Box Units

1821.07.02.01 Placement of Reinforcement

The concrete cover to the WWF shall be 40 mm $\pm$ 5 mm, and the cover to reinforcing bars shall be 50 mm $\pm$ 15 mm.

The clear distance of the end perimeter reinforcement shall not be less than 35 mm or greater than 50 mm from the ends of the box unit. Box units reinforced with WWF may be assembled using any combination of single or double layers of the fabric. Box units using reinforcing steel bars shall be assembled with single layers of reinforcement in each face in each direction.

The areas of steel reinforcement shall be the steel areas as shown in Table 1. Steel areas greater than those required, shall not be cause for rejection.

1821.07.02.02 Laps, Welds, and Spacing of Reinforcement

Splices in the perimeter reinforcement shall be made by lapping. Reinforcement shall not be lapped in tension zones. Sheets of the WWF shall be tack welded at lap locations. The overlap measured between the outermost longitudinal wires of each WWF sheet, shall not be less than the spacing of the longitudinal wires plus 50 mm or 250 mm, whichever is greater. The centre to centre spacing of the perimeter wires shall not be less than 50 mm or more than 105 mm. The centre to centre spacing of the longitudinal wires shall not be more than 205 mm.

1821.07.02.03 Joints

The box units shall be produced with bell and spigot ends. The ends shall be of such design that when the box units are laid together they will make a continuous box culvert with a smooth interior, free of irregularities in the flow line.

1821.07.03 Curing

Except for exposed ends, wet cast box units shall be cured by leaving the box units in the form or by low pressure steam. Dry cast box units and the exposed ends of the wet cast box units shall be covered and cured by low pressure steam or other system that will maintain a moist atmosphere. Curing compounds are not an acceptable method of curing. Box units shall be cured until a minimum strength of 25 MPa is achieved or for four days, whichever occurs first.

1821.07.04 Forms

The forms used in the production process shall be sufficiently rigid and accurate to maintain the specified box unit dimensions. All casting surfaces shall be of smooth, nonporous, and non-staining material. Insulated forms shall not be used.

1821.07.05 Handling

Devices or holes will be permitted in each box unit for the purpose of handling and installing.

1821.07.06 Marking

The following information in the order listed, shall be embossed on the top haunch of each box unit using numbers and letters 3 mm wide, 35 mm high, and 5 mm deep:

- a) Name or trademark of the manufacturer.
- b) Identification of plant, if manufacturer has more than one plant.
- c) Date of manufacture.
- d) Specification designation.
- e) Minimum and maximum height of fill over box units.

The word "Top" shall be lettered with waterproof paint on the top surface of each box unit.

Each box unit shall also be marked with the Prequalification Stamp as outlined in the publication, Prequalification Requirements for Precast Concrete Drainage Products.

1821.07.07 Surface Finish for Formed Surfaces

All surfaces shall be finished according to the Surface Finish sub-section in OPSS 904.

1821.07.08 Repairs

Box units may be repaired, provided the repaired box unit meets the requirements of this specification.

1821.07.09 Tolerances

1821.07.09.01 Dimensions

The span and rise dimensions shall not vary by more than 20 mm from the manufacturer's design dimensions.

The haunch dimensions shall not vary by more than 8 mm from the manufacturer's design dimensions.

1821.07.09.02 Slab and Wall Thickness

The slab and wall thickness shall not vary by more than 5 mm from the manufacturer's design dimensions.

1821.07.09.03 Squareness

Variations in the lengths of two opposite surfaces of the box unit shall not exceed 10 mm in each box unit along its length, except where special box units are specified by the Owner. The ends of the box units shall be perpendicular to the wall and centreline of the box unit within the tolerances specified elsewhere in this subsection, except where special box units are specified by the Owner.

1821.07.09.04 Length of Box Unit

The underrun in length of each box unit shall not exceed 15 mm.

1821.07.09.05 Straightness of Joints

The joint edge shall not deviate from straight, when measured around the perimeter of the box unit by more than the manufacturer's design joint annular space.

1821.07.10 Quality Control

1821.07.10.01 General

A production run shall be considered continual provided any interruption is not more than three consecutive Days and there is no change in materials, material proportions, source of materials, production or curing methods, or equipment.

Tests on concrete for compressive strength, box unit dimensions, and concrete cover over reinforcement shall be performed for each group of 15 box units or fraction thereof, for each continual production run of a single size.

Tests for air void system parameters of wet cast concrete and salt scaling resistance of dry cast concrete shall be performed on box units representing a lot size of 1,000 m² of box unit floor area or two months of production, whichever is more frequent. In addition, when there is a change in materials, source of materials, production or curing methods, or equipment, the concrete shall be tested for air void system or salt scaling resistance as specified herein.

All results shall be retained by the manufacturer for a period of two years from the date of manufacture and shall be provided to the Owner upon request.

1821.07.10.02 Concrete Compressive Strength

A set of two cylinders shall be made for determining the 28-Day strength of the concrete. The cylinders shall be made, cured, sampled, and tested according to OPSS 1350, except both cylinders shall be either 150 x 300 mm or 100 x 200 mm in size.

The cylinders shall be made by a:

- a) concrete testing technician employed by a laboratory certified according to the requirements of CSA A283, or
- b) ACI Concrete Field Testing Technician-Grade 1.

Compressive strength testing shall be carried out by a laboratory certified according to the requirements of CSA A283. In addition, the laboratory shall meet any pre-qualification requirements specified by the Owner.

The compressive strength result shall be the average of a set.

If the specified requirements of the concrete have not been reached after 28 Days, three cores shall be taken from a member at locations approved by the Contract Administrator. Cores shall be moisture conditioned and tested according to test method CAN/CSA A23.2-14C and evaluated according to CAN/CSA A23.1. The cores shall be tested no later than 35 days after manufacture of the box units represented by the failed results.

1821.07.10.03 Dimensional Verification

The box unit dimensions shall be verified by measuring one box unit for wet cast concrete or two box units for dry cast concrete selected at random from each group of box units.

1821.07.10.04 Concrete Cover Measurement

Concrete cover measurements shall be made on two box units, selected at random from each group of box units.

The measurements shall be obtained on a one metre grid on all interior and exterior surfaces of the box units, including the ends of the unit.

Cover measurements shall be carried out by a method acceptable to the Contract Administrator and shall be reported in writing to the Contract Administrator prior to installation of the box units.

1821.07.10.05 Testing of Air Void System of Hardened Concrete in Wet Cast Concrete

For evaluation of the air void system parameters, the manufacturer shall remove cores from hardened concrete and test the cores according to ASTM C 457, except that a magnification of 100 to 125 times shall be used. Testing shall be carried out by a laboratory and operators that are acceptable to the Owner.

As a minimum, two 100 x 200 mm cores from each lot of box units shall be removed and tested. All cores shall be taken when the concrete is a minimum of 7 Days of age. Cores shall be cut lengthwise into two halves with one half to be tested by the manufacturer and the other half to be forwarded to the Owner. Both halves shall be marked with a unique identification number. The half core forwarded to the Owner shall have an information sheet securely attached to it detailing the Contract number and concrete mix design for the box units. It shall also clearly identify which lot of box units it represents.

Air void samples shall be retained by the manufacturer for a period of one year from the date of testing and shall be provided to the Contract Administrator on request.

1821.07.10.06 Salt Scaling Resistance in Dry Cast Concrete

For evaluation of the salt scaling resistance of the dry cast concrete, the manufacturer shall cut a set of two specimens, each measuring 300 x 300 mm from each lot of the finished and cured box units. The specimens shall be tested according to LS-412 without further curing.

The salt scaling result shall be the average of a set.

1821.07.10.07 Plugging Core Holes

Core holes shall be plugged full depth with concrete by the manufacturer in a manner such that the box unit will be according to this specification.

1821.08 QUALITY ASSURANCE

1821.08.01 Acceptance

The latest test results of the manufacturer's quality control procedures specified in the subsection for Quality Control shall be submitted to the Owner.

Acceptance of the compressive strength shall be based on the average 28-Day compressive strength of the cylinders or, when required, from the compressive strength of the cores taken from the finished product.

Acceptance of air void system parameters shall be based on individual core results for air content and the average of each pair of cores for spacing factor.

Acceptance of salt scaling resistance shall be based on the average of a set.

The Owner may request submission of samples for testing.

The Owner shall be provided access to the manufacturer's plant, at times and locations determined by the Owner, to perform independent inspection, sampling, and testing.

1821.08.02 Rejection

A group of box units represented by failed compressive strength or failed air void system or failed salt scaling resistance results shall be rejected.

Individual box units may also be rejected for any of the following:

- a) Inadequate concrete cover to reinforcement.
- b) Defects resulting from incorrect proportioning, mixing, and forming.
- c) Cracks greater than 0.3 mm or full depth cracks.
- d) Honeycombed or open surface texture.
- e) Damaged ends, where such damage would prevent making a satisfactory joint.
- f) Out of tolerance.

1821.09 OWNER PURCHASE OF MATERIAL

1821.09.01 Inspection

The quality of materials, the process of manufacture, and the finished box units shall be subject to inspection by the Owner.

1821.09.02 Measurement for Payment

Box units shall be measured in metres along the centerline of the invert of the box unit. Payment at the price specified in the purchasing order shall be full compensation for the supply and delivery of the box units and jointing devices, to the destination at the times specified.

The cost of all testing, except that performed in the Owner's laboratory shall be included in the price.

TABLE 1
Welded Wire Fabric Reinforcement Areas

Height of Fill m	As1 mm ² /m	As2 mm ² /m	As3 mm ² /m	As4 mm ² /m	As5 mm ² /m	As6 mm ² /m
SPAN 1800(1829) X RISE 900(914) WALLS AND SLABS 200(203)mm Thick						
<0.6	552	980	480	400	300	402
0.6	400	400	400	400	63	-
0.9	400	400	400	400	63	-
1.2	400	400	400	400	63	-
1.5	400	400	400	400	63	-
1.8	400	400	400	400	63	-
2.4	400	400	400	400	63	-
3.0	400	400	400	400	63	-
3.6	386	407	418	400	63	-
4.3	445	469	480	400	63	-
4.9	498	524	535	400	63	-
5.5	552	580	591	400	63	-
SPAN 1800(1829) X RISE 1200(1219) WALLS AND SLABS 200(203)mm Thick						
<0.6	456	1040	480	400	300	426
0.6	400	440	457	400	63	-
0.9	400	400	400	400	63	-
1.2	400	400	400	400	63	-
1.5	400	400	400	400	63	-
1.8	400	400	400	400	63	-
2.4	400	400	400	400	63	-
3.0	400	403	420	400	63	-
3.6	400	459	476	400	63	-
4.3	400	527	545	400	63	-
4.9	422	589	607	400	63	-
5.5	467	652	670	400	63	-
SPAN 2400(2438) X RISE 1200(1219) WALLS AND SLABS 200(203)mm Thick						
<0.6	741	1280	567	400	300	448
0.6	663	690	712	400	63	-
0.9	488	509	530	400	63	-
1.2	448	467	488	400	63	-
1.5	455	475	497	400	63	-
1.8	476	499	520	400	63	-
2.4	536	564	586	400	63	-
3.0	614	648	670	400	63	-
3.6	702	741	763	400	63	-

Height of Fill m	As1 mm ² /m	As2 mm ² /m	As3 mm ² /m	As4 mm ² /m	As5 mm ² /m	As6 mm ² /m
SPAN 2400(2438) X RISE 1500(1524) WALLS AND SLABS 200(203)mm Thick						
<0.6	677	1315	630	400	300	460
0.6	603	762	793	400	63	-
0.9	446	560	591	400	63	-
1.2	410	514	544	400	63	-
1.5	415	522	552	400	63	-
1.8	434	546	577	400	63	-
2.4	487	617	648	400	63	-
3.0	556	707	738	400	63	-
3.6	633	808	839	400	63	-
SPAN 2400(2438) X RISE 1800(1829) WALLS AND SLABS 200(203)mm Thick						
<0.6	677	1445	677	400	300	506
0.6	552	825	867	400	63	-
0.9	412	606	647	400	63	-
1.2	400	554	595	400	63	-
1.5	400	564	602	400	63	-
1.8	400	587	628	400	63	-
2.4	448	660	702	400	63	-
3.0	510	755	797	400	63	-
3.6	579	861	904	400	63	-
SPAN 3000(3048) X RISE 1500(1524) WALLS AND SLABS 250(254) mm Thick						
<0.6	738	1250	620	500	300	400
0.6	797	825	858	500	79	-
0.9	592	612	664	500	79	-
1.2	544	564	595	500	79	-
1.5	552	573	604	500	79	-
1.8	577	600	632	500	79	-
2.4	648	678	709	500	79	-
3.0	739	775	807	500	79	-
3.6	841	884	917	500	79	-
SPAN 3000(3048) X 1800(1829) WALLS AND SLABS 250(254)mm Thick						
<0.6	777	1280	643	500	300	410
0.6	740	896	939	500	79	-
0.9	552	664	706	500	79	-
1.2	508	610	652	500	79	-
1.5	515	620	661	500	79	-
1.8	537	648	690	500	79	-
2.4	602	730	772	500	79	-
3.0	684	834	877	500	79	-
3.6	776	950	994	500	79	-

Height of Fill m	As1 mm ² /m	As2 mm ² /m	As3 mm ² /m	As4 mm ² /m	As5 mm ² /m	As6 mm ² /m
SPAN 3000(3048) X RISE 2100(2133) WALLS AND SLABS 250(254)mm Thick						
<0.6	639	1340	686	500	300	429
0.6	691	959	1014	500	79	-
0.9	519	711	764	500	79	-
1.2	478	652	705	500	79	-
1.5	485	661	715	500	79	-
1.8	505	691	744	500	79	-
2.4	563	776	830	500	79	-
3.0	638	884	939	500	79	-
3.6	723	1006	1062	500	79	-
SPAN 3000(3048) X RISE 2400(2438) WALLS AND SLABS 250(254)mm Thick						
<0.6	769	1380	744	500	300	442
0.6	648	1018	1087	500	79	-
0.9	490	754	821	500	79	-
1.2	453	691	757	500	79	-
1.5	456	699	766	500	79	-
1.8	479	729	796	500	79	-
2.4	531	816	884	500	79	-
3.0	601	928	997	500	79	-
3.6	678	1054	1124	500	79	-
Notes: 1. The dimensions in brackets are soft metric conversions of the actual imperial dimensions. 2. Yield strength of WWF is $F_y = 500$ MPa. 3. Area of steel reinforcement is per metre length of box unit. 4. Area of steel As5 minimum longitudinal reinforcement is per face. 5. Area of steel As6 is required when height of fill over box unit is less than 600 mm. 6. Reinforcement was proportioned using the loading, load factors, and resistance factors. 7. This design is according to CSA S6 and the Structural Manual, Division 1 for installation B-1 only.						

Appendix 1821-A, November 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

Related Ontario Provincial Standard Drawings

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 $< 0.6\text{m}$



NOTICE TO USERS OF OPSS 1840

MATERIAL SPECIFICATION FOR NON-PRESSURE POLYETHYLENE PLASTIC PIPE PRODUCTS

OPSS 1840 has been removed from this
OPS volume

The provincial version of OPSS 1840 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1840

The municipal version of OPSS 1840 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1840

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



NOTICE TO USERS OF OPSS 1841

MATERIAL SPECIFICATION FOR NON-PRESSURE POLYVINYL CHLORIDE PIPE PRODUCTS

OPSS 1841 has been removed from this
OPS volume

The provincial version of OPSS 1841 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1841

The municipal version of OPSS 1841 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1841

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



NOTICE TO USERS OF OPSS 1842

MATERIAL SPECIFICATION FOR PRESSURE POLYETHYLENE PIPE PRODUCTS

OPSS 1842 has been removed from this
OPS volume

The provincial version of OPSS 1842 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1842

The municipal version of OPSS 1842 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1842

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NOTICE TO USERS OF OPSS 1843

MATERIAL SPECIFICATION FOR NON-PRESSURE POLYPROPYLENE (PP) PLASTIC PIPE PRODUCTS

OPSS 1843 has been removed from this
OPS volume

The provincial version of OPSS 1843 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1843

The municipal version of OPSS 1843 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1843

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NOTICE TO USERS OF OPSS 1850

MATERIAL SPECIFICATION FOR FRAMES, GRATES, COVERS, AND GRATINGS

OPSS 1850 has been removed from this
OPS volume

The provincial version of OPSS 1850 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1850

The municipal version of OPSS 1850 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1850

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NOTICE TO USERS OF OPSS 1853

MATERIAL SPECIFICATION FOR RUBBER ADJUSTMENT UNITS FOR MAINTENANCE HOLES, CATCH BASINS, AND VALVE CHAMBERS

OPSS 1853 has been removed from this
OPS volume

The municipal version of OPSS 1853 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1853

There is no PROV version.

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NOTICE TO USERS OF OPSS 1854

MATERIAL SPECIFICATION FOR HIGH DENSITY POLYETHYLENE (HDPE) AND EXPANDED POLYSTYRENE (EPS) ADJUSTMENT UNITS FOR MAINTENANCE HOLES, CATCHBASINS, AND VALVE CHAMBERS

OPSS 1854 has been removed from this
OPS volume

The provincial version of OPSS 1854 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1854

The municipal version of OPSS 1854 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1854

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IN THE CONTRACT DOCUMENTS**



NOTICE TO USERS OF OPSS 1860

MATERIAL SPECIFICATION FOR GEOTEXTILES

OPSS 1860 has been removed from this
OPS volume

The provincial version of OPSS 1860 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 1860

The municipal version of OPSS 1860 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 1860

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MATERIAL SPECIFICATION FOR SIGNS

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2001-A	Commentary

2001.01	SCOPE

This specification covers the requirements for signs.

2001.01.01 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.

2001.01.02 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.

2001.02 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):
Book 2 - Sign Design, Fabrication & Patterns

CSA Standards

O121-08 (R2013) Douglas Fir Plywood

ASTM International

A 4956-13	Retroreflective Sheeting for Traffic Control
A 653/A 653M-11	Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
A 792/A 792M-10	Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
B 209-10	Aluminum and Aluminum-Alloy Sheet and Plate

2001.05 MATERIALS

2001.05.01 General

Signs shall be fabricated according to OTM Book 2. Sign dimensions, patterns, colour, minimum reflective sheeting, and sign blank number shall be according to OTM Book 2, Master Sign Library, Sign Pattern Template.

Sign blank material type shall be selected in accordance with OTM Book 2.

2001.05.02 Aluminum Sign Blanks

Aluminum sign blanks shall be fabricated from aluminum sheeting according to ASTM B 209, Alloy 6061-T6 or Alloy 5052-H38. The aluminum shall be 2.1 mm thick.

Sign blanks shall not deviate more than 3 mm from the specified size in any dimension, except thickness.

2001.05.03 Steel Sign Blanks

Steel sign blanks shall be fabricated from galvanized, galvanized, or galvalume steel made from sheets or coils. Coated steel shall be 1.6 mm thick.

Galvanized and galvanized steel shall be according to ASTM A 653M, regular type, coating designation Z275.

Galvalume steel shall be according to ASTM A 792M, coating designation AZM180.

Sign blanks shall not deviate more than 3 mm from the specified size in any dimension, except thickness.

2001.05.04 Plywood Sign Blanks

Plywood sign blanks shall be 19 mm thick, Douglas Fir Medium Density Overlaid Two Sides (MDO 2S) according to CSA O121. The front face and back face overlay shall be 60/60. Inner plies shall be Douglas Fir.

Sign blanks shall not deviate more than 4 mm from the specified size in any dimension, except thickness.

2001.05.05 Retroreflective Sheeting

Retroreflective sheeting shall be according to ASTM D 4956.

2001.07 PRODUCTION

2001.07.01 Aluminum and Steel Sign Blanks

2001.07.01.01 General

Sign blanks shall be flat. Raised edges and burrs shall be removed.

2001.07.01.02 Cleaning and Coating

Sign blanks shall be degreased.

Sign blanks shall be prepared ready to accept overlay sheetings and paints according to the manufacturer's specifications.

2001.07.02 Plywood Sign Blanks

2001.07.02.01 Sign Faces

Surfaces shall be smooth, impermeable, and weatherproof.

One coat of primer or appropriate sealer shall be applied to the back face of the sign.

The front face of the sign shall be primed and painted according to the sheeting manufacturer's specifications and instructions.

2001.07.02.02 Sign Edges

All voids in the sign edges shall be filled with plastic wood. One coat of primer or appropriate sealer shall be applied.

2001.07.03 Markings

The month, year of manufacture, and the name of the supplier shall be printed clearly on each sign with a weatherproof marking.

2001.08 QUALITY ASSURANCE

2001.08.01 Inspection and Testing

The quality of the finished product may be subject to inspection and approval by the Owner. The Owner may make tests to govern the acceptance or rejection of the materials.

2001.09 OWNER PURCHASE OF MATERIAL

2001.09.01 Measurement and Payment

For measurement purposes, a count shall be made of the number of signs delivered and accepted.

Payment at the price specified in the purchasing order shall be for the supply of signs delivered to the destination on the date and time specified.

The cost of all testing, except that performed in the Owner's laboratory, shall be included in the price.

Appendix 2001-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 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 2401

MATERIAL SPECIFICATION FOR ELECTRICAL HANDHOLES

OPSS 2401 has been removed from this
OPS volume

The provincial version of OPSS 2401 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 2401

The municipal version of OPSS 2401 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 2401

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



NOTICE TO USERS OF OPSS 2409

MATERIAL SPECIFICATION FOR TRAFFIC SIGNAL CABLE

OPSS 2409 has been removed from this
OPS volume

The provincial version of OPSS 2409 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 2409

The municipal version of OPSS 2409 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 2409

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



NOTICE TO USERS OF OPSS 2410

MATERIAL SPECIFICATION FOR EXTRA LOW-VOLTAGE CABLE

OPSS 2410 has been removed from this
OPS volume

The provincial version of OPSS 2410 is now in:

OPS Volume 6,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 2410

The municipal version of OPSS 2410 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 2410

**USE OF EITHER OF THE SPECIFICATIONS IS AS SPECIFIED
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MATERIAL SPECIFICATION FOR POWER SUPPLY EQUIPMENT

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2414-A	Commentary

2414.01 SCOPE

This specification covers the requirements for the following:

- a) Supply control cabinet assembly Type 1 - 120/240 V, 100 A, 1-phase, 3-wire.
- b) Supply control cabinet assembly Type 2A - 120/208 V, 100 A, 3-phase, 4-wire.
- c) Supply control cabinet assembly Type 2B - 347/600 V, 100 A, 3-phase, 4-wire.
- d) Supply control cabinet assembly Type 3 - 120/240 V, 100 A, 1-phase, 3-wire, no lighting contactor.
- e) Distribution assembly - 347/600 V.

2414.01.01 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.

2414.01.02 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.

2414.02 REFERENCES

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

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

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

CSA Standards

C9-02 (R2011)	Dry-Type Transformers
C22.2 No. 0.12-M1985 (R2012)	Wiring Space and Wire Bending Space in Enclosures for Equipment Rated 750 V or Less
C22.2 No. 0.17-00 (R2013)	Evaluation of Properties of Polymeric Materials
C22.2 No. 0.4-04 (R2013)	Bonding of Electrical Equipment
C22.2 No. 5-13	Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures
C22.2 No. 9.0-96 (R2011)	General Requirements for Luminaires

C22.2 No. 14-13	Industrial Control Equipment
C22.2 No. 18.1-13	Metallic Outlet Boxes
C22.2 No. 29-11	Panelboards and Enclosed Panelboards
C22.2 No. 38-14	Thermoset-Insulated Wires and Cables
C22.2 No. 45.1-07 (R2012)	Electrical Rigid Metal Conduit - Steel
C22.2 No. 45.2-08 (R2013)	Electrical Metal Conduit - Aluminum, Red Brass, and Stainless Steel
C22.2 No. 55-M1986 (R2012)	Special Use Switches
C22.2 No. 65-13	Wire Connectors
C22.2 No. 66.1-06 (R2011)	Low Voltage Transformers - Part 1: General Requirements
C22.2 No. 66.2-06 (R2011)	Low Voltage Transformers - Part 2: General Purpose Transformers
C22.2 No. 76-14	Splitters
C22.2 No. 83-M1985 (R2013)	Electrical Metallic Tubing
C22.2 No. 94-M91 (R2011)	Special Purpose Enclosures
C22.2 No. 106-05 (R2010)	HRC - Miscellaneous Fuses
C22.2 No. 144-M91 (R2011)	Ground Fault Circuit Interrupters
C22.2 No. 227.2.1-04 (R2013)	Liquid-Tight Flexible Nonmetallic Conduit
C227.5-08 (R2013)	Three-Phase Live-Front Pad-Mounted Distribution Transformers
G40.20-13/G40.21-13	General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
W59.2-M1991 (R2013)	Welded Aluminum Construction

Underwriter's Laboratories of Canada (ULC)

CAN/ULC-S102-10	Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

American National Standards Institute (ANSI)

B18.15-1985 (R2003)	Forged Eyebolts

ASTM International

A 480/A 480M-14	General Requirements for Flat Rolled Stainless Steel and Heat-Resisting Steel Plate, Sheet and Strip
A 489-12	Carbon Steel Lifting Eyes
A 666-10	Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
B 209-10	Aluminum and Aluminum-Alloy Sheet and Plate
G 34-01(2013)	Test Method for Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Test)

IEEE

C62.11-2005	Metal-Oxide Surge Arresters for AC Power Circuits (>1 kV)

National Equipment Manufacturers Association (NEMA)

NEMA 250-2008	Enclosure for Electrical Equipment (1000 Volts Maximum)

2414.04 DESIGN AND SUBMISSION REQUIREMENTS

2414.04.01 Design Requirements

2414.04.01.01 Power Supply Equipment Requirements

Supply control cabinet assemblies shall be according to the Contract Documents. Completed assemblies shall be "service entrance ready." The complete assembly shall pass Electrical Safety Authority (ESA) equipment inspection and have an ESA label of approval. These approvals shall be obtained prior to the unit being shipped.

Completed distribution assemblies shall be approved by the ESA or by an organization that has been accredited by the Standards Council of Canada.

2414.04.02 Submission Requirements

2414.04.02.01 Working Drawings

The Contractor shall submit 4 sets of Working Drawings to the Contract Administrator at least 14 Days prior to the commencement of fabrication, for information purposes only. An Engineer shall affix his or her seal and signature on the Working Drawings verifying that the drawings are consistent with the Contract Documents and sound engineering practices.

When multi-discipline engineering work is depicted on the same Working Drawing and a single Engineer is unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be signed and sealed by as many additional Engineers, as necessary.

As a minimum, the Working Drawings for supply control cabinet assemblies shall include the following information:

- a) Detailed dimensioned layout, including sections and details to show enclosures, equipment layouts and mounting arrangements, and exact weights.
- b) Detailed bill of materials.
- c) Wiring diagrams.
- d) Details of equipment nameplates.

As a minimum, the Working Drawings for distribution assemblies shall include the following information:

- a) Plans, elevations, sections, and details to show enclosures, structural details, equipment layouts and mounting arrangements, anchor bolt locations, and overall weights.
- b) Detailed bill of materials.
- c) Wiring diagrams.
- d) Details of equipment nameplates and notices.

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

2414.05 MATERIALS

2414.05.01 Enclosures

2414.05.01.01 Supply Control Cabinet Assemblies

Enclosures shall be welded 14 gauge stainless steel type 304 and shall have a No. 2B finish outside according to ASTM A 666 and ASTM A 480.

The panelboard cover for the supply control cabinet assembly shall be manufactured to accommodate the number of standard-sized single-pole branch circuit breakers as specified in the Contract Documents. Unused openings shall be covered with removable blank covers or inserts.

The removable internal equipment panel consisting of a combination backboard and drip shield shall be fabricated from 14 gauge stainless steel type 304 and shall have a No. 2B finish according to ASTM A 666 and ASTM A 480.

Barriers and dead-front panels shall be fabricated from clear thermoplastic polycarbonate according to CAN/CSA C22.2 No. 0.17.

2414.05.01.02 Distribution Assemblies

Exterior cubicles shall be according to CAN/CSA C22.2 No. 94, enclosure NEMA 250, Type 3.

Enclosures for electrical equipment inside the cubicle shall be according to CAN/CSA C22.2 No. 94, enclosure NEMA 250, Type 1.

The exterior of the cubicle shall be fabricated from 5052-H32 marine-type sheet aluminum according to ASTM G 34. The sheet aluminum shall be 4.7 mm thick minimum and reinforced. Fabrication shall be according to ASTM B 209 for 5052-H32 sheet aluminum.

The cabinet base shall be steel H-beam according to CSA G40.21, Grade 260W, and shall be hot dip galvanized according to CSA G164.

Equipment backplate supports shall be aluminum brackets welded to the aluminum sheeting. All other cabinet materials shall be sheet, formed, or cast aluminum or stainless steel.

Eyebolts shall be drop forged steel and according to ASTM A 489 and ANSI/ASME B18.15.

All mounting hardware shall be stainless steel.

2414.05.01.02.01 Insulation and Ventilation

Enclosure insulation shall be rated at minimum R 8/RSI 1.4 and have a flame spread rating not greater than 25 when tested according to CAN/ULC-S102. Insulation shall be applied to the entire surface of the walls, doors, and ceilings, except areas for openings to the exterior.

Enclosure ventilation shall be according to the Contract Documents. Ventilation openings shall be screened, vermin proof, and tamper proof louvres.

2414.05.02 Breakers

Breakers shall be according to CSA C22.2 No. 5 for use with copper bus.

2414.05.03 Contactors

Contactors shall be according to CSA C22.2 No. 14.

2414.05.04 Lightning Arrestors

Lightning arrestors shall be according to IEEE C62.11.

2414.05.05 Outlet Boxes and Fittings

Outlet boxes and fittings shall be according to CSA C22.2 No. 18.1.

2414.05.06 Thermoset Insulated Wires and Cables

All interconnecting wires and cables shall be copper with type RWU90 insulation and according to CSA C22.2 No. 38.

2414.05.07 Panelboards and Enclosed Panelboards

Panelboards and enclosed panelboards shall be according to CSA C22.2 No. 29. Buses shall be copper.

Panelboards shall accept bus bar bolt-on breakers and all bus work shall be of copper construction. All interconnecting wire and cables shall be of copper construction and bending radius according to CSA C22.2 No. 0.12.

2414.05.08 Grounding and Bonding Materials

All equipment used for grounding and bonding shall be according to CAN/CSA C22.2 No. 0.4 and C22.2 No. 41.

2414.05.09 Rigid Metal Conduits

Rigid metal conduits shall be according to CSA C22.2 No. 45.1 and CSA C22.2 No. 45.2.

2414.05.10 Dry-Type Distribution Transformers

Dry-type distribution transformers shall be according to CSA C9.

2414.05.11 Switches

Switches shall be according to CSA C22.2 No. 55.

2414.05.12 Ground Fault Circuit Interrupter (GFCI) Receptacles

Ground fault circuit interrupter (GFCI) receptacles shall be according to CAN/CSA C22.2 No. 144.

2414.05.13 Non-Metallic Liquid Tight Conduits and Connectors

Non-metallic liquid tight conduits and connectors shall be according to CSA/CAN C22.2 No. 227.2.1.

2414.05.14 Specialty Control Transformers

Specialty control transformers shall be according to CSA C22.2 No. 66.1 and CSA C22.2 No. 66.2.

2414.05.15 Electrical Metallic Tubing (EMT)

Electrical metallic tubing (EMT) shall be according to CSA C22.2 No. 83.

2414.05.16 Enclosure Lamps

Enclosure lamps shall be according to CSA C22.2 No. 9.0.

2414.05.17 Splitters

Splitters shall be according to CAN/CSA C22.2 No. 76.

2414.05.18 High Rupturing Capacity (HRC) Fuses

High rupturing capacity (HRC) fuses shall be according to CSA C22.2 No. 106.

2414.05.19 Wire Connectors

Wire connectors shall be according to CSA C22.2 No. 65.

2414.05.20 Neutral Bus Bars

Neutral bus bars shall be copper.

2414.07 PRODUCTION

2414.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

2414.07.02 Supply Control Cabinet Assemblies

2414.07.02.01 Cabinet Fabrication

Supply control cabinet assemblies shall be assembled and wired according to the Contract Documents.

2414.07.02.02 Enclosures

The enclosure for the supply control cabinet assembly shall be constructed so that exposure to weather, moisture, or external splashing do not impair the effectiveness of the enclosed electrical equipment. The enclosure shall be manufactured to meet the requirements of NEMA 250, Type 4X.

The enclosure shall consist of the following:

- a) Pole mounting brackets according to the Contract Documents.
- b) Doors with:
 - i. An inside mounted, continuous, piano-type stainless steel hinge.
 - ii. A latching mechanism to hold the door open at 90° and 150-180°.
 - iii. A copper or stainless steel flexible flat braid jumper connected between the door and the cabinet by means of welded studs.
 - iv. A stainless steel padlocking provision.
 - v. A stainless steel three-point padlocking handle with a nylon roller wheel complete with bearing.
 - vi. Tamperproof stainless steel mounting hardware accessible from the inside.

- vii. A door handle that travels and stops below the keyhole with minimum 25 mm clearance and rotates 90° pointing straight down for the closed position and pointing horizontally for the open position.
- c) Removable internal equipment panel with a combination backboard and drip shield. The drip shield shall be formed so that the electrical components mounted on the backboard are not affected by moisture forming on the interior at the top of the enclosure.
- d) Barriers formed according to CSA C22.2 No. 29 separating the service cables from the branch circuits and the photoelectric controller cables.
- e) Internal dead-front panels for the main breaker and circuit breaker sections that prevent unsafe contact by service personnel with the live circuits from all sides.
- f) A printed schedule for the supply control cabinet identifying circuits mounted on cardboard, inserted in a clear plastic bag, and permanently attached to the inside of the door.

Dead-front panels shall be formed so that the circuit breaker panel has to be removed prior to the main breaker panel can be removed. Both panels shall be supplied with quarter-turn screw latches welded to the dead-front panels.

2414.07.03 Distribution Cabinet Assemblies

2414.07.03.01 Cabinet Fabrication

Cabinets shall consist of self-supporting sheet aluminum cubicles and formed aluminum framework welded to form open bottom cubicles. The cabinet shall be tamperproof according to CAN/CSA C22.2 No. 94. Eyebolts suitable for lifting the cabinet shall be attached to the formed aluminum framework.

A minimum of 3 aluminum channels shall be mounted to the full height for the back side of the cabinet. Channels shall be welded to the aluminum sheeting and framework and may form part of the structural framework.

2414.07.03.02 Backplates

Aluminum backplates shall be installed for mounting of electrical components. Backplates shall be securely bolted to the aluminum channels using bolts through the channels with the heads tack-welded to the channels. Backplates shall be sized so that the total weight of the backplate plus electrical components does not exceed 70 kg.

Aluminum backplates shall be finished with fire-rated paint and provided with isolating means to minimize galvanic action between the backplates and the steel electrical components.

2414.07.03.03 Doors

Doors shall be according to CAN/CSA C227.5.

Doors shall be lapping and reinforced for strength and rigidity. Each door shall consist of:

- a) An inside mounted, continuous, piano-type stainless steel hinge.
- b) Two latching mechanisms to hold the door open at 90° and 150-180°, one at the top and one at the bottom.

- c) A copper or stainless steel flexible flat braid jumper connected between the door and the cabinet by means of welded studs.
- d) A stainless steel padlocking provision.
- e) A stainless steel three-point padlocking handle with a nylon roller wheel complete with bearing.
- f) Tamperproof stainless steel mounting hardware accessible from the inside.
- g) A door handle that travels and stops below the keyhole with minimum 25 mm clearance and rotates 90° pointing straight down for the closed position and pointing horizontally for the open position.
- h) Screened, vermin proof, and tamperproof louvres to give ventilation as required. All louvres shall be equipped with racks and 305 x 406 x 25 mm metal reusable filters.

2414.07.03.04 Welding

All welding shall be according to CSA W59.2. Welding on aluminum shall be done by the gas metal arc process.

2414.07.03.05 Cabinet Finish

Exterior and interior components of the cabinet shall have a natural aluminum finish with all welds and scratches ground smooth. Cabinets with scratches more than 0.5 mm wide, 0.5 mm deep, or 150 mm long shall not be accepted.

2414.07.03.06 Bonding and Grounding of Electrical Equipment

All non-current carrying metal parts of the electrical equipment shall be bonded according to CAN/CSA C22.2 No. 0.4.

2414.07.03.07 Spare Parts

Each cabinet shall include one set of contacts, packaged and identified for each contactor, and one set of fuses for each switch. A 450 x 150 x 150 mm spare part box shall be fabricated from sheet aluminum and mounted in a location inside the cabinet.

2414.07.03.08 Metering

Distribution assemblies shall have meter sockets acceptable to the power supply authority and mounted on a removable backplate in the metering cabinet cubicle.

2414.07.03.09 Warning Signs

Warning signs shall be as specified in the Contract Documents and be prominently displayed on the outside of each exterior door.

2414.07.03.10 Ground Bus

A continuous copper ground bus and ground connectors shall be installed in the distribution assembly according to CSA C227.5. The ground bus shall have 4 connectors suitable for #2/0 AWG cables in the lighting and services compartment, 4 connectors suitable for #6 AWG cables in the cubicle and extension cabinet assembly, and 1 connector suitable for #2/0 AWG cable in the metering cubicle for field connections.

2414.07.03.11 Electrical Components

The electrical components shall be as shown in Table 1.

2414.07.03.11.01 Installation of Electrical Components

Component arrangements shown on the Contract Documents are indicative of the general requirements and adjustments that may be made to component locations to suit different sizes of enclosures and regulations or physical requirements regarding spacing of enclosures.

Wiring shall be installed in flexible non-metallic liquid-tight conduit, rigid metal conduit, or electrical metallic tubing between enclosures.

2414.07.03.11.02 Nameplates for Electrical Components

The following nameplates shall be engraved lamacoid nameplates with 6 mm high, 1.5 mm stroke width black letters on yellow background fastened with stainless steel or aluminum pop rivets on the identified equipment for identification:

- a) To the main feed switch for distribution assemblies:

NOTICE READ BEFORE OPERATING Advanced Traffic Management Systems are 24 hour operational and <u>must remain ON</u> unless necessary to de-energize for safety reasons.

- b) To the 600 V utility disconnect:

NOTICE This breaker controls the feeder to the 120/240 V utility panel. Some circuits are 24 hour operational and <u>must remain ON</u> unless necessary to de-energize for safety reasons.

All other nameplates shall be engraved lamacoid with black letters on white background.

2414.07.03.11.03 Panelboard Schedules

A printed schedule for each panelboard shall be provided indicating equipment served and a description of circuit breaker sizes for each panel as specified in the Contract Documents. The schedule shall be mounted on cardboard, inserted in a clear plastic bag, and hung on the inside of the main door panel.

2414.07.04 Markings

Markings shall be engraved on a stainless steel plate permanently attached with stainless steel or aluminum pop rivets to the outside of the door and located in a highly visible location. Each power supply equipment shall have identification markings showing the following:

- a) Assembly manufacturer's name or trademark.
- b) Enclosure manufacturer's name or trademark.
- c) Standard designation OPSS 2414.
- d) Date of manufacture (i.e., yyyy-mm-dd).
- e) kVA rating (distribution assembly only).
- f) Total weight.

The manufacturer shall attach the label SERVICE ENTRANCE READY on the dead front panel of the supply control cabinet assembly.

2414.08 QUALITY ASSURANCE

2414.08.01 Inspection

The Contract Administrator shall be notified a minimum of 3 Business Days prior to the start of fabrication for the power supply equipment.

The Contract Administrator shall have free access to the place of manufacture of the power supply equipment for the purpose of inspecting and examining plant records and certificates; materials used; process of manufacturing, including welding and galvanizing; and to make any tests as may be considered necessary, while the power supply equipment is being fabricated.

The Contract Administrator and ESA shall be notified when the power supply equipment is ready for inspection.

All power supply equipment may be subject to an inspection by the Contract Administrator prior to shipment.

2414.09 OWNER PURCHASE OF MATERIAL

2414.09.01 Packaging and Shipment

The supplier shall provide 4 copies of Working Drawings when required by the Owner. Working Drawings shall include all detailed dimensions and a complete list of component materials and accessories.

The supplier is responsible for loading, delivery, and off-loading of power supply equipment to designated areas. Power supply equipment shall be subject to inspection during and on completion of off-loading. If any damage to the power supply equipment is encountered during the inspection, the supplier shall be responsible for the necessary corrective measures, which are subject to the approval of the Owner.

The supplier shall advise the Owner 3 Business Days prior to the shipping date of the intent to deliver and confirm that arrangements for off-loading has been made.

2414.09.02**Measurement and Payment**

For measurement purposes, a count shall be made of the number of power supply equipment delivered and accepted.

Payment at the price specified in the purchasing order shall be for the supply of the power supply equipment delivered to the destination on the date and time specified.

The cost of all testing, except that performed by the Owner, shall be included in the price.

TABLE 1
Electrical Components for Distribution Cabinet Assemblies

Electrical Components	Quantity
Service entrance disconnect - 600 V, 3-pole, fusible complete with three HRC1 Class R time delay fuses. Fuse holders and distribution blocks suitable for service cable.	1
Main feed switch - 600 V, 400 A, 3-pole, non-fusible switch complete with terminals suitable for service cable.	1
Lighting system disconnect - 600 V, 225 A, 3-pole, 4-wire, solid neutral complete with terminals suitable for lighting system feed cable.	1
Utility disconnect - 600 V, 30 A, 2-pole.	1
Lighting contactor - 600 V, 200 A, 3-pole, 120 V coil electrically operated, electrically held.	1
Lighting system panelboard - 600 V, 225 A, 3-phase, 4-wire, solid neutral, surface mount, enclosed, suitable for 48 branch circuits, 30 A, 1-pole, bolt-on type breakers.	1
Utility panelboard - 240 V, 3-wire, single phase, 100 A, surface mount, enclosed, suitable for 15 A, 1-pole, bolt-on type breakers.	1
Advanced Traffic Management System combination panelboard - 347/600 V, 225 A, 3-phase, 4-wire, solid neutral, surface mount, enclosed, suitable for 48 branch circuits, breakers suitable for load.	1
Relamp switch - 125 V, 15 A, 1-pole, toggle type, mounted in a utility box with steel cover.	1
Light switch - 125 V, 15 A, 1-pole, toggle type mounted in a utility box with steel cover.	1
GFCI receptacle - 125 V, 15 A, mounted in a utility box with steel cover.	1
Main splitter - 600 V, 400 A, 4-wire, surface mounted.	1
Incandescent lighting luminaire - 125 V, 150 W, wall-mounted type, enclosed, complete with gasket and clear glass globe.	1
Secondary lightning arrestor - 650 V, 3-pole, thyrite type, mounted on each load panel.	3
Dry type transformer -120/240/600 V, 15 KVA, 60 Hz, single phase.	1

Appendix 2414-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:

- Design requirements for power supply equipment. (2414.04.01.01)
- Assembly and wiring requirements for supply control cabinets. (2414.07.02.01)
- Description of equipment served for printed schedule. (2414.07.03.11.03)

The designer should perform voltage drop calculations as part of the design.

The designer should determine conductor sizes, service entrance switch ratings, and lug sizes and add these requirements to the Contract Documents.

For Owner purchase of supply control cabinet assemblies, the following technical information should be given to the supplier in the purchasing order:

- a) Secondary supply voltage.
- b) Number of branch breakers.
- c) The number of traffic signal breakers.

For Owner purchase of distribution assemblies, the following technical information should be given to the supplier in the purchasing order:

- a) Type of assembly.
- b) Total kVA rating.
- c) Lighting system plus auxiliary system kVA rating.
- d) Number and description of branch breakers.
- e) Metering requirements.
- f) Number and description of fusible auxiliary circuit switches.

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

Appendix 2414-A

Related Ontario Provincial Standard Drawings

OPSD 2126.010 to 2126.020	Distribution Assembly
OPSD 2130.010 to 2130.012	Supply Control Cabinet Installation
OPSD 2400.000 to 2400.030	Distribution Assembly
OPSD 2400.100 to 2400.101	Warning Signs
OPSD 2440.010 to 2441.061	Supply Control Cabinet Assembly



NOTICE TO USERS OF OPSS 2420

MATERIAL SPECIFICATION FOR WOODEN POLES

OPSS 2420 has been removed from this
OPS volume

The provincial version of OPSS 2420 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 2420

The municipal version of OPSS 2420 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 2420

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



NOTICE TO USERS OF OPSS 2421

MATERIAL SPECIFICATION FOR SPUN CONCRETE POLES

OPSS 2421 has been removed from this
OPS volume

The provincial version of OPSS 2421 is now in:

OPS Volume 6,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 2421

The municipal version of OPSS 2421 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 2421

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



NOTICE TO USERS OF OPSS 2422

MATERIAL SPECIFICATION FOR HEAVY CLASS STEEL AND SECTIONAL STEEL POLES, BASE MOUNTED

OPSS 2422 has been removed from this
OPS volume

The provincial version of OPSS 2422 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 2422

The municipal version of OPSS 2422 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 2422

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



NOTICE TO USERS OF OPSS 2423

MATERIAL SPECIFICATION FOR STEEL POLES, BASE MOUNTED

OPSS 2423 has been removed from this
OPS volume

The provincial version of OPSS 2423 is now in:

OPS Volume 6,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 2423

The municipal version of OPSS 2423 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 2423

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



NOTICE TO USERS OF OPSS 2426

MATERIAL SPECIFICATION FOR STEEL TRUSS BRACKETS

OPSS 2426 has been removed from this
OPS volume

The provincial version of OPSS 2426 is now in:

OPS Volume 6,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 2426

The municipal version of OPSS 2426 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 2426

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



NOTICE TO USERS OF OPSS 2428

MATERIAL SPECIFICATION FOR ALUMINUM TAPERED ELLIPTICAL BRACKETS

OPSS 2428 has been removed from this
OPS volume

The provincial version of OPSS 2428 is now in:

OPS Volume 6,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 2428

The municipal version of OPSS 2428 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 2428

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



NOTICE TO USERS OF OPSS 2432

MATERIAL SPECIFICATION FOR HIGH PRESSURE SODIUM LUMINAIRES FOR HIGHWAY LIGHTING

OPSS 2432 has been removed from this
OPS volume

The provincial version of OPSS 2432 is now in:

OPS Volume 6,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 2432

The municipal version of OPSS 2432 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 2432

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



NOTICE TO USERS OF OPSS 2434

MATERIAL SPECIFICATION FOR HIGH PRESSURE SODIUM LUMINAIRES FOR UNDERPASS LIGHTING

OPSS 2434 has been removed from this
OPS volume

The provincial version of OPSS 2434 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 2434

The municipal version of OPSS 2434 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 2434

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



NOTICE TO USERS OF OPSS 2452

MATERIAL SPECIFICATION FOR ALUMINUM POLES, BASE MOUNTED

OPSS 2452 has been removed from this
OPS volume

The provincial version of OPSS 2452 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 2452

The municipal version of OPSS 2452 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 2452

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IN THE CONTRACT DOCUMENTS**



NOTICE TO USERS OF OPSS 2453

MATERIAL SPECIFICATION FOR SECTIONAL STEEL POLES

OPSS 2453 has been removed from this
OPS volume

The provincial version of OPSS 2453 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 2453

The municipal version of OPSS 2453 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 2453

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



NOTICE TO USERS OF OPSS 2460

MATERIAL SPECIFICATION FOR TRAFFIC SIGNAL ARMS, BRACKETS, HANGERS, FITTINGS, AND HARDWARE

OPSS 2460 has been removed from this
OPS volume

The provincial version of OPSS 2460 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 2460

The municipal version of OPSS 2460 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 2460

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NOTICE TO USERS OF OPSS 2461

MATERIAL SPECIFICATION FOR SIGNAL HEADS

OPSS 2461 has been removed from this
OPS volume

The provincial version of OPSS 2461 is now in:

OPS Volume 6,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 2461

The municipal version of OPSS 2461 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 2461

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NOTICE TO USERS OF OPSS 2471

MATERIAL SPECIFICATION FOR SECTIONAL STEEL HIGH MAST LIGHTING POLES

OPSS 2471 has been removed from this
OPS volume

The provincial version of OPSS 2471 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 2471

The municipal version of OPSS 2471 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 2471

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NOTICE TO USERS OF OPSS 2474

MATERIAL SPECIFICATION FOR ANCHORAGE ASSEMBLY – HIGH MAST LIGHTING POLE

OPSS 2474 has been removed from this
OPS volume

The provincial version of OPSS 2474 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 2474

The municipal version of OPSS 2474 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 2474

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IN THE CONTRACT DOCUMENTS**



NOTICE TO USERS OF OPSS 2476

MATERIAL SPECIFICATION FOR RAISING AND LOWERING EQUIPMENT FOR HIGH MAST LIGHTING POLES

OPSS 2476 has been removed from this
OPS volume

The provincial version of OPSS 2476 is now in:

OPS Volume 6,
Provincial-Oriented
Material Specifications
and designated as OPSS.PROV 2476

The municipal version of OPSS 2476 is now in:

OPS Volume 8,
Municipal-Oriented
Material Specifications
and designated as OPSS.MUNI 2476

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NOTICE TO USERS OF OPSS 2479

MATERIAL SPECIFICATION FOR FLOODLIGHT LUMINAIRES USED IN HIGH MAST LIGHTING

OPSS 2479 has been removed from this
OPS volume

The provincial version of OPSS 2479 is now in:

OPS Volume 6,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 2479

The municipal version of OPSS 2479 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 2479

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IN THE CONTRACT DOCUMENTS**



NOTICE TO USERS OF OPSS 2485

MATERIAL SPECIFICATION FOR PHOTOELECTRIC CONTROLLERS

OPSS 2485 has been removed from this
OPS volume

The provincial version of OPSS 2485 is now in:

OPS Volume 6,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 2485

The municipal version of OPSS 2485 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 2485

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IN THE CONTRACT DOCUMENTS**



NOTICE TO USERS OF OPSS 2501

MATERIAL SPECIFICATION FOR CALCIUM CHLORIDE

OPSS 2501 has been removed from this
OPS volume

There is no provincial version.

The municipal version of OPSS 2501 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 2501

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NOTICE TO USERS OF OPSS 2502

MATERIAL SPECIFICATION FOR SODIUM CHLORIDE

OPSS 2502 has been removed from this
OPS volume

The provincial version of OPSS 2502 is now in:

OPS Volume 6,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 2502

The municipal version of OPSS 2502 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 2502

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IN THE CONTRACT DOCUMENTS**



NOTICE TO USERS OF OPSS 2503

MATERIAL SPECIFICATION FOR MAGNESIUM CHLORIDE SOLID AND MAGNESIUM CHLORIDE SOLUTION

OPSS 2503 has been removed from this
OPS volume

There is no provincial version.

The municipal version of OPSS 2503 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 2503

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NOTICE TO USERS OF OPSS 2510

MATERIAL SPECIFICATION FOR TALL OIL PITCH EMULSION

OPSS 2510 has been removed from this
OPS volume

The provincial version of OPSS 2510 is now in:

OPS Volume 6,
Provincial-Oriented
General and Construction Specifications
and designated as OPSS.PROV 2510

The municipal version of OPSS 2510 is now in:

OPS Volume 8,
Municipal-Oriented
General and Construction Specifications
and designated as OPSS.MUNI 2510

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