

Ontario Provincial Standards for Roads and Public Works



- Volume 8 -

MUNICIPAL-ORIENTED

MATERIAL SPECIFICATIONS



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MANUAL REVISION RECORD

Municipal-Oriented

Volume 8 – 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
1	Nov 2008	Included in new manuals	25		
2	Apr 2010	Included in new manuals	26		
3	Nov 2012	Included in new manuals	27		
4	April 2013	Included in new manuals	28		
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MATERIAL SPECIFICATION FOR AGGREGATES - GENERAL

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1001.01	SCOPE

This specification covers the source, processing, and testing requirements for aggregates and provides for the use of reclaimed asphalt pavement and reclaimed concrete material.

1001.01.01 Specification Significance and Use

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

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

1001.01.02 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.

1001.02 REFERENCES

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

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

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-602	Sieve Analysis of Aggregates
LS-609	Petrographic Analysis of Coarse Aggregate
LS-616	Petrographic Analysis of Fine Aggregate

ASTM International

D5744 - 18	Standard Test Method for Laboratory Weathering of Solid Materials Using a Humidity Cell from SAI Global
E11 - 20	Woven Wire Test Sieve Cloth and Test Sieves

Canadian General Standards Board

8.1-88	Sieves, Testing, Woven Wire, Inch Series

Others

ADTI-WP2 Leaching Column Method for Overburden Analysis and Prediction of Weather Rates, Hornberger, Roger J., et al., 2004.

DRAFT Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia, British Columbia Ministry of Employment and Investment, Energy and Minerals Division; Smithers, BC; Price, W.A., April 1997.

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Toxicity Characteristic Leaching Procedure, Method 1311; United States Environmental Protection Agency, Publication SW-846, July 1992.

1001.03 DEFINITIONS

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

Aggregate means natural mineral materials such as sand, gravel, and crushed bedrock. Reclaimed materials may substitute for aggregates when allowed by the appropriate specification.

Boulder means a detached rock mass with a diameter greater than 200 mm.

Clay means a fine-grained soil with particles smaller than 2 µm that exhibit plasticity over a range of water contents.

Coarse Aggregate means that portion of aggregate material retained on the 4.75 mm sieve when tested according to LS-602.

Cobble means a rounded or semi-rounded rock fragment with an average dimension between 75 mm and 200 mm.

Crushed Material means aggregate particles having at least one well-defined face resulting from fracture and could also be materials other than aggregates (e.g., iron blast-furnace slag or nickel slag, crushed concrete). Particles with smooth faces and rounded edges or with only small chips removed are not considered crushed.

Deleterious Material means materials that include, but not limited to, the following: wood, clay brick, clay tile, plastic, gypsum, gypsum plaster, wallboard, roots, and all other organic matter.

Fine Aggregate means that portion of aggregate passing the 4.75 mm sieve when tested according to LS-602.

Flat and Elongated Particles means aggregate particles whose greatest mean dimension in the longitudinal axis compared to the least mean dimension in a plane perpendicular to the longitudinal axis exceeds a ratio of 4:1.

Granular means any processed or natural aggregate material with less than 35% by mass passing the 75 µm sieve.

Gravel means rounded, water-worn rock fragments retained on the 4.75 mm sieve and passing through the 75 mm sieve.

Iron Blast-Furnace Slag means the material resulting from solidification of molten blast-furnace slag under atmospheric conditions. Subsequent cooling may be accelerated by application of water to the solidified surface.

Manufactured Sand means sand produced by the crushing and further processing, i.e., washing, grading, classifying of quarried rock, boulders, cobbles, or gravel from which the natural fine aggregate has been removed. Natural sand may be added to optimize properties.

Mine By-Product Rock means rock which is removed during an ore mining process and has not been subjected to any sort of chemical processing.

Natural Sand means naturally formed sand found in unconsolidated deposits.

Nickel Slag means the non-metallic product resulting from the production of nickel.

Reclaimed Asphalt Pavement (RAP) means the processed hot mix asphalt material that is recovered by partial or full depth removal.

Reclaimed Concrete Material (RCM) means removed or processed hardened Portland cement concrete.

Sand means fine aggregate passing the 4.75 mm sieve and retained on a 75 µm sieve resulting from natural disintegration of rock or from crushing.

Screenings means the fine aggregate produced by the crushing of quarried rock, boulders, cobbles, or gravel.

1001.04 DESIGN AND SUBMISSION REQUIREMENTS

1001.04.01 Submission Requirements

1001.04.01.01 General

The Contract Administrator shall be advised in writing of each intended aggregate source, prior to its use in the Work.

All test results shall be provided in either individual or mean values, which demonstrate conformance of the material with the requirements of the appropriate specification.

Test results shall be made available at the Contract Administrator's request.

1001.04.01.02 Report for Aggregates Produced from Mine By-Product Rock

If an aggregate produced from a mine by-product rock is proposed for use, a Mine By-Product Rock Aggregate Assessment Report (MRAAR), shall be submitted to the Contract Administrator at least 20 Business Days prior to its intended use. The MRAAR shall be signed by an Engineer or a licensed Professional Geoscientist (P. Geo.).

Prior to beginning the Work, the Engineer or licensed Professional Geoscientist (P. Geo.), shall have a minimum of 3 years experience in Acid Base Accounting, NAG testing, metal leachate testing, physical property, and any other related testing and analysis, acceptable to the Owner. Relevant qualifications and examples of past projects carried out within the past 5 years by the Engineer or licensed Professional Geoscientist (P. Geo) shall be submitted.

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

- a) Petrographic test results according to LS-609, Part A and LS-616, Part A carried out by a licensed Professional Geoscientist (P.Geo.). When sulphur minerals or non-iron bearing sulphides are found, sulphur mineral speciation and associated reactivity shall be determined using X-Ray Diffraction or Scanning Electron Microscopy or both.
- b) An Acid Rock Drainage (ARD) investigation, carried out by a licensed Professional Geoscientist (P.Geo.) including, but not limited to, the following:
 - i. Acid Base Accounting and Net Acid-Generating (NAG) tests. If either the neutralization potential ratio or the NAG tests indicate that the tested material is respectively not shown to be “Non-Acid Generating” or “Non-Acid Forming” according to the “DRAFT Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia”, then kinetic testing shall also be carried out using either humidity cells according to ASTM D5744 or columns according to ADTI-WP2 Leaching Column Method for Overburden Analysis and Prediction of Weather Rates.
 - ii. pH testing and any other chemical analyses considered necessary by the licensed Professional Geoscientist (P.Geo.).
 - iii. An assessment of all the test results and an identification of any potential impacts of the use of acid-generating materials on surface and groundwater, any proximate aquatic ecosystems as well as any other environmentally sensitive areas. When potential impacts are found, recommendations to eliminate or reduce those impacts to acceptable levels including an acceptable monitoring plan shall be included in the assessment.
- c) Metal leachate testing using Shake Flask Extraction, as described in “Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Toxicity Characteristic Leaching Procedure” or any other method acceptable to the Owner;
- d) An assessment of the suitability of the aggregate for its intended use, by assuring that the aggregate:
 - i. meets all applicable safety regulations, guidelines, and procedures;
 - ii. meets all applicable environmental regulations, guidelines and procedures, and shall not cause any adverse environmental effects;
 - iii. meets all current physical and production property requirements required for that aggregate;
 - iv. does not cause undue discolouration of the pavement or structure in which the aggregates shall be used; and
 - v. otherwise provides long term field performance at least as well as any other aggregates that are currently acceptable for the same application.
- e) Specified minimum sampling and testing rates, the location where the samples shall be taken and the recommended tests to be carried out, as well as any special recommendations outlining the handling and placement of aggregates produced from mine by-product rock during construction to ensure that all of the requirements specified in the Contract Documents shall continue to be met for the duration of the Contract.

The sampling, testing, and analyses required for parts a) to d) of the MRAAR of crushed mine by-product rock that is intended for use on the Contract shall be based on a minimum of 3 samples for up to 10,000

tonnes and a minimum of 5 additional samples between 10,000 and 100,000 tonnes. Quantities greater than 100,000 tonnes shall be 1 additional sample per 15,000 tonnes of material. All samples used for testing and assessment purposes required for parts a) to d) shall be obtained from stockpiles of at least 1000 tonnes of the crushed mine by-product rock which is intended for use in the Work. The details regarding the sampling and testing carried during construction shall be as specified in the MRAAR, according to part e) listed above.

In any case, the sampling and testing rates and the types of tests specified above in parts a) to d) for the preparation of the MRAAR and in part e) to be conducted during construction, shall only be considered minimums and the actual amount of sampling, testing, and types of tests carried out anytime during the Contract shall depend on the variability of the source, the Contractor's ability to control that variability as well as any other relevant recommendations that the MRAAR provides.

All testing carried out for the preparation of the MRAAR as well as during construction shall be conducted by laboratories that are acceptable to the Owner.

Within 15 Business Days after submission of the MRAAR, the Contractor shall be notified as to whether the mine by-product rock is acceptable for use.

In addition to the MRAAR, an aggregate management plan shall also be submitted to the Contract Administrator within 20 Business Days of using aggregate produced from mine by-product rock. The aggregate management plan shall detail how aggregate production will meet the requirements of the Work for the duration of the Contract.

1001.05 MATERIALS

1001.05.01 Aggregates

1001.05.01.01 General

Aggregates shall be composed of hard, durable fragments that are clean and free of clay coatings and other deleterious material.

1001.05.01.02 Fine Aggregates

Fine aggregates shall be according to the appropriate specifications and, unless otherwise specified in the Contract Documents, shall be one or a blend of the following:

- a) Natural sand.
- b) Manufactured sand.
- c) Screenings produced during crushing.
- d) Iron blast-furnace slag or nickel slag.
- e) Reclaimed asphalt pavement.
- f) Reclaimed concrete material.

1001.05.01.03 Coarse Aggregates

Coarse aggregates shall be according to the appropriate specifications and, unless otherwise provided specified in the Contract Documents, shall be one or a blend of the following:

- a) Crushed material of consistent quality throughout produced from bedrock formations or boulders.
- b) Uncrushed material of consistent quality produced from gravel formations.
- c) Iron blast-furnace slag or nickel slag.
- d) Reclaimed asphalt pavement.
- e) Reclaimed concrete material.

1001.07 PRODUCTION

1001.07.01 Stripping of Aggregate Source

Prior to excavating materials for aggregate production, the area to be worked shall be cleared of shrubs and trees, grubbed of roots, and stripped of all unsuitable surface materials and weathered zones. The area open ahead of the quarrying or excavating operation shall be of sufficient size to prevent contamination of the aggregate source working face.

1001.07.02 Processing

1001.07.02.01 General

When necessary to conform to the type of materials specified, aggregates shall be screened, crushed, washed, classified, or otherwise processed with suitable equipment to meet specification requirements.

Washed materials or materials excavated from underwater shall be stored for at least a 24 hours or longer period to allow all free water to drain and for the materials to attain uniform water content.

1001.07.02.02 Washing

When specified in the Contract Documents, aggregates shall be washed in washing plants, or otherwise processed to meet specification requirements. Truck or mixer washing and other similar methods shall not be permitted.

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

1001.07.02.03 Blending

Blending of aggregates including reclaimed materials that meet the gradation requirements of the material to be provided by the applicable specification shall be permitted. The blending shall produce a consistent and acceptable product. Except where noted elsewhere in the Contract Documents, blending to improve the physical requirements shall not be permitted, except to increase the percentage of crushed material or decrease the percentage of flat and elongated particles.

1001.07.03 Handling and Transporting

At all times, aggregates shall be handled and transported in a manner and with equipment that avoids segregation of the material, excess loss of fines, and contamination by any deleterious material.

1001.07.04 Stockpiling

Stockpile sites shall be level, well drained, free of all foreign materials, and of adequate bearing capacity to support the mass of the materials to be placed thereon. Stockpiles shall be either far enough apart or separated by substantial dividers to prevent intermingling.

For all coarse aggregates, except when stockpiled on Portland cement concrete or asphaltic concrete foundations or on an uncontaminated durable surface, a compacted granular pad of material with a maximum particle size no larger than that of the material being stockpiled and not less than 0.3 m in depth shall be provided to prevent contamination of the piled material.

For fine or combined aggregate stockpiles, the foundation shall be as specified above for coarse aggregates or the material may be placed on the ground provided that the bottom 0.3 m of the pile is not incorporated into the Work.

When samples are obtained for acceptance purposes from stockpiles of combined fine and coarse aggregate material for gradation testing, the stockpile shall be constructed in layers not exceeding 1 m in depth, and spilling of material over the edge of the stockpile shall not be permitted. These stockpile construction requirements shall not apply to separate stockpiles of fine and coarse aggregates, and shall not apply to stockpiles of combined fine and coarse aggregate when the gradation acceptance samples are obtained after the material has been removed from the stockpile.

1001.08 QUALITY ASSURANCE

1001.08.01 General

Irrespective of compliance or non-compliance with the gradation and physical requirements of the applicable specification, aggregates may be accepted or rejected on the basis of past field performance, as determined by the Owner.

When a change in the character of the material occurs or when the performance of the materials is found to be unsatisfactory, use of those materials shall be discontinued until it can be proven to the satisfaction of the Contract Administrator that the source remains acceptable or can be made acceptable.

1001.08.02 Sampling

Quality Assurance samples shall be obtained, handled, and stored as specified in the Contract Documents. The Contract Administrator shall be allowed to access all sampling locations and reserves the right to request quality assurance samples at any time.

Samples obtained for the purposes of mix design shall be representative of the materials to be placed in the Work.

1001.08.03 Testing

Tests on aggregates shall be as specified in the Contract Documents. The most recent published test method shall be used.

The Owner may require additional sampling and testing during construction. Such sampling and testing shall be carried out at no additional cost to the Owner.

Gradation analysis shall be based on the designated sieves shown in Table 1. As indicated, sieves complying with the alternative shown are compatible and may be used interchangeably with the MTO sieve designation shown.

TABLE 1
Laboratory Testing Sieves

MTO Sieve Designation	Alternate Sieve Standards, CAN/CGSB 8.1 and ASTM E11
150 mm	6 inch
106 mm	4.24 inch
75.0 mm	3 inch
63.0 mm	2-1/2 inch
53.0 mm	2.12 inch
37.5 mm	1-1/2 inch
26.5 mm	1.06 inch
25.0 mm	1 inch
22.4 mm	7/8 inch
19.0 mm	3/4 inch
16.0 mm	5/8 inch
13.2 mm	0.530 inch
12.5 mm	1/2 inch
9.5 mm	3/8 inch
6.7 mm	0.265 inch
4.75 mm	No. 4
2.36 mm	No. 8
1.18 mm	No. 16
600 µm	No. 30
425 µm	No. 40
300 µm	No. 50
150 µm	No. 100
75 µm	No. 200

Appendix 1001-A, November 2021 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

- All requirements. (1001.04.01.02)
- Additional sampling and testing requirements during construction. (1001.04.01.02)
- Fine aggregates. (1001.05.01.02)
- Coarse aggregates. (1001.05.01.03)
- Washing of aggregates. (1001.07.02.02)
- Blending. (1001.07.02.03)
- Obtaining, handling, and shorting of samples for Quality Assurance. (1001.08.02)
- Tests on aggregates. (1001.08.03)

This specification is to be used in conjunction with OPSS 1002, OPSS 1003, OPSS 1004, OPSS 1006, and OPSS 1010.

This specification incorporates Superpave aggregates, tests, and sieves.

Assessment of Potential for Acid Rock Drainage in Highway Construction, Materials Engineering and Research (MERO) Report (Unpublished), Smith, S.J., Rogers, C.A and Senior, S.A., March 2007. Some of the applicable sections within this report may be obtained upon request from the Head of the Soils and Aggregates Section, Materials Engineering and Research Office, MTO, at the following address:

Ministry of Transportation
95 Arrow Road
Toronto, ON
M9M 2L4
Soils-Aggregates@ontario.ca

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 AGGREGATES - CONCRETE

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1002.01 SCOPE

This specification covers material requirements for aggregates for use in hydraulic cement concrete.

1002.01.01 Specification Significance and Use

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

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

1002.01.02

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.

1002.02

REFERENCES

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

Ontario Provincial Standard Specifications, Material

OPSS 1001 Aggregates - General

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-412	Scaling Resistance of Concrete Surfaces Exposed to De-icing Chemicals
LS-601	Material Finer than 75 µm Sieve in Mineral Aggregates by Washing
LS-602	Sieve Analysis of Aggregates
LS-604	Relative Density and Absorption of Coarse Aggregate
LS-606	Soundness of Aggregate by Use of Magnesium Sulphate
LS-608	Percent Flat and Elongated Particles in Coarse Aggregate
LS-609	Petrographic Analysis of Coarse Aggregate
LS-610	Organic Impurities in Sands for Concrete
LS-613	Insoluble Residue of Carbonate Aggregates
LS-614	Freezing and Thawing of Coarse Aggregate
LS-616	Petrographic Examination of Fine Aggregate
LS-618	Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-619	Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-620	Accelerated Detection of Potentially Deleterious Alkali-Silica Reactive Aggregate by Expansion of Mortar Bars
LS-625	Guidelines for Sampling of Granular Materials

MTO Aggregate Sources Lists (ASL):
Aggregate Sources List for Structural Concrete Fine and Coarse Aggregates
Aggregate Sources List for Concrete Base/Pavement Coarse Aggregates

CSA Standards

- A23.2-1A Sampling Aggregates for Use in Concrete *
 - A23.2-12A Relative Density and Absorption of Coarse Aggregate *
 - A23.2-14A Potential Expansivity of Aggregates (Procedure for Length Change Due to Alkali-Aggregate Reaction in Concrete Prisms at 38 °C) *
 - A23.2-23A Test Method for the Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus *
 - A23.2-24A Test Method for Resistance of Unconfined Coarse Aggregate to Freezing and Thawing *
 - A23.2-25A Test Method for Detection of Alkali-Silica Reactive Aggregate by Accelerated Expansion of Mortar Bars *
 - A23.2-26A Determination of Potential Alkali-Carbonate Reactivity of Quarried Carbonate Rocks by Chemical Composition *
 - A23.2-27A Standard Practice to Identify Degree of Alkali-Reactivity of Aggregates and to Identify Measures to Avoid Deleterious Expansion in Concrete *
 - A23.2-29A Method of Test for the Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus *
- * [Part of A23.1-09/A23.2-09 Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete]

ASTM International

- C 87/C 87M-10 Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
- C 330/C 330M-09 Lightweight Aggregates for Structural Concrete
- C 666/C 666M-03 (2008) Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing

1002.03 DEFINITIONS

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

Alkali-Aggregate Reaction (AAR) means a chemical reaction that occurs in concrete between alkalis in the cement (e.g., sodium and potassium) and minerals in the aggregate. This reaction may cause deleterious expansion and cracking of the concrete. AAR includes alkali-carbonate and alkali-silica reactions.

Air-Cooled Blast-Furnace Slag means the material resulting from solidification of molten blast-furnace slag under atmospheric conditions. Subsequent cooling may be accelerated by application of water to the solidified surface.

Bench means a ledge parallel to stratigraphic bedding that in quarries forms a single level of operation above which rock is excavated from a contiguous face.

CCIL means the Canadian Council of Independent Laboratories.

Duplicate Samples means two samples taken at the same time and location – one to be used for Quality Assurance and the other for Referee Testing.

Manufactured Sand means sand produced by the crushing and further processing, i.e., washing, grading, classifying of quarried rock, boulders, cobbles, or gravel from which the natural fine aggregate has been removed. Natural sand may be added to optimize properties.

Mineral Filler means a finely pulverized, inert, inorganic mineral or rock (e.g., limestone powder) having physical and mineralogical properties suitable for use in concrete.

Nominal Maximum Size means the largest sieve listed in the applicable specification upon which any material is permitted to be retained.

Physical Property means an inherent attribute or feature of an aggregate material. Tests are carried out to determine a material's resistance to weathering or degradation or both.

Quality Assurance (QA) means a system or series of activities carried out by the Owner to ensure that Materials received from the Contractor meet the requirements specified in the Contract Documents.

Referee Testing means testing of a material property or attribute for the purpose of resolving acceptance.

Self-Consolidating Concrete means a highly flowable and stable concrete that can spread readily into place, fill formwork, and encapsulate the reinforcement without any mechanical consolidation and without undergoing segregation or excessive bleeding.

Siliceous Aggregates means rock particles containing or composed of silica (SiO_2) or minerals with silica in the crystal structure as silicate (SiO_4).

Steel Slag means the non-metallic product resulting from the production of steel in a basic oxygen furnace or an electric arc furnace.

1002.05 MATERIALS

1002.05.01 General

Aggregates shall be according to OPSS 1001, unless otherwise specified in this specification.

Aggregates may be sands, gravel, quarried rock, or air-cooled blast furnace slag provided the source is of such a nature and extent as to ensure acceptable processed aggregates of a consistent gradation and quality.

Steel slag shall not be used in hydraulic cement concrete.

Air-cooled blast furnace slag shall not be used as aggregate in concrete pavements.

When a change in the character of the aggregates occurs or when the performance of the aggregates is found to be unsatisfactory, use of those aggregates shall be discontinued until the Contractor can prove to the satisfaction of the Contract Administrator that the source remains acceptable or can be made acceptable.

Irrespective of compliance with the physical property requirements of this specification, aggregates may be accepted or rejected based on the demonstrated performance of the aggregate in accelerated freeze-thaw testing according to LS-412 and ASTM C 666, or demonstrated past field performance in hydraulic cement concrete. In the case of acceptance based on field performance, the structure shall have been in the same environment and application as that in which the aggregate is proposed for use and shall be at least 15 years old. In the case of rejection, the structure or pavement may be of any age.

Demonstration of field performance shall be done according to CSA 23.2-27A - Attachment 2, Guidelines for Evaluating the Field Performance of Aggregates: Field and Laboratory Testing.

1002.05.02 Fine Aggregate

1002.05.02.01 General

Manufactured sand made with carbonate rock (e.g., limestone and dolostone) shall not be accepted for use in a hydraulic cement concrete pavement surface exposed to vehicular traffic due to the risk of polishing, unless the acid insoluble residue as determined by LS-613 is greater than 50%.

1002.05.02.02 Gradation Requirements

Except as noted below, fine aggregates shall meet the gradation requirements shown in Table 1.

When mix design changes or other criteria require the use of a gradation other than as specified in Table 1, the required gradation shall be submitted to the Contract Administrator for review.

The fineness modulus for any sample shall not vary by more than 0.20 from the sample upon which initial acceptance was based.

1002.05.02.03 Mineral Filler

Mineral fillers shall be limited to use in self-consolidating concrete. When mineral fillers are added to the mix, they shall be inert, non-plastic, free of clay, and added as a separate ingredient to the mix.

1002.05.02.04 Physical Property Requirements

Fine aggregate shall meet the physical property requirements shown in Table 2.

1002.05.03 Coarse Aggregate

1002.05.03.01 Gradation Requirements

1002.05.03.01.01 General

Coarse aggregate gradation requirements shown in Table 3 and Table 4 represent the allowable limits.

1002.05.03.01.02 Concrete Structures, Sidewalks, Curb and Gutter

The nominal maximum aggregate size shall be 19.0 mm, or as specified in the Contract Documents. Gradation of the coarse aggregate shall be within the limits shown in Table 3. It is acceptable to stockpile aggregates in individual size fractions and blend them in the mix so as to meet the gradation limits.

1002.05.03.01.03 Concrete Pavement and Concrete Base

The gradation of the coarse aggregates used in concrete pavement and concrete base shall meet the requirements for 37.5 mm and 19 mm aggregate shown in Table 4. Aggregates shall be stockpiled as individual size fractions and blended in the mix so as to meet the combined gradation requirements shown in Table 4.

1002.05.03.01.04 Concrete Patches, Refacing, and Overlays

The nominal maximum aggregate size shall be 13.2 mm for concrete patches, refacing, and overlays 100 mm or less in thickness. When the thickness of the repair exceeds 100 mm, the nominal maximum aggregate size shall be 19 mm. Grading of the coarse aggregate shall be within the limits shown in Table 3.

1002.05.03.02 Physical Property Requirements

Coarse aggregate shall meet the physical property requirements shown in Table 5. When coarse aggregate contains more than 15% passing the 4.75 mm sieve, the material finer than 4.75 mm shall also meet the physical property requirements shown in Table 2.

1002.05.03.02.01 Scaling Resistance

Coarse aggregate composed of more than 80% siliceous aggregates as determined by LS-609 shall be tested in a salt scaling test according to LS-412 together with either the fine aggregate that the coarse aggregate is intended to be used with, or a fine aggregate from the same geographic area as the coarse aggregate.

For the purposes of this specification, the concrete for LS-412 shall be proportioned with 355 kg/m³ of Type GU hydraulic cement and shall have a plastic air content of 7.0% ± 1.5% and a slump of 80 mm ± 20 mm.

The maximum permitted loss shall be 0.80 kg/m² after 50 cycles of freezing and thawing.

This test shall be done at the time of first use of a source for aggregate in concrete. The need for data to demonstrate compliance with this requirement shall be waived by the Contract Administrator if the source is on the current Ministry of Transportation's regional Aggregate Sources List for Structural Concrete Fine and Coarse Aggregates or Aggregate Sources List for Concrete Base/Pavement Coarse Aggregates. Irrespective of the waiving of this requirement, the warranty provisions of the Contract Documents shall apply.

1002.05.03.02.02 D-Line Cracking

Coarse aggregate from limestone and dolostone bedrock quarries for concrete pavement and concrete base, except for aggregate produced from the Oxford, Gull River, or Bobcaygeon Formations, shall be tested in the concrete freezing and thawing test according to ASTM C 666, Procedure A.

For the purposes of this specification, ASTM C 666 shall be conducted using the following parameters:

- a) The concrete for the test shall be proportioned to the combined gradation shown in Table 4, with 325 kg/m³ of Type GU hydraulic cement, a plastic air content of 6.5% ± 1.5%, and a slump of 50 mm ± 20 mm.
- b) The fine aggregate shall be that which is intended for use with the coarse aggregate or a fine aggregate from the same geographic area as the coarse aggregate.
- c) A minimum of three beams shall be tested.
- d) Procedure A shall be modified so that each freeze cycle takes 10.5 hours ± 1 hour.
- e) The test shall be conducted for 350 cycles.

The average change in length of the beams tested shall be no more than $\pm 0.0350\%$. The average fundamental transverse frequency (FTF) shall not be less than 90% of the FTF at an age of 14 Days.

This test shall be done at the time of first use of a source for aggregate in concrete pavement. The bench within the quarry from which the aggregate is selected for testing shall be identified by the Contractor. Approval of aggregate for concrete pavement shall only apply to the bench of the quarry from which the aggregate was taken. Aggregate processed from other benches within the same quarry shall require testing according to ASTM C 666, Procedure A, as modified above, prior to use. The need for data to demonstrate compliance with this requirement shall be waived by the Contract Administrator if the source is on the current Ontario Ministry of Transportation's regional Concrete Aggregate Sources List for Concrete Base/Pavement Coarse Aggregate. Irrespective of the waiving of this requirement, the warranty provisions of the Contract Documents shall apply.

1002.05.03.02.03 Deleterious Expansion

Aggregates that produce excessive expansion or cracking of concrete through reactions other than AAR shall not be used in concrete. The total content of lime (CaO), periclase (MgO) and glass in the aggregate shall be less than 0.001% by mass. The content of gypsum and anhydrite shall be less than 1.0% by mass. Steel slag is prohibited.

1002.05.03.03 Lightweight Aggregate

Lightweight aggregate shall be according to ASTM C 330.

1002.07 PRODUCTION

1002.07.01 Aggregate Processing, Handling, and Stockpiling

Processed aggregates shall be separated into fine and coarse aggregates and stockpiled separately. Aggregates separated during processing, aggregates secured from different sources, aggregates from the same source but of different gradations or from a new bench in a quarry, or aggregates resulting from a significant change in production that affects physical quality shall be stockpiled separately.

Aggregates that have become mixed with foreign matter of any description, or aggregates that have become mixed with each other, shall not be used and shall be immediately removed from the stockpile.

Aggregates shall be retained in stockpiles for at least 24 hours before use. Suitable stockpile locations are at the construction site, the site of batching of the concrete, the concrete source, or any other location acceptable to the Contract Administrator.

1002.08 QUALITY ASSURANCE

1002.08.01 General

QA testing may be carried out by the Owner for the purposes of ensuring that the aggregates used in the work are according to the requirements of this specification. Individual test results may be forwarded to the Contractor, as they become available.

The Owner shall be responsible for all costs associated with testing for QA purposes, unless otherwise indicated in the Contract Documents.

1002.08.02 Laboratory Requirements

The Contract Administrator shall designate the QA laboratories.

An acceptable laboratory conducting tests for physical properties shall be one that holds a current Type D certificate from CCIL for the applicable test methods and also participates in the annual MTO Proficiency Sample Testing Program for the specific tests except for LS-616 and LS-620.

An acceptable laboratory conducting tests for gradation according to LS-602 and materials finer than 75 µm by washing of the aggregates according to LS-601 shall be one that holds a current Type C certificate from CCIL.

Testing shall be conducted by qualified laboratory staff that holds a current certificate from CCIL in aggregate testing.

Equivalent alternate laboratory and technician certifications or laboratory proficiency testing programs may be used to demonstrate similar requirements, provided that they are acceptable to the Contract Administrator.

1002.08.03 Alternative to LS-614

LS-614 shall be used for acceptance, unless written notification to the Contract Administrator to replace it with LS-606 for acceptance is received prior to sampling of the applicable materials for QA purposes. Provided the Contract Administrator has received such a request, LS-606 shall be used. Otherwise, conformance to LS-614 shall be required.

When notification is provided after QA testing using LS-614 has been initiated, then the Contractor shall be charged for the cost of the testing using LS-614, administrative charges, and additional sampling, if required.

1002.08.04 Special Gradation for Fine Aggregate

Prior to samples being taken for QA purposes, the Contractor may provide a written request to the Contract Administrator to use a fine aggregate with a gradation that falls outside the limits shown in Table 1. Such a request shall include test data necessary to demonstrate that the material shall produce concrete of acceptable quality and meet all relevant requirements specified elsewhere in the Contract Documents. The assessment of performance shall include, but not be limited to, the following tests: compressive strength, splitting tensile strength and drying shrinkage.

1002.08.05 Sampling

Sampling shall be according to CSA A23.2-1A and LS-625.

Duplicate samples shall be taken and sealed by the Contractor in the presence of the Contract Administrator from stockpiles at the concrete plant, or in the absence of a stockpile at the plant, from stockpiles at the aggregate source that contain a minimum quantity of 500 tonnes of each aggregate for each concrete mix unless otherwise directed by the Contract Administrator.

The mass of each sample shall meet the requirements shown in Table 6. When more than 30 kg is required, the total sample shall be recombined by the QA laboratory prior to testing. In the event that the Contractor is unavailable to take the sample, no further materials shall be placed in the work until the duplicate samples have been taken.

The Contractor shall provide new or clean sample bags or containers that are constructed to prevent the loss of any part of the material or contamination or damage to the contents during shipment. Metal or cardboard containers are unacceptable.

QA samples shall be identified on both the inside and outside of the sample container.

1002.08.06 Testing and Retention of Samples

When the Contract Administrator elects to carry out QA testing, one of the duplicate samples shall be randomly selected for testing by the QA laboratory and the remaining sealed sample shall be retained by the QA laboratory for possible referee testing.

1002.08.07 Acceptance

QA test results shall be used for acceptance purposes, except when referee testing has been carried out.

When QA test results show that the aggregates meet the requirements of this specification, the aggregates shall be accepted.

When QA test results show that the aggregates do not meet the requirements of this specification, the Contract Administrator shall notify the Contractor that the material represented by the test results shall not be accepted. This notification shall take place in writing within 3 Business Days of receipt of the non-conforming data. The Contractor has the option of either removing the aggregates from the Work or invoking referee testing. The Contractor may request a reduced price in lieu of removal for aggregates that fail to meet the requirements of this specification. Irrespective of the negotiation of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

1002.08.08 Referee Testing

When QA test results do not meet the requirements of this specification, the Contractor has the option of invoking referee testing of the test result that fails to meet the requirements. The Contractor shall notify the Contract Administrator of the selected option in writing within 2 Business Days following written notification of unacceptable material.

The Contract Administrator shall select a referee testing laboratory acceptable to the Contractor within 3 Business Days following the Contractor's notification to invoke referee testing. Referee test samples shall be delivered to the referee testing laboratory from the QA laboratory by the Contract Administrator. The sealed sample shall be opened in the presence of the Contractor and the Contract Administrator.

Referee testing shall be carried out in the presence of the Contract Administrator. When applicable, the referee laboratory shall also test a control aggregate sample for each test method required. The Contractor may observe the testing at no cost to the Owner.

The Contractor and Owner may send a maximum of two representatives each to observe the referee testing. The Contract Administrator shall notify the Owner and Contractor a minimum of 3 Business Days in advance of the date of referee testing. Provided that such notice was given, referee testing shall be carried out regardless of the absence of one or more observers.

Observers shall follow the referee laboratory protocols for access to the premises and testing equipment and shall not unnecessarily impede the progress of the testing. Observers shall be permitted to validate sample identification and view sample condition. Subject to safety requirements, test method and equipment limitations, they shall also be permitted to observe test procedures, take notes, view equipment readings, and review completed work sheets while in attendance.

Comments on the non-conformity of the test methods shall be made and corrected at the time of testing.

Referee test results shall be binding on both the Owner and the Contractor.

When a referee test result shows that the aggregates do not meet the requirements of this specification, the aggregates represented by the test result, including aggregates in existing stockpiles or in the Work, shall not be accepted. The Contractor shall remove the aggregates from the Work at no cost to the Owner. The Contractor may request a reduced price in lieu of removal of the aggregates that fail to meet the requirements of this specification. Irrespective of the negotiation of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

When referee test results show that the aggregates meet the requirements of this specification, the aggregates represented by the sample shall be accepted.

The Owner shall be responsible for the cost of referee testing, provided that the referee test results show that the aggregates meet the applicable specifications. Otherwise, the Contractor shall be responsible for the cost.

TABLE 1
Gradation Requirements (LS-602) for Fine Aggregate (Note 1)

MTO Sieve Designation	Percent Passing
9.5 mm	100
4.75 mm	95 - 100
2.36 mm	80 - 100
1.18 mm	50 - 85
600 µm	25 - 60
300 µm	10 - 30
150 µm	0 - 10
75 µm	0 - 3 Natural Sand 0 - 6 Manufactured Sand
Note: 1. Fine aggregate shall have no more than 45% passing any sieve and retained on the next consecutive sieve. The fineness modulus shall be a minimum of 2.3 and a maximum of 3.1.	

TABLE 2
Physical Property Requirements for Fine Aggregate

Laboratory Test Name	MTO or CSA Lab Test Number	Acceptance Limit
Organic Impurities, Maximum organic plate number (Note 1)	LS-610	3
Micro-Deval Abrasion, % maximum loss	LS-619 or CSA A23.2-23A	20
Accelerated Mortar Bar Expansion, % maximum at 14 Days (Notes 2 and 3)	LS-620 or CSA A23.2-25A	0.150
Concrete Prism Expansion, % maximum at 1 year (Notes 2 and 4)	CSA A23.2-14A	0.040
Notes: 1. A fine aggregate producing a colour darker than standard colour No. 3 shall be considered to have failed this requirement. A failed fine aggregate may be used if comparative mortar specimens prepared according to ASTM C87 meet the following requirements: a) Mortar specimens prepared using unwashed fine aggregate shall have a 7-Day compressive strength that is a minimum of 95% of the strength of mortar specimens prepared using the same fine aggregate washed in a 3% sodium hydroxide solution. Type GU hydraulic cement shall be used. b) Setting time of the unwashed fine aggregate mortar specimens shall not differ from washed fine aggregate mortar specimens by more than 10%. 2. The need for data to demonstrate compliance with this requirement shall be waived by the Contract Administrator if the aggregate source is on the current Ministry of Transportation's regional Aggregate Sources List for Structural Concrete Fine and Coarse Aggregates. 3. An aggregate that fails this requirement may be accepted provided the requirements of CSA A23.2-14A are met. 4. An aggregate need only meet this requirement if it fails the requirements of CSA A23.2-25A. Test data shall have been obtained within the past 18 months from aggregate that is from the same source and processed in the same manner as the material that is intended to be used.		

TABLE 3
Gradation Requirements (LS-602) for Coarse Aggregate
Structural Concrete, Sidewalks, Curb and Gutter

Nominal Maximum Size	19.0 mm	16.0 mm	13.2 mm	9.5 mm	6.7 mm
MTO Sieve Designation mm	Percent Passing				
26.5	100	-	-	-	-
19.0	85-100	100	100	-	-
16.0	65-90	96-100	-	-	-
13.2	-	67-86	90-100	100	100
9.5	20-55	29-52	40-70	85-100	-
6.7	-	-	-	-	75-100
4.75	0-10	0-10	0-15	10-30	40-80
2.36	-	-	-	0-10	0-20

TABLE 4
Gradation Requirements (LS-602) for Coarse Aggregate
Concrete Pavement or Concrete Base

Nominal Maximum Size	37.5 mm	19.0 mm	Combined
MTO Sieve Designation mm	Percent Passing		
53.0	100	-	100
37.5	90-100	-	95-100
26.5	20-55	100	-
19.0	0-15	85-100	35-70
9.5	0-5	20-55	10-30
4.75	-	0-10	0-5

TABLE 5
Physical Requirements for Coarse Aggregates for Concrete

MTO or CSA Laboratory Test	MTO or CSA Laboratory Test Number	Acceptance Requirements (Note 1)	
		Pavement	Structures, Sidewalk, Curb and Gutter, and Concrete Base
Wash Pass 75 µm Sieve, Guideline A, % maximum - for gravel - for crushed rock	LS-601 (Guideline A)	1.0 2.0	1.0 2.0
Absorption, % maximum	LS-604 or CSA A23.2-12A	2.0	2.0 (Note 2)
Flat and Elongated Particles, % maximum	LS-608	20	20
Petrographic Number, Concrete, maximum	LS-609	125	140
Unconfined Freeze-Thaw, % maximum loss, (Note 3)	LS-614 or CSA A23.2-24A	6	6
Micro-Deval Abrasion, % maximum loss	LS-618 or CSA A23.2-29A	14	17 (Note 2)
Accelerated Mortar Bar Expansion, % maximum at 14 Days (Notes 2 and 5)	LS-620 or CSA A23.2-25A	0.150 (Note 6)	0.150 (Note 6)
Concrete Prism Expansion, % maximum at one year (Notes 4 and 7)	CSA A23.2-14A	0.040	0.040
Potential Alkali-Carbonate Reactivity of Quarried Carbonate Rock (Note 8)	CSA A23.2-26A	Chemical Composition Must Plot in the Non-Expansive Field of Fig. 1 of Test Method	
Alternative Requirement to Unconfined Freeze-Thaw Loss (LS-614)			
Magnesium Sulphate Soundness, 5 Cycles, % maximum loss (Note 3)	LS-606	12	12

Notes:

- Where a concrete surface is subject to vehicular traffic, the physical requirements for "Pavement" shall apply to the aggregate used.
- For air-cooled blast-furnace slag aggregate, the allowable maximum value for Micro-Deval shall be 21% for structures and the allowable maximum value for Absorption shall be according to the Owner's requirements for slag aggregate.
- The Owner shall waive the requirements for LS-614, Unconfined Freeze-Thaw, provided the Contractor has submitted a written request that the coarse aggregate meets the alternative requirements for LS-606, magnesium sulphate soundness.
- The need for data to demonstrate compliance with this requirement will be waived by the Contract Administrator if the source is on the current Ministry of Transportation's regional Aggregate Sources List (ASL) for Structural Concrete Fine and Coarse Aggregates or the Aggregate Sources List of Concrete Base/Pavement Coarse Aggregates. If the aggregate is potentially expansive due to alkali-carbonate reaction as determined by CSA A23.2-26A, the aggregate shall meet the requirements of CSA A23.2-14A, even though it may be shown on as coarse aggregate on the ASL.
- An aggregate that fails to meet these requirements shall be accepted by the Contract Administrator provided the requirements of CSA A23.2-14A are met.
- If the aggregate is a quarried sandstone, siltstone, granite, or gneiss, the expansion shall be less than 0.080% after 14 Days. For quarried aggregates of the Gull River, Bobcaygeon, Verulam and Lindsay Formations, the expansion shall be less than 0.100% after 14 Days.
- An aggregate needs to meet this requirement only if it fails the requirements of either CSA A23.2-25A or CSA A23.2-26A. The test data shall have been obtained within the past 18 months from aggregate from the same location within the source as that to be used in the work. If this test is conducted to show that an aggregate deemed potentially expansive by CSA A23.2-26A does not exceed 0.040% after 1 year, then chemical analysis, CSA A23.2-26A, shall be provided to show that the aggregate intended for use has the same chemical composition as the material tested in CSA A23.2-14A.
- This requirement only applies to aggregate quarried from the Gull River and Bobcaygeon Formations of southern and eastern Ontario. These dolomitic limestones outcrop on the southern margin of the Canadian Shield from Midland to Kingston and in the Ottawa-St Lawrence Lowlands near Cornwall.

TABLE 6
Sample Size

Material	Minimum Mass of Field Samples (Note 1) kg
Fine aggregate	15
19 mm coarse aggregate	25
37.5 mm coarse aggregate	50
Note: 1. Individual sample containers shall hold no more than 30 kg of aggregate. When more than 30 kg is required, additional sample container shall be used.	

Appendix 1002-A, November 2013
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

- The nominal maximum size of aggregate if other than 19.0 mm is required. (1002.05.03.01.02)
- If the quality assurance sampling and testing frequencies provided in Appendix 1002-B are to be used, Appendix 1002-B needs to be invoked by reference in the Contract Documents.
- If the payment reduction in lieu of aggregate removal provided in Appendix 1002-C is to be used, Appendix 1002-C needs to be invoked by reference in the Contract Documents.
- If the test data forms in Appendices 1002-D and 1002-E are to be used for submission purposes, Appendices 1002-D and 1002-E need to be invoked by reference in the Contract Documents.

The designer should be aware that quality assurance (QA) testing for purposes of ensuring material used in the Work meets the requirements of OPSS 1002 is not mandatory, unless specifically included in the Contract Documents. The designer should determine the need for QA testing based on the size and complexity of the work and specify the required frequency of QA sampling and testing (1002.08.01). Appendix B provides recommended QA sampling and testing frequencies.

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

Related Ontario Provincial Standard Drawings

No information provided here.

Appendix 1002-B, November 2013**FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS**

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

Supplementary Requirements for Quality Assurance Sampling and Testing Frequencies

OPSS.MUNI 1002 Aggregates - Concrete, is amended as follows:

1002.08 QUALITY ASSURANCE**1002.08.01 General**

The first paragraph of subsection 1002.08.01 is deleted in its entirety and replaced with the following:

QA sampling and testing shall be carried out by the Owner for the purposes of ensuring that the aggregates used in the work are according to the requirements of the Contract Documents. QA sampling and testing shall be carried out at the frequency specified in Table B-1. Individual test results may be forwarded to the Contractor as they become available.

Table B-1 is added.

TABLE B-1
Sampling and Testing Frequency for Physical Property and Gradation Requirements

Concrete Production Per Mix Design, m³	Minimum Frequency Each Aggregate Type per Each Concrete Type
$\leq 5,000$	One sample.
$> 5,000$ (Note 1)	One sample per 5,000 m ³ .
Note: 1. When the concrete production per mix design is: a) Less than one-half the quantity required for a sample, then that quantity shall be added to the quantity representing the previous sample. b) Greater than or equal to one-half the quantity required for a sample, then that quantity shall require its own sample.	

Appendix 1002-C, November 2013

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

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

Supplementary Requirements for a Price Reduction In Lieu of Removal of Aggregates

OPSS.MUNI 1002 Aggregates - Concrete, is amended as follows:

When a tested sample of aggregates shows that the aggregates do not meet the requirements of this specification, the aggregates represented by the test result, including material in existing stockpiles or in the Work, shall not be accepted. The Contractor may request a reduced price in lieu of removal provided the applicable test results:

- a) Do not exceed the requirement for LS-614, or LS-606 if it has replaced LS-614, by more than 25% of the specified value.
- b) Do not exceed the Petrographic Number of 135 for concrete pavement and 150 for structural concrete when tested according to LS-609.
- c) Do not exceed the requirement for LS-618 by more than 10% of the specified value
- d) Meet all other requirements of this specification.

Irrespective of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

Appendix 1002-D, November 2013

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

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

**OPSS 1002- CONCRETE AGGREGATE TEST DATA
FINE AGGREGATE**

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory:		Telephone No.:	Fax No.:
Sampled By (Print Name):		Date Sampled (YY/MM/DD):	

Fineness Modulus:	Aggregate Inventory Number(AIN):		Gradation (Attach grading or control chart):	
Source Name/Location:	Sieve Size:	Gradation Requirement: 0-3% natural sand 0-6% manufactured sand	Sample Results:	Meets Requirements (Y/N):
	% pass 75 µm			

Laboratory Test and Number	Requirement	Concrete ASL (√)	Test Results		
			Reference Material	Sample	Meets Requirements (Y/N)
Organic Impurities, Maximum organic plate number, LS-610	3 (Notes 1 and Note 5)				
Micro-Deval Abrasion, % maximum loss, LS-619 or CSA A23.2-23A	20				
Accelerated Mortar Bar Expansion, % maximum at 14 Days, LS-620 or CSA A23.2-25A, (Note 2)	0.150 (Note 3)				
Concrete Prism Expansion, % maximum at 1 year, CSA A23.2-14A, (Note 2)	0.040 (Note 4)				
Structural Strength, minimum at 7 Days, ASTM C 87, (Note 5)	≥ 95% strength of mortar washed in NaOH				

I hereby certify that testing has been carried out by a properly qualified/certified test technician:

Issued by: _____
PRINT NAME TESTING LABORATORY REPRESENTATIVE SIGNATURE DATE

Received by: _____
PRINT NAME CONTRACT ADMINISTRATOR REPRESENTATIVE SIGNATURE DATE

Copies to: ☐ Contract Administrator ☐ Contractor

Appendix 1002-D

Note:

1. A fine aggregate producing a darker colour than standard colour No. 3 shall be considered to have failed the requirement for LS-610.
2. Compliance with this requirement is waived, if the aggregate source is on the current Ontario Ministry of Transportation Regional Aggregate Sources List for Structural Concrete - Fine and Coarse Aggregates.
3. An aggregate that fails this requirement may be accepted provided the requirements of CSA 23.2-14A are met.
4. An aggregate only has to meet this requirement if it fails the requirements of CSA A23.3-25A. Test data shall have been obtained within the past 18 months from an aggregate sample taken from the same source and processed in the same manner as the material intended for use.
5. This test is only required if the aggregate has failed LS-610. An aggregate that has failed the requirements for LS-610 may be accepted if comparative mortar specimens prepared according to ASTM C 87 meet the following requirements:
 - a) Mortar specimens prepared using unwashed fine aggregate shall have a 7-Day compressive strength that is a minimum of 95% of the strength of the mortar specimens prepared using the same fine aggregate washed in a 3% sodium hydroxide solution. Type GU hydraulic cement shall be used.
 - b) Setting time of the unwashed fine aggregate mortar specimens shall not differ from washed fine aggregate mortar specimens by more than 10%.

Appendix 1002-E, November 2013
FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

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

**OPSS 1002- CONCRETE AGGREGATE TEST DATA
COARSE AGGREGATE**

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory:		Telephone No.:	Fax No.:
Sampled By (Print Name):		Date Sampled (YY/MM/DD):	
Nominal Maximum Size (mm):	Aggregate Inventory Number(AIN):	Gradation (Attach grading or control chart):	
Source Name/Location:		Meets Requirements (Y/N):	

Laboratory Test and Number	Requirement (Note 1)		Concrete ASL (✓)	Test Results		
	Pavement	Structures, Sidewalks, Curb and Gutter, Concrete Base		Reference Material	Sample	Meets Requirements (Y/N)
Salt Scaling, maximum loss @ 50 cycles, LS-412 (Notes 2, 3, and 4))	0.80 kg/m ²					
Wash Pass 75 µm Sieve , Guideline A, % maximum, LS-601	1.0 (gravel) 2.0 (crushed rock)					
Absorption, % maximum LS-604 or CSA A23.3-12A	2.0 (Note 5)					
Flat and Elongated Particles, % maximum, LS-608	20					
Petrographic Number, Concrete, Maximum, LS-609	125 (Attach PN report)	140 (Attach PN report)				
Unconfined Freeze-Thaw, % maximum loss, LS-614 or CSA A23.2-24A, (Note 6)	6					
Micro-Deval Abrasion, % maximum loss, LS 618 or CSA A23.2-29A	14	17 (Note 7)				
Accelerated Mortar Bar Expansion, % maximum at 14 Days, LS-620 or CSA A23.2-25A, (Notes 3 and 8)	0.150 (Notes 9 and 10)					
Concrete Prism Expansion, % maximum at 1 year, CSA A23.2-14A, (Notes 3, 8, and 11)	0.040					
Potential Alkali-Carbonate Reactivity, Carbonate Rock, CSA A23.2-26A, (Note 12)	Chemical composition must plot in the non-expansive field of Fig. 1			Attach data	Attach graph	
Concrete Freeze-Thaw, ASTM C 666, Procedure A (Notes 3 and 13)	Average Δ length ≤ ± 0.350% Average FTF ≥90% of FTF @ 14 Days					
Alternative Requirement to Unconfined Freeze-Thaw (LS-614 or CSA A 23.2-12A)						
Magnesium Sulphate Soundness, % maximum loss, LS-606, (Note 6)	12					

Appendix 1002-E

I hereby certify that testing has been carried out by a properly qualified/certified test technician:

Issued by:

PRINT NAME	TESTING LABORATORY REPRESENTATIVE SIGNATURE	DATE

Received by:

PRINT NAME	CONTRACT ADMINISTRATOR REPRESENTATIVE SIGNATURE	DATE

Copies to: ☐ Contract Administrator ☐ Contractor

Notes:

1. Where a concrete surface is exposed to vehicular traffic, the physical requirements for "Pavement" shall apply to the aggregate used.
2. This test only needs to be done at the time of first use of a source for concrete aggregate.
3. Compliance with this requirement is waived if the aggregate source is on the MTO regional Aggregate Source List for Structural Concrete - Fine and Coarse Aggregates, or the MTO regional Aggregate Source List for Concrete Base/Pavement Coarse Aggregates.
4. Coarse aggregate composed of more than 80% siliceous aggregates, as determined by petrographic examination (LS-609), shall be tested, together with either the fine aggregate that the coarse aggregate is intended to be used with, or a fine aggregate from the same geographic area as the coarse aggregate. The concrete shall be proportioned with 355 kg/m³ of Type GU hydraulic cement, shall have a plastic air content of 7.0 ± 1.5% and a slump of 80 ± 20 mm.
5. For air-cooled blast-furnace slag aggregate, the allowable maximum value for absorption shall conform to the Owner's requirements for slag aggregate.
6. Compliance with the unconfined freeze-thaw test, LS-614 or CSA A23.2-24A is waived if the aggregate meets the alternative requirement for magnesium sulphate soundness loss, LS-606.
7. For air-cooled blast-furnace slag aggregate, the allowable maximum value for Micro-Deval shall be 21% for structures.
8. If the aggregate is potentially expansive due to alkali-carbonate reaction as determined by CSA A23.2-26A, the aggregate must meet the requirement of CSA A23.2-14A, even though it may be shown as a coarse aggregate on the MTO regional Aggregate Sources List for Structural Concrete Fine and Coarse Aggregates or the Aggregate Sources List for Concrete Base/Pavement Coarse Aggregates.
9. If the aggregate is a quarried sandstone, siltstone, granite or gneiss, the expansion shall be less than 0.080% after 14 Days. For quarried aggregates of the Gull River, Bobcaygeon, Verulam and Lindsay Formations, the expansion shall be less than 0.100% after 14 days.
10. An aggregate that fails this requirement may be accepted provided the requirement for CSA A23.2- 14A is met.
11. An aggregate needs to meet this requirement only if it fails the requirements of either CSA A23.2-25A or CSA A23.2-26A. If this test is conducted for an aggregate deemed potentially expansive according to CSA A23.2-26A, then a chemical analysis (CSA A23.2-26A) shall be provided to show that the aggregate intended for use has the same chemical composition as the material tested. Test data shall have been obtained within the past 18 months from aggregate from the same location within the source as that to be used in the work.
12. This requirement only applies to aggregates quarried from the Gull River and Bobcaygeon Formations of southern and eastern Ontario. These dolomitic limestones outcrop on the southern margin of the Canadian Shield from Midland to Kingston and in the Ottawa-St Lawrence Lowlands near Cornwall.
13. The following apply to this test:
 - a) Coarse aggregates from limestone and dolostone bedrock quarries for concrete pavement and concrete base shall be tested, except for aggregate produced from the Oxford, Gull River or Bobcaygeon Formations.
 - b) The fine aggregate shall be either the fine aggregate intended for use or a fine aggregate from the same geographic area as the coarse aggregate.
 - c) The bench within the quarry from which the aggregate is selected for testing shall be defined. Acceptance shall only apply to the bench of the quarry from which the selected aggregate was taken. Aggregate processed from other benches within the same quarry will require further testing prior to use.
 - d) The concrete for the test shall be proportioned to the combined grading shown in Table 4, of OPSS 1002, with 325 kg/m³ of Type GU hydraulic cement, a plastic air content of 6.5 ± 1.5%, and a slump of 50 ± 20 mm.
 - e) Procedure A shall be modified so that each freeze cycle takes 10.5 ± 1 hours; and the test shall be conducted for 350 cycles.



MATERIAL SPECIFICATION FOR AGGREGATES - HOT MIX ASPHALT

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1003.01	SCOPE

This specification covers material requirements for aggregates for use in hot mix asphalt (HMA).

1003.01.01 Specification Significance and Use

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

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

1003.01.02 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.

1003.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

OPSS 1001 Aggregates - General

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-312	Fractionation of Unextracted Reclaimed Asphalt Pavement (RAP) and Hot Mix Aggregate for Testing or Incorporation in Other Test Samples
LS-601	Materials Finer than 75 µm Sieve in Mineral Aggregates by Washing
LS-602	Sieve Analysis of Aggregates
LS-604	Relative Density and Absorption of Coarse Aggregate
LS-606	Soundness of Aggregate by Use of Magnesium Sulphate
LS-607	Percent Crushed Particles in Processed Coarse Aggregate
LS-608	Percent Flat and Elongated Particles in Coarse Aggregate
LS-609	Petrographic Analysis of Coarse Aggregate
LS-613	Insoluble Residue of Carbonate Aggregates
LS-614	Freezing and Thawing of Coarse Aggregate

LS-617	Percent Particles with Two or More Crushed Faces and Uncrushed Particles in Processed Coarse Aggregate
LS-618	Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-619	Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-625	Guidelines for Sampling of Aggregate Materials
LS-629	Uncompacted Void Content of Fine Aggregate
LS-703/704	Liquid Limit, Plastic Limit and Plasticity Index of Soils

ASTM International

D 4791-10	Standard Method of Test for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
D 5821-01(2006)	Standard Method of Test for Determining the Percentage of Fractured Particles in Coarse Aggregate

American Association of State Highway and Transportation Officials (AASHTO)

T 176-08	Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

1003.03 DEFINITIONS

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

Air-Cooled Blast Furnace Slag means the material resulting from solidification of molten blast-furnace slag under atmospheric conditions. Subsequent cooling may be accelerated by application of water to the solidified surface.

Bench means a ledge parallel to stratigraphic bedding that in quarries forms a single level of operation above which rock is excavated from a contiguous face.

Blending Method means a production process for monitoring coarse and fine aggregates used in the mix whereby the combined materials are sampled from the cold feed stream at the HMA facility after mixing prior to the addition of liquid asphalt cement.

CCIL means the Canadian Council of Independent Laboratories.

Chip Product means an aggregate co-product from the crushing operation with 100% passing the 9.5 mm sieve, predominantly passing the 4.75 mm sieve, and retained on the 2.36 mm sieve.

Consensus Property means an aggregate property required for use in a Superpave mix.

Copper Slag means the non-metallic product resulting from the production of copper.

Duplicate Samples means two samples taken at the same time and location, one to be used for quality assurance testing and the other for referee testing.

Equivalent Single Axle Load (ESAL) means equating the damage to a pavement structure caused by the passage of a non-standard axle load to a standard 80 kN axle load.

Hot Mix Asphalt (HMA) means hot mixed, hot laid asphaltic concrete. The terms are used interchangeably. HMA may include recycled or specialty mixes.

Nickel Slag means the non-metallic product resulting from the production of nickel.

Physical Property means an inherent attribute or feature of an aggregate material. Tests are carried out to determine a material's resistance to weathering or degradation or both.

Quality Assurance (QA) means a system or series of activities carried out by the Owner to ensure that Materials received from the Contractor meet the requirements specified in the Contract Documents

Reclaimed Asphalt Pavement (RAP) means the processed HMA material that is recovered by partial or full depth removal.

Referee Testing means testing of a material property or attribute for the purpose of resolving acceptance.

Roof Shingle Tabs (RST) means ground roof shingle scrap generated when new shingles are trimmed during production.

Steel Slag means the non-metallic product resulting from the production of steel in a basic oxygen furnace or an electric arc furnace.

Stone Mastic Asphalt or Stone Matrix Asphalt (SMA) means HMA consisting of a gap-graded, stone-on-stone coarse aggregate skeleton with an asphalt binder rich mortar.

Superpave means an acronym for Superior Performing Asphalt Pavements. It is an alternative system to the Marshall method for specifying material components and asphalt mix design using the Superpave gyratory compactor.

1003.05 MATERIALS

1003.05.01 General

Aggregates shall be according to OPSS 1001, unless otherwise specified in this specification.

Aggregates may be sands, gravels, quarried rock, or the aggregate portion of RST, or the aggregate portion of RAP, provided the source is of such a nature and extent as to ensure acceptable processed aggregates of a consistent gradation and quality.

Steel slag, air-cooled blast furnace slag, nickel slag, and copper slag are not acceptable for use in HMA.

RAP containing steel slag is not permitted.

RST containing asbestos is not permitted. Post consumer shingle material is not permitted.

If one or more of the aggregates to be used in the mix requires an anti-stripping agent, then all aggregates shall be treated with the same anti-stripping agent.

When an aggregate stockpile consists of both fine and coarse aggregate in which either component is greater than 15% by mass of the total, both the fine aggregate and coarse aggregate shall meet the respective physical requirements of this specification.

When a change in the character of the aggregate occurs or when the performance of the aggregate is found to be unsatisfactory, use of those aggregates shall be discontinued until the Contractor can prove to the satisfaction of the Contract Administrator that the source remains acceptable or can be made acceptable.

For HL1,

- a) Coarse aggregate shall be produced by crushing bedrock or gravel.
- b) Coarse aggregate shall be supplied from sources named on the MTO pre-qualified products list.

For Superpave 12.5 FC1, a minimum of 85% of the total aggregate in the mix retained on the 2.36 mm sieve shall be produced from a source named on the MTO pre-qualified products list.

For Superpave 12.5 FC2 and DFC,

- a) Coarse and fine aggregates in the mix shall be produced from crushed bedrock material supplied from a source named on the MTO pre-qualified products list.
- b) Coarse aggregate may be obtained from a different source than the fine aggregate.
- c) When RAP is used, the coarse aggregate portion of the RAP may be derived from a different source or sources than the rest of the coarse aggregate. In all other cases, blending of coarse aggregates from different sources is not permitted, except for the chip product.
- d) Blending of fine aggregate from different sources is permitted providing the aggregate particles retained on the 4.75 mm sieve as part of the blended fine aggregate comprise less than 20% by mass of the total amount of coarse aggregate.

For HDBC,

- a) Coarse aggregates shall be produced by crushing either bedrock material, gravel, cobble, or boulder material retained on the 50.0 mm sieve.
- b) Fine aggregates shall be produced by crushing either bedrock material, gravel, cobble, or boulder material retained on the 9.5 mm sieve.
- c) If necessary, coarse and fine aggregates shall be processed to meet the HMA requirements specified in the Contract Documents, including washing and classification.

For SMA,

- a) Coarse and fine aggregates shall be produced from crushed bedrock material supplied from sources shown in Table 1.
- b) Coarse and fine aggregates shall be obtained from the same source.
- c) Aggregate derived from RST may be from a source different than the rest of the aggregates for the SMA.

Irrespective of compliance or non-compliance with the physical requirements, aggregates may be accepted or rejected on the basis of documented field performance. The pavement with which satisfactory field performance is demonstrated shall have been in a similar environment and application to that in which the aggregate is proposed for use and shall be at least 10 years old. A petrographic study shall be conducted to demonstrate that the aggregate in the original pavement is the same as that under consideration. Field performance shall be determined by the Owner.

Blending of aggregates shall be permitted at the hot mix plant.

1003.05.02 Fine Aggregate

1003.05.02.01 Gradation Requirements

Fine aggregates shall be graded so that when combined with other aggregates, they consistently meet the overall gradation of the HMA specified in the Contract Documents.

1003.05.02.02 Physical Property Requirements

Fine aggregates shall be composed of clean, hard, durable particles meeting the requirements shown in Table 2, unless the blending method has been selected.

When the Contract Administrator has received a written request from the Contractor to use the blending method, acceptance for physical properties shall be based on the total combined fine aggregate. In this case the total combined fine aggregate shall meet the requirements shown in Table 2. In addition, for each individual fine aggregate component of the blend, the maximum loss shall not exceed 35%, when tested according to LS-619.

1003.05.02.03 Consensus Property Requirements

For Superpave HMA, the fine aggregate portion of the combined HMA aggregate, including aggregate derived from RAP or RST or both which has been fractionated and proportioned according to LS-312 and the mix design, shall meet the consensus property requirements of AASHTO T 176 and LS-629 shown in Table 3 for the traffic category specified in the Contract Documents. However, for AASHTO T 176 only, the combine fine aggregate portion shall exclude any fine aggregate that is derived from RAP or RST or both.

1003.05.03 Coarse Aggregate

1003.05.03.01 Gradation Requirements

Coarse aggregates shall be graded so that when combined with other aggregates, they consistently meet the overall gradation of the HMA specified in the Contract Documents.

1003.05.03.02 Physical Property Requirements

Coarse Aggregates for use in HMA binder and leveling courses shall meet the physical property requirements shown in Table 4.

Coarse aggregates for use in HMA surface courses shall meet the physical property requirements shown in Table 5.

A chip product shall also meet the appropriate physical property requirements of this specification unless:

- a) the chip product is derived:
 - i. for Superpave 12.5 FC2 and SMA 12.5 or SMA 9.5, from the same sources as the primary coarse aggregate used in the mix; or
 - ii. for Superpave 12.5 FC1, from an aggregate source listed on the MTO pre-qualified products list; or
 - iii. for all other mixes, either from an aggregate source listed on the MTO pre-qualified products list or from a coarse aggregate in the mix that meets all of the applicable physical property requirements; and
- b) according to the gradation determined from the mix design, the retained 4.75 mm fraction of the chip product does not exceed 15% by mass of the total cumulative combined coarse aggregate fraction of the mix including any aggregate derived from RAP.

When the Contractor elects to sample blended coarse aggregates from the cold feed to show conformance with this specification, the blended coarse aggregate shall also meet the above requirements.

1003.05.03.03 Consensus Property Requirements

For Superpave HMA, the coarse aggregate portion of the combined HMA aggregate, including any coarse aggregate derived from RAP, which has been fractionated and proportioned according to LS-312 and the mix design, shall meet the consensus property requirements shown in Table 3 for the traffic category specified in the Contract Documents.

1003.05.04 Filler

Filler shall consist of mineral filler, hydrated lime, Portland cement, or other material as designated and currently approved by the Owner for use in HMA. For SMA, the filler shall be mineral filler. Mineral filler shall be produced from rock sources acceptable for coarse aggregates meeting the physical property requirements shown in Tables 4 and 5 for Superpave mixes. Mineral filler shall be sufficiently dry so as to flow freely, free from agglomerations, non-plastic according to LS-703/704, and meet the following gradation requirements according to LS-601 and LS-602:

- a) 100% passing 600 µm sieve.
- b) Not less than 70% passing 75 µm sieve.
- c) Not more than 20% passing 20 µm sieve, SMA only.

1003.07 PRODUCTION

1003.07.01 Aggregate Processing, Handling, and Stockpiling

Processed aggregates shall be separated into fine and coarse aggregates and stockpiled separately.

Aggregates separated during processing, aggregate secured from different sources, and aggregates from the same source but of different gradations shall be placed in individual stockpiles. When screenings from primary and secondary crushers are produced separately, they shall be stockpiled separately.

Aggregates that have become mixed with foreign matter of any description or aggregates that have become mixed with each other shall not be used and shall be immediately removed from the stockpile.

Aggregates shall be retained in stockpiles for at least 24 hours prior to use. Suitable stockpile locations are the site of mixing of the HMA, the aggregate source, or any other location acceptable to the Contract Administrator.

1003.08 QUALITY ASSURANCE

1003.08.01 General

QA testing may be carried out by the Owner for the purposes of ensuring that the aggregates used in the work are according to the requirements of this specification. Individual test results may be forwarded to the Contractor, as they become available.

Test data for each aggregate type shall be managed independently. When more than one source is used for supplying materials, test data from each source and product shall be managed independently.

The Contractor shall elect to either:

- a) Have QA sampling and testing done on a stockpile basis, when each aggregate stockpile shall meet the physical requirements; or
- b) Have QA sampling and testing of the material after the cold feed bins, but before the material is mixed with liquid asphalt cement, when the combined fine aggregates and the combined coarse aggregates shall meet the physical requirements.

If the Contractor elects to use process b) above, and one or more components do not by themselves meet this specification, the Contractor shall notify the Contract Administrator and provide a production process satisfactory to the Contract Administrator.

When anti-stripping agent is used, test samples for the physical property requirements shall be taken prior to the addition of hydrated lime. If this is not practical for samples that are coated in hydrated lime, the lime may be removed by washing prior to testing. In this case, the requirements for LS-601 shall be waived.

The Owner shall be responsible for all costs associated with testing for QA purposes, unless otherwise specified in the Contract Documents.

1003.08.02 Laboratory Requirements

The Contract Administrator shall designate the QA laboratories.

An acceptable laboratory conducting tests for physical and consensus properties shall be one that holds a current Type D certificate from CCIL for the applicable test methods and also participates in the annual MTO Proficiency Sample Testing Program for the specific tests, when applicable.

An acceptable laboratory for testing gradation according to LS-602, percent crushed particles according to LS-607, and materials finer than 75 μm by washing of the aggregates according to LS-601 shall be one that holds a current Type C certificate from CCIL.

Testing shall be conducted by qualified laboratory staff that holds a current certificate from CCIL in aggregate testing.

Equal alternate laboratory and technician certifications or laboratory proficiency testing programs may be used to demonstrate similar requirements, provided that they are acceptable to the Contract Administrator.

1003.08.03 Alternative to LS-614

LS-614 shall be used for acceptance, unless written notification to the Contract Administrator to replace it with LS-606 for acceptance is received prior to sampling of the applicable materials for QA purposes. Provided the Contract Administrator has received such a request, LS-606 shall be used. Otherwise, conformance to LS-614 shall be required.

When notification is provided after QA testing using LS-614 has been initiated, the Contractor shall be charged for the cost of the testing using LS-614, administrative charges, and additional sampling, if required.

1003.08.04 Blending Method

The Contractor may select to have QA acceptance of the total combined aggregate conducted according to the blending method. The Contractor shall provide appropriate facilities and equipment for QA sampling otherwise this option shall not be available. To select this method, the Contractor shall notify the Contract Administrator in writing along with a description of the sampling facilities and equipment, prior to paving.

1003.08.05 Sampling

Sampling shall be conducted by the Contractor according to LS-625.

Duplicate samples shall be taken and sealed by the Contractor in the presence of the Contract Administrator from stockpiles at the hot mix plant or from after the cold feed at the plant, but before the addition of liquid asphalt cement. The place of sampling shall be determined by the Contractor.

Duplicate samples taken from stockpiles at the hot mix plant shall be from stockpiles that contain a minimum quantity of 500 tonnes of each aggregate for each HMA.

Duplicate samples taken from after the cold feed during production of the HMA shall be taken at a time determined by the Contract Administrator.

The mass of each sample shall meet the requirements shown in Table 6. When more than 30 kg is required, the total sample shall be recombined by the QA laboratory prior to testing.

In the event that the Contractor is unavailable to take the sample, no further materials shall be placed in the work until the duplicate samples have been taken.

The Contractor shall provide new or clean sample bags or containers that are constructed to prevent the loss of any part of the material or contamination or damage to the contents during shipment. Metal or cardboard containers are unacceptable. QA samples shall be identified both inside and outside of the sample container.

1003.08.06 Testing and Retention of Samples

When the Contract Administrator elects to carry out QA testing, one of the duplicate samples shall be randomly selected for testing by the QA laboratory and the remaining sealed sample shall be retained by the QA laboratory for possible referee testing.

Samples taken from the stockpiles shall be treated as individual samples.

Samples taken from after the cold feed shall be separated on the 4.75 mm sieve and the fine aggregate portion and the coarse aggregate portion tested as the fine or the coarse aggregate of the mix, even though a combination of aggregates may have been used in forming the fine or coarse aggregate.

1003.08.07 Acceptance

QA test results shall be used for acceptance purposes, except when referee testing has been carried out.

When QA test results show that the aggregates meet the requirements of this specification, the aggregates shall be accepted.

When QA test results show that the aggregates do not meet the requirements of this specification, the Contract Administrator shall notify the Contractor that the aggregates represented by the test results shall not be accepted. This notification shall take place in writing within 3 Business Days of receipt of the non-conforming data. The Contractor has the option of either removing the material from the work or invoking referee testing. The Contractor may request a reduced price in lieu of removal for aggregates that fail to meet the requirements of this specification. Irrespective of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

1003.08.08**Referee Testing**

When QA test results do not meet the requirements of this specification, the Contractor has the option of invoking referee testing of the test result that fails to meet the requirements. The Contractor shall notify the Contract Administrator of the selected option in writing within 2 Business Days following written notification of unacceptable material.

The Contract Administrator shall select a referee testing laboratory acceptable to the Contractor, within 3 Business Days following the Contractor's notification to invoke referee testing. Referee test samples shall be delivered to the referee testing laboratory from the QA laboratory by the Contract Administrator. The sealed sample shall be opened in the presence of the Contractor and the Contract Administrator.

Referee testing shall be carried out in the presence of the Contract Administrator. When applicable, the referee testing laboratory shall also test a control aggregate sample for each test method required. The Contractor may observe the testing at no cost to the Owner.

The Contractor and Owner may send a maximum of two representatives each to observe the referee testing. The Contract Administrator shall notify the Owner and Contractor a minimum of 3 Business Days in advance of the date of referee testing. Provided that such notice was given, referee testing shall be carried out regardless of the absence of one or more observers.

Observers shall follow the referee laboratory protocols for access to the premises and testing equipment and shall not unnecessarily impede the progress of the testing. Observers shall be permitted to validate sample identification and view sample condition. Subject to safety requirements, test method and equipment limitations, they shall also be permitted to observe test procedures, take notes, view equipment readings, and review completed work sheets while in attendance.

Comments on the non-conformity of the test methods shall be made and corrected at the time of testing.

Referee test results shall be binding on both the Owner and the Contractor.

When a referee test result shows that the aggregates do not meet the requirements of this specification, the material represented by the test result, including materials in existing stockpiles or in the Work, shall not be accepted. The Contractor shall remove the material from the Work at no cost to the Owner. The Contractor may request a reduced price in lieu of removal of the aggregates that fail to meet the requirements of this specification. Irrespective of the negotiation of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

When a referee test result shows that the aggregates meet the requirements of this specification, the aggregates represented by the sample shall be accepted.

The Owner shall be responsible for the cost of referee testing, provided that the referee test results show that the aggregates meet the applicable specifications. Otherwise, the Contractor shall be responsible for the cost.

TABLE 1
SMA – Coarse and Fine Aggregate Sources

Source Name	Inventory Number	Owner
Methuen Township Quarry	B02-071	MRT Aggregate Incorporated
Brockville Quarry	B15-039	Lafarge Canada Incorporated
Rosewarne Quarry	B17-013	Fowler Construction Company Limited
Bruce Mines Quarry	B22-072	Ontario Trap Rock-Bruce Mines Limited
Havelock Quarry	C01-054	Drain Brothers Excavating Limited
Marmora Quarry	C01-058	Aecon Construction and Materials Limited
Rideau Road Quarry	O05-067	R.W. Tomlinson Limited
Boyce Quarry	O05-070	Dibblee Paving and Materials Limited
Ottawa Quarry	O05-072	Aecon Construction and Materials Limited
Hawthorne Quarry	O05-155	Lafarge Canada Incorporated

TABLE 2
Physical Property Requirements for Fine Aggregates

Laboratory Test	MTO Test No.	Surface Course				Binder Course
		SMA 9.5, SMA 12.5, DFC, and Superpave 12.5 FC2	HL 1, HL 3, HL 3HS, HL 3F, and Superpave 4.75 and 12.5 FC1	HL 2, HL 4	Superpave 9.5 and 12.5	HL 2, HL 4, HL 4F, HL 8, HDBC, MDBC, SMA 19.0, and Superpave 4.75, 19.0, and 25.0
Acid Insoluble Residue, minimum % (material retained on 2.36 mm sieve only)	LS-613	--	--	--	60 (Note 1)	--
Micro-Deval Abrasion, % maximum loss, (Note 2)	LS-619	15	20	25	25	25
Plasticity Index, maximum	LS-703/704	0	0	0	0	0

Notes:

- The requirements listed below are only applicable to surface courses placed in the area to the north and west of a boundary defined by the north shore of Lake Superior, the north shore of the St. Mary's River, the south shore of St. Joseph Island, the north shore of Lake Huron easterly to the north and east shore of Georgian Bay (excluding Manitoulin Island), along the Severn River to Washago and a line easterly passing through Norland, Burnt River, Burleigh Falls, Madoc, and hence easterly along Highway 7 to Perth and northerly to Calabogie and easterly to Arnprior and the Ottawa River:
 - When a fine aggregate for use in a surface course mix is obtained from a gravel pit or quarry source which contains carbonate rock type (e.g., limestone and dolostone) then blending with aggregate from non-carbonate rock types shall be required to increase the soluble residue content to meet the minimum 60% requirement. The method of blending shall be uniform and shall be subject to approval by the Owner.
 - When the fine aggregate for use in a surface course mix is obtained from a non-carbonate gravel or quarry source, blending with carbonate rock types is not permitted.
- When the blending method has been selected, this requirement applies to the total fine aggregate blend. In addition, when the blending method has been selected, the Micro-Deval Abrasion loss for each individual fine aggregate in stockpile, prior to blending, shall not exceed 35%.

TABLE 3
Consensus Property Requirements for Superpave Aggregates (Including RAP or RST or Both)

Ontario Traffic Category (Note 1)	Fine Aggregate			Coarse Aggregate		
	AASHTO T 176, Sand Equivalent Method 1 % minimum (Note 2)	LS-629 Uncompacted Void Content % minimum		ASTM D 4791 Flat and Elongated Particles, % maximum at 5:1	ASTM D 5821 Fractured Particles in Coarse Aggregate, % minimum (Note 4)	
		≤100 mm (Note 3)	>100 mm (Note 3)		≤100 mm (Note 3)	>100 mm (Note 3)
A	40	-	-	-	55/-	-/-
B	40	40	40	10	75/-	50/-
C	45	45 (Note 5)	40		85/80	60/-
D	45	45 (Note 5)	40		95/90	80/75
E	50	45 (Note 5)	45 (Note 5)		100/100	100/100

Notes:

1. The Ontario Traffic Category shall be as specified in the Contract Documents.
2. When the total combined fine aggregate includes aggregate derived from RAP or RST or both, this requirement shall be met prior to blending with RAP or RST or both.
3. Denotes the depth of the top of lift below final pavement surface. If less than 25% of a layer is within 100 mm of the surface, the layer may be considered to be below 100 mm.
4. 85/80 denotes that 85% of the coarse aggregate has one fractured face and 80% has two or more fractured faces.
5. An uncompacted void content of 43% is acceptable provided that the selected mix satisfies the mix volumetrics specified in OPSS 1151.

TABLE 4
Physical Property Requirements for Coarse Aggregates – Binder Course

Laboratory Test	MTO Test No.	Superpave 4.75, 9.5, 19.0, 25.0	HL4, HL8	HDBC, SMA 19.0	MDBC
Wash Pass 75 µm sieve, % maximum loss (Note 1)	LS-601 Guideline B	1.3	1.3	1.3	1.3
Absorption, % maximum	LS-604	2.0	2.0	2.0	2.0
Percent Crushed Particles, % minimum	LS-607	--	60	--	95
Flat and Elongated Particles, % maximum at 4:1	LS-608	20 (Note 2)	20	15	15
Unconfined Freeze-Thaw, % maximum loss (Note 3)	LS-614	15	15	15	15
Particles with 2 Faces Crushed, % minimum (Note 4)	LS-617	--	--	95	80 (Note 5)
Micro-Deval Abrasion, % maximum loss	LS-618	21	21	21	21
Alternative Requirement for Unconfined Freeze-Thaw Loss, LS-614					
Magnesium Sulphate Soundness, % maximum loss	LS-606	15	15	15	15
Notes: - When quarried rock is used as a source of coarse aggregate, a maximum of 2.0% passing the 75 µm sieve shall be permitted. - For Ontario Traffic Categories D and E, Superpave 19.0 shall be 15% maximum. - This requirement shall be waived by the Owner when the aggregate meets the alternative magnesium sulphate soundness requirements, LS-606. - This only applies to HDBC and MDBC coarse aggregate crushed from gravel sources. - The maximum allowable amount of uncrushed particles is 5%, MDBC only.					

TABLE 5
Physical Property Requirements for Coarse Aggregates – Surface Course

Laboratory Test	MTO Test No.	HL1	Superpave 12.5 FC1	HL1, DFC, SMA 9.5 and 12.5, Superpave 12.5 FC1 and 12.5 FC2			Superpave 4.75, 9.5, and 12.5	HL 3 HL 3F HL 3HS	HL4 HL 4F
		Gravel	Gravel	Quarry Rock					
				Dolomitic Sandstone	Traprock, Diabase, and Andesite	Meta-Arkose, Meta-Gabbro, and Gneiss			
Wash Pass 75 µm sieve, % maximum loss	LS-601 Guideline B	1.0	1.0	1.0	1.0	1.0	1.3 (Note 1)	1.3 (Note 1)	1.3 (Note 1)
Absorption, % maximum	LS-604	1.0	1.0	1.0	1.0	1.0	2.0	1.75	2.0
Percent Crushed Particles, % minimum	LS-607	--	--	--	--	--	--	60	60
Flat and Elongated Particles, % maximum at 4:1	LS-608	15	15	15	15	15	20	20	20
Petrographic Number (HL), maximum	LS-609	120	120	145	120	145	(Note 2)	--	--
Petrographic Examination, non-carbonate of retained 4.75 mm, % minimum	LS- 609	--	--	--	--	--	--	60 (Note 2)	60 (Note 2)
Insoluble Residue retained 75 µm sieve, % minimum	LS-613	--	--	45	--	--	--	--	--
Unconfined Freeze-Thaw, % maximum loss	LS-614	6	6	7	6	6	6 (Note 3)	6 (Note 3)	6 (Note3)
Particles with 2 Faces Crushed, % minimum	LS-617	80	--	--	--	--	--	--	--
Micro-Deval Abrasion, % maximum loss	LS-618	10	10	15	10	15	17	17	17
Alternative Requirement for Unconfined Freeze-Thaw Loss, LS-614									
Magnesium Sulphate Soundness, % maximum loss	LS-606	--	--	--	--	--	12	12	12

Notes:

- When quarried rock is used as a source of coarse aggregates, a maximum of 2.0% passing the 75 µm sieve shall be permitted.
- The requirements listed below are only applicable to surface courses placed in the area to the north and west of a boundary defined by the north shore of Lake Superior, the north shore of the St. Mary's River, the south shore of St. Joseph Island, the north shore of Lake Huron easterly to the north and east shore of Georgian Bay (excluding Manitoulin Island), along the Severn River to Washago and a line easterly passing through Norland, Burnt River, Burleigh Falls, Madoc, and hence easterly along Highway 7 to Perth and northerly to Calabogie and easterly to Arnprior and the Ottawa River:
 - When the coarse aggregate for use in a surface course mix is obtained from a gravel pit or quarry source containing more than 40% carbonate rock type (e.g., limestone and dolostone) then blending with aggregate from non-carbonate rock types shall be required to increase the minimum non-carbonate rock type content of the coarse aggregate to 60%, as determined by petrographic examination (LS-609). In cases of dispute, LS-613 shall be used with minimum acid insoluble residue of 60%. The method of blending shall be uniform and shall be subject to approval by the Owner.
 - When the coarse aggregate for use in a surface course mix is obtained from a non-carbonate source, blending with carbonate rock types is not permitted.
- This requirement shall be waived by the Owner when the aggregate meets the alternative magnesium soundness requirements, LS-606.

TABLE 6
Field Sample Size

Material	Minimum Mass of Field Sample (Note 1) kg
Fine aggregate	15
Coarse aggregate	25
RAP	10
RST	5
Combined coarse and fine aggregate sampled from the cold feed, prior to the addition of asphalt cement.	45
Hot Mix Asphalt	25
Filler/Baghouse Fines	2
Note: 1. Individual sample containers shall hold no more than 30 kg of aggregate. When more than 30 kg is required, additional sample containers shall be used.	

Appendix 1003-A, November 2013
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should be aware that OPSS 1003 includes the introduction of Superpave mixes and new physical test methods.

The designer should specify the following in the Contract Documents:

- Hot mix asphalt (HMA) type requirements. (1003.05.01)
- Storage and delivery requirements for quality assurance (QA) samples. (1003.08.02)
- Ontario traffic category using the following table as a guideline (1003.05.02.03, 1003.05.03.03, Table 3):

Superpave and SMA Design Traffic Categories by ESALs

Ontario Traffic Category	20-Year Design ESALs (Note 1)	Typical Applications
A	Less than 0.3 million	Low volume roads, parking lots, driveways, and residential roads.
B	0.3 to 3 million	Minor collector roads.
C	3 to 10 million	Major collector and minor arterial roads.
D	10 to 30 million	Major arterial roads and transit routes.
E	Greater than 30 million	Freeways, major arterial roads with heavy truck traffic, and special applications such as truck and bus climbing lanes or stopping areas.
Note: 1. Equivalent Single Axle Load (ESAL) for the projected traffic level expected in the design lane over a 20-year period, regardless of the actual design life of the pavement.		

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

- If the grading requirements provided in Appendix 1003-B are to be used, Appendix 1003-B needs to be invoked by reference in the Contract Documents.
- If the sampling and testing frequencies provided in Appendix 1003-C are to be used for QA purposes, Appendix 1003-C needs to be invoked by reference in the Contract Documents.
- If the payment reduction in lieu of aggregate removal provided in Appendix 1003-D is to be used, Appendix 1003-D needs to be invoked by reference in the Contract Documents.

Appendix 1003-A

- If the forms in Appendices 1003-E, 1003-F, and 1003-G are to be used for submission purposes, Appendices 1003-3, 1003-F, and 1003-G need to be invoked by reference in the Contract Documents.

The designer should be aware that fine and coarse aggregate gradations are not given in this specification. For quality control (QC) of any specific operation, the Contractor should develop an average gradation for the particular source and production facilities and control the gradation within reasonable tolerances from this average in such a way as to ensure a suitable HMA meeting the requirements of the Contract Documents. For the information of aggregate suppliers and others, the gradation requirements for fine and coarse aggregate are included in Appendix 1003-B.

The designer should be aware that quality assurance (QA) testing for purposes of ensuring material used in the Work meets the requirements of OPSS 1003 is not mandatory, unless specifically included in the Contract Documents. The designer should determine the need for QA testing based on the size and complexity of the work and specify the required frequency of QA sampling and testing (1003.08.01). Appendix 1003-C provides recommended QA sampling and testing frequencies.

The designer should be aware that in cases of high traffic volumes and high frictional demand, the use of HL1 and DFC or SMA, Superpave 12.5 FC1 and 12.5 FC2 aggregates may be necessary to give adequate frictional properties. In this case, the designer should provide a list of prequalified aggregate sources for SMA, DFC, Superpave 12.5 FC2 coarse and fine aggregates, and HL1 and Superpave 12.5 FC1 coarse aggregate. (1003.05.01)

Although this specification does not include testing for frictional properties, prequalified aggregate sources that have met specific friction property criteria may be found listed on the MTO pre-qualified products list: Designated Sources for Materials (DSM) #3.05.25 Asphalt - Aggregates, Coarse for Superpave 12.5 FC1, Superpave 12.5 FC2, SMA, HL1, DFC, and OFC; and Aggregates, Fine for Superpave 12.5 FC2, SMA, DFC, and OFC.

The designer should be aware that the use of steel slag is prohibited because of deleterious expansion associated with the hydration of lime (CaO) and periclase (MgO) within the slag. Nickel and copper slags are prohibited because of performance concerns.

The designer should be aware that blending to improve the physical properties of aggregates is not permitted by OPSS 1001, except to increase the percentage of crushed particles or decrease the percentage of flat and elongated particles. In this specification, blending of aggregates shall be permitted at the hot mix plant, provided it takes place at the cold feed and it is possible to take a sample of the blended aggregate. This permits the use of small amounts of material such as coarse crusher screenings that do not normally meet the specification, provided that the overall physical properties of the aggregate mix meet the specification. The Contractor may elect to either have quality assurance (QA) testing done on a stockpile basis, in which case each aggregate stockpile shall meet the physical requirements, or have QA testing done of the material after the cold feed bins, but before the material is mixed with asphalt cement.

The specification requires that coarse and fine aggregates for SMA be from the same aggregate source.

The designer should be aware of any additional referee testing laboratory requirements, including time lines, selection criteria, or roster for referee laboratories and include them in the Contract Documents.

The designer should be aware that the requirement for a minimum of 60% non-carbonate aggregate outlined in Table 2 and Table 5, in certain parts of the province is based on the following considerations: Carbonate aggregates due to their low resistance to abrasion polish easily under traffic, and depending on traffic volume may result in pavements with relatively differing frictional properties. In areas of the province with a predominant type of rock, siliceous or carbonate, it has been found that it is best to give consistent frictional properties to pavement surfaces.

Appendix 1003-A

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

Related Ontario Provincial Standard Drawings

No information provided here.

Appendix 1003-B, November 2013**FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS**

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents.

OPSS.MUNI 1003 is modified by the addition of the following gradation requirements for fine and coarse aggregates:

TABLE B-1
OPSS 1003 - Gradation for Fine Aggregate, LS-602

MTO Sieve Designation	Percent Passing by Mass				
	DFC	HL 1 and HL 3	HL 2	HL 4, HL 8, and MDBC	HDBC
9.5 mm	100	100	100	100	100
4.75 mm	85 - 100	90 - 100	85 - 100	85 - 100	95 - 100
2.36 mm	65 - 95	70 - 100	70 - 90	60 - 100	80 - 100
1.18 mm	48 - 80	50 - 90	50 - 75	34 - 90	50 - 90
600 µm	25-60	30 - 70	30 - 55	17 - 70	28 - 70
300 µm	10 - 35	15 - 40	15 - 35	9 - 40	10 - 40
150 µm	5 - 15	5 - 15	5 - 15	3 - 15	0 - 15
75 µm	0 - 6	0 - 5	3 - 8	0 - 7	0 - 5
Note: A. The difference between the amount retained between any two consecutive sieves, excluding the 75 µm sieve shall not be less than 5%.					

TABLE B-2
OPSS 1003 - Gradation for Coarse Aggregate, LS-602

MTO Sieve Designation	Percent Passing by Mass		
	HL 1, DFC, and HL 3	HL 4	HL 8, MDBC, and HDBC
26.5 mm	-	-	100
19.0 mm	-	100	90 - 100
16.0 mm	100	96 - 100	65 - 90
13.2 mm	96 - 100	67 - 86	-
9.5 mm	50 - 73	29 - 52	20 - 55
6.7 mm	-	-	-
4.75 mm	0 - 10	0 - 10	0 - 10

Appendix 1003-C, November 2013
FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

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

Supplementary Requirements for Quality Assurance Sampling and Testing Frequencies

OPSS.MUNI 1003, Aggregates – Hot Mix Asphalt, is amended as follows:

1003.08 Quality Assurance

1003.08.01 General

The first paragraph of subsection 1003.08.01 is deleted in its entirety and replaced with the following:

QA sampling and testing shall be carried out by the Owner for the purposes of ensuring that the aggregates used in the work are according to the requirements of the Contract Documents. QA sampling and testing shall be carried out at the frequency specified in Table C-1. Individual test results may be forwarded to the Contractor as they become available.

Table C-1 is added.

TABLE C-1
Sampling and Testing Frequency for Physical and Consensus Properties, Note 1

HMA Production per HMA Type, t	Minimum Frequency Each Aggregate Type Per Each HMA Type
$\leq 10,000$	One sample.
$> 10,000$ (Note 2)	One sample per 10,000 tonnes.
Note: - Sampling and testing for consensus properties is applicable to Superpave HMA aggregates only. - When the quantity of material is: - Less than one-half the quantity required for a sample, then that quantity shall be added to the quantity representing the previous sample. - Greater than or equal to one-half the quantity required for a sample, then that quantity shall require its own sample.	

Appendix 1003-D, November 2013
FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

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

Supplementary Requirements for a Price Reduction In Lieu of Removal of Aggregates

When a tested sample of aggregates shows that the aggregates do not meet the requirements of this specification, the aggregates represented by the test result, including material in existing stockpiles or in the Work, shall not be accepted. The Contractor may request a reduced price in lieu of removal provided the applicable test results:

- a) Do not exceed the requirement for LS-614, or LS-606 if it has replaced LS-614, by more than 25% of the specified value.
- b) Do not exceed the requirement for LS-618 by more than 10% of the specified value.
- c) Do not exceed the requirement for LS-619 by more than 15% of the specified value.
- d) Meet all other requirements of this specification.

Irrespective of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

Appendix 1003-E, November 2013

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

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents.

OPSS 1003 - HOT MIX AGGREGATE TEST DATA PHYSICAL PROPERTIES - FINE AGGREGATE

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory:		Telephone No.:	Fax No.:
Sampled By (Print Name):		Date Sampled (YY/MM/DD):	
Mix Type:		Sample Type: Stockpile [] Cold Feed (Blended FA) []	

Source Name/Location:	Aggregate Inventory Number (AIN):	Pit (P) or Quarry (Q):	% of Mix:
Source Name/Location:	Aggregate Inventory Number (AIN):	Pit (P) or Quarry (Q):	% of Mix:
Source Name/Location:	Aggregate Inventory Number (AIN):	Pit (P) or Quarry (Q):	% of Mix:

Note: All sources of fine aggregates used in blend should be included in the table given above.

Laboratory Test and Number	Requirement					Reference Material Results	Sample Test Results	Meets Requirement (Y/N)
	Surface Course				Binder Course			
	SMA 9.5 and 12.5, DFC, Superpave 12.5 FC2	HL 1, HL 3, HL 3HS, Superpave 4.75 and 12.5 FC1	HL 2, HL 4	Superpave 9.5 and 12.5	HL 2, HL 4, HL 4F, HL 8, HDBC, MDBC, SMA 19.0, Superpave 4.75, 19.0, and 25.0			
Acid Insoluble Residue, Minimum % retained on 2.36 mm sieve, LS-613	--	--	--	60 (Note 1)	--			
Micro-Deval Abrasion, % maximum loss, LS-619 (Note 2)	15	20	25	25	25			
Plasticity Index, Maximum, LS-703/704	0							

I hereby certify that testing has been carried out by a properly qualified/certified test technician:

Issued by: _____
PRINT NAME TESTING LABORATORY REPRESENTATIVE SIGNATURE DATE

Received by: _____
PRINT NAME CONTRACT ADMINISTRATOR REPRESENTATIVE SIGNATURE DATE

Copies to: ☐ Contract Administrator ☐ Contractor

Appendix 1003-E

Notes:

1. The requirements listed below are only applicable to surface courses placed in the area to the north and west of a boundary defined by the north shore of Lake Superior, the north shore of the St. Mary's River, the south shore of St. Joseph Island, the north shore of Lake Huron easterly to the north and east shore of Georgian Bay (excluding Manitoulin Island), along the Severn River to Washago and a line easterly passing through Norland, Burnt River, Burleigh Falls, Madoc, and hence easterly along Highway 7 to Perth and northerly to Calabogie and easterly to Arnprior and the Ottawa River:
 - a) When a fine aggregate for use in a surface course mix is obtained from a gravel pit or quarry source which contains carbonate rock type (e.g., limestone and dolostone) then blending with aggregate from non-carbonate rock types shall be required to increase the soluble residue content to meet the minimum 60% requirement. The method of blending shall be uniform and shall be subject to approval by the Owner.
 - b) When the fine aggregate for use in a surface course mix is obtained from a non-carbonate gravel or quarry source, blending with carbonate rock types is not permitted.
2. For blended aggregates sampled from the cold feed, the Micro-Deval Abrasion loss for each individual fine aggregate in stockpile, prior to blending, shall not exceed 35 percent.

Appendix 1003-F, November 2013

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

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents.

OPSS 1003 - HOT MIX AGGREGATE TEST DATA PHYSICAL PROPERTIES – COARSE AGGREGATE

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory:		Telephone No.:	Fax No.:
Sampled By (Print Name):		Date Sampled (YY/MM/DD):	
Mix Type:	Source Name/Location:	Aggregate Inventory Number (AIN):	

HL1, DFC, SMA 9.5 and 12.5, Superpave 12.5 FC1 and 12.5 FC2									
Laboratory Test and Number	Requirements					Rock Type (Note 1)	Test Results		
	Gravel (G)		Quarry Rock				Reference Material	Sample	Meets Requirements (Y/N)
	HL 1	Superpave 12.5 FC1	Dolomitic Sandstone (D)	Traprock, Diabase, and Andesite (T)	Meta-Arkose, Meta-Gabbro, Gneiss, Granite (M)				
Wash Pass 75 µm sieve, % maximum loss, LS-601, Guideline B	1.0	1.0	1.0	1.0	1.0				
Absorption, % maximum, LS-604	1.0	1.0	1.0	1.0	1.0				
Flat and Elongated Particles, % maximum at 4:1, LS-608	15	15	15	15	15				
Petrographic Number (HL), Maximum, LS-609	120	120	145	120	145				
Insoluble Residue retained 75 µm sieve, % minimum, LS-613			45						
Unconfined Freeze-Thaw, % maximum loss, LS-614	6	6	7	6	6				
Particles with 2 Faces Crushed, % minimum, LS-617	80								
Micro-Deval Abrasion, % maximum loss, LS-618	10	10	15	10	15				

Superpave 4.75, 9.5, 12.5, 19.0, and 25.0, HL 3, HL 3F, HL 3HS, HL 4, HL 4F, HL 8, SMA 19.0, HDBC, MDBC									
Laboratory Test and Number	Requirements							Test Results	
	Surface Course			Binder Course				Reference Material	Sample Test Results
	Superpave 4.75, 9.5, and 12.5	HL 3, HL 3F, HL 3HS	Results	Superpave 4.75, 9.5, 12.5, 19.0, and 25.0	HL 4, HL 8	SMA 19.0, HDBC	MDBC		
Wash Pass 75 µm sieve, % maximum loss, LS-601-Guideline B, (Note 2)	1.3	1.3	1.3	1.3	1.3	1.3	1.3		
Absorption, % maximum, LS-604	2.0	1.75	2.0	2.0	2.0	2.0	2.0		
Percent Crushed Particles, % minimum, LS-607	--	60	60	--	60	--	95		
Flat and Elongated Particles, % maximum at 4:1, LS-608	20	20	20	20 (Note 3)	20	15	15		
Petrographic Number (HL), maximum, LS-609	Note 4	--	--	--	--	--	--		
Petrographic Examination, non-carbonate of retained 4.75 mm, % minimum, LS-609	--	60 (Note 4)	60 (Note 4)	--	--	--	--		
Unconfined Freeze-Thaw, % maximum loss, LS-614 (Note 5)	6	6	6	15	15	15	15		
Particles with 2 Faces Crushed, % minimum, LS-617 (Note 6)	--	--	--	--	--	95	80 (Note 7)		
Micro-Deval Abrasion, % maximum loss, LS-618	17	17	17	21	21	21	21		
Alternative Requirement for Unconfined Freeze-Thaw Loss, LS-614									
Magnesium Sulphate Soundness, % maximum loss, LS-606	12	12	12	15	15	15	15		

Appendix 1003-F

I hereby certify that testing has been carried out by a properly qualified/certified test technician:

Issued by: _____
PRINT NAME TESTING LABORATORY REPRESENTATIVE SIGNATURE DATE

Received by: _____
PRINT NAME CONTRACT ADMINISTRATOR REPRESENTATIVE SIGNATURE DATE

Copies to: ☐ Contract Administrator ☐ Contractor

Notes:

1. Enter the type of rock or material used in the mix as follows:
G – gravel
D – dolomitic sandstone
T – traprock, diabase, andesite
M – meta-arkose, meta-gabbro, gneiss, granite
2. When quarried rock is used as a source of coarse aggregates, a maximum of 2% passing the 75 µm sieve shall be permitted.
3. For Ontario Traffic Categories D and E, Superpave 19.0 shall be 15% maximum.
4. The requirements listed below are only applicable to surface course placed in the area to the north and west of a boundary defined by the north shore of Lake Superior, the north shore of the St. Mary's River, the south shore of St. Joseph Island, the north shore of Lake Huron easterly to the north and east shore of Georgian Bay (excluding Manitoulin Island), along the Severn River to Washago and a line easterly passing through Norland, Burnt River, Burleigh Falls, Madoc, and hence easterly along Highway 7 to Perth and northerly to Calabogie and easterly to Arnprior and the Ottawa River.
 - a) When the coarse aggregate for use in surface course mix is obtained from a gravel pit or quarry source containing more than 40% carbonate rock type (e.g., limestone and dolostone) then blending with aggregate of non-carbonate rock types shall be required to increase the minimum non-rock carbonate rock type content of the coarse aggregate to 60%, as determined by petrographic examination, LS-609. The method of blending shall be uniform and shall be subject to approval by the Owner. In cases of dispute, LS-613 shall be used with a minimum acid insoluble residue of 60%.
 - b) When the coarse aggregate for use in surface course mix is obtained from a non-carbonate source, blending with carbonate rock types shall not be permitted.
5. This requirement shall be waived by the Owner when the aggregate meets the alternative magnesium sulphate soundness requirement, LS-606.
6. This only applies to coarse aggregate crushed from gravel sources.
7. The maximum allowable amount of uncrushed particles is 5%.

Appendix 1003-G, November 2013
FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents.

**OPSS 1003 - HOT MIX AGGREGATE TEST DATA
SUPERPAVE CONSENSUS PROPERTY REQUIREMENTS**

Contract No.:	Contractor:	Contract Location:	
Testing Laboratory:		Telephone No.:	Fax No.:
Sampled By (Print Name):		Date Sampled (YY/MM/DD):	
Superpave Mix Type: 4.75 [] 9.5 [] 12.5 [] 12.5 FC1 [] 12.5 FC2 [] 19.0 [] 25 []			Sample Type (Stockpile, Belt, etc.):

FINE AGGREGATES								
Source Name/Location:			Aggregate Inventory Number (AIN):		Pit (P) or Quarry (Q):		% of Mix:	
Source Name/Location:			Aggregate Inventory Number (AIN):		Pit (P) or Quarry (Q):		% of Mix:	
Source Name/Location:			Aggregate Inventory Number (AIN):		Pit (P) or Quarry (Q):		% of Mix:	
Laboratory Test and Number		Requirement					Test Result	
		Traffic Category (Note 1)					Sample Test Result	Meets Requirement (Y/N)
		A	B	C	D	E		
Uncompacted Void Content, % minimum, LS-629	≤ 100 mm (Note 2)	--	40	45 (Note 3)	45 (Note 3)	45 (Note 3)		
	> 100 mm (Note 2)	--	40	40	40	45 (Note 3)		
Sand Equivalent Method 1, % minimum, AASHTO T 176 (Note 4)		40	40	45	45	50		

COARSE AGGREGATES								
Source Name/Location:			Aggregate Inventory Number (AIN):		Pit (P) or Quarry (Q):		% of Mix:	
Source Name/Location:			Aggregate Inventory Number (AIN):		Pit (P) or Quarry (Q):		% of Mix:	
Source Name/Location:			Aggregate Inventory Number (AIN):		Pit (P) or Quarry (Q):		% of Mix:	
Laboratory Test and Number		Requirement					Test Result	
		Traffic Category (Note 1)					Sample Test Result	Meets Requirement (Y/N)
		A	B	C	D	E		
Fractured Particles in Coarse Aggregate, % minimum, ASTM D 5821 (Note 5)	≤ 100 mm (Note 2)	55/-	75/-	85/80	95/90	100/100		
	> 100 mm (Note 2)	-/-	50/-	60/-	80/75	100/100		
Flat and Elongated Particles (5:1), % maximum, ASTM D 4791		--	10					

Appendix 1003-G

I hereby certify that testing has been carried out by a properly qualified/certified test technician:

Issued by: _____
PRINT NAME TESTING LABORATORY REPRESENTATIVE SIGNATURE DATE

Received by: _____
PRINT NAME CONTRACT ADMINISTRATOR REPRESENTATIVE SIGNATURE DATE

Copies to: ☐ Contract Administrator ☐ Contractor

Notes:

1. The Ontario Traffic Category shall be as specified in the Contract Documents.
2. Denotes the depth of the top lift below the final pavement surface. If less than 25% of a layer is within 100 mm of the surface, the layer may be considered to be below 100 mm.
3. A minimum uncompacted void content of 43% is acceptable provided that the selected mix satisfies the mix volumetrics specified in the Contract Documents.
4. When the total combined fine aggregate includes aggregate derived from RAP or RST or both, this requirement shall be met prior to blending with RAP or RST or both.
5. 85/80 denotes that 85% of the coarse aggregate has one fractured face and 80% has two or more fractured faces.



MATERIAL SPECIFICATION FOR AGGREGATES - MISCELLANEOUS

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1004.07	PRODUCTION
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1004.09	OWNER PURCHASE OF MATERIAL - Not Used

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1004-B	Supplementary Requirements for Quality Assurance Sampling and Testing Frequencies

1004.01 SCOPE

This specification covers material requirements for aggregates for use as clear stone, granular sheeting, mortar sand, gabion stone, rip-rap, rock protection, truck arrester bed aggregate, and winter sand.

1004.01.01 Specification Significance and Use

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

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

1004.01.02 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.

1004.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

OPSS 1001 Aggregates - General
OPSS 1010 Aggregates - Base, Subbase, Select Subgrade, and Backfill Material

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-601 Materials Finer than 75 µm Sieve in Mineral Aggregates by Washing
LS-602 Sieve Analysis of Aggregates
LS-604 Relative Density and Absorption of Coarse Aggregate
LS-607 Percent Crushed Particles in Processed Coarse Aggregate
LS-608 Percent Flat and Elongated Particles in Coarse Aggregate
LS-610 Organic Impurities in Concrete Sands
LS-614 Freezing and Thawing of Coarse Aggregate
LS-616 Petrographic Analysis of Fine Aggregate
LS-618 Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-619 Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-625 Guidelines for Sampling of Aggregate Materials
LS-703/704 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM International

C87/C87M-17	Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
D6473-15	Standard Test Method for Specific Gravity and Absorption of Rock for Erosion Control

1004.03

DEFINITIONS

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

CCIL means the Canadian Council of Independent Laboratories.

Clear Stone means a graded aggregate intended for use in drainage, backfill, bedding, and other applications.

Control Chart means a graphical method used to monitor the central tendency and the variability of material characteristic in order to control production.

Deleterious Material means materials that include, but not limited to, the following: wood, clay brick, clay tile, plastic, gypsum, gypsum plaster, wallboard, roots, and all other organic material.

Duplicate Samples means two samples taken at the same time and location, one to be used for quality assurance testing and the other for referee testing.

Gabion Stone means a graded fractured rock aggregate intended for use in gabion baskets, gabion mats and revet (gabion) mattresses.

Granular Sheetting means a graded granular aggregate material intended for use as a protective surface layer on erodible soil slopes.

Mortar Sand means a fine aggregate intended for application in hydraulic cement-based mortars.

Nominal Maximum Size means the largest sieve in the applicable specification upon which material is permitted to be retained.

Physical Property means an inherent attribute or feature of an aggregate material. Tests are carried out to determine an aggregate's resistance to weathering or degradation or both.

Pit-Run Material means material excavated directly from an existing bank in a pit and delivered to the job site without further processing, i.e., crushing, screening, washing, and classifying.

Referee Testing means testing of a material property or attribute for the purpose of resolving acceptance.

Rip-Rap means a well graded, fractured rock or crushed reclaimed concrete intended for use as slope protection in hydraulic channels.

Rock Protection means a well graded, fractured rock or crushed reclaimed concrete intended for use as general slope protection.

Spheroidal Particle means when the ratio of the greatest dimension in the longitudinal axis compared to the least dimension in a plane perpendicular to the longitudinal axis is less than 2:1.

Statistical Control means when all sources of assignable variation have been removed, the variability of the process is confined to probability variation alone,

Truck Arrester Bed Aggregate means a single-sized aggregate used in runaway truck lanes to slow and stop the progress of vehicles.

Winter Sand means a fine aggregate intended for application to roadways during winter conditions to improve frictional properties of the pavement surface.

1004.05 MATERIALS

1004.05.01 General

Aggregates shall be according to OPSS 1001, unless otherwise specified in this specification.

All aggregate source materials shall be clean, hard, durable particles free of earth, humus, clay or other coatings, clay lumps, shale or shaley partings, and other deleterious materials. Aggregates shall be produced from sands, gravels, cobbles, boulders, or quarried rock. Reclaimed asphalt pavement, reclaimed hydraulic cement concrete, glass, other reclaimed materials, and slag materials shall not be used. When reclaimed materials are permitted by this specification or as specified in the Contract Documents, they shall be homogeneously blended. When reclaimed hydraulic cement concrete is permitted, it shall not contain loose reinforcing material and shall be free of protruding metal.

When a change in the character of the aggregate occurs or when the performance of aggregate that meets the requirements of this specification is found to be unsatisfactory, use of the aggregate shall be discontinued until it can be proven to the satisfaction of the Contract Administrator that the source remains acceptable or can be made acceptable.

Irrespective of compliance or non-compliance with the gradation and physical property requirements of this specification, aggregates may be accepted or rejected on the basis of field performance as determined by the Owner.

1004.05.02 Clear Stone

Clear stone may be 53.0 mm, 19.0 mm Type I, 19.0 mm Type II, 16.0 mm, 13.2 mm, or 9.5 mm and shall meet the physical property requirements shown in Table 1 and the gradation requirements shown in Table 2.

1004.05.03 Granular Sheeting

Granular sheeting shall meet the physical property requirements shown in Table 3 and the gradation requirements shown in Table 4.

1004.05.04 Mortar Sand

Mortar sand shall consist of natural sand, or subject to the approval of the Contract Administrator other inert materials with similar characteristics, or combinations thereof, having hard, strong, durable particles. The sand shall be free from a coating of any deleterious material and free from other deleterious substances.

Mortar sand shall meet the physical property requirements shown in Table 5 and the gradation requirements shown in Table 6.

1004.05.05 Gabion Stone, Rip-Rap, and Rock Protection

1004.05.05.01 General

Rip-rap, rock protection, and gabion stone shall be produced from crushed or fractured bedrock fragments with 100% fractured faces or crushed from cobbles or boulders greater than 300 mm diameter and shall not deteriorate when exposed to air and water and shall be resistant to deterioration by cycles of wetting, drying, freezing, and thawing.

Reclaimed hydraulic cement concrete may be used in non-watercourse applications.

1004.05.05.02 Rip-Rap and Gabion Stone

Rip-rap R-10 and R-50 classifications and gabion stone G-3 and G-10 classifications shall meet the physical property requirements shown in Table 7 and gradation requirements shown in Table 8.

1004.05.05.03 Rock Protection

Rock protection shall meet the physical property requirements shown in Table 7 and the gradation requirements shown in Table 8.

1004.05.06 Truck Arrester Bed Aggregate

Truck arrester bed aggregate shall be pit-run material meeting the physical property requirements shown in Table 9 and the gradation requirements shown in Table 10. In addition, truck arrester bed aggregate shall meet the following shape requirements:

- a) Rounded particles shall be a minimum of 30% by mass. Rounded particles shall be determined by the procedure given in LS-607, reporting the percentage of rounded particles instead of crushed particles. The test specimen size shall be a minimum of 3,000 g passing the 26.5 mm sieve and retained on the 19 mm sieve.
- b) Spheroidal particles shall be a minimum of 50% by mass. Spheroidal particles shall be determined by the procedure given in LS-608, using a figure-eight calliper in which the ratio of the opening at one end to that at the other end is 2:1 instead of 4:1. The test specimen size shall be a minimum of 3,000 g passing the 26.5 mm sieve and retained on the 19 mm sieve.

1004.05.07 Winter Sand

Winter sand shall meet the physical property requirements shown in Table 11 and the gradation requirements shown in Table 12.

1004.07 PRODUCTION

1004.07.01 Aggregate Processing, Handling, and Stockpiling

Aggregates separated during processing shall be placed in individual stockpiles. Processed aggregates secured from different sources and aggregates from the same source but of different gradations shall be placed in individual stockpiles.

Aggregates that have become mixed with foreign matter of any description or aggregates from different stockpiles that have become mixed with each other shall not be used and shall be immediately removed from the stockpile.

Once a stockpile has been produced, sampled, and tested, no further material may be added to the stockpile. Stockpiles produced, sampled, and tested under the procedure for control chart method may continue to have material added, provided that sampling and testing show that the material in the stockpile is in accordance to this specification and that the process remains in statistical control.

1004.08 QUALITY ASSURANCE

1004.08.01 General

QA testing may be carried out by the Owner for the purposes of ensuring that the aggregates used in the work are according to the requirements of this specification. Individual test results may be forwarded to the Contractor as they become available.

Test data for each aggregate type shall be managed independently. When more than one source is used for supplying material, test data from each source and product shall be managed independently.

The laboratory designated by the Owner shall carry out testing for purposes of ensuring that aggregates used in the Work are according to the physical property and grading requirements of this specification. The Owner shall be responsible for all costs associated with testing for QA purposes, unless otherwise indicated in this specification. Individual test results shall be forwarded to the Contractor, as they become available.

1004.08.02 Laboratory Requirements

The Contract Administrator shall designate all QA laboratories.

An acceptable laboratory conducting tests for physical properties shall be one that holds a current Type D certificate from CCIL for the applicable test methods and also participates in the annual MTO Proficiency Sample Testing Program for the specific tests, when applicable.

An acceptable laboratory conducting tests for gradation according to LS-602, materials finer than 75 µm by washing of the aggregates according to LS-601, and percent crushed particles according to LS-607 shall be one that holds a current Type C certificate from CCIL.

Testing shall be conducted by qualified laboratory staff that holds a current certificate from CCIL in aggregate testing.

Equivalent alternate laboratory and technician certifications or laboratory proficiency testing programs may be used to demonstrate similar requirements, provided that they are acceptable to the Contract Administrator.

1004.08.03 Sampling

Sampling shall be according to LS-625.

Duplicate samples shall be taken and sealed by the Contractor in the presence of the Contract Administrator at the time and location determined by the Contract Administrator. When material contains blended or reclaimed aggregates or both, QA sampling shall be performed on the final blended product.

The mass of each sample shall meet the requirements of Table 13. When more than 30 kg is required, the total sample shall be recombined by the QA laboratory prior to testing.

In the event that the Contractor is unavailable to take the sample, no further materials shall be placed in the Work until the QA sample has been taken.

The Contractor shall provide new or clean sample bags or containers that are constructed to prevent the loss of any part of the material or contamination or damage to the contents during shipment. Metal or cardboard containers are unacceptable. QA samples shall be identified both on the inside and outside of the sample container.

1004.08.04 Testing and Retention of Samples

When the Contract Administrator elects to carry out QA testing, one of the duplicate samples shall be randomly selected for testing by the QA laboratory and the remaining sealed sample shall be retained by the QA laboratory for possible referee testing.

1004.08.05 Winter Sand

Following delivery, winter sand shall be subject to a visual inspection of the stockpile to determine the presence of oversize material. Oversize particles may be confirmed with a 9.5 mm sieve.

1004.08.06 Acceptance

QA test results shall be used for acceptance purposes, except when referee testing or a visual examination of winter sand has been carried out.

When QA test results show that the material meets the requirements of this specification, the aggregates shall be accepted.

When QA test results show that the material does not meet the requirements of this specification, the Contract Administrator shall notify the Contractor that material represented by the test results shall not be accepted. This notification shall take place in writing within 3 Business Days of receipt of the non-conforming data. The Contractor has the option of either removing the material from the work or invoking referee testing. The Contractor may request a reduced price in lieu of removal for aggregates that fail to meet the requirements of this specification. Irrespective of the negotiation of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

1004.08.07 Referee Testing

When QA test results do not meet the requirements of this specification, the Contractor has the option of invoking referee testing of the test result that fails to meet the requirements. The Contractor shall notify the Contract Administrator of the selected option in writing within 2 Business Days following written notification of unacceptable material.

The Contract Administrator shall select a referee testing laboratory acceptable to the Contractor within 3 Business Days following the Contractor's notification to invoke referee testing.

Referee test samples shall be delivered to the referee testing laboratory from the QA laboratory by the Contract Administrator. The sealed sample shall be opened in the presence of the Contractor and the Contract Administrator. If referee materials are not available, the Contractor shall be responsible for obtaining and submitting new samples to the referee laboratory from a location to be decided by the Contract Administrator. The Contract Administrator shall be present to witness the sampling.

Referee testing shall be carried out in the presence of the Contract Administrator. When applicable, the referee testing laboratory shall also test a control aggregate sample for each test method required. The Contractor may observe the testing at no cost to the Owner.

The Contractor and the Owner may send a maximum of two representatives each to observe the referee testing. The Contract Administrator shall notify the Owner and the Contractor a minimum of 3 Business Days in advance of the date of referee testing. Provided that such notice was given, referee testing shall be carried out regardless of the absence of one or more observers.

Observers shall follow the referee laboratory protocols for access to the premises and testing equipment and shall not unnecessarily impede the progress of testing. Observers shall be permitted to validate sample identification and view sample condition. Subject to safety requirements, test method and equipment limitation, the shall also be permitted to observe test procedures, take notes, view equipment readings, and review completed work sheets while in attendance.

Comments on the non-conformity of the test methods shall be made and corrected at the time of testing.

Referee test results shall be binding on both the Owner and the Contractor.

When a referee test result shows that the aggregates do not meet the requirements of this specification, the aggregates represented by the test result, including aggregates in existing stockpiles or in the Work, shall not be accepted. The Contractor shall remove the aggregates from the Work at no cost to the Owner. The Contractor may request a reduced price in lieu of removal of the aggregates that fail to meet the requirements of this specification. Irrespective of the negotiation of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

When a referee test result shows that the aggregates meet the requirements of this specification, the aggregates represented by the sample shall be accepted.

The Owner shall be responsible for the cost of referee testing, provided that the referee test results show that the aggregates meet the applicable specifications. Otherwise, the Contractor shall be responsible for the cost.

TABLE 1
Physical Property Requirements for Clear Stone

Laboratory Test	MTO Test Number	Nominal Maximum Size			
		53 mm	19 mm		16 mm, 13.2 mm, and 9.5 mm
			Type I	Type II	
Wash Pass 75 µm Sieve, Guideline B, % maximum	LS-601	2.0	2.0	2.0	2.0
Percent Crushed Particles, % minimum	LS-607	-	50	60	60
Micro-Deval Abrasion, Coarse Aggregate, % maximum loss	LS-618	25	25	25	25

TABLE 2
Gradation Requirements for Clear Stone

Sieve Size	Gradation (LS-602), Percent Passing					
	Nominal Maximum Size					
	53 mm	19 mm		16 mm	13.2 mm	9.5 mm
		Type I	Type II			
63 mm	100	-	-	-	-	-
53 mm	90 - 100	-	-	-	-	-
26.5 mm	-	100	100	-	-	-
19.0 mm	0 - 15	90 - 100	90 - 100	100	-	-
16.0 mm	-	-	65 - 90	96 - 100	100	-
13.2 mm	-	-	-	67 - 86	96 - 100	100
9.5 mm	-	0 - 55	20 - 55	29 - 52	50 - 73	95 - 100
6.7 mm	-	-	-	-	-	20 - 45
4.75 mm	-	0 - 10	0 - 10	0 - 10	0 - 10	0 - 10
75 µm	0 - 2.0	0 - 2.0	0 - 2.0	0 - 2.0	0 - 2.0	0 - 2.0

TABLE 3
Physical Property Requirements for Granular Sheeting

Laboratory Test	MTO Test Number	Granular Sheeting
Petrographic Requirement, Fine Aggregate Part A	LS-616	(Note 1)
Micro-Deval Abrasion, Coarse Aggregate, % maximum loss (Note 2)	LS-618	30
Micro-Deval Abrasion, Fine Aggregate, % maximum loss	LS-619	35
Plasticity Index, maximum	LS-703/704	0
Notes: 1. For materials north of the French/Mattawa Rivers only: For materials with > 4.0% passing the 75 µm sieve, passing the 150 µm sieve and retained on the 75 µm sieve shall not exceed 10% of the material on that sieve. Prior data demonstrating compliance with this requirement shall be acceptable provided such testing has been done within the past 5 years and the Contractor can show to the satisfaction of the Owner that field performance has continued to be acceptable. 2. The requirement for the coarse aggregate Micro-Deval abrasion loss test shall be waived if the material has more than 80% passing the 4.75 mm sieve.		

TABLE 4
Gradation Requirements for Granular Sheeting

Sieve Size	Gradation (LS-602), Percent Passing
150 mm	100
26.5 mm	50 - 100
13.2 mm	35 - 100
9.5 mm	-
4.75 mm	20 - 80
1.18 mm	10 - 50
300 µm	5 - 25
150 µm	0 - 15
75 µm	0 - 8.0

TABLE 5
Physical Property Requirements for Mortar Sand

Laboratory Test	Test Number	Requirement
Organic Impurities, Organic Plate Number	LS-610	3 (Note 1)
Mortar Strength Test	ASTM C87/C87M	(Note 2)
Notes: 1. When the fine aggregate is subjected to this test, it shall not produce a colour darker than the standard solution or Organic Plate Number 3. A fine aggregate failing this test may be approved if it meets the requirements of the mortar strength test according to ASTM C87/C87M. 2. Mortar specimens comprised of fine aggregate for use as mortar sand and hydraulic cement shall develop a compressive strength at the age of 7 Days of not less than 90% of the strength developed by a mortar prepared in the same manner with the same cement and with graded Ottawa sand having a fineness modulus of 2.40 ± 0.10.		

TABLE 6
Gradation Requirements for Mortar Sand

Sieve Size	Gradation (LS-602), Percent Passing
4.75 mm	100.0
2.36 mm	95 - 100
1.18 mm	60 - 100
600 µm	35 - 80
300 µm	15 - 50
150 µm	2 - 15
75 µm	0 - 5.0

TABLE 7
Physical Property Requirements for Gabion Stone, Rip-Rap and Rock Protection

Laboratory Test	Test Number	Rip-Rap	Gabion Stone	Rock Protection
Specific Gravity, minimum	ASTM D6473 (Note 1)	2.50	2.50	2.5
Absorption, % maximum		2.0	2.0	2.0
Flat and Elongated Particles, % maximum	LS-608 (Note 2)	15	15	15
Micro-Deval Abrasion, Coarse Aggregate, Grading A % maximum loss	LS-618 (Note 3)	25	25	25

Notes:

1. These requirements shall be based on the average test results for at least five pieces of rock when the source is macroscopically uniform or at least 8 pieces of rock when the source is macroscopically non-uniform. In addition, no individual piece of tested rock shall have a specific gravity less than 2.30 or absorption greater than 3.5%.
2. These requirements shall be based on measurements taken of at least 20 randomly-chosen pieces of rock either in stockpile at the source or after being delivered to the site.
3. Testing using LS-618 may be carried out on another aggregate product that is being simultaneously produced from the same crushing stage as rip-rap, gabion stone, or rock protection, as long as the other aggregate product being produced is sufficient for sampling and testing, according to the requirements of the procedure. As an example, if the Contractor can show that rip-rap and Granular A which meets the requirements of OPSS 1010 are being simultaneously produced from a primary crusher, a sample of the Granular A may be used for acceptance testing, in-lieu of testing a sample of rip-rap.

TABLE 8
Gradation Requirements for Gabion Stone, Rip-Rap, and Rock Protection

Mass kg	Approximate Dimension mm (Note 1)	Gradation, percent less than mass specified (Note 2)				
		Gabion Stone		Rip-Rap		Rock Protection
		G-3	G-10	R-10	R-50	
330	500	-	-	-	-	100
75	305	-	-	-	100	Well-graded
50	265	-	-	-	70 - 90	
25	210	-	-	-	40 - 55	
15	180	-	100	100	-	
10	155	-	90 - 100	70 - 90	-	
5	125	100	-	40 - 55	-	
3	105	90 - 100	-	-	-	0-10
2.5	100	-	0 - 5	-	0 - 15	-
0.5	60	0 - 5	-	0 - 15	-	-
Notes: 1. Masses are based on approximate size of an equivalent cube with a specific gravity of 2.65 and are provided for estimating purposes only. 2. The gradation shall be determined by individually weighing a minimum of 20 randomly-chosen stone particles from a sample taken from the stockpile representing a lot when comparing the total mass of the stone particles within each fraction with the total mass of all of the stone particles measured in the sample. For pieces of rock with masses that are larger than 25 kg, the approximate dimension of the piece determined using an average of three rectilinear measurements of the piece shall be allowed in lieu of weighing.						

TABLE 9
Physical Property Requirements for Truck Arrester Bed Aggregate

Laboratory Test	MTO Test Number	Requirement
Wash Pass 75 µm Sieve, Guideline B, % maximum	LS-601	1.0
Absorption, % maximum	LS-604	2.0
Unconfined Freeze-Thaw, % maximum loss	LS-614	6
Micro-Deval Abrasion, Coarse Aggregate, % maximum loss	LS-618	21

TABLE 10
Gradation Requirements for Truck Arrester Bed Aggregate

Sieve Size mm	Gradation (LS-602), Percent Passing
37.5	100
26.5	90 - 100
19.0	0 - 10

TABLE 11
Physical Property Requirements for Winter Sand

MTO Laboratory Test	MTO Test Number	Requirement
Micro-Deval Abrasion, Fine Aggregate, % maximum loss	LS-619	25 (Note 1)
Notes: 1. When obtained from sources on St. Joseph Island, Manitoulin Island, or areas of Ontario south and west of a boundary delineated by the Severn River, Provincial Highway 12, and Provincial Highway 7 east of Highway 12.		

TABLE 12
Gradation Requirements for Winter Sand

Sieve Size	Gradation (LS-602), Percent Passing
9.5 mm	100.0 (Note 1)
6.7 mm	97 - 100
4.75 mm	90 - 100
2.36 mm	50 - 95
1.18 mm	20 - 90
600 µm	0 - 70
300 µm	0 - 35
150 µm	0 - 15
75 µm	0 - 5.0
Notes: 1. In addition to LS-602, to be confirmed by visual inspection of the stockpile. A. The minimum size of the test sample shall be 5 kg. Following oven drying, the sample shall be sieved on the 9.5 mm, 6.7 mm, and 4.75 mm sieves. Material passing the 4.75 mm sieve shall be split to an appropriate size according to LS-602 for subsequent washing and fine sieving. The final grading shall be calculated according to LS-602 as the percentage of material passing each sieve based on the total mass of the oven dried sample.	

TABLE 13
Sample Size Requirements

Aggregate Type	Nominal Maximum Size mm	Minimum Sample Size kg
Clear Stone	53	80
	19.0	20
	16.0	15
	13.2	15
	9.5	10
Granular Sheeting		25
Mortar Sand		10
Rip-rap / Gabion Stone / Rock Protection (for physical properties only)		25 (consisting of stone particles from 2 to 5 kg each)
Truck Arrestor Bed Aggregate		75
Winter Sand		10

Appendix 1004-A, November 2021
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:

- Requirements for meeting QA. (1004.03)
- Reclaimed materials. (1004.05.01)
- Warranty provisions. (1004.08.06)
- Warranty provisions in referee testing. (1004.08.07)

The designer should be aware that OPSS 1004 includes the introduction of physical test methods:

The designer may consider the use of reclaimed materials as an alternate aggregate source material. If so, the designer should specify this requirement in the Contract Documents. (1004.05.01)

The designer should be aware that quality assurance (QA) testing for purposes of ensuring material used in the Work meets the requirements of OPSS 1004 is not mandatory, unless specifically included in the Contract Documents. The designer should determine the need for QA testing based on the size and complexity of the work and specify the required frequency of QA sampling and testing (1006.08.01). Appendix 1004-B provides recommended QA sampling and testing frequencies. The designer should determine if the sampling and testing frequencies provided in Appendix 1004-B are to be used for QA purposes. If so, they need to be invoked by reference in the Contract Documents.

The designer should ensure that the need for stability of 53 mm clear stone is considered. When required, the minimum percent crushed requirement should be added. (Table 1)

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

Related Ontario Provincial Standard Drawings

No information provided here.

Appendix 1004-B, November 2021**FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS**

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

Supplementary Requirements for Quality Assurance Sampling and Testing Frequencies

OPSS.MUNI 1004, Aggregates - Miscellaneous, is amended as follows:

1004.08 Quality Assurance**1004.08.01 General**

The first paragraph of subsection 1004.08.01 is deleted in its entirety and replaced with the following:

QA sampling and testing shall be carried out by the Owner for the purposes of ensuring that the aggregates used in the work are according to the requirements of the Contract Documents. QA sampling and testing shall be carried out at the frequency specified in Table B-1. Individual test results may be forwarded to the Contractor as they become available.

Table B-1 is added.

TABLE B-1
Sampling and Testing Frequencies for Physical Property and Gradation Requirements

Aggregate Type	Tender Quantity	Minimum Frequency
Clear stone	< 200 tonnes	At the Contract Administrator's discretion.
	≥ 200 tonnes and < 1,000 tonnes	One sample.
	≥ 1,000 tonnes (Note 1)	One sample per 1,000 tonnes.
Gabion Stone, (m ³ of gabion baskets)	< 100 m ³	At the Contract Administrator's discretion.
	≥ 100 m ³ and < 1,000 m ³	One sample.
	≥ 1,000 m ³ (Note 1)	One sample per 1,000 m ³ .
Granular Sheeting Rip-Rap	< 200 m ²	At the Contract Administrator's discretion.
	≥ 200 m ² and < 5,000 m ²	One sample.
	≥ 5,000 m ² (Note 1)	One sample per 5,000 m ² .
Rock Protection	< 200 m ³	At the Contract Administrator's discretion.
	≥ 200 m ³ and < 5,000 m ³	One sample.
	≥ 5,000 m ³ (Note 1)	One sample per 5,000 m ³ .
Truck Arrestor Bed	< 5,000 tonnes	One sample.
	≥ 5,000 tonnes (Note 1)	One sample per 5,000 tonnes.
Winter Sand	< 500 tonnes	At the Contract Administrator's discretion.
	≥ 500 tonnes and ≤ 5,000 tonnes	One sample.
	> 5,000 tonnes (Note 1)	One sample per 5,000 tonnes.

Notes:

1. When the tender quantity of material is:

- a) Less than one-half the quantity required for a sample, then that quantity shall be added to the quantity representing the previous sample.
- b) Greater than or equal to one-half the quantity required for a sample, then that quantity shall require its own sample.



MATERIAL SPECIFICATION FOR AGGREGATES – WATERBODY

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1005-A	Commentary

1005.01 SCOPE

This specification covers the requirements for aggregate materials placed in waterbodies.

1005.01.01 Specification Significance and Use

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

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

1005.01.02 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.

1005.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Materials

OPSS 1001 Aggregates - General

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-602	Sieve Analysis of Aggregates
LS-604	Relative Density and Absorption of Coarse Aggregate
LS-618	Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-619	Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-625	Guidelines for Sampling of Aggregate Materials
LS-630	Determination of the Amount of Contamination of Coarse Aggregate

MTO Forms:

PH-CC-112	Waterbody Materials Worksheet
PH-D-10	Aggregate Sample Data Sheet

ASTM International

D6473-15 Standard Test Method for Specific Gravity and Absorption of Rock for Erosion Control

1005.03

DEFINITIONS

For the purpose of this specification, the definitions in OPSS 182 and the following definitions apply:

Deleterious Material means as defined in OPSS 1001.

Waterbody means any permanent or intermittent, natural or constructed body of water including lakes, ponds, wetlands and watercourses.

Watercourse means a stream, creek, river, or channel including ditches, in which the flow of water is permanent, intermittent, or ephemeral.

1005.05

MATERIALS

1005.05.01

General

The requirements of OPSS 1001 shall apply to this specification.

All waterbody materials shall consist of clean, hard, durable, natural particles that are free of earth, humus, clay or other coatings, clay lumps, shale or shaley partings, deleterious materials, or deleterious substances. Crushed rock, reclaimed asphalt pavement, reclaimed hydraulic cement concrete, glass, ceramics, or any other reclaimed or slag materials shall not be used.

Waterbody materials for the WB-100 and smaller gradation bands, shall consist of naturally-formed, rounded or sub-rounded materials obtained from pit sources. Waterbody materials with top sizes larger than the gradation band for WB-100 may come from pit sources, quarry sources or both, unless otherwise specified in the Contract Documents.

When any change in the character of the aggregate occurs or when the performance of an aggregate meeting the requirements of this specification is found to be unsatisfactory, use of that aggregate shall be discontinued until a reappraisal with the approval of the Contract Administrator proves the source to be satisfactory.

All waterbody materials shall be according to Table 1 for physical properties and according to Tables 2, 3, and 4, for gradation or size & mass requirements for larger boulders or pieces of rock.

1005.07

PRODUCTION

1005.07.01

Aggregate Processing, Handling, and Stockpiling

Aggregates separated during processing shall be placed in individual stockpiles. Processed aggregates secured from different sources and aggregates from the same source, but of different gradations shall be placed in individual stockpiles.

Aggregates that have become mixed with foreign matter of any description or aggregates from different stockpiles that have become mixed with each other shall not be used and shall be removed from the stockpile immediately.

1005.08 QUALITY ASSURANCE

1005.08.01 General

The total quantity of each different waterbody material type from each source location shall represent an individual lot.

Each lot shall be randomly sampled, as specified in the Contract Documents.

The Contract Administrator shall be allowed access to all sampling locations.

The laboratory designated by the Owner shall carry out QA testing for the purpose of ensuring that the aggregates used in the Work are according to the physical property and gradation requirements of this specification. The Owner shall be responsible for all costs associated with testing for QA purposes, unless otherwise indicated in this specification. Individual test results shall be forwarded to the Contractor, as they become available.

Test data for each aggregate type shall be managed independently. When more than one source is used for supplying material, test data from each source and product shall be managed independently.

1005.08.02 Sampling

Sampling shall be according to LS-625 and taken at the time and location determined by the Contract Administrator. Samples shall be of sufficient mass to conduct the necessary gradation and physical property tests of the material. Minimum sample sizes for each aggregate type, up to the WB-350 gradation, shall be as shown in Table 5.

Unless otherwise specified, all QA samples shall be taken from individual stockpiles constructed at the Working Area or at the source. Each QA sample shall be treated as a discrete sample and not combined or blended with any other sample.

All samples, representing one lot of aggregate, shall be duplicate samples.

The Contractor shall provide new or clean sample bags or containers that are constructed to prevent the loss of any part of the material or contamination or damage to the contents during shipment. Metal or cardboard containers are unacceptable. QA samples shall be identified both inside and outside of the sample container. Data shall be included with QA samples shall be according to the requirements of MTO Form PH-D-10.

At least one set of QA samples shall be obtained for each aggregate type used in the Work. The Contract Administrator shall seal each QA sample container at the time and place of sampling.

Medium to large boulders, as specified in Table 4, shall be randomly chosen for sampling, at the discretion of and at the location determined by the Contract Administrator.

Duplicate sawed portions of individual boulders for specific gravity and absorption testing of WB-350 and larger waterbody materials, as specified in Note 1 of Table 1, shall be obtained from the Working Area.

1005.08.03 Testing and Retention of Samples

When the Contract Administrator has elected to carry out QA testing, one of the duplicate samples shall be randomly selected for testing by the QA laboratory. The QA laboratory shall retain the remaining sealed sample for possible referee testing, if required.

1005.08.04 Acceptance

QA test results shall be used for acceptance purposes, except when referee testing has been carried out.

When QA test results for the sample representing an individual lot shows that the material meets the applicable gradation and physical property requirements of this specification, the lot shall be accepted.

When QA test results show that the material does not meet the applicable requirements of this specification, then all the aggregates in that lot shall be considered rejected and shall be removed from the Work at no additional cost to the Owner.

The Contract Administrator shall notify the Contractor that material represented by the test result is not acceptable. This notification shall take place in writing within 3 Business Days of receipt of the non-conforming data.

1005.08.05 Referee Testing

The Contractor may invoke referee testing for one or more attributes by submitting a written request to the Contract Administrator within 5 Business Days following notification that the aggregate does not meet the requirements of this specification.

Referee testing shall be carried out, as specified herein and elsewhere in the Contract Documents.

The retained duplicate QA sample shall be used for referee testing.

All referee test results for a lot shall replace the respective QA tests for acceptance of the applicable lot and shall be binding on both the Owner and the Contractor.

If a lot is not accepted based on the referee test results, then the Contractor shall be responsible for the cost of the referee testing of that lot, including the cost of transporting the samples to the referee laboratory, at the rates specified elsewhere in the Contract Documents. In all other cases, the Owner shall bear the cost of the referee testing and the cost of transporting the samples of that lot.

TABLE 1
Physical Property Requirements for Waterbody Materials

Description of Test	Test Number	WB-6.7	WB-13.2	WB-19	WB-37.5	WB-53	WB-100	WB-200	WB-350	WB-400	WB-500	WB-750	WB-1000	WB-1250	WB-1500
Specific Gravity, Minimum	ASTM D 6473 (Note 1)	-	-	-	-	-	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Absorption, % Maximum		-	-	-	-	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Loss by Washing, Pass 75 µm Sieve, Guideline A, % Maximum	LS-602	5.0	2.0	2.0	-	2.0	-	-	-	-	-	-	-	-	-
Absorption, % Maximum	LS-604	2.0	2.0	2.0	2.0	2.0	-	-	-	-	-	-	-	-	-
Micro-Deval Abrasion Coarse Aggregate Loss, Grading A % Maximum	LS-618	-	30	30	30 (Note 2)	30	30 (Note 3)	-	-	-	-	-	-	-	-
Micro-Deval Abrasion Fine Aggregate Loss, % Maximum	LS-619	35	-	-	35	-	-	-	-	-	-	-	-	-	-
Amount of Contamination, % Maximum	LS-630	0.5	0.5	0.5	0.5	0.5	(Note 4)	(Note 4)	(Note 4)	(Note 4)	(Note 4)	(Note 4)	(Note 4)	(Note 4)	(Note 4)

Notes:

1. These requirements shall be based on the average test results for at least five cobbles or boulders, where the source appears lithologically uniform or at least eight cobbles or boulders, where the source appears lithologically non-uniform. The cobbles or boulders, to be tested, shall be randomly sampled, as specified in Notes 1, 2, 3, and 4 of Table 5. In addition, no individual piece of tested rock shall have a specific gravity less than 2.30 or an absorption greater than 3.5%.
2. This requirement shall be waived if the material has more than 80% passing the 4.75 mm sieve.
3. Testing may be carried out on another aggregate product, if it is being simultaneously produced from the same formation and location within a pit or a quarry and during the same production stage, as the WB-100, as long as the quantity of the other aggregate product being produced is sufficient for sampling and testing using LS-618. For example, if it can be demonstrated that the cobbles used to produce WB-100 are the oversize for the simultaneous production of a coarse granular material which has a Micro-Deval Abrasion Loss of no more than 30%, according to LS-618, then the WB-100 cobbles being simultaneously produced with that granular material shall also be considered to meet the requirements of LS-618.
4. Stockpiles of these waterbody materials shall not contain any visible contamination.

TABLE 2
Gradation Requirements for Sand and Gravel Used for Waterbody Materials,
Percent Passing

Sieve Size mm	Gradation (L.S-602) of Waterbody Materials % Less Than Sieve Size Specified					
	WB-6.7	WB-13.2	WB-19	WB-37.5	WB-53	
63.00	-	-	-	-	100	
53.00	-	-	-	100	90-100	
37.50	-	-	-	90-100	-	
26.50	-	-	100	50-100	-	
19.00	-	-	90-100	-	0-15	
16.00	-	100	-	-	-	
13.20	-	96-100	-	-	-	
9.50	100	50-73	0-55	30-100	-	
6.70	97-100	-	-	-	-	
4.75	90-100	0-10	0-10	20-100	-	
2.36	50-95	-	-	-	-	
1.18	20-90	-	-	10-100	-	
0.60	0-70	-	-	-	-	
0.30	0-35	-	-	2 - 65	-	
0.15	0-15	-	-	-	-	
0.07	0-5	0-2	0-2	0-8	0-2	

TABLE 3
Mass Gradation Requirements for Cobbles and Small Boulders Used as Waterbody Materials

Gradation %, By Mass, Less Than Mass Specified (Note 1)				
Maximum 2nd Smallest Dimension of an Equivalent Rectangular Prism (mm)	Mass of Gravel/Cobble /Boulder (kg)	Waterbody Material Designation		
		WB-100	WB-200	WB-350
350	97 (Note 2)	-	-	100
300	60 (Note 2)	-	-	75-100
200	18	-	100	20-40
150	7.7	-	40-60	0-15
100	2.3	100	0-10	-
63	0.55	40-60	-	-
53	0.35	0-10	-	-
Note: 1. The mass gradation shall be determined by individually weighing a minimum of 20 randomly-chosen cobbles and small boulders from a sampling pad, constructed according to LS-625, from the stockpiled material that's intended for use and then comparing the mass of the stone particles within each specified fraction of the mass gradation with the total mass of all of the stone particles that were measured for that sample. That information shall be recorded on Form PH-CC-112. 2. For a boulder with a mass larger than 25 kg, its approximate mass may be determined by multiplying the average of its three rectilinear dimensions (i.e. for an equivalent rectangular prism) by the average specific gravity for the same waterbody material, determined in accordance with Note 1 of Table 1.				

TABLE 4
Medium to Large Boulders Used For Waterbody Materials

Size	Waterbody Material Designation					
	WB-400	WB-500	WB-750	WB-1000	WB-1250	WB-1500
Designated Size (i.e. the Average of the Two Smallest Dimensions of an Equivalent Rectangular Prism) (mm)	(Note 1)					
	400	500	750	1000	1250	1500
Average Approximate Mass of Boulders (kg) (Note 2)	145	285	955	2265	4425	7645
Note: - For each waterbody material designation, the dimensions for a minimum of 20 randomly-chosen boulders, that are intended for use, shall be recorded on Form PH-CC-112. Within that sample: - the largest rectilinear dimension of every boulder shall be no more than 1.5 times the average of its 2 smallest rectilinear dimensions (i.e. for an equivalent rectangular prism); and - At least 80% of the boulders, by mass, shall have an average of their two smallest rectilinear dimensions (i.e. for an equivalent rectangular prism), no larger than the Designated Size and no smaller than 60% of the Designated Size. - Note that the mass of any individual boulder, will vary significantly from the stated values, depending on its shape (e.g. cubical, prism, sphere, oblate spheroid etc.) and actual dimensions.						

TABLE 5
Sample Size Requirements

Waterbody Material Designation	Minimum Sample Size for Physical Properties Testing kg (Note 1)
WB-6.7	10
WB-13.2	20
WB-19	20
WB-37.5	40
WB-53	80
WB-100	25 (Note 2)
WB-200	75 (Note 3)
WB-350	150 (Note 3)
WB-400, WB-500, WB-750, WB-1000, WB-1250 and WB-1500	(Note 4)
Notes: 1. Duplicate samples shall be randomly taken from sampling pads constructed from each stockpiled material that's intended for use and individual sample bags shall not exceed 25 kg. 2. Each duplicate sample shall consist of at least five cobbles from lithologically uniform sources or at least eight cobbles from lithologically non-uniform sources and no cobble shall have a mass less than 0.4 kg. 3. Each duplicate sample shall consist of at least five cobbles or boulders from lithologically uniform sources or at least eight cobbles or boulders from lithologically non-uniform sources and no boulder shall have a mass greater than 25 kg 4. Where duplicate portions of medium to large boulders are required for specific gravity and absorption testing, as specified in Note 1 of Table 1, such boulders shall be randomly chosen, at the locations determined by the Contract Administrator and the duplicate sample portions that are required for testing, shall be cut from the boulders, using a portable diamond saw at the contract site.	

Appendix 1005-A, November 2021
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 AGGREGATES - SURFACE TREATMENT

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1006.01 SCOPE

This specification covers the requirements for aggregates for use in surface treatment.

1006.01.01 Specification Significance and Use

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

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

1006.01.02

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.

1006.02

REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

OPSS 1001 Aggregates - General

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-601	Material Finer than 75 µm Sieve in Mineral Aggregates by Washing
LS-602	Sieve Analysis of Aggregates
LS-604	Relative Density and Absorption of Coarse Aggregate
LS-606	Soundness of Aggregates by Use of Magnesium Sulphate
LS-607	Percent Crushed Particles in Processed Coarse Aggregate
LS-608	Percent Flat and Elongated Particles in Coarse Aggregate
LS-609	Petrographic Analysis of Coarse Aggregate
LS-613	Insoluble Residue of Carbonate Aggregates
LS-614	Freezing and Thawing of Coarse Aggregate
LS-618	Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-619	Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-625	Guidelines for Sampling of Aggregate Materials
LS-703/704	Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1006.03

DEFINITIONS

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

CCIL means the Canadian Council of Independent Laboratories.

Duplicate Samples means two samples taken at the same time and location – one to be used for Quality Assurance testing and the other for referee testing.

Physical Property means an inherent attribute or feature of an aggregate material. Tests are carried out to determine an aggregate's resistance to weathering or degradation or both.

Referee Testing means testing of a material property or attribute for the purpose of resolving acceptance.

Slag means fused silicate material from the processing of ores and includes air-cooled blast furnace slag, blast furnace slag, copper slag, nickel slag, and steel slag.

1006.05

MATERIALS

1006.05.01

Aggregates

1006.05.01.01

General

Aggregates shall be according to OPSS 1001, unless otherwise specified in this specification.

Aggregates shall be clean, hard durable particles produced from sands, gravels, or quarried rock and shall be free of earth, humus, clay coatings, and clay lumps or fragments of any size or shape.

Aggregates containing slag or composed of slag are not acceptable for use as surface treatment aggregates.

At the discretion of the Owner, the physical property requirements may be waived provided the Contractor has demonstrated satisfactory field performance for a pavement that is at least 3 years old and constructed in a similar environment for the same application and using the same aggregate that is being proposed. An independent petrographic examination and report shall be provided to the Owner that demonstrates to the Owner's satisfaction that the aggregate used in the pavement being referred to is the same as the aggregate under consideration for acceptance.

When a change in the character of the aggregate occurs or when the performance of the aggregate is found to be unsatisfactory, use of those aggregates shall be discontinued until it is demonstrated to the satisfaction of the Contract Administrator that the source remains acceptable or can be made acceptable.

1006.05.01.02

Gradation Requirements

Aggregate shall meet the gradation requirements shown in Table 1.

1006.05.01.03

Physical Property Requirements

Aggregate shall meet the physical property requirements of Table 2.

1006.07 PRODUCTION

1006.07.01 Aggregate Processing, Handling, and Stockpiling

Aggregates separated during processing, aggregates secured from different sources, and aggregates from the same source but of different gradations shall be placed in individual stockpiles. When screenings from primary and secondary crushers are produced separately, they shall be stockpiled separately.

Aggregates that have become mixed with foreign matter of any description or aggregates from different stockpiles that have become mixed with each other shall not be used and shall be immediately removed from the stockpile.

1006.08 QUALITY ASSURANCE

1006.08.01 General

QA testing may be carried out by the Owner for purposes of ensuring that the aggregates used in the work are according to the requirements of this specification. Individual test results may be forwarded to the Contractor as they become available.

When a hydrated lime anti-stripping agent is used and testing is required, test samples for the physical property requirements shall be taken prior to the addition of the hydrated lime. If this is not practical, samples coated in hydrated lime may be taken and the lime removed by washing prior to testing. In this case, the requirements for LS-601 shall be waived.

The Owner shall be responsible for all costs associated with testing for QA purposes, unless otherwise specified in the Contract Documents.

1006.08.02 Laboratory Requirements

The Contract Administrator shall designate all QA laboratories.

An acceptable laboratory conducting aggregate tests for physical properties shall be one that holds a current Type D certificate from CCIL for the applicable test methods and also participates in the annual MTO Proficiency Sample Testing Program for the specific tests, when applicable.

An acceptable laboratory conducting tests for gradation according to LS-602, materials finer than 75 µm by washing of the aggregates according to LS-601, and percent crushed particles according to LS-607 shall be one that holds a current Type C certificate from CCIL.

Testing shall be conducted by qualified laboratory staff that holds a current certificate from CCIL in aggregate testing.

Equivalent alternate laboratory and technician certifications or laboratory proficiency testing programs may be used to demonstrate similar requirements provided that they are acceptable to the Contract Administrator.

1006.08.03 Alternative to LS-614

LS-614 shall be used for acceptance, unless written notification to the Contract Administrator to replace it with LS-606 for acceptance is received prior to sampling of the applicable materials for QA purposes. Provided the Contract Administrator has received such a request, LS-606 shall be used. Otherwise, conformance to LS-614 shall be required.

When notification is provided after QA testing using LS-614 has been initiated, the Contractor shall be charged for the cost of the testing using LS-614, administrative charges, and additional sampling, if required.

1006.08.04 Sampling

Sampling shall be conducted by the Contractor according to LS-625.

Duplicate samples shall be randomly obtained from the stockpile and sealed by the Contractor in the presence of the Contract Administrator. The stockpiles from which the samples are to be taken shall contain at least 10% of the total quantity of aggregate needed, unless otherwise directed by the Contract Administrator.

The mass of each sample shall meet the requirements shown in Table 3. Each bag or container shall hold not more than 30 kg. When more than 30 kg is required, the total sample shall be recombined by the QA laboratory prior to testing.

In the event that the Contractor is unavailable to take the sample, no further materials shall be placed in the work until the duplicate samples have been taken.

The Contractor shall provide new or clean sample bags or containers that are constructed to prevent the loss of any part of the material or contamination or damage to the contents during shipment. Metal or cardboard containers are unacceptable.

QA samples shall be identified on both the inside and the outside of the sample container.

1006.08.05 Testing and Retention of Samples

When the Contract Administrator elects to carry out QA testing, one of the duplicate samples shall be randomly selected for testing by the QA laboratory and the remaining sealed sample shall be retained by the QA laboratory for possible referee testing.

1006.08.06 Acceptance

QA test results shall be used for acceptance purposes, except when referee testing has been carried out.

When QA test results show that the aggregates meet the requirements of this specification, the aggregates shall be accepted.

When QA test results show that the aggregates do not meet the requirements of this specification, the Contract Administrator shall notify the Contractor that the aggregates represented by the test results shall not be accepted. This notification shall take place in writing within 3 Business Days of receipt of the non-conforming data. The Contractor has the option of either removing the material from the work or invoking referee testing. The Contractor may request a reduced price in lieu of removal for aggregates that fail to meet the requirements of this specification. Irrespective of the negotiation of a reduced price payment, the warranty provisions as specified in the Contract Documents shall apply.

1006.08.07 Referee Testing

When QA test results do not meet the requirements of this specification the Contractor has the option of invoking referee testing of the test result that fails to meet the requirements. The Contractor shall notify the Contract Administrator of the selected option in writing within 2 Business Days following notification of unacceptable material.

The Contract Administrator shall select a referee testing laboratory acceptable to the Contractor within 3 Business Days following the Contractor's notification to invoke referee testing. Referee test samples shall

be delivered to the referee testing laboratory from the QA laboratory by the Contract Administrator. The sealed test sample shall be opened in the presence of the Contractor and the Contract Administrator.

Referee testing shall be carried out in the presence of the Contract Administrator. Where applicable, the referee testing laboratory shall also test a control aggregate sample for each test method required. The Contractor may observe the testing at no cost to the Owner.

The Contractor and Owner may send a maximum of two representatives each to observe the referee testing. The Contract Administrator shall notify the Owner and Contractor a minimum of 3 Business Days in advance of the date of referee testing. Provided that such notice was given, referee testing shall be carried out regardless of the absence of one or more observers.

Observers shall follow the referee laboratory protocols for access to the premises and testing equipment and shall not unnecessarily impede the progress of the testing. Observers shall be permitted to validate sample identification and view sample condition. Subject to safety requirements, test method and equipment limitations, they shall also be permitted to observe test procedures, take notes, view equipment readings and review completed work sheets while in attendance.

Comments on the non-conformity of the test methods shall be made and corrected at the time of testing.

Referee test results shall be binding on both the Owner and the Contractor.

When a referee test result shows that the aggregates do not meet the requirements of this specification, the aggregates represented by the test result, including aggregates in existing stockpiles or in the Work, shall be rejected. The Contractor shall remove the aggregates from the work at no cost to the Owner. The Contractor may request a reduced price in lieu of removal for aggregates that fail to meet the requirements of this specification. Irrespective of the negotiation of a reduced price payment, the warranty provisions as specified in the Contract Documents shall apply.

When referee test results show that the aggregates meet the requirements of this specification, the aggregates represented by the sample shall be accepted.

The Owner shall be responsible for the cost of referee testing provided that the referee test results show that the aggregates meet the applicable specifications otherwise the Contractor shall be responsible for the cost.

TABLE 1
Gradation Requirements, LS-602

MTO Sieve Designation	Percent Passing by Mass					
	Class 1 (Note 1)	Class 2	Class 3 (Note 2)	Class 4	Class 5 (Note 1)	Class 6 (Note 3)
19.0 mm	--	100	100	--	--	--
16.0 mm	--	98-100	96-100	--	--	100
13.2 mm	100	75-95	67-86	--	--	96-100
9.5 mm	75-100	50-80	29-52	100	100	50-73
6.7 mm	0-40	--	--	--	40-85	--
4.75 mm	0-10	25-50	0-10	70-100	5-25	0-10
2.36 mm	--	--	--	10-100	0-10	--
1.18 mm	--	10-40	--	5-90	0-5	--
600 µm	--	--	--	3-70	--	--
300 µm	--	2-20	--	2-40	--	--
150 µm	--	2-13	--	0-15	--	--
75 µm	Note 4	2-7	Note 4	0-7	Note 4	Note 4
Notes: 1. Class 1 and Class 5 aggregates shall be washed according to OPSS 1001. 2. Class 3 aggregate has the same gradation requirements as HL4 coarse aggregate. 3. Class 6 aggregate has the same gradation requirements as HL3 coarse aggregate. 4. Class 1, 3, 5, and 6 requirements for percent passing 75 µm are shown in Table 2.						

TABLE 2
Physical Property Requirements

MTO Laboratory Test	MTO Test No.	Class 1 (Note 1)	Class 2 (Note 1)	Class 3 (Note 1)	Class 4	Class 5 (Note 1)	Class 6 (Note 1)
Wash Pass 75 µm sieve, Guideline B, % maximum	LS-601	1.3 (Note 2)	--	1.3 (Note 2)	--	1.3 (Note 2)	1.3 (Note 2)
Absorption, % maximum	LS-604	1.75	--	2.0	--	1.75	1.75
Percent Crushed Particles, % minimum	LS-607	60	60	60	--	60	60
Flat and Elongated Particles, % maximum	LS-608	20	20	20	--	20	20
Petrographic Examination, % non-carbonate retained 4.75 mm sieve, % minimum	LS-609	60 (Note 3)	60 (Note 3)	60 (Note 3)	--	60 (Note 3)	60 (Note 3)
Unconfined Freeze-Thaw, % maximum loss, (Note 4)	LS-614	6	15	6	--	6	6
Micro-Deval Abrasion (Coarse Aggregate), % maximum loss	LS-618	17	25	17	--	17	17
Micro-Deval Abrasion (Fine Aggregate), % maximum loss	LS-619	--	30	--	25	--	--
Plasticity Index, maximum	LS-703/704	--	0	--	0	--	--
Alternative Requirement to Unconfined Freeze-Thaw Loss, LS-614							
Magnesium Sulphate Soundness (coarse aggregate), % maximum loss	LS-606	12	15	12	--	12	12
Notes: - With the exception of LS-619 and LS-703/704, the physical property requirements for Class 1, 2, 3, 5, and 6 aggregates noted above shall be conducted on the material retained on the 4.75 mm sieve. - When quarried rock is used as a source of coarse aggregate, a maximum of 2.0% passing the 75 µm sieve shall be permitted. - The requirements listed below are only applicable to the area to the north and west of a boundary defined by the north shore of Lake Superior, the north shore of the St. Mary's River, the south shore of St. Joseph's Island, the north shore of Lake Huron easterly to the north and east shore of Georgian Bay (excluding Manitoulin Island), along the Severn River to Washago and a line easterly passing through Norland, Burnt River, Burleigh Falls, Madoc, and hence easterly along Highway 7 to Perth and northerly to Calabogie and easterly to Arnprior and the Ottawa River: - When the coarse aggregate for use in surface treatment is obtained from a gravel pit or quarry containing more than 40% carbonate rock type (e.g. limestone and dolostone), then blending with aggregate of non-carbonate rock types shall be required to increase the minimum non-carbonate rock type content of the coarse aggregate to 60%, as determined by petrographic examination (LS-609). In cases of dispute LS-613, shall be used with a minimum acid insoluble residue of 60%. - When the coarse aggregate for use in surface treatment is obtained from a non-carbonate source, blending with aggregate from carbonate rock types is not permitted. - The Owner shall waive the requirements for LS-614, unconfined freeze-thaw, provided the Contractor has submitted a written request that the coarse aggregates meet the alternative requirements for LS-606, magnesium sulphate soundness.							

TABLE 3
Sample Size

Material	Minimum Mass of Field Samples (Note 1) kg
Fine aggregate	15
19 mm coarse aggregate	25
37.5 mm coarse aggregate	50
Note: 1. Individual sample containers shall hold no more than 30 kg of aggregate. When more than 30 kg is required, additional sample containers shall be used.	

Appendix 1006-A, November 2021 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:

- Requirements for meeting QA. (1006.03)
- Costs of QA testing. (1006.08.01)
- Warranty provisions. (1006.08.06)
- Warranty provisions in referee testing. (1006.08.07)

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

- If the QA sampling and testing frequencies provided in Appendix 1006-B are to be used for QA purposes, Appendix 1006-B needs to be invoked by reference in the Contract Documents.
- If the payment reduction in lieu of aggregate removal provided in Appendix 1006-C is to be used, Appendix 1006-C needs to be invoked by reference in the Contract Documents.
- If the form in Appendix 1006-D is to be used for submission purposes, Appendix 1006-D needs to be invoked by reference in the Contract Documents.

The designer should be aware that quality assurance (QA) testing for purposes of ensuring material used in the Work meets the requirements of is not mandatory, unless specifically included in the Contract Documents. The designer should determine the need for QA testing based on the size and complexity of the work and specify the required frequency of QA sampling and testing. Appendix 1006-B provides recommended QA sampling and testing frequencies.

The requirement for a minimum of 60% non-carbonate aggregate, Table 2, Note 3, in certain parts of the province is based on the following considerations: Carbonate aggregates, due to their low resistance to abrasion, polish easily under traffic and, depending on traffic volume, may result in pavements with relatively differing low frictional properties. In areas of the province with a predominant type of rock, siliceous or carbonate, it has been found that it is best to give consistent frictional properties to pavement surfaces. For instance, it has been found that the use of carbonate aggregates in areas of predominantly siliceous rocks results in lower frictional values than normal for that area and a relatively higher proportion of wet weather skidding accidents in those areas paved with carbonate rocks. In areas of the predominant use of carbonate rocks it has been found that drivers appear to adjust their behaviour to the generally lower frictional properties.

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

Related Ontario Provincial Standard Drawings

No information provided here.

Appendix 1006-B, November 2021
FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

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

Supplementary Requirements for Quality Assurance Sampling and Testing Frequencies

OPSS.MUNI 1006, Aggregates - Surface Treatment is amended as follows:

1006.08 QUALITY ASSURANCE

1006.08.01 General

The first paragraph of subsection 1006.08.01 is deleted in its entirety and replaced with the following:

QA sampling and testing shall be carried out by the Owner for the purpose of ensuring that the aggregates used in the Work are according to the requirements of the Contract Documents. QA sampling and testing carried out at the frequency specified in Table B-1. Individual test results may be forwarded to the Contractor as they become available.

Table B-1 is added.

TABLE B-1
Sampling and Testing Frequencies for Physical Property and Gradation Requirement (Note 1)

Aggregate Quantity from Each Source t	Minimum Frequency Class 1, 2, 3, 4, 5 and 6
< 500	Sampling and testing may be waived at the discretion of the Contract Administrator.
≥ 500 and ≤ 2,000	One sample for both physical properties and gradation.
> 2,000 (Note 2)	<u>Gradation</u> : One sample per 2,000 tonnes. <u>Physical Properties</u> : One sample per 20,000 tonnes.
Notes: 1. The physical property requirements may be waived at the discretion of the Owner, provided that the Contractor has demonstrated satisfactory field performance for a pavement that is at least 3 years old and constructed in a similar environment for the same application and using the same aggregate that is being proposed. An independent petrographic examination and report shall also be provided to the Owner that demonstrates to the Owner's satisfaction that the aggregate used in the pavement being referred to is the same as the aggregate under consideration for acceptance. 2. When the quantity of granular material is: a) Less than one-half the quantity required for a sample, then that quantity shall be added to the quantity representing the previous sample. b) Greater than or equal to one-half the quantity required for a sample, then that quantity shall require its own sample.	

Appendix 1006-C, November 2021
FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

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

Supplementary Requirements for Payment Reduction In Lieu of Removal of Aggregates

OPSS.MUNI 1006, Aggregates - Surface Treatment is amended as follows:

When a tested sample of aggregates shows that the aggregates do not meet the requirements of this specification, the aggregates represented by the test result, including material in existing stockpiles or in the Work, shall not be accepted. The Contractor may request a reduced price in lieu of removal provided that the applicable test results for that sample:

- a) Do not exceed the requirement for LS-614, or LS-606 if it has replaced LS-614, by more than 25% of the specified value.
- b) Do not exceed the requirement for LS-618 by more than 10% of the specified value.
- c) Do not exceed the requirement for LS-619 by more than 15% of the specified value.
- d) Do not identify a plasticity index within the material, when determined according to LS-703/704, and meet the requirement for LS-602 on the 75 µm sieve.
- e) Do not exceed 10% of the specified value for any other requirement in this specification.

Irrespective of the negotiation of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

Appendix 1006-D, November 2021**FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS**

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

OPSS 1006 – Surface Treatment Aggregate Test Data

Contract No.:	Contractor:	Contract Location:	
Name of Testing Laboratory:		Telephone No.:	Fax No.:
Sampled by (Print Name):		Date Sampled (YY/MM/DD):	
Aggregate Class:		Quantity (tonnes) :	
Source Name/Location:		Aggregate Inventory Number (AIN) :	

Laboratory Test and Number	Requirements						Test Results		
	Class 1 (Note 1)	Class 2 (Note 1)	Class 3 (Note 1)	Class 4	Class 5 (Note 1)	Class 6 (Note 1)	Reference Material	Sample	Meets Requirements (Y/N)
Wash Pass 75 µm Sieve Guideline B, % maximum, LS-601	1.3 (Note 2)	--	1.3 (Note 2)	--	1.3 (Note 2)	1.3 (Note 2)			
Absorption, % maximum, LS-604	1.75	--	2.0	--	1.75	1.75			
Percent Crushed Particles, % minimum, LS-607	60	60	60	--	60	60			
Flat and Elongated Particles, % maximum, LS-608	20	20	20	--	20	20			
Petrographic Examination, Minimum % non-carbonate retained on 4.75 sieve, LS-609	60 (Note 3)	60 (Note 3)	60 (Note 3)	--	60 (Note 3)	60 (Note 3)			
Unconfined Freeze-Thaw, % maximum loss, LS-614 (Note 4)	6	15	6	--	6	6			
Micro-Deval Abrasion(CA), % maximum loss, LS-618	17	25	17	--	17	17			
Micro Deval Abrasion (FA), % maximum loss, LS-619	--	30	--	25	--	--			
Plasticity Index, maximum, LS-703/704	--	0	--	0	--	--			
Alternative Requirement to Unconfined Freeze-Thaw (LS-614)									
Magnesium Sulphate Soundness, % maximum loss, LS-606 (Note 4)	12	15	12	--	12	12			

I hereby certify that testing has been carried out by a properly qualified/certified test technician:

Issued by:

PRINT NAME	TESTING LABORATORY REPRESENTATIVE SIGNATURE	DATE

Received by:

PRINT NAME	CONTRACT ADMINISTRATOR REPRESENTATIVE SIGNATURE	DATE

Copies to: ☐ Contract Administrator ☐ Contractor

Appendix 1006-D

Notes:

4. With the exception of LS-619 and LS-703/704, the physical property requirements for Class 1, 2, 3, 5, and 6 aggregates noted above shall be conducted on the material retained on the 4.75 mm sieve.
5. When quarried rock is used as a source of coarse aggregate, a maximum of 2.0% passing the 75 μ m sieve shall be permitted.
6. The requirements listed below are only applicable to the area to the north and west of a boundary defined by the north shore of Lake Superior, the north shore of the St. Mary's River, the south shore of St. Joseph's Island, the north shore of Lake Huron easterly to the north and east shore of Georgian Bay (excluding Manitoulin Island), along the Severn River to Washago and a line easterly passing through Norland, Burnt River, Burleigh Falls, Madoc, and hence easterly along Highway 7 to Perth and northerly to Calabogie and easterly to Arnprior and the Ottawa River:
 - a) When the coarse aggregate for use in surface treatment is obtained from a gravel pit or quarry containing more than 40% carbonate rock type (e.g, limestone and dolostone), then blending with aggregate of non-carbonate rock types shall be required to increase the minimum non-carbonate rock type content of the coarse aggregate to 60%, as determined by petrographic examination (LS-609). In cases of dispute LS-613, shall be used with a minimum acid insoluble residue of 60%.
 - b) When the coarse aggregate for use in surface treatment is obtained from a non-carbonate source, blending with aggregate from carbonate rock types is not permitted.
4. The Owner shall waive the requirements for LS-614, provided the Contractor has submitted a written request that the coarse aggregates meet the alternative requirements for LS-606.



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

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1010.01	SCOPE

This specification covers the material requirements for aggregates for use in base, subbase, select subgrade, granular surface, shouldering, and backfill material.

1010.01.01 Specification Significance and Use

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

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

1010.01.02 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.

1010.02 REFERENCES

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

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

Ontario Provincial Standard Specification, Material

OPSS 1001 Aggregates - General

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-601	Material Finer than 75 µm Sieve in Mineral Aggregates by Washing
LS-602	Sieve Analysis of Aggregates
LS-607	Percent Crushed Particles in Processed Coarse Aggregate
LS-614	Freezing and Thawing of Coarse Aggregate
LS-616	Petrographic Analysis of Fine Aggregate
LS-617	Percent Particles with Two or More Crushed Faces and Uncrushed Particles in Processed Coarse Aggregate
LS-618	Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-619	Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-621	Determination of Amount of Asphalt-Coated Particles in Coarse Aggregate

LS-625	Guidelines for Sampling of Aggregate Materials
LS-630	Amount of Contamination of Coarse Aggregates
LS-702	Particle Size Analysis of Soils
LS-703/704	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
LS-709	Permeability of Granular Soils

1010.03 DEFINITIONS

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

Air-Cooled Blast-Furnace Slag means the material resulting from solidification of molten blast-furnace slag under atmospheric conditions. Subsequent cooling may be accelerated by application of water to the solidified surface.

CCIL means the Canadian Council of Independent Laboratories.

Ceramic means porcelain, china, and whiteware (e.g., sinks, toilets, and bidets made from clay and silica fired at a high temperature, excluding clay brick and tile) that is free of organic materials, metal, and plastic.

Deleterious Material means materials from the recycling stream other than glass, ceramic, reclaimed asphalt pavement, and reclaimed concrete material that includes but is not limited to the following: wood, clay brick, clay tile, plastic, gypsum, gypsum plaster, and wallboard.

Duplicate Samples means two samples taken at the same time and location-one to be used for quality assurance testing and the other for referee testing.

Fines means material passing the 75 µm sieve when tested according to LS-601 or LS-602.

Free of Clay means the amount of material with a particle diameter less than 2 µm shall not be greater than 1% of the total sample when tested according to LS-702.

Glass means processed glass obtained from the recycling stream that is free of organic materials, metal, and plastic.

Granular A means a set of requirements for dense graded aggregates intended for use as granular base within the pavement structure, granular shouldering, and backfill.

Granular B means a set of requirements for well-graded aggregates intended for use as granular subbase within the pavement structure and granular backfill. Granular B may be Type I, Type II, or Type III.

Granular M means a set of requirements for dense graded aggregates intended for use on unpaved road surfaces and for the maintenance of unpaved shoulders.

Granular O means a set of requirements for open graded aggregates intended only for use as a free draining granular base within the pavement structure.

Granular S means a set of requirements for dense graded aggregates intended only for use as surface dressing of low volume unpaved roads with an AADT less than 200.

Nickel Slag means the non-metallic product resulting from the production of nickel.

Physical Property means an inherent attribute or feature of an aggregate or soil material. Tests are carried out to determine a materials resistance to weathering or degradation or both.

Quality Assurance (QA) means a system or series of activities carried out by the Owner to ensure that Materials received from the Contractor meet the requirements specified in the Contract Documents.

Reclaimed Asphalt Pavement (RAP) means processed hot mix asphalt material that is recovered by partial or full depth removal.

Reclaimed Concrete Material (RCM) means removed or processed old hydraulic cement concrete.

Referee Testing means testing of a material property or attribute for the purpose of resolving acceptance.

Select Subgrade Material (SSM) means a set of requirements for well-graded non-plastic aggregates used to replace poor subgrade materials and as swamp backfill.

Steel Slag means the non-metallic product resulting from the production of steel in a basic oxygen furnace or electric arc furnace.

1010.05 MATERIALS

1010.05.01 General

Aggregates shall be according to OPSS 1001, unless otherwise specified in this specification.

Aggregates shall meet the physical property requirements shown in Table 1 and the gradation requirements shown in Table 2.

When aggregates are tested according to LS-630, the total amount of wood shall not exceed 0.1% by mass, and the total amount of deleterious material and other contaminants shall not exceed a combined total of 1.0% by mass.

Glass and ceramic material shall be processed to remove all deleterious organic materials. 100% of the processed glass and ceramic material shall pass the 13.2 mm sieve.

When RCM is permitted, RCM shall not contain loose reinforcing materials.

When air-cooled blast furnace slag, nickel slag, and RAP containing steel slag aggregates are used, site-specific notification shall be given by the Contractor to the Ontario Ministry of the Environment (MOE).

When reclaimed materials are permitted, they shall be homogeneously blended.

Steel slag shall not be used.

When a change in the character of the aggregate occurs or when the performance of the aggregate is found to be unsatisfactory, use of those aggregates shall be discontinued until the Contractor can prove to the satisfaction of the Contract Administrator that the source remains acceptable or can be made acceptable.

1010.05.02 Granular A, Granular M, and Granular S

Granular A, Granular M, and Granular S shall be produced by crushing one or more of the following:

- a) Quarried bedrock.
- b) Boulders, cobbles, gravel, sand, and fines from naturally formed deposits.

- c) RAP up to 30% by mass.
- d) RCM up to 100% by mass.
- e) Air-cooled blast-furnace slag or nickel slag.
- f) Glass or ceramic materials up to a combined total of 15% by mass.

Granular A and Granular M containing RAP with steel slag aggregates shall be acceptable for unpaved gravel shoulders only.

1010.05.03 Granular B

Granular B may be Type I, Type II, or Type III.

1010.05.03.01 Granular B Type I and Type III

Granular B Type I and Type III may be produced from naturally formed deposits of sand, gravel, and cobbles or by crushing one or more of the following:

- a) Quarried bedrock.
- b) Air-cooled blast-furnace slag or nickel slag.
- c) RCM up to 100% by mass.
- d) RAP up to 30% by mass.
- e) Glass or ceramic materials up to 15% by mass combined.

RAP containing steel slag aggregates shall not be allowed.

1010.05.03.02 Granular B Type II

Granular B Type II shall only be produced by crushing:

- a) Quarried bedrock.
- b) Air-cooled blast furnace slag or nickel slag.

Steel slag and reclaimed materials shall not be used in the production of Granular B Type II.

1010.05.04 Granular O

Granular O shall only be produced by crushing:

- a) Quarried bedrock.
- b) Cobbles or boulders retained on the 50 mm sieve.

Steel slag and reclaimed materials shall not be used in the production of Granular O.

1010.05.05 Select Subgrade Material

Select subgrade material shall only be produced from natural deposits of non-plastic silt, sand, and gravel material. Reclaimed materials of any type shall not be used.

1010.07 PRODUCTION

1010.07.01 Aggregate Processing, Handling, and Stockpiling

Aggregates that have become mixed with foreign matter of any description or aggregates that have become mixed with each other shall not be used and shall be immediately removed from the stockpile.

1010.08 QUALITY ASSURANCE

1010.08.01 General

QA testing may be carried out by the Owner for the purposes of ensuring that the aggregates used in the work are according to the requirements of this specification. Individual test results shall be forwarded to the Contractor, as they become available.

Test data for each aggregate type shall be managed independently. When more than one source is used for supplying materials, test data from each source and product shall be managed independently.

The Owner shall be responsible for all costs associated with testing for QA purposes, unless otherwise specified in the Contract Documents.

1010.08.02 Laboratory Requirements

The Contract Administrator shall designate the QA laboratories.

An acceptable laboratory conducting tests for physical properties shall be one that holds a current Type D certificate from CCIL for the applicable test methods and also participates in the annual MTO Proficiency Sample Testing Program for the specific tests, except LS-616 and LS-709.

An acceptable laboratory conducting tests for gradation according to LS-602 and percent crushed particles according to LS-607 shall be one that holds a current Type C certificate from CCIL.

Testing shall be conducted by qualified laboratory staff that holds a current certificate from CCIL in aggregate testing.

Equivalent alternate laboratory and technician certifications or laboratory proficiency testing programs may be used to demonstrate similar requirements, provided that they are acceptable to the Contract Administrator.

1010.08.03 Sampling

Sampling shall be according to LS-625.

Duplicate samples shall be taken and sealed by the Contractor in the presence of the Contract Administrator at the time and location determined by the Contract Administrator. When materials contain blended or reclaimed aggregates or both, QA sampling shall be performed on the final blended product.

The mass of each sample shall meet the requirements shown in Table 3. When more than 30 kg is required, the total samples shall be recombined by the QA laboratory prior to testing.

In the event that the Contractor is unavailable to take the sample, no further materials shall be placed in the work until the duplicate samples been taken.

The Contractor shall provide new or clean sample bags or containers that are constructed to prevent the loss of any part of the material or contamination or damage to the contents during shipment. Metal or cardboard containers are unacceptable.

QA samples shall be identified on both the inside and the outside of the sample container.

1010.08.04 Testing and Retention of Samples

When the Contract Administrator elects to carry out QA testing, one of the duplicate samples shall be randomly selected for testing by the QA laboratory and the remaining sealed sample shall be retained by the QA laboratory for possible referee testing.

1010.08.05 Acceptance

QA test results shall be used for acceptance purposes, except when referee testing has been carried out.

When QA test results show that the aggregates meet the requirements of this specification, the aggregates shall be accepted.

When QA test results show that the aggregates do not meet the requirements of this specification, the Contract Administrator shall notify the Contractor that aggregates represented by the test results shall not be accepted. This notification shall take place in writing within 3 Business Days of receipt of the non-conforming data. The Contractor has the option of either removing the aggregates from the work or invoking referee testing. The Contractor may request a reduced price in lieu of removal of aggregates that fail to meet the requirements of this specification. Irrespective of the negotiation of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

At the discretion of the Contract Administrator, irrespective of non-compliance with the requirements of this specification, aggregates may be accepted on the basis of satisfactory field performance.

1010.08.06 Referee Testing

When QA test results do not meet the requirements of this specification, the Contractor has the option of invoking referee testing of the test result that fails to meet the requirements. The Contractor shall notify the Contract Administrator of the selected option in writing within 2 Business Days following written notification of unacceptable material.

The Contract Administrator shall select a referee laboratory acceptable to the Contractor within 3 Business Days following the Contractor's notification to invoke referee testing. Referee test samples shall be delivered to the referee testing laboratory from the QA laboratory by the Contract Administrator. The sealed sample shall be opened in the presence of the Contractor and the Contract Administrator. If referee materials are not available, the Contractor shall be responsible for obtaining and submitting new samples to the referee laboratory from a location to be decided by the Contract Administrator. The Contract Administrator shall be present to witness the sampling.

Referee testing shall be carried out in the presence of the Contract Administrator. When applicable, the referee laboratory shall also test a control aggregate sample for each test method required. The Contractor may observe the testing at no cost to the Owner.

The Contractor and Owner may send a maximum of two representatives each to observe the referee testing. The Contract Administrator shall notify the Owner and Contractor a minimum of 3 Business Days in advance of the date of referee testing. Provided that such notice was given, referee testing shall be carried out regardless of the absence of one or more observers.

Observers shall follow the referee laboratory protocols for access to the premises and testing equipment and shall not unnecessarily impede the progress of the testing. Observers shall be permitted to validate sample identification and view sample condition. Subject to safety requirements, test method and equipment limitations, they shall also be permitted to observe test procedures, take notes, view equipment readings and review completed work sheets while in attendance.

Comments on the non-conformity of the test methods shall be made and corrected at the time of testing.

Referee test results shall be binding on both the Owner and the Contractor.

When a referee test result shows that the aggregates do not meet the requirements of this specification, the aggregates represented by the test result, including aggregates in existing stockpiles or in the Work, shall not be accepted. The Contractor shall remove the aggregates from the Work at no cost to the Owner. The Contractor may request a reduced price in lieu of the removal of aggregates that fail to meet the requirements of this specification. Irrespective of the negotiation of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

When a referee test result shows that the aggregates meet the requirements of this specification, the aggregates represented by the sample shall be accepted.

The Owner shall be responsible for the cost of referee testing provided that the referee test results show that the aggregates meet the applicable specifications. Otherwise, the Contractor shall be responsible for the cost.

TABLE 1
Physical Property Requirements

MTO Laboratory Test and Number	Granular O	Granular A	Granular S	Granular B Type I and Type III	Granular B Type II	Granular M	Select Subgrade Material
Percent crushed particles, % minimum, LS-607	100	60	50	--	--	60	--
Unconfined Freeze-Thaw, % maximum loss, LS-614	15	--	--	--	--	--	--
2 or more crushed faces, % minimum, LS-617	85 (Note 1)	--	--	--	--	--	--
Micro-Deval Abrasion Coarse Aggregate, % maximum loss, LS-618	21	25	25	30 (Note 2)	30	25	30 (Note 2)
Micro-Deval Abrasion, Fine Aggregate, % maximum loss, LS-619	25	30	30	35	35	30	N/A
Asphalt Coated Particles, % maximum, LS-621	0	30	30	30	0	30	0
Amount of Contamination, LS-630	(Note 3)						
Plasticity Index, maximum LS-703/704	0						
Determination of Permeability, k, LS-709	(Note 4)						
Notes:							
1. When Granular O is produced from boulders, cobbles, or gravel retained on the 50 mm sieve.							
2. The coarse aggregate Micro-Deval abrasion loss test requirements shall be waived if the material has more than 80% passing the 4.75 mm sieve.							
3. Granular A, B Type I, B Type III, or M may contain crushed glass or ceramic materials up to a combined total of 15% by mass. Granular A, B Type I, B Type III, M, O, and S shall not contain more than 1% by mass of wood, clay brick and/or gypsum and/or gypsum wall board or plaster. Granular B Type II and SSM shall not contain more than 0.1% by mass of wood.							
4. For materials north of the French and Mattawa Rivers only, the coefficient of permeability, k, shall be greater than 1.0×10^{-4} cm/s or alternatively, where past field experience has demonstrated satisfactory performance. Prior data demonstrating compliance with this requirement for k shall be acceptable, provided such testing has been done within the 5 years of the material being used and field performance has continually been shown to be satisfactory.							

TABLE 2
Gradation Requirements - Percent Passing

MTO Test	Sieve	Granular							Select Subgrade Material
		A	B (Note 1)			M	O	S	
			Type I (Note 2)	Type II	Type III (Note 2)				
Sieve Analysis, % Passing, LS-602	150 mm	N/A	100	N/A	100	N/A	N/A	N/A	100
	106 mm	N/A	N/A	100	N/A	N/A	N/A	N/A	N/A
	37.5 mm	N/A	N/A	N/A	N/A	N/A	100	N/A	N/A
	26.5 mm	100	50-100	50-100	50-100	N/A	95-100	100	50-100
	19.0 mm	85-100 (87-100, Note 3)	N/A	N/A	N/A	100	80-95	90-100	N/A
	13.2 mm	65-90 (75-95, Note 3)	N/A	N/A	N/A	75-95	60-80	75-100	N/A
	9.5 mm	50-73 (60-83, Note 3)	N/A	N/A	32-100	55-80	50-70	60-85	N/A
	4.75 mm	35-55 (40-60, Note 3)	20-100	20-55	20-90	35-55	20-45	40-60	20-100
	1.18 mm	15-40	10-100	10-40	10-60	15-40	0-15	20-40	10-100
	300 µm	5-22	2-65	5-22	2-35	5-22	N/A	11-25	5-95
	150 µm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.0-65.0
	75 µm	2.0-8.0 (2.0-10.0, Note 4)	0-8.0 (0-10.0, Note 4)	0-10.0	0-8.0 (0-10.0, Note 4)	2.0-8.0 (2.0-10.0, Note 4)	0-5.0	9.0-15.0 (9.0-17.0, Note 4)	0-25.0

Notes:

1. When Granular B is used for granular backfill for pipe subdrains, 100% of the material shall pass the 37.5 mm sieve.
2. When RAP is blended with Granular B Type I or Type III, 100% of the RAP shall pass the 75 mm sieve. Conditions in Note 1 supersede this requirement.
3. When the aggregate is obtained from an air-cooled blast furnace slag source.
4. When the aggregate is obtained from a quarry or an air-cooled blast furnace slag or nickel slag source.

TABLE 3
Sample Size

Material	Minimum Mass of Individual Field Samples kg
Granular A, S, M, and O	25
Granular B and SSM	50
Granular B and SSM (100% passing 26.5 mm sieve)	25
Note: A. Each sample container shall hold no more than 30 kg of aggregate. When more than 30 kg is required, additional sample containers shall be used.	

Appendix 1010-A, November 2013 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Type of Granular B to be used. (1010.05.03)

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

- If the quality assurance sampling and testing frequencies provided in Appendix 1010-B are to be used, Appendix 1010-B needs to be invoked by reference in the Contract Documents.
- If the payment reduction in lieu of aggregate removal provided in Appendix 1010-C is to be used, Appendix 1010-C needs to be invoked by reference in the Contract Documents.
- If the test data forms in Appendices 1010-D and 1010-E are to be used for submission purposes, Appendices 1010-D and 1010-E need to be invoked by reference in the Contract Documents.

The use of steel slag aggregate is prohibited.

The designer should be aware that aggregates that are wholly or partially comprised of industrial by-products and/or recycled materials such as, but not limited to, air-cooled iron blast furnace slag, nickel slag, and RAP containing steel slag aggregates, may have specific placement and approval requirements or constraints to mitigate adverse affects on the environment based on local conditions and/or municipal and MOE policy. Prior to tendering, when such Owner supplied or specified materials are to be used, the designer should provide site notification to MOE and ensure any applicable environmental placement and approval requirements and constraints are included in the Contract Documents.

RAP content is determined by LS-621, percent Asphalt Coated Particles. However, this test is limited to identifying RAP content in the coarse aggregate portion only. When RAP in fine aggregate is a concern a Petrographic Examination of the material passing the 4.75 mm sieve is recommended. (1010.05.02)

The designer should be aware that quality assurance (QA) testing for the purpose of ensuring material used in the work meet the requirements of OPSS 1010 is not mandatory unless specifically included in the Contract Documents. The designer should determine the need for QA testing based on the size and complexity of the work and specify the required frequencies of QA sampling and testing. Appendix 1010-B provides recommended QA sampling and testing frequencies.

The designer may specify a higher percent crushed requirement to improve performance in higher traffic areas.

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

Appendix 1010-A

Related Ontario Provincial Standard Drawings

No information provided here.

Appendix 1010-B, November 2013**FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS**

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

Supplementary Requirements for Quality Assurance Sampling and Testing Frequency

OPSS.MUNI 1010, Aggregates-Base, Subbase, Select Subgrade, and Backfill Material, is amended as follows:

1010.08 QUALITY ASSURANCE**1010.08.01 General**

The first paragraph of subsection 1010.08.01 is deleted in its entirety and replaced with the following:

QA sampling and testing shall be carried out by the Owner for the purposes of ensuring that the aggregates used in the work are according to the requirements of the Contract Documents. QA sampling and testing shall be carried out at the frequency specified in Table B-1. Individual test results may be forwarded to the Contractor as they become available.

Table B-1 is added.

TABLE B-1
Sampling and Testing Frequency for Physical Property Requirements

Quantity from Each Source or Process	Granular A; Granular B - Type I, II, and III; Granular M; Granular O; and Select Subgrade Material
≤ 5,000	One sample.
> 5,000 (Note 1)	One sample per 5,000 tonnes.
Note: 1. When the quantity of material is: a) Less than one-half the quantity required for a sample, then that quantity shall be added to the quantity representing the previous sample. b) Greater than or equal to one-half the quantity required for a sample, then that quantity shall require its own sample.	

Appendix 1010-B

Table B-2 is added.

TABLE B-2
Sampling and Testing Frequency for Gradation Requirements

Quantity from Each Source or Process t	Granular A, O, and M	Granular B - Type I, II, and III, and Select Subgrade Material
< 250	At the Contract Administrator's discretion.	
≥ 250 and ≤ 1,000	One sample.	
> 1,000 (Note 1)	One sample per 1,000 tonnes.	
Note: 1. When the quantity of granular material is: a) Less than one-half the quantity required for a sample, then that quantity shall be added to the quantity representing the previous sample. b) Greater than or equal to one-half the quantity required for a sample, then that quantity shall require its own sample.		

Appendix 1010-C, November 2013

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

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

Supplementary Requirements for Reduced Price Payment In Lieu of Aggregate Removal

When a tested sample of aggregates shows that the aggregates do not meet the requirements of this specification, the aggregates represented by the test result, including material in existing stockpiles or in the Work, shall not be accepted. The Contractor may request a reduced price in lieu of removal provided the applicable test results:

- a) Do not exceed the requirement for LS-614 by more than 25% of the specified value.
- b) Do not exceed the requirement for LS-618 by more than 10% of the specified value.
- c) Do not identify a plasticity index within the material when determined according to LS-703/704 and the requirement for LS-602 on the 75 µm is met.
- d) Meet all other requirements of this specification.

Irrespective of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

Appendix 1010-D, November 2013

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

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

OPSS 1010 - Aggregate Test Data - Granulars Physical Properties

Contract No.:	Contractor:	Contract Location:	
Name of Testing Laboratory:		Telephone No.:	Fax No.:
Sampled by (Print Name):		Date Sampled (YY/MM/DD):	Date Tested (YY/MM/DD):
Granular Type:		Quantity (tonnes) :	
Source Name/Location:		Aggregate Inventory Number (AIN) :	

Laboratory Test and Number	Requirements								Test Results		
	A	B Type I	B Type II	B Type III	M	O	S	SSM	Reference Material	Sample	Meets Requirements (Y/N)
Crushed Particles, % minimum, LS-607	60	--	100	--	60	100	50	--			
Unconfined Freeze-Thaw, % maximum loss, LS-614	--	--	--	--	--	15	--	--			
2 or more Crushed Faces, % minimum, LS-617	--	--	--	--	--	85 (Note 1)	--	--			
Micro-Deval Abrasion, Coarse Aggregate % maximum loss, LS-618	25	30 (Note 2)	30	30 (Note 2)	25	21	25	30 (Note 2)			
Micro-Deval Abrasion, Fine Aggregate % maximum loss, LS-619	30	35	35	35	30	25	30	--			
Asphalt Coated Particles, % maximum, LS-621	30	30	0	30	30	0	30	0			
Amount of Contamination, LS-630	(Note 3)										
Plasticity Index, maximum, LS-703/704	0										
Determination of Permeability, k, LS-709	(Note 4)										

Notes:
1. When Granular O is produced from boulders, cobbles, or gravel retained on the 50 mm sieve.
2. The coarse aggregate Micro-Deval abrasion loss test requirement shall be waived if the material has more than 80% passing the 4.75 mm sieve.
3. Granular A, B Type I, B Type III, or M may contain up to 15 percent by mass crushed glass or ceramic materials. Granular A, B Type III, M, O, and S shall not contain more than 1.0 percent by mass of wood, clay brick and/or gypsum and/or gypsum wall board or plaster. Granular B Type II and SSM shall not contain more than 0.1 percent by mass of wood.
4. For materials north of the French/Mattawa Rivers only, the coefficient of permeability, k , shall be greater than 1.0×10^{-4} cm/s or field experience has demonstrated satisfactory performance. Prior data demonstrating compliance with this requirement for k , shall be acceptable provided that such testing has been done within 5 years of the material being used and field performance has continually been shown to be satisfactory.

I hereby certify that testing has been carried out by a properly qualified/certified test technician:

Issued by: _____
PRINT NAME TESTING LABORATORY REPRESENTATIVE SIGNATURE DATE

Received by: _____
PRINT NAME CONTRACT ADMINISTRATOR REPRESENTATIVE SIGNATURE DATE

Copies to: Contract Administrator Contractor

Appendix 1010-E, November 2013

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

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

OPSS 1010 - AGGREGATE TEST DATA - GRANULARS GRADATION REQUIREMENTS, LS-602

Contract No.:	Contractor:	Contract Location:	
Name of Testing Laboratory:		Telephone No.:	Fax No.:
Sampled by (Print Name):		Date Sampled (YY/MM/DD):	Date Tested (YY/MM/DD):
Granular Type:		Quantity (tonnes) :	
Source Name/Location:		Aggregate Inventory Number (AIN) :	

Sieve Size	Gradation Requirement, % Passing								Test Result	
	A	B (Note 1)			M	O	S	SSM	Sample	Meets Requirements (Y/N)
		Type I (Note 2)	Type II	Type III (Note 2)						
150 mm	--	100	--	100	--	--	--	100		
106 mm	--	--	100	--	--	--	--	--		
37.5 mm	--	--	--	--	--	100	--	--		
26.5 mm	100	50-100	50-100	50-100	--	95-100	100	50-100		
19.0 mm	85-100 (87-100, Note 3)	--	--	--	100	80-95	90-100	--		
13.2 mm	65-90 (75-95, Note 3)	--	--	--	75-95	60-80	75-100	--		
905 mm	50-73 (60-73, Note 3)	--	--	32-100	55-80	50-70	60-85	--		
4.75 mm	35-55 (40-60, Note 3)	20-100	20-55	20-90	35-55	20-45	40-60	20-100		
1.18 mm	15-40	10-100	10-40	10-60	15-40	0-15	20-40	10-100		
300 µm	2-55	2-65	5-22	2-35	5-22	--	11-25	5-95		
150 µm	--	--	--	--	--	--	--	2-65		
75 µm	2.0-8.0 (2.0-10.0, Note 4)	0-8.0 (0-10.0, Note 4)	0-10.0	0-8.0 (0-10.0, Note 4)	2.0-8.0 (2.0-10.0, Note 4)	0-5.0	9.0-15.0 (9.0-17.0, Note 4)	0-25.0		

Notes:

- When Granular B is used for granular backfill for pipe subdrains, 100% of the material shall pass the 37.5 mm sieve.
- When RAP is blended with Granular B Type I or Type III, 100 percent of the RAP shall pass the 75 mm sieve. Conditions in Note 1 supersede in this requirement.
- When the aggregate is obtained from an iron blast furnace slag source.
- When the aggregate is obtained from a quarry or blast furnace slag or nickel slag source.

I hereby certify that testing has been carried out by a properly qualified/certified test technician:

Issued by: _____
PRINT NAME TESTING LABORATORY REPRESENTATIVE SIGNATURE DATE

Received by: _____
PRINT NAME CONTRACT ADMINISTRATOR REPRESENTATIVE SIGNATURE DATE

Copies to: Contract Administrator Contractor



MATERIAL SPECIFICATION FOR PERFORMANCE GRADED ASPHALT CEMENT

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1101.01	SCOPE

This specification covers the requirements for the properties and use of performance graded asphalt cements.

1101.01.01 Specification Significance and Use

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

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

1101.01.02 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.

1101.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 310 Hot Mix Asphalt

Ontario Ministry of Transportation Publications

Laboratory Testing Manual:

LS-227	Determination of Ash Content
LS-299	Determining Asphalt Cement's Resistance to Ductile Failure Using Double Edge Notched Tension Test (DENT)
LS-308	Determination of Performance Grade of Physically Aged Asphalt Cement Using Extended Bending Beam Rheometer (BBR) Method

ASTM International

D 3665-12	Standard Practice for Random Sampling of Construction Materials
D 7343-12	Standard Practice for Optimization, Sample Handling, Calibration, and Validation of X-ray Fluorescence Spectrometry Methods for Elemental Analysis of Petroleum Products and Lubricants

American Association of State Highway and Transportation Officials (AASHTO)

M 320-10	Standard Specification for Performance Graded Asphalt Binder
M 332-14	Standard Specification for Performance-Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test
R 29-14	Grading or Verifying the Performance Grade of an Asphalt Binder

T 40-02 (2012) Sampling Bituminous Materials
T 350-14 Standard Method of Test for Multiple Stress Creep Recovery (MSCR) Test of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)

1101.03 DEFINITIONS

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

Asphalt Binder means modified or unmodified asphalt cement.

CTOD means Critical Crack Tip Opening Displacement as defined in LS-299.

Hot Mix Asphalt (HMA) means as defined in OPSS 310.

Independent Laboratory means a third party laboratory that is not owned or corporately affiliated with the laboratory that prepared the mix design or with the Contractor.

Low Temperature Limiting Grade (LTLG) means the warmest of the Limiting Grades, T_L , obtained for 1 hour, 24 hours, 72 hours and the two conditioning temperatures according to LS-308, and Form B of LS-308.

Low Temperature Performance Grade (-YY) means the low temperature performance grade of PGAC specified in the Contract Documents where the PGAC grade specified is PGAC XX-YY.

Performance Graded Asphalt Cement (PGAC) means an asphalt binder that is produced from petroleum residue, either with or without the addition of non-particulate modifiers and meets the requirements of AASHTO M 320 or M 332.

PGAC XX-YY means PGAC with XX being the high temperature performance grade and -YY being the low temperature performance grade, as specified elsewhere in the Contract Documents, and meets the requirements of AASHTO M 320.

PGAC XXS-YY means PGAC graded using Multiple Stress Creep Recovery (MSCR) test for standard traffic level, as specified in the Contract Documents, and meets the requirements of AASHTO M 332.

PGAC XXH-YY means PGAC graded using Multiple Stress Creep Recovery (MSCR) test for high traffic level, as specified elsewhere in the Contract Documents, and meets the requirements of AASHTO M 332.

PGAC XXV-YY means PGAC graded using Multiple Stress Creep Recovery (MSCR) test for very high traffic level, as specified in the Contract Documents, and meets the requirements of AASHTO M 332.

PGAC XXE-YY means PGAC graded using Multiple Stress Creep Recovery (MSCR) test for extreme traffic level, as specified in the Contract Documents, and meets the requirements of AASHTO M 332.

Recompaction Temperature means the temperature to which plant produced mix is to be reheated for testing purposes and shall be the same as the laboratory mix design compaction temperature.

1101.04 DESIGN AND SUBMISSION REQUIREMENTS

1101.04.01 Submission Requirements

1101.04.01.01 PGAC Test Documentation

For each grade of PGAC specified in the Contract Documents, the Contractor shall supply the following items to the Contract Administrator at least 14 Days prior to the first use of each product:

- a) The PGAC supplier and the facility type and location that the product shall be supplied from.

- b) Applicable mixing and compaction temperatures for the product.
- c) Documentation of construction, storage and handling requirements, including the material safety data sheet, recompaction temperature, mix discharge temperature, and recommended extraction procedure.
- d) When the asphalt cement contains any zinc oxide or iron carboxylates or a combination, added as a Hydrogen Sulfide (H₂S) scavengers, they must be declared.
- e) When the PGAC contains any polyphosphoric acid (PPA) and a liquid anti-stripping additive is incorporated into the PGAC at the PGAC supplier's depot:
- i. Information on how much anti-stripping additive was added to the PGAC.
- ii. Documentation from the PGAC supplier stating that the PPA modified PGAC with the liquid anti-stripping additive added at the PGAC supplier's depot shall meet all asphalt cement material requirements specified in the Contract Documents including AASHTO M 320 for the PGAC grade specified.

1101.05 MATERIALS

PGAC shall be according to AASHTO M 320 for the performance grades specified in the Contract Documents when tested using the methods designated in AASHTO R 29, section Test Procedure for Verifying the Nominal Grade of an Asphalt Binder.

PGAC shall be homogeneous, free of water and any contamination, and shall not foam when heated to the temperatures specified by the manufacturer for the safe handling and use of the product. Silicone oils are allowed as anti-foaming agents at less than five parts per million. Zinc oxide and iron carboxylates may be used as hydrogen sulfide (H₂S) scavengers..

PGAC shall not contain more than 0.3% polyphosphoric acid (PPA) or 0.3% elemental sulfur (S) in addition to the typical sulfur that is naturally presence in the asphalt cement, and these shall only be used as catalysts for the purpose of modification with epoxy(E)-type or styrene-butadiene (SB)-type polymer modifiers. PGAC shall not contain any orthophosphoric acid.

PGAC shall not be air blown or catalytically oxidized in any manner. PGAC shall not contain any air blown or catalytically oxidized residues.

The asphalt cement shall not contain any of the following additives added for PGAC modification: atactic polypropylene; carbon black; polyisobutylene; polyisoprene; natural rubber; alkaline bases; insoluble particulates or fibres; salts of iron, copper, manganese and/or cobalt; silicates; styrene-butadiene rubber (random copolymer latex); synthetic waxes (paraffin waxes, naphthenic waxes); synthetic and saturated oils (including but not limited to the following: vegetable oils or modified vegetable oils; (paraffin oils, polyalphaolefins (PAO), lube oils, and re-refined lube oils.); waste oils (including but not limited to the following: cracked residues, re-refined high vacuum distillate oils; tall oils, vacuum tower asphalt extenders; waste cooking oils, waste engine oils, waste engine oil residues). Asphalt cement supplier shall declare in writing that they have not added the PGAC additives listed above.

If modifiers or additives other than styrene-butadiene (e.g., SB diblock, SBS triblock, SBS radial, SBS high vinyl, SB tapered, etc.) or epoxy-type (e.g. reactive elastomeric terpolymers) polymers are used for the modification of neat asphalt cement, pre-approval from the Owner is required.

Organic bases may be contained in the PGAC provided they are used as anti-stripping or warm mix additives or both. If any of the above additives are present in anti-stripping and/or warm mix asphalt additives, they shall be declared at the time of mix submission.

PGAC grades shall meet the additional requirements shown in Table 1.

PGAC shall be shipped, used, and handled at all times in accordance with the manufacturer's specifications.

1101.07 PRODUCTION

1101.07.01 Sampling and Testing

Sampling shall be as described in the Quality Assurance section.

1101.08 QUALITY ASSURANCE

1101.08.01 Basis of Acceptance

Material acceptance of asphalt cement for performance grading and the properties and attributes shown in Table 1 shall be determined by the Owner based on QA test results conducted by the Owner's designated laboratory, unless superseded by referee test results, according to the requirements of the Contract Documents.

The Contractor shall be provided with test results from the tests that are completed.

The Owner shall be responsible for all costs associated with testing for QA purposes, unless otherwise specified in the Contract Documents.

The Owner may conduct elemental testing according to ASTM D7343 or other tests to determine if the asphalt cement meets the material requirements as specified in the Materials section.

1101.08.01.01 Laboratory Requirements

The laboratory conducting PGAC testing shall have participated in the most recent AASHTO Materials Reference Laboratory proficiency sample correlation program for PGAC and the most recent MTO correlation for all PGAC testing to be carried out. All QA and referee labs shall be CCIL certified for the tests required.

1101.08.02 Anti-Stripping Additive

The Contractor may request that an allowance be made for the impact of the anti-stripping additive on a PGAC grade for QA or referee purposes provided that:

- a) It was not added at the supplier depot to a PGAC containing polyphosphoric acid (PPA); and that
- b) When production begins the Contractor submits to the Contract Administrator complete AASHTO M 320 test results rounded to the nearest 0.5 °C for the following:
 - i. Asphalt cement with anti-stripping additive at the percentage identified in the mix design.
 - ii. Asphalt cement without the anti-stripping additive.

1101.08.03 Sampling

The Contract Administrator shall determine the frequency of sampling and testing for each grade of PGAC based on the HMA tender quantity. The Contract Administrator shall determine the quantity and location of HMA to be represented by each PGAC sample. When only one sample is taken on the job, the sample shall be deemed to represent all HMA placed on the Contract with that PGAC grade. All samples shall be obtained during the production of the asphalt mix at the asphalt mix plant from the storage tank which is directly feeding the production of the asphalt mix according to AASHTO T 40 and the asphalt plant's health and safety plan. The asphalt plant's health and safety plan and procedure for sampling shall be reviewed in advance. The QA, referee, and other required samples for possible Owner testing shall be taken at the same time.

PGAC shall be sampled when notified by the Contract Administrator.
Sample quantity, labelling and delivery requirements shall be according to Table 2. Samples shall be delivered in a condition suitable for testing.

1101.08.03.01 Switching Performance Grade or Source of Supply

The Contract Administrator shall be advised in writing whenever there is a change in performance grade or source of supply.

1101.08.04 Quality Assurance Testing

When the Contract Administrator elects to carry out QA testing, one of the samples shall be randomly selected for testing by the QA laboratory and the remaining sealed sample shall be retained by the QA laboratory for possible referee testing.

Test results for samples that do not comply with the performance grading requirements shall be categorized as borderline or rejectable. PGAC shall be categorized based on its test result's deviation from the individual design maximum or minimum pavement temperature and the sum of the deviations from the design maximum or minimum pavement temperatures defined as follows. The actual performance grading that is either higher than the design maximum pavement temperature or lower than the design minimum pavement temperature is not considered a deviation.

Borderline: Individual deviations are less than or equal to 3 °C and the sum of deviations is less than or equal to 3 °C.

Rejectable: Not complying with the above.

When a sample does not comply with more than one property, attribute, and PG grading, acceptance of the HMA shall be dealt with using the property, attribute, or PG grading selected by the Owner.

The Owner may conduct elemental testing according to ASTM D7343 or other tests to determine if the asphalt cement meets the material requirements as specified in the Materials section.

1101.08.05 Disposition of HMA Produced with PGAC Not Conforming with the Requirements of the Contract Documents

The Owner shall review the test results and determine the disposition of the HMA produced using any PGAC that does not conform to all requirements of the Contract Documents. HMA produced using PGAC for which test results indicate that the product did not conform to the Contract Documents shall be dealt with as follows:

Borderline: The HMA shall be accepted at full payment.

Rejectable: The HMA shall not be accepted into the Work. The Contract Administrator shall notify the Contractor in writing within 3 Business Days of receipt of the non-conforming data. The Contractor has the option of either removing the HMA from the Work and replacing it with acceptable HMA or invoking referee testing. The Contractor may request a reduced price in- lieu of removal of the HMA. Irrespective of the negotiation of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

When test results indicate non-compliance with the Contract Documents, all costs to the Owner to establish the degree and extent of the non-compliance shall be the responsibility of the Contractor.

1101.08.06 Referee Testing

Referee testing by an independent laboratory may be invoked by the Contractor for any sample of PGAC within 5 Days of receiving all the QA test results for the sample, provided the Contractor has taken and delivered all referee samples in a condition suitable for testing.

The Contract Administrator shall select a referee testing laboratory acceptable to the Owner within 3 Business Days following the Contractor's written notification to invoke referee testing. Referee test samples shall be delivered to the referee testing laboratory from the QA laboratory by the Contract Administrator.

The referee testing shall determine the actual performance high and low temperatures, rounded to the nearest 0.5 °C of the PGAC and the properties and attributes shown in Table 1.

Test results generated by the referee laboratory shall be used to re-evaluate the PGAC to determine whether the product conforms to the Contract Documents and the disposition of the HMA represented by the sample tested.

Referee testing shall be carried out in the presence of the Owner's designate. The Contractor may observe the testing at no cost to the Owner.

The Contractor and the Owner may send a maximum of two representatives each to observe the referee testing. The Contract Administrator shall notify the Owner and Contractor a minimum of 3 Business Days in advance of the date of referee testing. Provided that such notice was given, referee testing shall be carried out regardless of the absence of one or more observers.

Observers shall follow the referee laboratory protocols for access to the premises and testing equipment and shall not unnecessarily impede the progress of the testing. Observers shall be permitted to validate sample identification and view sample condition. Subject to safety requirements, test method and equipment limitations, they shall also be permitted to observe test procedures, take notes, view equipment readings, and review completed work sheets while in attendance. The taking of photographs and videos shall not be permitted.

Concerns with sample condition or sample identification shall be made known to all observers prior to commencement of the referee testing. Comments on deviations from the applicable test method shall be made at the time of referee testing. Unresolved concerns shall be specific in nature and submitted in writing to the referee laboratory's designated representative and the other observers present, at the time of testing.

Referee test results shall be binding on both the Owner and the Contractor.

When referee test results show that the PGAC is rejectable, the HMA represented by the test results shall not be accepted. The Contractor shall remove the HMA from the Work at no cost to the Owner. The Contractor may request a reduced price in-lieu of removal of HMA produced with PGAC with rejectable test results. Irrespective of the negotiation of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

The Owner shall be responsible for the cost of referee testing, provided that the referee test results confirm total conformance of the PGAC sample to the Contract Documents. Otherwise, the Contractor shall be responsible for the cost.

Table 1
Additional Asphalt Cement Testing Requirements and Acceptance Criteria for All PG Grades

PGAC Grade	Property and Attributes (Unit)		Test Method	Results Reported Rounded to the Nearest	Acceptance Criteria	Rejectable
All PGAC Grades	Ash Content, % by mass of residue (%)	PG XX-28	LS-227	0.1	≤ 0.6	> 0.6
		PG XX-34			≤ 0.6	> 0.6
		PG XX-40			≤ 0.6	> 0.6
All PGAC Grades Except PG 58-28 and PG 52-34	Low temperature limiting grade (LTLG) (°C)		LS-308	0.5	$\leq (-YY + 3)$	$> (-YY + 3)$
	Grade Loss (°C)		LS-308	0.5	≤ 6.0	> 6.0
	Non-recoverable creep compliance at 3.2 kPa ($J_{nr-3.2}$) (kPa ⁻¹)		AASHTO T 350 For testing temperature see Note 1	0.01	≤ 4.5	> 4.5
	Average percent recovery at 3.2 kPa ($R_{3.2}$) (%)			0.1	$\geq$ the lesser of $[(29.371) (J_{nr-3.2})^{-0.2633}]$ or 50	$<$ the lesser of $[(29.371) (J_{nr-3.2})^{-0.2633} - 10]$ or 50
	CTOD, δ_t (mm)	PG XX-28	LS-299	0.1	≥ 8.0	< 8.0
		PG XX-34			≥ 12.0	< 12.0
		PG XX-40			≥ 16.0	< 16.0
Notes: 1. The testing temperature shall be 52°C for PGAC Zone 1 and 58°C for PGAC Zones 2 and 3.						

TABLE 2
Sampling Requirements

Samples	Minimum Sample Quantity	Labelling	Delivery
QA	2 litres (Note 1)	Label shall include: • Contract number. • Date (i.e., yyyy-mm-dd) and time of sampling • Performance grade of the asphalt cement. • Supplier's name.	• Samples shall be delivered as specified in the Contract Documents. • Samples shall be delivered at the same time.
Referee	2 litres (Note 1)		
Notes: 1. 2 litres shall be provided in 2 suitable one litre containers or a container able to hold a minimum of 2 litres.			

Appendix 1101-A, November 2016 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should be aware that OPSS 1101 has been revised to reflect the adoption of performance grading of asphalt cements in Ontario and additional testing to further characterize properties of the asphalt cement.

The designer should be aware that in this specification asphalt binder means asphalt cement. The former term is used in the AASHTO references cited, while the latter continues to be used in OPS specifications.

The designer should be aware that for the purpose of PGAC grade designation, Ontario has been divided into three zones as follows:

Zone 1: The area north of the boundary formed by the French River, Lake Nipissing, and the Mattawa River.

Zone 2: The area south of Zone 1, and north of a line from Honey Harbour, to Longford, Taylor Corners, Cavan, Campbellford, and Mallorytown.

Zone 3: The area south of Zone 2.

For design purposes, the designer shall ensure:

- a) Towns located along a zone boundary line are to be included in the zone south of the boundary line.
- b) Projects located within 10 km of zone boundary lines may be included in either zone at the discretion of the designer so that they may be considered within one zone only.

Appendix Table A-1 provides the basic performance grades for each Ontario zone. Recycling ratios in excess of 15% should be addressed on a Contract specific basis.

The designer is advised to use LTPP-Bind (Version 3.1 or later) to confirm the cold temperature grade of PGAC. A percent reliability of greater than 90% is recommended for low volume and residential roads and greater than 95% is recommended for highways and major projects according to NCHRP Report 673. OHMPA is recommending selecting a grade based on 98% reliability.

The designer shall consider the following when selecting PGAC grades:

- a) The location of the Contract (i.e., the geographical zone in which it is located) percent reliability appropriate for facility and work being carried out, noting that some discretion is allowed.
- b) The type of hot mix, new versus recycled hot mix.
- c) Upgrades for heavy commercial traffic, frequent starts and stops, and vehicle speeds. The designer may bump the high temperature grade according to Appendix Table A-2, or when invoking Appendix B, use MSCR graded PGAC according to Appendix Table A-3.

The designer shall include delivery instructions for the asphalt cement samples elsewhere in the Contract Documents.

The designer may include Appendix B to require Multiple Stress Creep Recovery (MSCR) graded PGAC in lieu of bumping the high temperature grade. Appendix B uses the AASHTO M 332 standard which encompasses the MSCR grading system for asphalt cement. It is intended to replace the PG system for grading asphalt cement described in AASHTO M 320. AASHTO M 332 uses the MSCR test to determine the high temperature rutting properties and elastic response of the binder.

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

Note: When the Owner is concerned about testing variability they may request that the lab conducting quality assurance testing participate in MTO's PGAC correlation and may on request ask the laboratory to provide their correlation ranking. MTO typically requires a ranking of 4 or better for their QA labs. Municipalities may contact MTO Bituminous Section for a list of labs appropriate for carrying out PGAC referee testing.

Related Ontario Provincial Standard Drawings

No information provided here.

**Appendix Table A-1
OPSS 1101 - Grade Selection for Ontario**

	PGAC Zones		
	Zone 1	Zone 2	Zone 3
New Hot Mix or up to 15% RAP by Mass	52 - 34	58 - 34	58 - 28

**Appendix Table A-2
OPSS 1101 - Guidelines for the Adjustment of PGAC High Temperature Grade
Based on Roadway Classification and Traffic Conditions**

Highway Type	Increase from Standard	Optional Additional Grade Increase (Note 1)
Urban Freeway	2 Grades	N/A
Rural Freeway Urban Arterial	1 Grade	1 Grade
Rural Arterial Urban Collector	Consider increasing by 1 grade if heavy truck traffic is greater than 20% of AADT	1 Grade
Rural Collector Rural Local Urban/Suburban Collector	No Change	1 or 2 Grades
Notes: A. Upgrading of the high temperature grade is recommended for use in both surface and top binder courses, i.e., top 80 to 100 mm of hot mix. B. Alternatively, Multiple Stress Creep Recovery (MSCR) graded PGAC acceptance criteria, according to Appendix B and Appendix Table A-3, can be used. 1. Consideration should be given to an increase in the high temperature grade for roadways which experience a high percentage of heavy truck or bus traffic at slow operating speeds, frequent stops and starts, and historical concerns with instability rutting.		

Appendix Table A-3
OPSS 1101 - Guidelines for the Selection of PGAC Graded Using Multiple
Stress Creep Recovery (MSCR) Test When Invoking Appendix “B” Based on
Roadway Classification and Traffic Conditions

Highway Type	Recommended PGAC Grade Using MSCR Test	Optional Grade Increase (Note 1)
Urban Freeway	XXV-YY	N/A
Rural Freeway Urban Arterial	XXH-YY	XXV-YY
Rural Arterial Urban Collector	Consider specifying XXH-YY if heavy truck traffic is greater than 20% of AADT	XXV-YY
Rural Collector Rural Local Urban/Suburban Collector	XXS-YY	XXH-YY or XXV-YY
Toll Plaza Port Facility Dedicated Transitways Truck Marshaling Yards (standing traffic)	XXE-YY	N/A
Notes: A. It is recommended that Multiple Stress Creep Recovery (MSCR) graded PGAC is used in both surface and top binder courses, i.e., top 80 to 100 mm of hot mix. 1. Consideration should be given to an increase in the high temperature traffic level for roadways which experience a high percentage of heavy truck or bus traffic at slow operating speeds, frequent stops and starts, and historical concerns with instability rutting.		

Appendix 1101-B, November 2016

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

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

Additional Requirements for Performance Graded Asphalt Cement Further Graded for Traffic Loading Using Multiple Stress Creep Recovery Testing

AASHTO M332 replaces AASHTO M320, unless superceded by requirements in Appendix B Table 1 below.

OPSS.MUNI 1101 Performance Graded Asphalt Cement, is amended as follows:

1101.04 DESIGN AND SUBMISSION REQUIREMENTS

1101.04.01 Submission Requirements

1101.04.01.01 PGAC Test Documentation

Point d) of clause 1101.04.01.01 of OPSS 1101 is deleted in its entirety and replaced with the following:

- d) When the PGAC contains any polyphosphoric acid (PPA) and a liquid anti-stripping additive is incorporated into the PGAC at the PGAC supplier's depot:
 - i. Information on how much anti-stripping additive was added to the PGAC.
 - ii. Documentation from the PGAC supplier stating that the PPA modified PGAC with the liquid anti-stripping additive added at the PGAC supplier's depot shall meet all asphalt cement material requirements specified in the Contract Documents including AASHTO M332 for the PGAC grade specified.

1101.05 MATERIALS

The first paragraph in Section 1101.05 of OPSS 1101 is deleted in its entirety and replaced with the following:

PGAC shall be according to AASHTO M 332 with the exception of percent difference in non-recoverable creep compliance between 0.1 kPa and 3.2 kPa (J_{nrdiff}) requirements, for the performance grades specified in the Contract Documents.

1101.08 QUALITY ASSURANCE

1101.08.02 Anti-Stripping Additive

Subsection 1101.08.02 of OPSS 1101 is deleted in its entirety and replaced with the following:

The Contractor may request that an allowance be made for the impact of the anti-stripping additive on a PGAC grade for QA or referee purposes provided that:

- a) It was not added at the supplier depot to a PGAC containing polyphosphoric acid (PPA); and that

b) When production begins the Contractor submits to the Contract Administrator complete AASHTO M 332 and Table 1 test results for the following:

i) Asphalt cement with anti-stripping additive at the percentage identified in the mix design.

ii) Asphalt cement without the anti-stripping additive.

Table 1 is deleted in its entirety and replaced with the following:

Appendix B Table -1
Additional Asphalt Cement Testing Requirements and Acceptance Criteria for All PG Grades

	Property and Attributes (Unit)		Test Method	Results Reported Rounded to the Nearest	Acceptance Criteria	Rejectable
All PGAC Grades	Ash Content, % by mass of residue (%)	for -YY = -28	LS-227	0.1	≤ 0.6	> 0.6
		for -YY = -34			≤ 0.6	> 0.6
		for -YY = -40			≤ 0.6	> 0.6
	Non-recoverable creep compliance at 3.2 kPa ($J_{nr3.2}$) (kPa^{-1}) when PGAC XXS-YY is specified		AASHTO T 350 testing conducted at high temperature grade of the PGAC (Note 1)	0.01	≤ 4.5	> 4.5
	Non-recoverable creep compliance at 3.2 kPa ($J_{nr3.2}$) (kPa^{-1}) when PGAC XXH-YY is specified			0.01	≤ 2.0	> 2.0
	Non-recoverable creep compliance at 3.2 kPa ($J_{nr3.2}$) (kPa^{-1}) when PGAC XXV-YY is specified			0.01	≤ 1.0	> 1.0
Non-recoverable creep compliance at 3.2 kPa ($J_{nr3.2}$) (kPa^{-1}) when PGAC XXE-YY is specified		0.01		≤ 0.55	> 0.55	
Average percent recovery at 3.2 kPa ($R_{3.2}$) (%)		0.1		$\geq$ the lesser of $[(29.371)(J_{nr-3.2})^{0.2633}]$ or 50	$<$ the lesser of $[(29.371)(J_{nr-3.2})^{0.2633} - 10]$ or 50	
All H, V and E Grades	Percent difference in non-recoverable creep compliance between 0.1 kPa and 3.2 kPa, $J_{nr\text{diff}}$ (%)		0.1	N/A Testing carried out for information purpose		
	All PGAC Grades Excluding PG 58S-28 and PG 52S-34	CTOD, δ_t (mm)	for -YY = -28	LS-299	0.1	≥ 8.0
for -YY = -34			≥ 12.0			< 12.0
for -YY = -40			≥ 16.0			< 16.0
	Low temperature limiting grade (LTLG) ($^{\circ}\text{C}$)		LS-308	0.5	$\leq (-YY + 3)$	$> (-YY + 3)$
	Grade Loss ($^{\circ}\text{C}$)		LS-308	0.5	≤ 6.0	> 6.0
Notes: 1. For example, the testing temperature for PG58V-28 is 58 $^{\circ}\text{C}$ and for 52H-34 it is 52 $^{\circ}\text{C}$.						



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

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1102-A	Commentary

1102.01 SCOPE

This specification covers the requirements for different types and grades of liquid asphalt for use in highway construction and maintenance.

1102.01.01 Specification Significance and Use

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

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

1102.01.02 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.

1102.02 REFERENCES

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

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

Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-200	Penetration of Bituminous Materials
LS-201	Flash Point by Cleveland Open Cup
LS-202	Kinematic Viscosity of Asphalt
LS-204	Solubility of Bituminous Materials
LS-205	Ductility of Bituminous Materials

ASTM International

D 36-14e1	Softening Point of Bitumen (Ring-and-Ball Apparatus)
D 140-15	Sampling Bituminous Materials
D 243-08	Residue of Specified Penetration
D 402-14	Distillation of Cut-back Asphaltic (Bituminous) Products
D 3143-13	Flash Point of Cut-back Asphalt with Tag Open-Cup Apparatus

1102.03 DEFINITIONS

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

Liquid Asphalt means an asphalt cement mixed with volatile materials to increase the flow qualities of the asphalt cement.

1102.05 MATERIALS

1102.05.01 General

Liquid asphalt shall be of the type and grade specified in the Contract Documents and shall be supplied from a source approved by the Owner.

Under no circumstances shall the source of supply or the product be changed or partial or total supply allocated to another supplier without the prior approval of the Owner.

1102.05.02 Physical Requirements

Liquid asphalt shall be according to Tables 1, 2, 3, and 4.

1102.05.03 Shipment

The material shall be shipped in clean containers. Containers which are being reused shall be inspected, and cleaned, if required, prior to loading to ensure there is no contamination.

When shipment is by tank truck or railway tank car, the material shall arrive at the destination at a temperature at least 5 °C higher than the minimum spraying/mixing temperature specified in Table 5 and not more than the maximum temperature specified in Table 5.

1102.08 QUALITY ASSURANCE

1102.08.01 Compliance

Liquid asphalt shall be according to Tables 1, 2, 3, and 4 for the particular grade and type when tested according to the test methods designated in the tables.

1102.08.02 Inspection

The Owner may inspect shipping containers for cleanliness at any time.

1102.08.03 Sampling

Representative samples of material being supplied shall be taken, if specified in the Contract Documents, according to ASTM D 140 from either the supplier's plant or any shipment in the presence of the Contract Administrator. Samples taken prior to delivery shall be at no extra cost to the Owner.

1102.08.04 Testing

Samples may be tested by the Owner according to the tests listed in material requirements tables.

1102.08.05**Rejection**

Failure of any sample to conform to any of the material requirements shall be cause for rejection of the material. Rejected materials shall be replaced at no extra cost to the Owner.

1102.09**OWNER PURCHASE OF MATERIAL**

Liquid asphalt shall be measured by mass in tonnes as specified in the purchasing order. The tare of the hauling vehicle shall be determined for each load.

Payment at the price specified in the purchasing order shall be for the supply of the liquid asphalt 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.

TABLE 1
Rapid Curing Liquid Asphalts

Grade	RC-30		RC-70		RC-250		RC-800		RC-3000		Test Method
Requirements	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Tests on Liquid Asphalt											
Flash Point (Tag Open Cup), °C	--	--	--	--	27	--	27	--	27	--	ASTM D 3143
Kinematic Viscosity (at 60 °C), mm ² /s	30	60	70	140	250	500	800	1600	3000	6000	LS-202
Distillation Test Distillate (% of total distillate to 360 °C)											ASTM D 402
to 190 °C	15	--	10	--	--	--	--	--	--	--	
to 225 °C	55	--	50	--	35	--	15	--	--	--	
to 260 °C	75	--	70	--	60	--	45	--	25	--	
to 316 °C	90	--	85	--	80	--	75	--	70	--	
Residue from Distillation to 360 °C, Volume, % by Difference	50	--	55	--	65	--	75	--	80	--	
Tests on Residue from Distillation											
Penetration (at 25 °C, 100 g, 5 s), 0.1 mm	80	120	80	120	80	120	80	120	80	120	LS-200
Ductility (at 25 °C, 5 cm/min), cm (Note 1)	100	--	100	--	100	--	100	--	100	--	LS-205
Solubility, % by mass (Note 2)	99.5	--	99.5	--	99.5	--	99.5	--	99.5	--	LS-204
Notes:											
1. If the ductility at 25 °C is less than 100, the material is acceptable if the ductility at 15 °C is more than 100.											
2. Using trichloroethylene as solvent.											

TABLE 2
Medium Curing Liquid Asphalts

Grade	MC-30		MC-70		MC-250		MC-800		MC-3000		Test Method
Requirements	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Tests on Liquid Asphalt											
Flash Point (Tag Open Cup), °C	38	--	38	--	65	--	65	--	65	--	ASTM D 3143
Kinematic Viscosity (at 60 °C), mm ² /s	30	60	70	140	250	500	800	1600	3000	6000	LS-202
Distillation Test Distillate (% of total distillate to 360 °C)											ASTM D 402
to 225 °C	--	25	--	20	--	10	--	--	--	--	
to 260 °C	40	70	20	60	15	55	--	35	--	15	
to 316 °C	75	93	65	90	60	87	45	80	15	75	
Residue from Distillation to 360 °C, Volume, % by Difference	50	--	55	--	67	--	75	--	80	--	
Tests on Residue from Distillation											
Penetration (at 25 °C, 100 g, 5 s), 0.1 mm	120	250	120	250	120	250	120	250	120	250	LS-200
Ductility (at 25 °C, 5 m/min), cm (Note 1)	100	--	100	--	100	--	100	--	100	--	LS-205
Solubility, % by mass (Note 2)	99.5	--	99.5	--	99.5	--	99.5	--	99.5	--	LS-204
Notes:											
1. If the ductility at 25 °C is less than 100, the material is acceptable if the ductility at 15 °C is more than 100.											
2. Using trichloroethylene as solvent.											

TABLE 3
Slow Curing Liquid Asphalts

Grade	SC-70		SC-250		SC-800		SC-3000		Test Method
Requirements	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Tests on Liquid Asphalt									
Flash Point (Cleveland Open Cup), °C.	65	--	80	--	90	--	105	--	LS-201
Kinematic Viscosity (at 60 °C), mm ² /s	70	140	250	500	800	1600	3000	6000	LS-202
Distillation Test Distillate (% of total Distillate to 360 °C)	10	30	4	20	2	12	--	5	ASTM D 402
Tests on Residue from Distillation									
Kinematic Viscosity (at 60 °C), mm ² /s	4	70	8	100	20	160	40	350	LS-202
Solubility, % by mass (Note 1)	99.5	--	99.5	--	99.5	--	99.5	--	LS-204
Asphalt Residue of Specified Penetration and Test									
Residue of 100 Penetration, %	50	--	60	--	70	--	80	--	ASTM D 243
Ductility of 100 Penetration Residue (at 25 °C, 5 cm/min), cm (Note 2)	100	--	100	--	100	--	100	--	LS-205
Notes:									
1. Using trichloroethylene as solvent.									
2. If the ductility at 25 °C is less than 100, the material is acceptable if the ductility at 15 °C is more than 100.									

TABLE 4
MTO Primer and Mixed In Place (M.I.P.)

Grade	MTO Primer		M.I.P.		Test Method
Requirements	Min.	Max.	Min.	Max.	
Tests on Liquid Asphalt					
Flash Point (Tag Open Cup), °C.	--	--	27	--	ASTM D 3143
Kinematic Viscosity (at 60 °C), mm ² /s	20	35	120	180	LS-202
Distillation Test Distillate (% of total distillate to 360 °C), to 190 °C to 225 °C to 260 °C to 316 °C	 20 40 70 85	 80 -- -- --	 10 20 40 --	 -- -- -- --	ASTM D 402
Residue from Distillation to 360 °C Volume, % by Difference	50	--	80	--	
Tests on Residue					
Penetration (at 25 °C, 100 g, 5 s), 0.1 mm	80	200	--	--	LS-200
Ductility (at 25 °C, 5 cm/min), cm (Note 1)	100	--	--	--	LS-205
Softening point, °C	--	--	21	32	ASTM D 36
Solubility, % by mass (Note 2)	99.5	--	99.5	--	LS-204
Notes:					
1. If the ductility at 25 °C is less than 100, the material is acceptable if the ductility at 15 °C is more than 100.					
2. Using trichloroethylene as solvent.					

TABLE 5
Temperature Range of Liquid Asphalts for Spraying and Mixing

Grade	Temperature, °C			
	Spraying		Mixing	
	Min.	Max.	Min.	Max.
RC-30, MC-30	30	45	25	45
RC-70, MC-70, SC-70	60	70	55	70
RC-250, MC-250, SC-250	75	90	70	90
RC-800, MC-800, SC-800	90	105	80	105
RC-3000, MC-3000, SC-3000	115	130	110	130
MTO Primer	30	45	--	--
Mixed in Place	--	--	80	105

**Appendix 1102-A, Commentary for OPSS.MUNI 1102, November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Type and grade of liquid asphalt. (1102.05.01)
- Requirements for quality assurance sampling. (1102.08.03)

Typically the types of liquid asphalt listed in this specification are used for priming of granular base, granular sealing, in cold recycled mix, and in asphalt patching material.

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



MATERIAL SPECIFICATION FOR EMULSIFIED ASPHALT

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APPENDICES

1103-A	Commentary

1103.01	SCOPE

This specification covers the requirements for different types and grades of emulsified asphalt suitable for both roadway construction and as a straw mulch adhesive.

1103.01.01 Specification Significance and Use

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

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

1103.01.02 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.

1103.02 REFERENCES

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

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

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-200	Penetration of Bituminous Materials
LS-204	Solubility of Bituminous Materials in Trichloroethylene
LS-205	Ductility of Bituminous Materials
LS-207	Float of Bituminous Materials
LS-208	Elastic Recovery by Ductilometer
LS-216	Determination of Residue by Distillation of Emulsified Asphalts
LS-217	Determination of Oil Portion of Distillate in Emulsified Asphalt Primers
LS-218	Particle Charge of Emulsified Asphalt and Emulsified Asphalt Primers
LS-219	Viscosity of Emulsified Asphalts
LS-220	Demulsibility of Emulsified Asphalts
LS-221	Settlement and Storage Stability of Emulsified Asphalt
LS-222	Cement Mixing of Emulsified Asphalts
LS-223	Sieve Test for Emulsified Asphalts
LS-224	Coating for Emulsified Asphalts
LS-226	Test for High Float Emulsified Asphalt

ASTM International

D 140/D 140M -15	Standard Practice for Sampling Bituminous Materials
D 1310-14	Standard Test Method for Flash Point and Fire Point of Liquids by Tag Open-Cup Apparatus
D 2939-03	Test Methods for Emulsified Bitumens Used As Protective Coating
D 6930-10	Standard Test Method for Settlement and Storage Stability of Emulsified Asphalts
D6998-11	Standard Practice for Evaluating Aggregate Coating Using Emulsified Asphalts
D36/D36M-14e1	Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)

1103.03 DEFINITIONS

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

Emulsified Asphalt means asphalt cement mixed with water to increase the flow qualities of the asphalt cement.

1103.05 MATERIALS

1103.05.01 General

Emulsified asphalt shall be of the type and grade as specified in the Contract Documents and shall be supplied from a source approved by the Owner. Under no circumstances shall the source of supply or the product be changed, or partial or total supply allocated to another supplier without prior written approval of the Owner.

1103.05.02 Physical Requirements

Emulsified asphalts shall consist of suitable paving asphalts dispersed in water and shall meet the requirements specified in Tables 1, 2, 3, 8, 9 and 10 and Figure 1. The addition of polymers or other additives after the manufacture of an emulsified asphalt shall not be permitted.

Emulsified asphalts and polymer-modified emulsified asphalts shall be homogeneous after mixing and show no signs of separation within 14 Days of delivery.

1103.05.03 Straw Mulch Adhesive

Emulsified asphalt used as a straw mulch adhesive shall be a specially refined petroleum asphalt emulsified in water, of fluid consistency designed for cold spray applications, containing neither petroleum solvents nor other components toxic to plant life, and shall be according to Table 1.

1103.05.04 Shipping

The material shall be shipped in clean containers. Containers that are being reused shall be inspected and cleaned, if required, prior to loading to ensure there is no contamination.

When shipping is by tank truck or railway tank car, the material shall arrive at the destination at a temperature at least 5 °C higher than the minimum spraying temperature specified in Table 4 and not more than the maximum spraying temperature specified in Table 4.

When no spraying temperatures are specified in Table 4, the material shall arrive at a temperature meeting the manufacturer's requirements.

1103.08 QUALITY ASSURANCE

1103.08.01 Compliance

Emulsified asphalts shall be according to Tables 1, 2, 3, 8, 9 and 10 and Figure 1 for the particular type and grade when tested according to the test methods designated in the tables.

1103.08.02 Inspection

The Owner may inspect shipping containers for cleanliness at any time.

1103.08.03 Sampling

Representative samples of material being supplied may be taken, where specified in the Contract Documents, according to ASTM D 140 from either the supplier's plant or, any shipment in the presence of the Contract Administrator. Sample material taken prior to delivery shall be at no additional cost to the Owner.

1103.08.04 Testing

Samples may be tested by the Owner according to the tests listed in Tables 1, 2, 3, 8, 9, and 10.

1103.08.05 Rejection

Failure of any sample to conform to any of the material requirements shall be cause for rejection of the material. Rejected materials shall be replaced at no additional cost to the Owner.

TABLE 1
Anionic Emulsified Asphalts

Requirements	Type	Rapid Setting						Medium Setting				Slow Setting								Test Method
	Grade	RS-1		RS-2		RS-1HH		MS-1		MS-2		SS-1		SS-1H		SS-1HH		Straw Mulch Adhesive		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Tests on Emulsion																				
Viscosity, Saybolt Furol Seconds : at 25 °C at 50 °C		20 --	100 --	-- 75	-- 300	20 --	60 --	20 --	60 --	-- 35	-- 400	20 --	60 --	20 --	60 --	20 --	60 --	17 --	40 --	LS-219
Residue by Distillation, % by Mass		55	--	60	--	55	--	55	--	65	--	55	--	55	--	55	--	55	--	LS-216
Settlement, %, 5 Days 7 Days		-- --	3 --	-- --	3 --	-- --	5 --	-- --	3 --	-- --	3 --	-- --	5 --	-- --	5 --	-- --	5 --	-- --	-- 5	LS-221
Demulsibility, % 35 ml, 0.02 N CaCl2 50 ml, 0.1 N CaCl2		60 --	-- --	60 --	-- --	60 --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- 2.0	LS-220
Oil Portion of Distillate, % by Volume/Mass		--	--	--	--	--	1	--	--	--	10	--	--	--	--	--	1	--	--	LS-217
Sieve Text, % by Mass		--	0.1	--	0.1	--	0.1	--	0.1	--	0.1	--	0.1	--	0.1	--	0.1	--	0.1	LS-223
Cement Mixing Test, % by Mass		--	--	--	--	--	--	--	--	--	--	--	2.0	--	2.0	--	--	--	--	LS-222
Particle Charge		NEGATIVE OR NEUTRAL																		LS-218
Coating Ability and Water Resistance, %, Note 1		--	--	--	--	--	--	80	--	80	--	80	--	80	--	--	--	--	--	LS-224
Fire Resistance		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	PASS		Note 2
Tests on Residue																				
Penetration (at 25 °C, 100 g, 5 s), 0.1 mm		100	200	100	200	20	55	100	200	100	250	100	200	40	100	20	55	100	200	LS-200
Ductility (at 25 °C, 5 cm/min), cm		60	--	60	--	40	--	40	--	40	--	40	--	40	--	40	--	40	--	LS-205

Requirements	Type	Rapid Setting						Medium Setting				Slow Setting								Test Method
	Grade	RS-1		RS-2		RS-1HH		MS-1		MS-2		SS-1		SS-1H		SS-1HH		Straw Mulch Adhesive		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Solubility in Trichloroethylene, % by Mass		97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	LS-204
Notes:																				
1. This requirement does not apply for tack coat or joint painting emulsified asphalts.																				
2. There shall be no flash or flare-up when the flame of a bunsen burner is held in contact with the surface of the material, as received, for a period of 10 seconds.																				

TABLE 2
Cationic Emulsified Asphalts

Requirements	Type	Rapid Setting						Medium Setting				Slow Setting						Slurry Seal		Test Method
	Grade	CRS-1		CRS-2		CRS-1HH		CMS-2		CMS-2H		CSS-1		CSS-1H		CSS-1HH		CSS-H		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Tests on Emulsion																				
Viscosity, Saybolt Furol Seconds :																				
at 25 °C		--	--	--	--	20	60	--	--	--	--	20	100	20	100	20	60	20	100	LS-219
at 50 °C		50	150	100	400	--	--	50	400	50	400	--	--	--	--	--	--	--	--	
Residue by Distillation, % by Mass		62	--	67	--	55	--	65	--	65	--	57	--	57	--	55	--	57	--	LS-216
Settlement, %, 5 Days		--	5	--	5	--	5	--	5	--	5	--	5	--	5	--	5	--	5	LS-221
Demulsibility, % 35 ml 0.8% Dioctyl Sodium Sulfosuccinate Solution		40	--	40	--	40	--	--	--	--	--	--	--	--	--	--	--	--	--	LS-220
Oil Portion of Distillate, % by Volume/Mass		--	3	--	3	--	1	--	10	--	10	--	5	--	5	--	1	--	--	LS-217
Sieve Text, % by Mass		--	0.1	--	0.1	--	0.1	--	0.1	--	0.1	--	0.1	--	0.1	--	0.1	--	0.1	LS-223
Cement Mixing Test, % by Mass		--	--	--	--	--	--	--	--	--	--	--	2.0	--	2.0	--	--	--	--	LS-222
Particle Charge		POSITIVE																		LS-218
Coating Ability and Water Resistance, % (Note 1)		--	--	--	--	--	--	80	--	80	--	80	--	80	--	--	--	--	--	LS-224
Tests on Residue																				
Penetration (at 25 °C, 100 g, 5 s), 0.1 mm		100	250	100	250	20	55	100	250	40	125	100	250	40	125	20	55	40	125	LS-200
Ductility (at 25 °C, 5 cm/min), cm		60	--	60	--	40	--	60	--	40	--	60	--	40	--	40	--	40	--	LS-205

Requirements	Type	Rapid Setting						Medium Setting				Slow Setting						Slurry Seal		Test Method
	Grade	CRS-1		CRS-2		CRS-1HH		CMS-2		CMS-2H		CSS-1		CSS-1H		CSS-1HH		CSS-H		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Solubility in Trichloroethylene, % by Mass		97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	LS-204

Notes:

1. This requirement does not apply for tack coat or joint painting emulsified asphalts.

TABLE 3
High Float Emulsified Asphalts

Requirements	Type	High Float														Test Method
	Grade	HFRS-2		HFMS-2(ON)		HF-100S		HF-150S		HF-250S		HF-150M		HF-1000M		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Tests on Emulsion																
Viscosity, Saybolt Furol Seconds at 50 °C		75	400	50	300	35	150	35	150	35	150	50	--	50	--	LS-219
Residue by Distillation, % by Mass		63	--	62	--	62	--	62	--	62	--	62	--	65	--	LS-226 LS-216
Demulsibility, % 35 ml 0.02 N CaCl2 50 ml 0.10 N CaCl2 50 ml 0.02 N CaCl2		60	--	--	--	--	--	--	--	--	--	--	--	--	--	LS-220
Oil Portion of Distillate, % by Volume/Mass		--	--	0.5	3	0.5	4	0.5	4	1	6	1	6	1	7	LS-217
Sieve Text, % by Mass		--	0.10	--	0.10	--	0.10	--	0.10	--	0.10	--	0.10	--	0.10	LS-223
Particle Charge		--	--	Negative		--	--	--	--	--	--	--	--	--	--	LS-218
Coating Test		--	--	(Note 1)		(Note 1)		(Note 1)		(Note 1)		(Note 2)		(Note 2)		ASTM D6998
Storage Stability 24 h, % by Mass		--	1.0	--	1.5	--	1.5	--	1.5	--	1.5	--	1.5	--	1.5	ASTM D 6930
Tests on Residue																
Penetration (at 25 °C, 100 g, 5 s), 0.1 mm		100	200	90	200	100	175	150	250	250	500	150	--	--	--	LS-226 LS-200
Ductility (at 25 °C, 5 cm/min), cm		40	--	--	--	--	--	--	--	--	--	--	--	--	--	LS-205
Solubility in Trichloroethylene, % by Mass		97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	LS-204
Float Test at 60 °C, s		1200	--	1200	--	1200	--	1200	--	1200	--	1200	--	1200	--	LS-226 LS-207
Apparent Viscosity (at 60 °C), Pa·s		--	--	--	--	Requirements outlined on Figure 1						10	80 (Note 3)	2	8 (Note 3)	LS-226

Requirements	Type	High Float														Test Method
	Grade	HFRS-2		HFMS-2(ON)		HF-100S		HF-150S		HF-250S		HF-150M		HF-1000M		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Notes:																
1. Follow ASTM D6998, except that the mixture of aggregate and emulsified asphalt shall be mixed vigorously for 5 min. at the end of which period the aggregates shall be thoroughly and uniformly coated. The mixture shall then be completely immersed in tap water and the water poured off. The aggregate shall then be at least 90% coated.																
2. Follow ASTM D6998, except that the mixture of aggregate and emulsified asphalt shall be mixed vigorously for 5 min. then allowed to stand for 3 hours after which the mixture shall be capable of being mixed an additional 1 min. The mixture shall then be rinsed twice with approximately its own volume of tap water, without showing appreciable loss of bituminous film. After the second washing the aggregate shall be at least 90% coated.																
3. Viscosity limits (at 60 °C at 1.0 s-1) shown for mixing grades are tentative. Supplier to advise purchaser before delivery, if limits cannot be met.																

TABLE 4
Temperature for Spraying and Mixing Emulsified Asphalts, °C

Grade	Spraying		Mixing	
	Minimum	Maximum	Minimum	Maximum
RS-1, RS-1P, RS-1HH	30 (Note 1) 20 (Note 2)	70 70	-- --	-- --
RS-2, RS-2P	60 (Note 1)	80	--	--
MS-1	--	--	30	70
MS-2	--	--	30	70
SS-1	20	70	20	70
SS-1H, SS-1HH	20	70	20	70
HFRS-2	60	80	--	--
HFMS-2(ON), HFMS-2P(ON)	60	80	--	--
HF-100S, HF-100SP	60	80	--	--
HF-150S, HF-150SP	60	80	--	--
HF-250S	60	80	--	--
HF-150M, HF-150MP	--	--	40	80
HF-1000M	--	--	40	75
CRS-1, CRS-1P, CRS-1HH	60	80	--	--
CRS-2, CRS-2P	60	80	--	--
CMS-2	--	--	30	70
CMS-2H	--	--	30	70
CSS-1	--	--	30	70
CSS-1H	--	--	30	70
CSS-1HH	20	70	--	--
CSS-H (Slurry)	--	--	20	35
CQS-1HP	--	--	Manufacturer's Requirements	
Emulsified Asphalt Primer (EAP)	Manufacturer's Requirements		--	--
Solvent-Free Emulsified Asphalt	Manufacturer's Requirements		--	--

Grade	Spraying		Mixing	
	Minimum	Maximum	Minimum	Maximum
Notes: 1. For surface treatment. 2. For other uses.				

TABLE 5
Minimum Apparent Viscosity, HF-100S

Penetration at 25 °C 0.1 mm	Minimum Apparent Viscosity at 60 °C, Pa·s at 0.5 s ⁻¹	Penetration at 25 °C 0.1 mm	Minimum Apparent Viscosity at 60 °C, Pa·s at 0.5 s ⁻¹	Penetration at 25 °C 0.1 mm	Minimum Apparent Viscosity at 60 °C, Pa·s at 0.5 s ⁻¹
75	1428	117	823	159	563
76	1405	118	815	160	559
77	1382	119	806	161	554
78	1360	120	798	162	550
79	1339	121	790	163	546
80	1318	122	782	164	542
81	1298	123	774	165	538
82	1279	124	766	166	534
83	1260	125	759	167	530
84	1241	126	751	168	526
85	1223	127	744	169	522
86	1205	128	737	170	518
87	1188	129	729	171	515
88	1172	130	723	172	511
89	1155	131	716	173	507
90	1139	132	709	174	504
91	1124	133	702	175	500
92	1109	134	696	176	496
93	1094	135	690	177	493
94	1080	136	683	178	490
95	1066	137	677	179	486
96	1052	138	671	180	483
97	1038	139	665	181	480
98	1025	140	659	182	476
99	1013	141	653	183	473
100	1000	142	648	184	470
101	988	143	642	185	467
102	976	144	637	186	464
103	964	145	631	187	461
104	953	146	626	188	458
105	941	147	621	189	455
106	930	148	615	190	452
107	920	149	610	191	449
108	909	150	605	192	446
109	899	151	600	193	443
110	889	152	595	194	440
111	879	153	591	195	437
112	869	154	586	196	435
113	860	155	581	197	432
114	850	156	576	198	429
115	841	157	572	199	426
116	832	158	567	200	424

Notes:

1. This table is based on the apparent viscosity of 1000 Pa·s at 0.5 s⁻¹ at 100 penetration, and 500 Pa·s at 0.5 s⁻¹ at 175 penetration.

TABLE 6
Minimum Apparent Viscosity, HF -150S

Penetration at 25 °C 0.1 mm	Minimum Apparent Viscosity at 60 °C, Pa·s at 0.5 s ⁻¹	Penetration at 25 °C 0.1 mm	Minimum Apparent Viscosity at 60 °C, Pa·s at 0.5 s ⁻¹	Penetration at 25 °C 0.1 mm	Minimum Apparent Viscosity at 60 °C, Pa·s at 0.5 s ⁻¹
125	164	155	136	200 - 201	109
126	163	156 - 157	135	202 - 203	108
127	162	158	134	204 - 205	107
128	161	159	133	206 - 208	106
129	160	160 - 161	132	209 - 210	105
130	158	162	131	211 - 212	104
131	157	163 - 164	130	213 - 215	103
132	156	165	129	216 - 217	102
133	155	166 - 167	128	218 - 220	101
134	154	168	127	221 - 222	100
135	153	169 - 170	126	223 - 225	99
136	152	171	125	226 - 227	98
137	151	172 - 173	124	228 - 230	97
138 - 139	150	174 - 175	123	231 - 233	96
140	149	176	122	234 - 236	95
141	148	177 - 178	121	237 - 239	94
142	147	179 - 180	120	240 - 242	93
143	146	181	119	243 - 245	92
144	145	182 - 183	118	246 - 248	91
145	144	184 - 185	117	249 - 251	90
146	143	186 - 187	116	252 - 254	89
147 - 148	142	188 - 189	115	255 - 258	88
149	141	190 - 191	114	259 - 261	87
150	140	192 - 193	113	262 - 265	86
151	139	194 - 195	112	266 - 268	85
152 - 153	138	196 - 197	111	269 - 272	84
154	137	198 - 199	110	273 - 275	83

Notes:

1. This table is based on the apparent viscosity of 140 Pa·s at 0.5 s⁻¹ at 150 penetration, and 90 Pa·s at 0.5 s⁻¹ at 250 penetration.

TABLE 7
Minimum Apparent Viscosity, HF-250S

Penetration at 25 °C 0.1 mm	Minimum Apparent Viscosity at 60 °C, Pa•s at 1.0 s⁻¹	Penetration at 25 °C 0.1 mm	Minimum Apparent Viscosity at 60 °C, Pa•s at 1.0 s⁻¹
225 - 227	57	311 - 317	37
228 - 231	56	318 - 323	36
232 - 234	55	324 - 331	35
235 - 237	54	332 - 338	34
238 - 240	53	339 - 346	33
241 - 244	52	347 - 354	32
245 - 248	51	355 - 363	31
249 - 251	50	364 - 372	30
252 - 255	49	373 - 382	29
256 - 259	48	383 - 392	28
260 - 264	47	393 - 404	27
265 - 268	46	405 - 416	26
269 - 273	45	417 - 428	25
274 - 277	44	429 - 442	24
278 - 282	43	443 - 457	23
283 - 287	42	458 - 473	22
288 - 293	41	474 - 490	21
294 - 298	40	491 - 509	20
299 - 304	39	510 - 525	19
305 - 310	38		
Notes: 1. This table is based on the apparent viscosity of 50 Pa•s at 1.0 s ⁻¹ at 250 penetration, and 20 Pa•s at 1.0 s ⁻¹ at 500 penetration.			

TABLE 8
Polymer-Modified Emulsified Asphalts

Requirements	Type	Anionic				Cationic						High Float								Test Method
	Grade	RS-1P		RS-2P		CRS-1P		CRS-2P		CQS-1HP		HFMS-2P(ON)		HF-100SP		HF-150SP		HF-150MP		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Tests on Emulsion																				
Viscosity, Saybolt Furol Seconds: at 25 °C at 50 °C	20 --	100 --	-- 75	-- 300	-- 25	-- 150	-- 75	-- 400	20 --	100 --	-- 50	-- 300	-- 35	-- 150	-- 35	-- 150	-- 50	-- --	-- --	LS-219
Residue by Distillation to 204.4 °C, % by Mass	55	--	60	--	62	--	65	--	62	--	62	--	62	--	62	--	62	--	--	LS-216 LS-226
Settlement, 24 h, % by Mass	--	1	--	1	--	1	--	1	--	1	--	--	--	--	--	--	--	--	--	LS-221
Demulsibility, % 35 ml, 0.02 N CaCl2 35 ml, 0.8% Dioctyl Sodium Sulfo-Succinate Solution 50 ml 0.10 N CaCl2 50 ml 0.02 N CaCl2	60 -- -- --	-- -- -- --	60 -- -- --	-- -- -- --	-- 40 -- --	-- -- -- --	-- 40 -- --	-- -- -- --	-- -- -- --	-- -- -- --	-- -- -- 40	-- -- -- --	-- -- 75 --	-- -- -- --	-- -- 75 --	-- -- -- --	-- -- -- --	-- -- -- --	-- -- -- --	LS-220
Oil Portion of Distillate, % by Volume/Mass	--	--	--	--	--	--	--	--	--	--	0.5	3	0.5	4	0.5	4	1	6	LS-217	
Sieve Text, % by Mass	--	0.20	--	0.20	--	0.20	--	0.20	--	0.10	--	0.10	--	0.10	--	0.10	--	0.10	LS-223	
Particle Charge	Negative or Neutral				Positive						Negative		--		--		--		LS-218	
Coating Test	--		--		--		--		--		(Note 1)		(Note 1)		(Note 1)		(Note 2)		ASTM D 6998	
Storage Stability, 24 h, % by Mass	--	--	--	--	--	--	--	--	--	--	--	--	--	1.5	--	1.5	--	1.5	ASTM D 6930	
Tests on Residue																				
Penetration (at 25 °C, 100 g, 5 s), 0.1 mm	100	200	100	200	100	250	100	250	40	90	90	200	90	150	150	250	150	250	LS-200 LS-226	
Solubility in Trichloroethylene, % by Mass (Note 2)	97.5	--	97.5	--	97.5	--	97.5	--	97.5	---	97.5	---	97.5	--	97.5	--	97.5	--	LS-204	
Float Test at 60 °C, s	--	--	--	--	--	--	--	--	--	--	1200	--	1200	--	1200	--	1200	--	LS-226 LS-207	
Ash Content, % by Mass of Residue (Note 3)	--	1.0	--	1.0	--	1.0	--	1.0	--	1.0	--	1.0	--	1.0	--	1.0	--	1.0	ASTM D 2939	
Elastic Recovery (at 10 °C), %	55	--	55	--	55	--	55	--	50	--	55	--	55	--	50	--	50	--	LS-208	

Requirements	Type	Anionic				Cationic						High Float								Test Method
	Grade	RS-1P		RS-2P		CRS-1P		CRS-2P		CQS-1HP		HFMS-2P(ON)		HF-100SP		HF-150SP		HF-150MP		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Force Ductility at 800% Elongation, 5 cm/min. Pull Rate at 4 °C, kg		0.5	--	0.5	--	0.5	--	0.5	--	--	--	0.5	--	0.5	--	--	--	--	--	LS-205
Softening Point, R&B, °C										57										ASTM D36

Notes for Table 8:

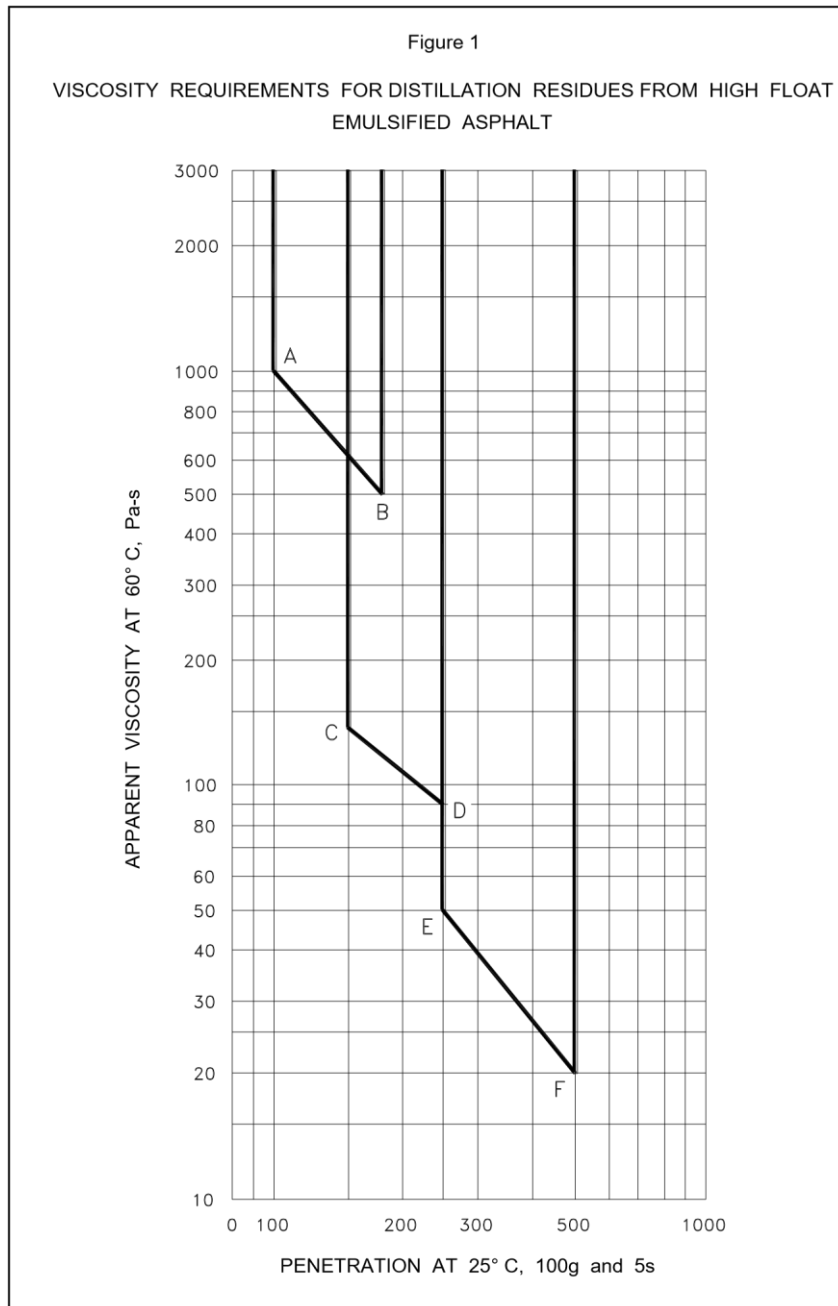
1. Follow ASTM D6998, except that the mixture of aggregate and emulsified asphalt shall be mixed vigorously for 5 min. at the end of which period the aggregates shall be thoroughly and uniformly coated. The mixture shall then be completely immersed in tap water and the water poured off. The aggregate shall then be at least 90% coated.
2. Follow ASTM D6998, except that the mixture of aggregate and emulsified asphalt shall be mixed vigorously for 5 min. then allowed to stand for 3 hours after which the mixture shall be capable of being mixed an additional 1 min. The mixture shall then be rinsed twice with approximately its own volume of tap water, without showing appreciable loss of bituminous film. After the second washing the aggregate shall be at least 90% coated.
3. The ash content shall be determined when the manufacturer indicates that the polymer additive is not soluble in trichloroethylene.

TABLE 9
Emulsified Asphalt Primer (EAP)

Requirements	Min.	Max.	Test Method
Viscosity, Saybolt Furol Seconds at 50 °C	35	150	LS-219
Residue by Distillation to 260 °C, % by Mass	40	--	LS-216
Oil Portion of Distillate, % by Volume/Mass	10	30	LS-217 (Note 1)
Particle Charge	Neutral		LS-218 (Note 2)
Flash Point, Tag Open Cup, °C	45	--	ASTM D 1310
Storage Stability, 24 h	No visible separation		ASTM D 6930 (Note 3)
Tests on Residue			
Penetration (at 25 °C, 100 g, 5 s), 0.1 mm	100	300	LS-200
Ductility (at 25 °C, 5 cm/min), cm (Note 4)	100	--	LS-205
Solubility in Trichloroethylene, % by Mass	97.5	--	LS-204
Notes:			
1. Since the total distillate exceeds 100 ml, follow LS-217 with the following modification: Prior to reaching 100 ml of distillate, carefully replace the first 100 ml graduated cylinder with a second one. After the distillation is complete, determine the volume of oil distillate in both cylinders and record the sum. Calculate the oil portion of the distillate as a percentage of the original weight of primer: % Oil = (Total Volume of oil distillate, ml X 100) / (200 g primer)			
2. Follow LS-218 with the modification that the asphalt does not deposit due to an electrical charge on either the anode (positive electrode) or the cathode (negative electrode). Equal adherence to both electrodes due to the viscous nature of the material is not considered deposition.			
3. Follow ASTM D 6930 except storage stability shall be based on visual separation of 500 ml representative sample in the glass cylinder after 24 hours.			
4. If the ductility at 25 °C is less than 100 cm, the material shall be acceptable if its ductility at 15 °C is more than 100 cm.			

Table 10
Solvent-Free Emulsified Asphalt

Requirements	Min.	Max.	Test Method
Viscosity, Saybolt Furol Seconds at 25 °C	5	50	LS-219
Residue by Distillation to 260 °C, % by Mass	40	-	LS-216
Sieve Test, % by Mass	-	0.1	LS-223
Oil Portion of Distillate, % by Volume/Mass	-	0.5	LS-217 (Note 1)
Storage Stability, 24 h, %	No visible separation		ASTM D 6930 (Note 2)
Particle Charge	Negative or Neutral		LS-218
Tests on Residue			
Penetration (at 25 °C, 100 g, 5 s), 0.1 mm	40	150	LS-200
Ductility (at 25 °C, 5 cm/min), cm	40	--	LS-205
Solubility in Trichloroethylene, % by Mass	97.5	--	LS-204
Notes:			
1. Since the total distillate will exceed 100 ml, follow LS-217 with the following modification: Prior to reaching 100 ml of distillate, carefully replace the first 100 ml graduated cylinder with a second one. After the distillation is complete, determine the volume of oil distillate in both cylinders and record the sum. Calculate the oil portion of the distillate as a percentage of the original weight of solvent-free emulsified asphalt: % Oil = (Total Volume of oil distillate, ml X 100) / (200 g solvent-free emulsified asphalt)			
2. Follow ASTM D 6930 except storage stability shall be based on visual separation of 500 ml representative sample in the glass cylinder after 24 hours.			



Notes:

- A. Grade of high float emulsified asphalt: HF-100S - A, B
HF-150S - C, D
HF-250S - E, F
- B. Viscosity shall be above the extrapolated line* designated by specified letters and between penetration limits contained in vertical lines extending upwards from these points.
* See Tables 5, 6, and 7 for acceptable values.
- C. Viscosity value shall be reported at the shear rate: 0.5 s^{-1} for grades HF-100S and HF-150S
 1.0 s^{-1} for grade HF-250S

Appendix 1103-A, November 2019
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:

- Emulsified asphalt. (1103.05.01)
- Representative samples of material. (1103.08.03)

Related Ontario Provincial Standard Drawings

No information provided here.



MATERIAL SPECIFICATION FOR HOT MIX ASPHALT

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1150.01 SCOPE

This specification covers the requirements for the materials, equipment, and methods to be followed for proportioning and mixing hot mix asphalt, including recycled mixes and mixes for miscellaneous work.

1150.01.01 Specification Significance and Use

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

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

1150.01.02 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.

1150.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

OPSS 1001	Aggregates - General
OPSS 1003	Aggregates - Hot Mix Asphalt
OPSS 1101	Performance Graded Asphalt Cement

Ontario Ministry of Transportation Publications

DSM	Designated Sources of Material

MTO Laboratory Testing Manual:

LS-261	Preparation of Marshall Specimens
LS-262	Bulk Relative Density of Compacted Bituminous Mixtures
LS-263	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
LS-264	Theoretical Maximum Relative Density of Bituminous Paving Mixtures
LS-265	Percent Air Voids in Compacted Dense Bituminous Pavement Mixtures
LS-282	Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
LS-292	Quantitative Determination of Asphalt Cement Content by Ignition and Analysis of Remaining Aggregate from Bituminous Paving Mixtures

American Association of State Highway and Transportation Officials (AASHTO)

M320-16	Performance-Graded Asphalt Binder
T-283-03	Resistance of Compacted Bituminous Mixture to Moisture Induced Damage

Asphalt Institute Publications (AI)

MS-02, Sixth Edition Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types

1150.03 DEFINITIONS

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

AMRL means the AASHTO Materials Reference Laboratory.

Anti-Stripping Additive means hydrated lime and liquid anti-stripping additive used to minimize or eliminate stripping from aggregates in hot mix asphalt (HMA).

Binder Course means a hot mix asphalt (HMA) course between a surface course and either a granular base course or stabilized base course, an existing pavement, or another HMA binder course.

Blending Aggregates means any coarse or fine aggregate that is added to HMA in order to produce hot mix that is according to this specification.

CCIL means the Canadian Council of Independent Laboratories.

Field Adjustment means adjustments to the target gradation or asphalt cement content or both of a mix without a redesign of the HMA, resulting in a revised job-mix formula (JMF).

Hot Mix, Mixture, Mix, and Hot Mix Asphalt means hot mixed, hot laid asphaltic concrete. The terms are used interchangeably. HMA may include recycled or specialty mixes.

Hot Mix Types means those specified in Table 1.

Job-Mix Formula (JMF) means the percentage passing on each designated sieve of the total mass of aggregate and the amount of asphalt cement as a percentage by mass of the mixture that are based on specified mix design procedures, and when mixed results in a paving mixture that is according to this specification.

Levelling Course means a HMA course of variable thickness used to eliminate transverse and longitudinal irregularities on an existing surface prior to placing an HMA binder or surface course.

Mix Design means the design of the proportions of aggregates, asphalt cement, and additives when uniformly mixed results in an acceptable HMA in accordance with the specified method.

Mixes for Miscellaneous Work means HMA used for miscellaneous work such as the paving of shoulders, boulevards and sidewalks, and the construction of curb and gutter and spillways. These mixes do not meet normal HMA gradation and mix design requirements.

Performance Graded Asphalt Cement (PGAC) means an asphalt binder that is asphalt-based cement produced from petroleum residue, either with or without the addition of non-particulate modifiers, according to AASHTO M320.

Reclaimed Asphalt Pavement (RAP) means the processed HMA material that is recovered by partial or full depth removal.

Surface Course means the HMA wearing course of any flexible or composite pavement.

1150.04 DESIGN AND SUBMISSION REQUIREMENTS

1150.04.01 Design Requirements

1150.04.01.01 Mixture Requirements for Design Purposes

The mixture made during mix design shall be according to the requirements specified in Tables 2, 3, 4, 5, 6, and 7.

The JMF shall be according to the requirements specified in Tables 2 and 3.

1150.04.01.01.01 Reclaimed Asphalt Pavement Proportions

RAP is not permitted in HL1 and DFC, unless specified in the Contract Documents.

The use of:

- a) Up to 15% by mass of RAP shall be permitted for HL 3, HL 3F, HL 4, and HL 4F surface course mixes.
- b) Up to 30% by mass of RAP shall be permitted for HL 4, HL 8, and medium duty binder mixes.
- c) Over 50% by mass of RAP is not permitted for any mix.

When 31 to 50% by mass of RAP is proposed for HL 4 or HL 8 binder mixes, written approval by the Contract Administrator shall be obtained for the mix design, including PGAC modification.

If the composition of the mix is modified by including RAP to exceed 20% by mass of the total mixture, but less than 40% by mass, both the high and low grade of the PGAC shall be lowered by 6 °C.

1150.04.01.02 Mix Design

1150.04.01.02.01 General

The mix design shall be the responsibility of the Contractor. The job-mix formula selected for use by the Contractor shall produce hot mix that is in accordance to all requirements specified in the Contract Documents.

1150.04.01.02.02 Mix Design Method

A laboratory that has current CCIL Type A Certification or AMRL equivalent certification or other equivalent certified laboratory acceptable to the Contract Administrator shall be used to conduct all mix designs, designate the mix proportions, and prepare the job-mix formula. For all mixes, except those that contain RAP, the mix design procedures and tests shall be in accordance to the Marshall Method in the Asphalt Institute Manual Series No. 2, MS-02, following the LS-261, LS-262, LS-263, LS-264, LS-265, and T-283-03 tests and the requirements detailed herein. Mix design procedures for mixes that contain RAP shall be according to Table 10.

All mixes shall be designed using 75 blows per side of the test specimen with a manual compaction hammer or a mechanical equivalent to 75 blows per side of the test specimen with a manual compaction hammer.

The aggregate gradings used for the mix design may be gradings provided by the Contractor or the actual gradings of the mix design aggregate samples. However, when the mix is to be produced from a plant that returns fines to the mixture or the aggregate gradations change during production due to aggregate breakdown, appropriate adjustments shall be made to the mix design gradations.

When a mix contains additives and the source of asphalt cement changes from that used in the mix design, tests shall be re-done to verify the dosage of such additives.

RAP as processed and ready for use in a HMA shall be tested by the Contractor using test LS-282 or LS-292 to determine the average percentage asphalt cement and the average gradation for the extracted reclaimed asphalt pavement aggregates.

1150.04.01.02.03 Changes to the Job-Mix Formula and the Mix Design

Changes to the JMF shall be permitted when it has been determined that the mix properties specified in the Contract Documents are not being met. All changes are subject to the conditions specified below.

Changes to the material proportions based on process control test results shall be permitted without a new mix design, but further hot mix production shall be subject to conditions imposed by the Contract Administrator. In this situation, when the Contractor changes the JMF, the Contract Administrator shall review the revised JMF for conformance to the mix properties with the Contract requirements. Within 1 Business Day of the modified JMF being received in full by the Contract Administrator, the Contract Administrator shall provide in writing conditional permission to construct HMA or the reason why permission is being withheld.

A new mix design and mix designation documents and a new JMF shall be completed when:

- a) A material is eliminated.
- b) A new material is added.
- c) It is not possible to comply with the maximum permitted fine aggregate blending ratio.
- d) Changes to the material proportions have not resulted in correction of the problems with the mix.
- e) The net impact of all adjustments to the original JMF exceeds any of the maximum field adjustments specified in Table 8.

The new mix design, new JMF documents, and new samples, if required, for monitoring purposes shall be delivered to the Contract Administrator. The new mix design shall be accepted or rejected within 5 Business Days, which commence when all of the required samples and documents have been submitted.

1150.04.01.03 Anti-Stripping Treatments

The Contractor shall determine the need for and the amount of anti-stripping additive required using T-283-03.

The need for and the amount of anti-stripping additive required shall not be affected by any previous determination made with respect to the same or any other aggregate source.

Regardless of the hot mix type, the amount of liquid anti-stripping additive either specified in the Contract Documents or determined through mix design procedure shall be a percentage of the total asphalt cement required.

The amount of anti-stripping additive required shall be the greater of the:

- a) Amount required to provide a minimum of 80% of Tensile Strength Ratio (TSR) , as determined by T-283-03.
- b) Minimum dosage requirements outlined in the MTO's DSM list for asphalt aggregates.

- c) Minimum dosage requirements outlined in the Owner's pre-qualified products list for asphalt aggregates.

Whenever an anti-stripping additive is required, the following applies:

- a) For all DFC mixes or other mixes consisting of more than 75% dolomitic sandstone or meta-arkose aggregates or combinations thereof, the anti-stripping additive shall be hydrated lime ($\text{Ca}(\text{OH})_2$) with a minimum dosage requirement of 1% by mass of the total dry aggregate.
- b) For all other combinations of aggregates, the anti-stripping additive may be hydrated lime or a chemical agent.

Anti-stripping additive shall be used according to supplier information. The following information on the hydrated lime anti-stripping additive shall be provided to the Contract Administrator:

- a) Documentation that the hot mix shall be produced in accordance to all requirements of the Contract.
- b) Amount of hydrated lime to be used as determined in the mix design procedures.
- c) Complete information on how the hydrated lime is to be used and how the hydrated lime is to be incorporated into the mixture.
- d) The amount of hydrated lime as a percentage of the mass of the aggregate.

1150.04.02 Submission Requirements

1150.04.02.01 Mix Design

A minimum of 10 Business Days prior to the start of the paving operation, the proposed mix design and JMF shall be submitted in writing to the Contract Administrator. The Contract Administrator shall provide in writing the permission to construct using the documentation referred to above or the reason why the permission is being withheld within 10 Business Days of submission of all the required samples and documents.

1150.04.02.01.01 Changes to the Job-Mix Formula and the Mix Design

When the Contractor changes the JMF, the revised JMF shall be submitted in writing to the Contract Administrator.

When the Contractor submits a new mix design, it must be accompanied by samples for monitoring purposes, if required; a mix design report; and the supporting documents as detailed in the Documents clause of the Submission Requirements subsection.

1150.04.02.02 Samples for Monitoring Purposes

Representative samples of the materials to be used in the work shall be provided to the Contract Administrator at the same time that the mix design and JMF documents are submitted.

The samples shall be labelled with the Contract number, material type, material source, and date of sampling (i.e., yyyy-mm-dd). The samples of coarse aggregate, fine aggregate, and blending aggregates shall be identified.

Each material sample shall be packaged separately and the samples shall be in containers that are clean, closed, and shall not rupture when lifted or handled. Each filled sample container shall have a maximum mass of 25 kg.

The minimum sample quantities shall be as specified in Table 9.

1150.04.02.03 Documents

The Contract Administrator shall be provided with a copy of the mix design and JMF documents that shall be signed, dated, and certified correct by the person accountable for the engineering and management responsibility for the laboratory that conducted the work. When the Owner has a Bituminous mix design report form, that form may be required along with other supporting documents. Information shall be provided in a legible manner. The documents shall include the following information, as a minimum:

- a) Contract number, item number, and mix type for which the mix design and JMF were completed and a description of the usage of the mix on the Contract.
- b) All test results, mix design work sheets, and graphs.
- c) Material proportions and sources, including the Owner's Mineral Aggregate Inventory for the aggregate sources, when such information is available. The amount of RAP in per cent by mass and volumetric data shall also be included.
- d) Designation of the fine aggregate and the coarse aggregate.
- e) PGAC and source and per cent by mass of the required new asphalt cement.
- f) A graph of the temperature-viscosity relationship for the PGAC that is to be used in the mix shall be produced according to LS-261.
- g) Information on additives, including source, type, per cent by mass of asphalt cement, and test results according to T-283-03, when anti-stripping tests are required.
- h) Information regarding fines that are returned to the mix, aggregate breakdown during production, and the resultant change in the aggregate gradations.
- i) For both coarse and fine aggregates, complete grading and volumetrics are required.
- j) The per cent air voids, Marshall flow, voids in mineral aggregate, and Marshall stability of the mixture selected and the mix design criteria to be met for each test.
- k) Graphs of the air voids, Marshall flow, voids in mineral aggregate, and Marshall stability of the mixture plotted against asphalt cement content.
- l) Aggregate absorptions.
- m) Bulk relative density and saturated surface dry density for each aggregate.
- n) Mix bulk relative density.
- o) Mix maximum relative density.
- p) Mix maximum relative density and surface dry density, where applicable.
- q) Extracted bulk relative density, percentage asphalt cement, and gradation for the RAP used in the mix, when RAP is permitted for use.
- r) All visual observations made during the design process with particular attention and comments regarding stripping and coating for both the coarse and fine aggregates.

- s) The JMF.
- t) The mixing and compaction temperature used in the mix design and the compaction temperature of the reheated mixture to be employed in the testing of the production mix.
- u) The typical mix weight to produce a briquette with a height of 63.5 mm $\pm$ 1.5 mm.

1150.05 MATERIALS

1150.05.01 Asphalt Cement

Asphalt cement shall be performance graded asphalt cement according to OPSS 1101.

The supply and use of asphalt cement shall be as specified in the Contract Documents.

1150.05.02 Aggregates

Aggregates shall be according to OPSS 1003.

1150.05.02.01 Reclaimed Asphalt Pavement

RAP, when permitted in a HMA, shall be according to the aggregate requirements of OPSS 1003 for the mix type specified in the Contract Documents. Absorption, freeze thaw, and magnesium sulphate requirements do not apply to RAP.

RAP that is contaminated with deleterious material shall not be used and shall be removed from the work.

RAP shall be stockpiled conforming to the stockpiling requirements for coarse aggregates according to OPSS 1001, except when the material is stockpiled on a compacted granular pad, the top 75 mm of the pad shall be the coarse aggregate that is required for a new (virgin) mixture of the tendered hot mix item.

The use of RAP that is obtained from existing stockpiles that do not have a foundation conforming to the above paragraph shall be permitted, provided that the bottom 0.3 m of the stockpile is not incorporated into the work.

The ground surface under any working RAP stockpile shall be sloped at a minimum of 3% away from the load out point to promote drainage of the RAP.

RAP shall be processed to the maximum nominal size sieve for the HMA specified.

Process control sampling and testing of the RAP shall be as specified in the Contract Documents.

1150.05.03 Silicone

When added to the asphalt cement, silicone oil shall be less than five parts per million of asphalt cement.

1150.05.04 Filler

Filler shall be according to OPSS 1003.

1150.06 EQUIPMENT

1150.06.01 Requirements for all Mixing Plants

The equipment shall be such that the HMA produced shall meet this specification and shall demonstrate adequate control and documentation of the HMA materials, mixing temperature, and storage for monitoring and production purposes.

The recycle cold feed bin system shall be equipped with either a RAP gator or lump breaker to break up large chunks or a vibrating screen, maximum 37.5 mm square opening, to remove oversize pieces, or a combination of both.

When required by the Contract Administrator, all equipment shall be on the site and available for inspection before operations are commenced and during production operations.

1150.06.02 Truck Scales

Truck scales shall be as specified in the Contract Documents.

1150.07 PRODUCTION

1150.07.01 General

The hot mix shall be produced to meet the submitted JMF or the adjusted JMF that was accepted in writing by the Contract Administrator.

The Contractor shall be responsible for the quality and characteristics of the mixture. If the hot mix produced does not meet the requirements of this specification, hot mix production shall stop and appropriate corrections shall be made to the process.

The Contractor is responsible for the process control and condition of all materials during the handling, blending, and mixing operations. The Contractor is responsible for determining and making all necessary adjustments in proportioning materials used to produce HMA to meet the Contract requirements.

1150.07.02 Operational Constraints

The JMF is the target to which the hot mix shall be compared to determine the acceptance of the aggregate gradation and asphalt cement. HMA shall not be placed until the Contract Administrator provides permission in writing to proceed with a submitted JMF.

The JMF shall remain in effect until the Contract Administrator receives any requested changes in writing and approves them.

1150.07.03 Handling of Materials

1150.07.03.01 Aggregate Stockpile Requirements

Before any production of the mixture is started, stockpiles of each size and gradation of aggregate shall be provided at the asphalt plant site. Each stockpile shall contain sufficient aggregate for one full Day's production of hot mix, before that Day's paving begins.

1150.07.03.02 Aggregates

1150.07.03.02.01 General

Aggregates shall be loaded into the cold feed bins in a manner that prevents the mixing of separate sizes of aggregates.

1150.07.03.02.02 Batch and Continuous Mixing Plants

When delivered to the mixing plant, the heated and dried aggregate shall be at a temperature consistent with proper mixing and laying of the mix. Surfaces of all dried aggregates shall be free of carbon or unburnt fuel oil.

1150.07.03.03 Anti-Stripping Treatments

1150.07.03.03.01 Liquid Anti-Stripping Treatments

Anti-stripping additive shall be handled and mixed with the asphalt cement according to the manufacturer's recommendations.

The Contractor shall provide the Contract Administrator with the following documentation:

- a) Verification that the chemical anti-stripping additive shall remain stable in the heated asphalt cement for a minimum of 4 Days.
- b) Type and dosage of anti-stripping additive used.
- c) Time, date (i.e., yyyy-mm-dd), and temperature when anti-stripping was added to the asphalt cement.

If the liquid anti-stripping additive is added to the asphalt cement at the refinery or asphalt cement depot, the Contractor shall provide the Contract Administrator with the above documentation in the form of a weighbill or bill of lading that accompanies each tanker of asphalt cement delivered.

If liquid anti-stripping additive is added to the asphalt tank at the hot mix plant, the liquid agent may be added to the asphalt tank by an in-line metering device or by another means, provided the above documentation is given to the Contract Administrator for each batch of asphalt cement to which anti-stripping agent is added.

If a liquid anti-stripping additive is not added to the asphalt tank, a continual record of the process for adding the additive shall be provided to the Contract Administrator in addition to the above documentation each time liquid anti-stripping additive is metered into the asphalt cement.

The Contract Administrator shall be provided with an approved statement of calibration for any metering device used to add the liquid anti-stripping additive.

1150.07.03.03.02 Hydrated Lime

When hydrated lime is added to the mix, it shall be added to all aggregates requiring an anti-stripping agent by one of the following methods:

- a) Hydrated lime slurry shall be homogeneously mixed with the aggregate in a pugmill or tumble mixer, prior to entering the asphalt plant.
- b) Hydrated lime shall be homogeneously mixed with wetted aggregate in a pugmill or tumble mixer, prior to entering the asphalt plant. The wetted coarse and fine aggregate shall have a sufficient moisture content to ensure uniform and complete adhesion of lime to the aggregate.

- c) Hydrated lime shall be homogeneously mixed with the aggregate at the pit or quarry, prior to delivery of the limed aggregate to the hot mix plant.

Regardless of the mixing equipment or procedure used, the aggregate shall possess a uniform and homogeneous coating of hydrated lime. Aggregate treated with hydrated lime shall be used within the same construction season it is treated. Aggregate that was treated and stored from a previous construction season may only be used if the Contract Administrator agrees to a written proposal from the Contractor. The written proposal shall verify the effectiveness of the stored aggregate, indicate the sampling protocol used, and include the current test results from samples that indicate the aggregate meets the Contract requirements for retained stability.

1150.07.04 Preparation of the Mixture

Proportioning and mixing of materials shall be of sufficient accuracy and duration to produce a uniform homogeneous mixture in which all particles of the aggregate are thoroughly and uniformly coated.

The temperature of the mixture, except for RHM, as it is discharged from the mixer shall be controlled within the temperature range that corresponds to the PGAC manufacturer's recommending mixing temperature.

1150.08 QUALITY ASSURANCE

1150.08.01 General

The Contractor shall obtain for the Contract Administrator, within 1 Business Day of submission of request in writing, the right to enter upon the premises of any of the material manufacturers, suppliers, plants, laboratories, or equipment for purposes pertaining to the work, to carry out such inspection, sampling, and testing as specified or as requested by the Contract Administrator.

TABLE 1
Hot Mix Types

Hot Mix Type (Note 1)	Abbreviation	Summary of Hot Mix Use and Properties
Dense Friction Course	DFC	A dense-graded surface course mix with high frictional resistance for high volume roads. Aggregates have an identical gradation to HL 1 aggregates with a maximum aggregate size of 16 mm. Premium 100% crushed aggregates are used for fine and coarse aggregates that are from the same source. (Note 2)
Hot Laid 1	HL 1	A dense-graded surface course mix with a premium quality coarse aggregate. It is used on high volume roads and has a maximum aggregate size of 16 mm. Coarse aggregates are 100% crushed material. (Note 2)
Hot Laid 2	HL 2	A sand mix used primarily as a levelling course on existing pavements or a surface course on low speed traffic areas requiring a thin overlay. It is also used to fill wide cracks and has 100% of the aggregate passing the 9.5 mm sieve size.
Hot Laid 3	HL 3	A dense-graded surface course mix for intermediate volume roads with a maximum aggregate size of 16 mm.
Hot Laid 3 High Stability	HL 3HS	A dense-graded padding and levelling mix of high stability. The coarse aggregate conforms to the physical requirements of HL 3 with a maximum aggregate size of 16 mm. The fine aggregate conforms to the same physical requirements as HDBC. Coarse and fine aggregates are 100% crushed material.
Hot Laid 3 Fine	HL 3F	A fine-graded mix used as a surface course where hand work is necessary for placement. It is also used on low volume roads, driveways, boulevards, etc. The maximum aggregate size is 16 mm.
Hot Laid 4	HL 4	A dense-graded mix used as a surface or binder course on low volume roads. The maximum aggregate size is 19 mm.
Hot Laid 4 Fine	HL 4F	A fine graded mix used as a surface course where hand work is necessary for placement. It is also used on low volume roads, driveways, boulevards, etc. The maximum aggregate size is 19 mm.
Hot Laid 8	HL 8	A coarse-graded binder course mix. The maximum aggregate size is 26.5 mm.
Medium Duty Binder Course	MDBC	A binder course mix intended for use in locations where rutting and deformation is likely to occur due to frequent heavy traffic loading. A minimum of 80% of the coarse aggregates must have two crushed faces and the maximum aggregate size is 26.5 mm.
Heavy Duty Binder Course	HDBC (Note 3)	A high stability binder mix designed to provide superior resistance to rutting. Both fine and coarse aggregates are 100% crushed material. The maximum aggregate size is 26.5 mm.
Notes: 1. Specification requirements for the RHM are identical to those of the new hot mixes. 2. As listed in MTO's DSM or the Owner's pre-qualified products list for coarse aggregates for HL 1, DFC, and fine aggregates for DFC. 3. HDBC is also known as HL 8HS.		

TABLE 2
Gradation Requirements - Mix Design Criteria

Mix Types	Percentage Passing by Dry Mass of Aggregates											
	Sieves											
	mm								µm			
	26.5	19.0	16.0	13.2	9.5	4.75	2.36	1.18	600	300	150	75
DFC and HL 1			100	98-100	75-90	(Note 1)	36-64	25-58	16-45	7-26	3-10	0-5
HL 2					100	85-100	70-90	50-75	30-55	15-55	5-16	3-8
HL 3 and HL 3HS			100	98-100	75-90	50-60	36-60	25-58	16-45	7-26	3-10	0-5
HL 3F			100	98-100	85-94	65-75	52-75	36-72	23-56	10-32	3-12	0-6
HL 4		100	98-100	83-95	62-82	45-60	27-60	16-60	8-47	4-27	1-10	0-6
HL 4F		100	98-100	90-98	80-92	65-80	52-80	36-72	21-56	10-32	3-12	0-6
HL 8 and MDBC	100	94-100	77-95	65-90	48-78	30-50	21-50	12-49	6-38	3-22	1-9	0-6
HDBC	100	94-100	77-95	65-90	48-78	(Note 2)	21-54	12-49	6-38	3-22	1-9	0-6

Notes:

- HL 1 mix for use on facilities with a posted speed of less than 80 km/h shall contain a maximum of 60% by volume of the total aggregates passing the 4.75 mm sieve. The coarse aggregates used shall be approved for HL 1 and shall be listed in the MTO's DSM or the Owner's pre-qualified product list.

HL 1 mix for use on facilities with a posted speed of 80 km/h or greater shall contain a maximum of 50% by volume of the total aggregates passing the 4.75 mm sieve. The coarse aggregates used shall be approved for HL 1 and shall be listed in the MTO's DSM or the Owner's pre-qualified product list.

DFC mix shall contain from 50 to 55% by volume of the total aggregates passing the 4.75 mm sieve. The coarse and fine aggregates used shall be from the same source approved for DFC and listed in the MTO's DSM or the Owner's pre-qualified product list.
- HDBC shall contain from 35 to 52% by volume of the total aggregates passing the 4.75 mm sieve.

TABLE 3
Asphalt Cement Content - Mix Design Criteria

Hot Mix Type		% Asphalt Cement Content, minimum by mass of mixture
HL 1, HL 3, and HL 4		5.0
DFC	100% Trap Rock Aggregate	4.8
	100% Dolomitic Sandstone Aggregate	5.1
	100% Meta-arkose	5.1
	100% Gneiss	5.1
HL 2		6.0
HL 3F and HL 4F		5.5
HDBC, MDBC, and HL 8		4.7
HL 3HS		5.0

TABLE 4
Air Voids - Mix Design Criteria

Hot Mix Type	% Air Voids
All mixes, except HL 2 Surface and DFC	4.0 ± 0.5
HL 2 Surface	5.0 ± 0.5
DFC	3.5 ± 0.3

TABLE 5
Marshall Flow - Mix Design Criteria

Minimum Marshall Flow: Units of 0.2 mm at 3.5% Air Voids	
All mixes, except HL 2, HL 3F, and HL 4F	8
HL 2, HL 3F, and HL 4F	9

TABLE 6
Marshall Stability - Mix Design Criteria for All Paving Mixtures

Minimum Marshall Stability: N at 60 °C	
DFC, HL1, and HL3	8,900
Binder, Levelling, and Padding Courses, except for HL 2, HL 3F, HL 4F, HL 3HS, and HDBC	8,000
HL 2, HL 3F, and HL 4F Surface Course	5,800
HL 2, HL 3F, and HL 4F Levelling and Binder Courses	4,400
HL 3HS and HDBC	12,000

TABLE 7
VMA Requirements - Mix Design Criteria

Voids in Mineral Aggregate (VMA), % minimum (Note 1)									
Hot Mix Type	Passing 4.75 mm Sieve by Mass	Nominal Maximum Particle Size							
		2.36 mm	4.75 mm	9.5 mm	13.2 mm	16.0 mm	19.0 mm	26.5 mm	37.5 mm
All Mixes Except HL 2 and DFC (Note 2)	40%				13.5	13.0	12.5	11.5	11.0
	45%				14.0	13.5	13.0	12.0	11.5
	50%				14.5	14.0	13.5	12.5	12.0
	55%				15.0	14.5	14.0	13.0	12.5
	60%				15.5	15.0	14.5	13.5	13.0
	more than 60%	21	18	16	16.0	15.5	15.0	14.0	13.5
HL 2		21.0	18.0	16.0					
Notes: 1. The per cent voids in compacted mineral aggregate allowing for volume of absorbed asphalt, per cent VMA, is based on the nominal maximum particle size of the total aggregate. Nominal maximum particle size is the sieve next larger than the designated large sieve on which no more than 90% of the total aggregate is accumulatively passing. 2. The per cent voids in mineral aggregate and asphalt cement film thickness in DFC mix based on MS-02 shall be reported in the mix design.									

TABLE 8
Permitted Field Adjustment to a Job-Mix Formula

JMF Property	Maximum Field Adjustment
Asphalt cement content	± 0.2%
Per cent RAP	- 5.0%
Per cent passing 26.5 mm, 19.0 mm, and 16.0 mm sieves	± 5.0%
Per cent passing 13.2 mm and 9.5 mm sieves	± 4.0%
Per cent passing 4.75 mm, 2.36 mm, and 1.18 mm sieves	± 3.0%
Per cent passing 600 µm, 300 µm, and 150 µm sieves	No limits
Per cent passing 75 µm sieve	± 1.0%

TABLE 9
Minimum Sample Quantities for Mix Design Monitoring

Material	Quantity
Asphalt cement	4 L evenly split between 2 containers
Aggregate	75 kg of each type
RAP	75 kg, required when RAP contained in the mix
Fines material passing 75 µm sieve	5 kg, when the mix is to be produced with a plant that returns fines to the mixture
Any other material samples including anti-stripping agents to be used in HMA	Quantity large enough to allow for a complete mix design

TABLE 10
PGAC Selection Guidelines for Hot Mix Asphalt Incorporating RAP

Level	RAP Content	Recommended New PGAC Grade
I	Equal to or Below 20%	Use the same PGAC grade as for a new mix; based on location (zone) and traffic level.
II	21 to 40%	Reduce both the low and high temperature grades by one grade (e.g. if a PG 58-28 would normally be used, select a PG 52-34).

Appendix 1150-A, November 2020 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

OPSS 1150 has been updated to include the requirements of OPSS 1149, Material Requirements; OPSS 1155, Medium Duty Binder Course Mix and sections of OPSS 1154, Hot Mix Containing Reclaimed Asphalt Pavement. Excluded from this specification are the previously covered Electrically Conductive Mix and Open Friction Course Mix.

The designer should specify the PGAC grade required for each HMA specified. The designer should be aware that high temperature PGAC grade adjustments may be required for facilities experiencing a high volume of heavy commercial traffic and a high frequency of slow moving or stop and start operations.

The designer may reduce mix stability requirements based on traffic volumes of less than 1,000 vehicles per lane or the fact that the facility type such as driveways, boulevards, and pathways may not require the Mix Marshall Stability specified. For mixes with reduced Marshall stability, Appendix 1150-B should be invoked by reference in the Contract Documents.

Based on local aggregate performance, the designer may reduce the 100% crushed requirement for HL 3HS. If so, Appendix 1150-C should be invoked by reference in the Contract Documents.

The designer should be aware that for low absorption aggregates, minimum asphalt cement contents may require adjustment.

The designer should specify the percentage of coarse aggregate in the HL 1 mix based on the posted traffic speed. A finer HL 1 mix allows more workability and may be more appropriate for use in urban areas. (Table 2)

The designer should be aware that RAP is permitted in all mixes except DFC, HL 1, HL 2, HL 3HS, and HDBC. (1150.04.01.01.01)

In this specification, HDBC and HL 3HS require 100% crushed aggregates from bedrock or oversize sources. The designer should specify in the Contract Documents where conditions require the aggregate to be only from an aggregate source.

RAP proportions permitted in this specification are based on standard practice for hot mix plants. If an Owner would like to encourage greater use of RAP, Appendix 1150-D may be invoked by reference in the Contract Documents. When greater RAP proportions are specified, it is recommended that the Owner carry out suitable acceptance testing as outlined in OPSS 1003.

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

Related Ontario Provincial Standard Drawings

No information provided here.

Appendix 1150-B, November 2020

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

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

Marshall Stability Design Criteria for Lower Traffic Volume Facilities

OPSS 1150, Hot Mix Asphalt, is amended as follows:

Table 6 is deleted in its entirety and replaced by the following:

TABLE 6
Marshall Stability - Mix Design Criteria for All Paving Mixtures

Minimum Marshall Stability: N at 60 °C	
Surface Course, except for HL 2, HL 3F, and HL 4F	6,700
Binder, Levelling, and Padding Courses, except for HL 2, HL 3F, and HL 4F	5,800
HL 2, HL 3F, and HL 4F Surface Course	5,800
HL 2, HL 3F, and HL 4F Levelling and Binder Courses	4,400

Appendix 1150-C, November 2020**FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS**

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

Marshall Stability Design Criteria When 100% Crushed Requirement for the Aggregates Used in HL 3HS Do Not Apply

OPSS 1150, Hot Mix Asphalt, is amended as follows:

Table 6 is deleted in its entirety and replaced by the following:

TABLE 6
Marshall Stability - Mix Design Criteria for All Paving Mixtures

Minimum Marshall Stability: N at 60 °C	
Surface Course, except for HL 2, HL 3F, HL 4F, and HL 3HS	8,900
Binder, Levelling, and Padding Courses, except for HL 2, HL 3F, HL 4F, HL 3HS, and HDBC	8,000
HL 2, HL 3F, and HL 4F Surface Course	5,800
HL 2, HL 3F, and HL 4F Levelling and Binder Courses	4,400
HDBC	12,000
HL 3HS	14,000

Appendix 1150-D, November 2020

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

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

Supplementary Requirements for Increased RAP Proportions in Municipal Contracts

OPSS 1150, Hot Mix Asphalt, is amended as follows:

1150.04.01.02 Reclaimed Asphalt Pavement Proportions

Clause 1150.04.01.02 is deleted in its entirety and replaced by the following:

The use of:

- a) Up to 20% by mass of RAP shall be permitted for HL 3, HL 3F, HL 4, and HL 4F surface course mixes.
- b) Up to 30% by mass of RAP shall be permitted for medium duty binder course mix.
- c) Up to 40% by mass of RAP shall be permitted for HL 4 and HL 8 binder mixes.
- d) Over 50% by mass of RAP is not permitted for any mix.

When 41 to 50% by mass of RAP is proposed for HL 4 or HL 8 binder mixes, written approval by the Contract Administrator shall be obtained for the mix design, including PGAC modification.

If the composition of the mix is modified by including RAP to exceed 20% by mass of the total mixture but less than 40% by mass, both the high and low grade of the PGAC shall be lowered by 6 °C.



**MATERIAL SPECIFICATION FOR
SUPERPAVE AND STONE MASTIC ASPHALT MIXTURES**

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1151.01 SCOPE

This specification covers the requirements for the materials, equipment, and processes for proportioning and mixing hot mix asphalt (HMA) including warm mix asphalt, recycled mixes, and mixes for miscellaneous work according to the Superpave and SMA mix design methodology.

1151.01.01 Specification Significance and Use

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

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

1151.01.02 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.

Appendix 1151-A is a commentary appendix to provide designers with information on the use of the specification in a Contract.

1151.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

OPSS 1001	Aggregates - General
OPSS 1003	Aggregates - Hot Mix Asphalt
OPSS 1101	Performance Graded Asphalt Cement

Ontario Ministry of Transportation Publications

Designated Sources for Materials (DSM) Manual

MTO Laboratory Testing Manual:

LS-282	Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
LS-292	Quantitative Determination of Asphalt Cement Content by Ignition and Analysis of Remaining Aggregate From Bituminous Paving Mixtures
LS-306	Bulk Relative Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
LS 309	Superpave Mix Design
LS 311	Stone Mastic Asphalt Mix Design
LS-313	Method of Test for Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
LS 316	Mix Check

LS 318	Practice for Warm Mix Asphalt (WMA) Mix Design
LS 602	Sieve Analysis of Aggregates
LS-603	Resistance to Degradation of Coarse Aggregate by Abrasion and Impact in the Los Angeles Abrasion Machine
LS-604	Relative Density and Absorption of Coarse Aggregate
LS-605	Relative Density and Absorption of Fine Aggregate
LS-629	Uncompacted Void Content of Fine Aggregate

American Association of State Highway and Transportation Officials

T 305 14	Determination of Drain down Characteristics in Uncompacted Asphalt Mixtures
M 320-05	Standard Specification for Performance Graded Asphalt Binder
T 166-05	Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens
T 283-03	Resistance of Compacted Bituminous Mixtures to Moisture Induced Damage
T 305-14(2014)	Determination of Drain down Characteristics in Uncompacted Asphalt Mixtures
T 312-15	Standard Method of Test for Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor

ASTM International

C 612-14	Standard Specification for Mineral Fiber Block and Board Thermal Insulation
D 6752-11	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method

Asphalt Institute Publications

Superpave Series:
 SP-2 Superpave Mix Design Method
 NAPA QIS-122 Designing and Constructing SMA Mixtures

National Cooperative Highway Research Program

NCHRP Report 452	Recommended Use of Reclaimed Asphalt Pavement in the Superpave Mix Design Method, Technician's Manual

1151.03 DEFINITIONS

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

AMRL means the AASHTO Materials Reference Laboratory.

Anti Stripping Treatment (AST) means a treatment used to minimize stripping of asphalt cement from HMA aggregates, and can be either AST-AGG or AST-AC.

Aggregate AST-AGG (AST-AGG) means an AST applied directly to the HMA aggregates prior to incorporating them into the mix or dryer at the HMA plant.

Asphalt Cement AST-AC (AST-AC) means an AST added directly to the asphalt cement to be used in the mix, prior to incorporating it into the mixer at the HMA plant.

Binder Course means an HMA course between a surface course and either a granular base course or stabilized base course, an existing pavement, or another HMA binder course.

Binder Replacement means the methodology used to determine changes in the PGAC grade required based on the contribution of asphalt cement from the RAP added to the mix.

CCIL means the Canadian Council of Independent Laboratories.

Coarse Aggregate means that portion of aggregate material retained on the 4.75 mm sieve, when tested according to LS 602.

Deleterious Material means materials other than reclaimed asphalt pavement, and that includes but is not limited to the following: ceramic, clay brick, clay tile, glass, gypsum, gypsum plaster, plastic, reclaimed concrete material, wallboard, and wood.

Drain down means that portion of SMA mix, fines, and asphalt cement that separates and flows downwards through the mix.

Equivalent Single Axle Load (ESAL) means equating the damage to a pavement structure caused by the passage of a non-standard load to a standard 80 kN axle load.

Field Adjustment to the JMF means adjustments to the target gradation or asphalt cement content or both of a mix without a redesign of the HMA, resulting in a revised job-mix formula (JMF).

Fine Aggregate means that portion of aggregate material passing the 4.75 mm sieve when tested according to LS 602.

Hot Mix Asphalt (HMA) Types means Superpave and SMA mixes, including Superpave 4.75, 9.5, 12.5, 12.5 FC1, 12.5 FC2, 19.0, 25.0, and 37.5 and SMA 9.5, 12.5, and 19.0.

Job-Mix Formula (JMF) means the percentage passing on each designated sieve of the total mass of aggregate and the amount of asphalt cement as a percentage by mass of the mix that are based on specified mix design procedures that when mixed result in a paving mix that is according to this specification.

Levelling Course means an HMA course of variable thickness used to eliminate transverse and longitudinal irregularities on an existing surface prior to placing an HMA binder or surface course.

Maximum Aggregate Size means one sieve size larger than the nominal maximum size.

Mix Design means the design of the proportions of aggregates, asphalt cement, and additives when uniformly mixed results in an acceptable HMA in accordance with the specified method.

Mixes for Miscellaneous Work means HMA used for miscellaneous work such as the paving of shoulders, boulevards, and sidewalks and the construction of curb and gutter and spillways. These mixes do not meet normal HMA gradation and mix design requirements.

Nominal Maximum Aggregate Size (NMAS) means one sieve size larger than the first sieve to retain more than 10%.

Performance Graded Asphalt Cement (PGAC) means an asphalt binder that is an asphalt-based cement produced from petroleum residue, either with or without the addition of non-particulate modifiers according to AASHTO M 320.

Primary Control Sieve (PCS) means the sieve defining the break point between fine and coarse-graded mixes for each nominal maximum aggregate size.

RAP Content means the amount of RAP expressed as a percentage by mass of the mix.

Reclaimed Asphalt Pavement (RAP) means the processed HMA material that is recovered by partial or full depth removal.

Stone Mastic Asphalt (SMA) Hot Mix Types means SMA 9.5, 12.5, and 19.0 mixes.

Stone Mastic Asphalt or Stone Matrix Asphalt (SMA) means HMA consisting of two parts of a coarse aggregate skeleton and an asphalt binder rich mortar. The mix has a gap graded aggregate skeleton with coarse aggregate stone-on-stone contact.

Stone Mastic Asphalt (SMA) Mortar means a mix of asphalt cement and any additives; filler, including all material passing the 75 μ m sieve from the dry sieving of all aggregate components, including any commercial filler; and fibres blended by volume to the proportions required by the JMF.

Superpave means an acronym for Superior Performing Asphalt Pavements. It is an alternative system to the Marshall method for specifying material components and asphalt mix design using the Superpave gyratory compactor.

Surface Course means the HMA wearing course of any flexible or composite pavement.

Voids in the Coarse Aggregate (VCA) means the volume in-between the coarse aggregate particles which includes filler, fine aggregate, air voids, asphalt binder, and fibres. For SMA, the coarse aggregate particles refer to that portion retained on the 4.75 mm sieve.

Warm Mix Asphalt (WMA) means warm mixed, warm laid asphaltic concrete produced using technologies that allow for the mixing, handling and compaction of the asphaltic concrete mixture at a temperature of 20 to 50 °C lower than conventional HMA.

1151.04 DESIGN AND SUBMISSION REQUIREMENTS

1151.04.01 Mix Requirements for Design Purposes

The Superpave mix designs shall be according to the requirements specified in Tables 1, 2, 4, 5, and 9.

The SMA mix designs shall be according to the requirements specified in Tables 1, 3, 6, 7, and 8.

The JMF for Superpave mixes shall be according to the requirements specified in Tables 2, 4, and 5.

The JMF for SMA mixes shall be according to the requirements specified in LS-311 and Tables 3 and 6.

1151.04.01.01 RAP Proportions

The amount of RAP allowable by mass in a mix will be calculated by the Binder Replacement method according to the following formula:

$$\% \text{ Binder Replacement} = \frac{\% \text{ Binder Content of RAP} \times \% \text{ RAP in Mix}}{\% \text{ Total Binder Content of Mix}} \times 100\%$$

RAP is not permitted in SMA, 12.5 FC1, and 12.5 FC2 mixes, unless specified in the Contract Documents. Up to 15% of RAP is allowed in other surface course mixes and up to 30% of RAP is allowed in binder course mixes.

If the composition of the mix is modified by including RAP to exceed 15% by Binder Replacement, Appendix B shall be used. If the RAP proportion is more than 15% but does not exceed 30%, then both the high and low temperature grade of the PGAC shall be lowered by one grade, i.e. 6 °C as per Appendix B.

Over 30% by mass of RAP is not permitted for any mix.

1151.04.02 Mix Design

1151.04.02.01 General

The mix design shall be the responsibility of the Contractor. The JMFs selected for use by the Contractor shall produce HMA that is in accordance to the requirements of this specification.

1151.04.02.02 Mix Design Method

1151.04.02.02.01 General

The Contractor shall use a laboratory that has current CCIL Type A Certification with CCIL Superpave Certified Technicians or AMRL equivalent certification or other equivalent certified laboratory acceptable to the Contract Administrator to conduct all mix designs, designate the mix proportions, and prepare the JMFs.

The aggregate gradations used for the mix design may be provided by the Contractor or may be from the actual gradations of the mix design aggregate samples. However, when the mix is to be produced from a plant that returns fines to the mix or the aggregate gradations change during production due to aggregate breakdown, appropriate adjustments shall be made to the mix design gradations.

When a mix contains additives and the source of asphalt cement changes from that used in the mix design, tests shall be re-done to verify the dosage of such additives.

1151.04.02.02.02 Superpave Mix Design Method

Superpave mixes shall be designed using procedures specifying in LS-309.

The calculation of Voids in Mineral Aggregated (VMA) shall be based on the densities of the blended coarse and blended fine aggregate.

RAP as processed and ready for use in an HMA shall be tested by the Contractor using test LS-282 or LS-292 to determine the average percentage asphalt cement and the average gradation for the extracted reclaimed asphalt pavement aggregates.

1151.04.02.02.03 Stone Mastic Asphalt Mix Design Method

SMA mixes shall be designed in accordance with LS-311.

1151.04.02.02.04 Warm Mix Asphalt Design Method

Warm Mix Asphalt shall be designed in accordance with LS-318.

1151.04.02.03 Mix Design Submission

The proposed mix design and JMF shall be submitted in writing to the Contract Administrator a minimum of 10 Business Days prior to the start of the paving operation. The mix shall not be placed until the Contract Administrator provides permission to construct hot mix using the submitted JMF. The Contract Administrator shall provide in writing the above permission or the reason why the permission is being withheld within 10 Business Days, which commence when all of the required samples and documents have been submitted.

1151.04.02.04 Changes to the Job-Mix Formula and the Mix Design

Changes to the JMF shall be permitted when it has been determined that the mix properties specified in the Contract Documents are not being met. All changes are subject to the conditions specified below.

Changes to the material proportions based on process control test results shall be permitted without a new mix design, but further hot mix production shall be subject to conditions imposed by the Contract Administrator. In this situation, when the Contractor changes the JMF, the revised JMF shall be submitted to the Contract Administrator. The Contract Administrator shall review the revised JMF for conformance to the mix properties with the Contract requirements. Within 1 Business Day of the modified JMF being received in full by the Contract Administrator, the Contract Administrator shall provide in writing conditional permission to construct HMA or the reason why permission is being withheld.

When the Contractor submits a new mix design it must be accompanied by samples for monitoring purposes, if required; a Mix Design Report; and the supporting documents as detailed in the Documents subsection. New mix design and mix designation documents and a new JMF shall be completed when:

- a) A material is eliminated.
- b) A new material is added.
- c) Changes to the material proportions have not resulted in correction of the problems with the mix.
- d) The net impact of all adjustments to the original JMF exceed any of the maximum field adjustments specified in Table 8.

New mix design, new JMF documents, and new samples for monitoring purposes shall be delivered to the Contract Administrator. The new mix design shall be accepted or rejected within 5 Business Days, which commence when all of the required samples and documents have been submitted.

1151.04.03 Samples for Monitoring Purposes

When requested by the Contract Administrator in writing, representative samples of the materials to be used in the work shall be provided to the Contract Administrator at the same time that the mix design and JMF documents are submitted.

The samples shall be labelled with the Contract number, material type, material source, and date of sampling. The samples of coarse aggregate and fine aggregate shall be identified.

Each material sample shall be packaged separately and the samples shall be in clean, closed containers that shall not rupture when lifted or handled. Each filled sample container shall have a maximum mass of 25 kg.

The minimum sample quantities shall be as specified in Table 9.

1151.04.04 Density of Hot Mix Aggregates

Density testing of the coarse and fine aggregates shall be carried out in accordance with LS-604 and LS-605 respectively using the procedure for blended aggregates.

1151.04.05 Documents

The Contract Administrator shall be provided with a copy of the mix design and JMF documents that shall be signed, dated, and certified correct by the person accountable for the engineering and management responsibility for the laboratory that conducted the work. When the Owner has a Bituminous Mix Design Report form, the Contract Administrator shall provide it to the Contractor for submission along with other supporting documents. Information shall be provided in a legible manner. For Superpave mixes, the

documentation required with the mix design submission is covered by LS-309. The documents shall include, but are not limited to, the following information:

- a) Contract number, item number, and mix type for which the mix design and JMF were completed and a description of the usage of the mix on the Contract.
- b) All test results, mix design work sheets, and graphs.
- c) Material proportions and sources, including the Owner's Mineral Aggregate Inventory for the aggregate sources, when such information is available. The amount of RAP in percent by mass and volumetric data shall also be included.
- d) Designation of the fine aggregate and the coarse aggregate.
- e) PGAC and source and percent by mass of the required new asphalt cement.
- f) A graph of the temperature-viscosity relationship for the PGAC that is to be used in the mix.
- g) Information on additives, including source, type, percent by mass of asphalt cement, and test results according to LS-309, with specimens prepared according to LS-313.
- h) Information regarding fines that are returned to the mix, aggregate breakdown during production, and the resultant change in the aggregate gradations.
- i) Complete gradations for all coarse and fine aggregates.
- j) For Superpave mixes, excluding SMA, the volumetric properties for the mix selected in accordance with Table 5. Graphs shall be submitted for the air voids, voids in mineral aggregate, voids filled with asphalt, dust-to-asphalt ratio, bulk relative density, maximum relative density, and the gyratory curves of the mix plotted against asphalt cement content.
- k) For SMA mixes, the volumetric properties for the mix selected in accordance with Table 6. Graphs shall be reported for the air voids, voids in mineral aggregate, bulk relative density, and maximum relative density plotted against asphalt cement content.
- l) Aggregate absorptions.
- m) Bulk specific gravity and saturated surface dry density for each aggregate.
- n) Mix bulk specific gravity by AASHTO T 166. If the percent water absorbed by the specimen is found to exceed 2% by volume as described in AASHTO T 166, then the bulk specific gravity is according to LS-306, or ASTM D 6752.
- o) Theoretical maximum specific gravity by LS-309.
- p) When RAP is permitted for use, extracted bulk relative density, percentage asphalt cement, and gradation for the RAP used in the mix.
- q) All visual observations made during the design process with particular attention and comments regarding stripping and coating for both the coarse and fine aggregates.
- r) The mixing and compaction temperature used in the mix design and the compaction temperature of the reheated mix to be employed in the testing of the production mix.
- s) The typical mix weight to produce a gyratory specimen with a height of 115 mm $\pm$ 5 mm.

t) For SMA mixes, the drain down test results according to AASHTO T 305.

1151.04.06 Anti Stripping Treatment

1151.04.06.01 General

The Contractor shall determine the need for and the amount of AST treatment required using AASHTO T 283.

The need for and the amount of AST required shall not be affected by any previous determination made with respect to the same or any other aggregate source.

Regardless of the hot mix type, the amount of AST either specified in the Contract Documents or determined through mix design procedure shall be a percentage of the total dry aggregate or total asphalt cement required.

The amount of AST required shall be based on the following:

- a) For Superpave mixes, excluding SMA, amount required to provide a minimum of 80% Tensile Strength Ratio as determined by AASHTO T 283.
- b) For SMA mixes, amount required to provide a minimum of 70% Tensile Strength Ratio as determined by AASHTO T 283.
- c) Minimum dosage requirements specified in the Contract Documents.

AST shall treat the mix components at the greater of the dosages specified in the Aggregate AST-AGG clause, the Asphalt Cement AST-AC clause, or as specified in the Contract Documents.

AST shall be used according to supplier information.

1151.04.06.02 Moisture Sensitivity

Moisture sensitivity shall meet the tensile strength ratio requirements specified in Table 5 or Table 6.

1151.04.06.03 Aggregate Anti Stripping Treatment (AST-AGG)

1151.04.06.03.01 General

Irrespective of any moisture sensitivity testing that shows that AST-AGG is not required, hydrated lime shall be used in all mixes consisting of more than 75% quartzite and dolomitic sandstone aggregates, or combinations thereof.

Irrespective of any moisture sensitivity testing that shows that AST-AGG is not required, the AST-AGG dosage and type shown in the DSM List Aggregates: Surface Friction Courses shall be the minimum used for all aggregates to be incorporated into SMA and Superpave 12.5FC 2.

For all other aggregates, the AST-AGG may be hydrated lime or an approved Aggregate AST-AGG from the MTO DSM listing.

1151.04.06.03.02 Hydrated Lime

When hydrated lime is used as the AST-AGG, the dosage shall be the greater of:

- a) The amount determined to meet the moisture sensitivity requirements, or

- b) The listed dosage from the DSM List Aggregates: Surface Friction Courses, or
- c). One percent by mass of total dry aggregate if the mix has more than 75% quartzite and dolomitic sandstone aggregates, or combinations thereof.

The following information on the hydrated lime AST-AGG shall be provided to the Contract Administrator:

- a) Documentation that the hot mix shall be produced as specified in the Contract Documents.
- b) Amount of hydrated lime to be used as determined in the mix design procedures expressed as a percentage of the specified aggregate.
- c) Complete information on how hydrated lime is to be incorporated into the mix.

1151.04.06.03.03 Alternate Aggregate Anti Stripping Treatment

When an alternate is used as the AST-AGG in place of hydrated lime, the dosage shall be the greater of:

- a) The amount determined to meet the moisture sensitivity requirements; or
- b) The listed dosage from the DSM List Aggregates: Surface Friction Courses.

1151.04.07 Submission Requirements

1151.04.07.01 Mix Design

A copy of all mix design and JMF documents, signed, dated, and certified correct by the person accountable for the engineering and management responsibility for the laboratory that conducted the work, shall be submitted to the Contract Administrator. The mix design shall include a statement if the percentage of the mix comprising quartzite and dolomitic sandstone aggregates, or combinations thereof, is more than 75%. The flow number test results shall be submitted with the mix design, or up to 1 month after submission of the original WMA mix design

The mix design shall be valid for a maximum of 14 months from when the mix design was prepared. To extend use of the mix design for each calendar year past the initial 14 months, a One Point Mix Check for the properties listed in Table 10 using the methodology in LS 316 as applicable, shall be submitted to the Contract Administrator. The mix must meet the requirement and tolerances given in Table 10.

The mix shall not be placed until the Contract Administrator gives a written confirmation that the submitted mix design documents and JMF meet the Contract requirements. Within 4 Business Days following the delivery of all required documentation, the Contract Administrator shall provide written confirmation that the mix design and all samples meet the Contract requirements or; advise of any requirements that have not been met.

Confirmation of conformance to Contract requirements of the submitted mix design does not constitute any guarantee that the mix can be produced or constructed or both to Contract requirements, and does not relieve the Contractor of the responsibility for ensuring the specified quality of Materials and workmanship.

1151.04.07.02 Material Samples

At the written request of the Contract Administrator, one set of material samples representative of those used for mix design shall be submitted to the laboratory specified in the Contract Documents. The materials shall be delivered within 2 Days of the request made by the Contract Administrator or within 2 Days of submission of the mix design to the Contract Administrator, whichever is later.

For the One Point Mix Check, new samples for aggregate density determination shall be submitted within 2 Days of submission of the mix check to the Contract Administrator.

Each material sample shall be packaged separately and each filled sample container shall not exceed a mass of 30 kg.

The sample quantities are specified in Table 11

1151.04.07.03 Warm Mix Asphalt

For WMA, the following information shall be submitted to the Contract Administrator in writing with the mix design:

- a) The WMA technology to be used.
- b) Complete name and address of the WMA supplier.
- c) The type and dosage of WMA additives, if applicable, and how the additives are incorporated to produce the WMA.
- d) The WMA technology supplier's established recommendations for usage.

1151.05 MATERIALS

1151.05.01 Asphalt Cement

Asphalt cement shall be performance graded asphalt cement according to OPSS 1101.

The supply and use of performance graded asphalt cement shall be as specified in the Contract Documents.

1151.05.02 Aggregates

Aggregates shall be according to OPSS 1003.

Both the coarse and fine aggregates used for SMA shall be crushed from the same source and shall be as listed in the MTO DSM.

1151.05.02.01 Reclaimed Asphalt Pavement

RAP, when permitted in a Superpave HMA, shall be according to the aggregate requirements of OPSS 1003 for the HMA type specified in the Contract Documents. Absorption, freeze thaw, and magnesium sulphate requirements do not apply to RAP.

RAP that is contaminated with deleterious material shall not be used and shall be removed from the Work. RAP shall be stockpiled conforming to the stockpiling requirements for coarse aggregates according to OPSS 1001.

Process control sampling and testing of the RAP shall be as specified in the Contract Documents.

1151.05.03 Silicone

When added to the asphalt cement, silicone oil shall be less than five parts per million of asphalt cement.

1151.05.04 Filler

Filler shall be according to OPSS 1003.

1151.05.05 Fibres

Fibres shall be either cellulose or mineral fibres, and appropriate for use in the SMA mix design, according to NAPA QIS 122. The use of rock wool, asbestos and fibreglass is prohibited.

1151.06 EQUIPMENT

1151.06.01 Requirements for All Mixing Plants

The equipment shall be such that the HMA produced shall meet this specification and shall demonstrate adequate control and documentation of the HMA materials, mixing temperature, and storage for monitoring and production purposes.

When required by the Contract Administrator, all equipment shall be on the site and available for inspection before operations are commenced and during production operations.

1151.06.02 Truck Scales

Truck scales shall be as specified in the Contract Documents.

1151.07 PRODUCTION

1151.07.01 General

The HMA shall be produced to meet the submitted JMF or the adjusted JMF that was accepted in writing by the Contract Administrator.

The Contractor shall be responsible for the quality and characteristics of the mix. If the hot mix produced does not meet the requirements of this specification, hot mix production shall stop and appropriate corrections shall be made to the process.

The Contractor is responsible for the process control and condition of all materials during the handling, blending, and mixing operations. The Contractor is responsible for determining and making all necessary adjustments in proportioning materials used to produce HMA to meet the Contract requirements.

1151.07.02 Operational Constraints

The JMF is the target to which the HMA shall be compared to determine the acceptance of the aggregate gradation and asphalt cement content. HMA shall not be placed until the Contract Administrator provides permission in writing to proceed with a submitted JMF.

The JMF shall remain in effect until the Contract Administrator receives any requested changes in writing and approves them.

1151.07.03 Handling of Materials

1151.07.03.01 Aggregate Stockpile Requirements

Before any production of the mix is started, stockpiles of each size and gradation of aggregate shall be provided at the asphalt plant site. Each stockpile shall contain sufficient aggregate for one full day's production of hot mix, before that day's paving begins.

1151.07.03.02 Aggregates

1151.07.03.02.01 General

Aggregates shall be loaded into the cold feed bins in a manner that prevents the mixing of separate sizes of aggregates.

1151.07.03.02.02 Batch and Continuous Mixing Plants

The heated and dried aggregate shall be at a temperature consistent with proper mixing and laying of the mix. Surfaces of all dried aggregates shall be free of carbon or unburnt fuel oil.

1151.07.03.03 Asphalt Cement Antistripping Treatment (AST-AC)

1151.07.03.03.01 Liquid AST-AC

AST-AC shall be handled and mixed with the asphalt cement according to the manufacturer's recommendations.

The Contractor shall provide the Contract Administrator with the following documentation:

- a) Verification that the chemical AST-AC shall remain stable in the heated asphalt cement for a minimum of 4 Days.
- b) Type and dosage of AST-AC used.
- c) Time, date, and temperature when anti-stripping was added to the asphalt cement.

If the liquid AST-AC is added to the asphalt cement at the refinery or asphalt cement depot, the Contractor shall provide the Contract Administrator with the above documentation in the form of a waybill or bill of lading that accompanies each tanker of asphalt cement delivered.

If liquid AST-AC is added to the asphalt tank at the hot mix plant, the liquid agent may be added to the asphalt tank by an in-line metering device or by another means, provided the above documentation is given to the Contract Administrator for each batch of asphalt cement to which anti-stripping agent is added.

If a liquid AST-AC is not added to the asphalt tank, a continual record of the process for adding the additive shall be provided to the Contract Administrator in addition to the above documentation each time liquid AST-AC is metered into the asphalt cement.

The Contract Administrator shall be provided with an approved statement of calibration for any metering device used to add the liquid AST-AC.

1151.07.03.04 Aggregate Anti Stripping Treatment (AST-AGG)

Aggregate treated and stored from a previous construction season may be used only after the Contract Administrator agrees to a written proposal that verifies the effectiveness of the stored aggregate. The proposal shall include the sampling protocol used and test results from those samples that show that the aggregates meet the moisture sensitivity requirements of this specification.

When hydrated lime or an alternative AST-AGG is used, it shall be added to all aggregates requiring AST by one of the following processes:

a) Blending During Aggregate Production

Hydrated lime or an alternative AST-AGG can be mixed with aggregate at the pit or quarry prior to delivery of the aggregate to the HMA plant. The mixing shall be sufficient to ensure uniform and complete adhesion of the AST-AGG to the aggregate.

b) Blending At the HMA Plant

The AST-AGG may be homogeneously mixed with aggregate prior to entering the dryer at the HMA plant. The HMA plant shall be equipped with suitable pumps, mixers and spray bars for introducing the required quantity of AST-AGG to the aggregates. Mixing shall be accomplished with a pugmill or a drum type mixer.

Regardless of the process or mixing equipment used, the process shall result in the production of aggregates that are uniformly and homogeneously coated with the quantity of the AST-AGG specified in the Contract Documents, and that are free of clumps and balls prior to entering the dryer at the HMA plant.

1151.07.04 Preparation of the Mixture

Proportioning and mixing of materials shall be of sufficient accuracy and duration to produce a uniform homogeneous mixture in which all particles of the aggregate are thoroughly and uniformly coated.

The maximum temperature of the mixture after it is discharged from the mixing chamber shall not exceed the maximum specified mixing temperature from the mix design by more than 20 °C, to a maximum of 170°C. For WMA, the maximum temperature of the mixture after it is discharged from the mixing chamber shall not exceed the maximum specified mixing temperature of the unmodified asphalt cement by more than 20 °C, to a maximum of 170°C.

1151.08 QUALITY ASSURANCE

1151.08.01 General

The Contractor shall obtain for the Contract Administrator, within 1 Business Day of submission of request in writing, the right to enter upon the premises of any of the material manufacturers, suppliers, plants, laboratories, or equipment for purposes pertaining to the work, to carry out such inspection, sampling, and testing as specified or as requested by the Contract Administrator.

TABLE 1
Superpave and SMA Design Traffic Categories by ESALs

Ontario Traffic Category	20-Year Design ESALs (Note 1)	Typical Applications
A	Less than 0.3 million	Low volume roads, parking lots, driveways, and residential roads.
B	0.3 to 3 million	Minor collector roads.
C	3 to 10 million	Major collector and minor arterial roads.
D	10 to 30 million	Major arterial roads and transit routes.
E	Greater than 30 million	Freeways, major arterial roads with heavy truck traffic, and special applications such as truck and bus climbing lanes or stopping areas.
Note: 1. Equivalent Single Axle Load (ESAL) for the projected traffic level expected in the design lane over a 20-year period, regardless of the actual design life of the pavement.		

TABLE 2
Superpave Aggregate Gradation Control Points

Hot Mix Asphalt Type	Percentage Passing by Dry Mass of Aggregates									
	Sieve Size mm									
	50.0	37.5	25	19.0	12.5	9.5	4.75	2.36	1.18	0.075
Superpave 4.75	-	-	-	-	100	95-100	90-100	-	30-60	6-12
Superpave 9.5	-	-	-	-	100	90-100	32-90	32-67	-	2-10
Superpave 12.5	-	-	-	100	90-100	28-90	-	28-58	-	2-10
Superpave 12.5 FC1 and 12.5 FC2	-	-	-	100	90-100	45-90	45-60	28-58	-	2-10
Superpave 19.0	-	-	100	90-100	23-90	-	-	23-49	-	2-8
Superpave 25.0	-	100	90-100	19-90	-	-	-	19-45	-	1-7
Superpave 37.5	100	90-100	15-90	-	-	-	-	15-41	-	0-6

TABLE 3
SMA Aggregate Gradation Control Points

Hot Mix Asphalt Type	Percentage Passing by Dry Mass of Aggregates							
	Sieve Size mm							
	37.5	25	19.0	12.5	9.5	4.75	2.36	0.075
SMA 9.5	-	-	-	100	70-95	30-50	20-30	8-12
SMA 12.5	-	-	100	90-100	50-80	20-35	16-24	8-11
SMA 19.0	-	100	90-100	50-88	25-60	20-28	16-24	8-11
Note: A. For the SMA 9.5 mm the Upper Gradation Control Points are 21, 18, and 15 percent passing for the 1.18 mm, 0.600 mm, and 0.300 mm sieves, respectively.								

TABLE 4
Superpave Gradation Primary Control Sieve (PCS) Points

Hot Mix Asphalt Type	Primary Control Sieve mm	PCS Control Point At % Passing
Superpave 4.75	-	-
Superpave 9.5	2.36	47
Superpave 12.5, 12.5 FC1, and 12.5 FC2	2.36	39
Superpave 19.0	4.75	47
Superpave 25.0	4.75	40
Superpave 37.5	9.5	47

TABLE 5
Superpave HMA Volumetric Properties

Ontario Traffic Category	% of Theoretical Maximum Specific Gravity			Voids in Mineral Aggregate (VMA) % minimum (Note 4)						Voids Filled With Asphalt (VFA) %	Dust to Binder Ratio (Note 1)	Minimum Tensile Strength Ratio %
	N _{initial}	N _{design}	N _{max}	Nominal Maximum Aggregate Size mm								
				37.5	25.0	19.0	12.5	9.5	4.75			
A	≤ 91.5	96.0	≤ 98.0	11.0	12.0	13.0	14.0	15.0	16.0	70-80 (Note 2)	0.6-1.2	80
B	≤ 90.5									65-78		
C	≤ 89.5									65-75 (Note 3)		
D												
E												

Notes:

1. For Superpave 4.75 mixes, the dust-to-binder ratio shall be 0.9 to 2.0. Superpave mixes with gradations that pass beneath the PCS Control Point specified in Table 4, the dust-to-binder ratio shall be 0.8-1.6.
2. For Traffic Category A, Superpave 25.0 mixes shall have a VFA range of 67% to 80%.
3. Superpave 4.75 mixes shall have a VFA range of 75% to 78%.
Superpave 9.5 mixes shall have a VFA range of 73% to 76%.
Superpave 37.5 mixes shall have a VFA range of 64% to 75%.
4. Density testing of the coarse and fine aggregate shall be carried out in accordance with LS-604 and LS-605 respectively using the procedure for blended aggregates.

TABLE 6
SMA Hot Mix Asphalt Volumetric Properties

% Air Voids (Note 1)	Voids in Mineral Aggregate (VMA) % minimum			Voids in Coarse Aggregate (VCA) of the Compacted Mix %	Maximum Draindown at Production Temperature (Note 2) %	Minimum Tensile Strength Ratio %
	Nominal Maximum Aggregate Size mm					
	19.0	12.5	9.5			
4.0	17			Less than the VCA in the dry rodded condition.	0.3	70
Notes: 1. SMA mixes shall be designed with 100 gyrations unless the mix aggregates have a LS-603 value greater than 30%, then the SMA mix shall be designed with 75 gyrations. 2. Tested according to AASHTO T 305.						

TABLE 7
Superpave Compactive Effort

Ontario Traffic Category (Note 1)	Number of Gyration		
	N _{initial}	N _{design}	N _{max}
A	6	50	75
B and C	7	75	115
D	8	100	160
E	9	125	205
Note: 1. The traffic categories are according to Table 1.			

TABLE 8
Permitted Field Adjustment to a JMF

JMF Property	Maximum Field Adjustment (Note 1)
Percent asphalt cement content, all mixes except SMA	± 0.2
Percent asphalt cement content, SMA only	± 0.4
Percent RAP	-5.0
Percent passing 26.5 mm, 25.0 mm, 19.0 mm, and 16.0 mm sieves	± 5.0
Percent passing 13.2 mm, 12.5 mm, and 9.5 mm sieves	± 4.0
Percent passing 4.75 mm, 2.36 mm, and 1.18 mm sieves	± 3.0
Percent passing 600 µm, 300 µm, and 150 µm sieves	No limits
Percent passing 75 µm sieve, all mixes except SMA	± 1.0
Percent passing 75 µm sieve, SMA only	± 2.0
Note: 1. The maximum field adjustment is applied against the actual JMF property value.	

TABLE 9
Minimum Sample Quantities for Mix Design Monitoring

Material	Quantity
Asphalt cement	4 litres evenly split between 2 containers
Aggregate	75 kg of each type
RAP	75 kg required when RAP contained in the mix
Fines material passing 75 μ m sieve	5 kg when the mix is to be produced with a plant that returns fines to the mix
Mineral Filler	5 kg sample for SMA
Any other material samples, including anti-stripping agents and fibres, to be used in HMA	Quantity large enough to allow for a complete mix design

TABLE 10
One Point Mix Check Requirements

Material	Quantity
Gradation of component aggregates	For information only
Bulk Relative Density (BRD) of (blended) coarse aggregate and (blended) fine aggregate, and the resulting BRD of the combined aggregate	For information only
Bulk Relative Density and Maximum Relative Density of Mix	For information only
Air voids at N_{design}	$\pm 0.5\%$ from submitted mix design
VMA	$\pm 1.0\%$ from submitted mix design and not less than contract design minimum
VFA	Within specified mix design range
$\%G_{\text{mm}}$ at N_{initial}	Not more than contract design maximum
$\%G_{\text{mm}}$ at N_{max}	Not more than contract design maximum
Dust Proportion	Within specified mix design range
Tensile Strength Ratio	Not less than 0.8

Appendix 1151-A, Commentary for OPSS.MUNI 1151, April 2018

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 refer to the Superpave and Stone Mastic Asphalt (SMA) hot mix types and typical uses are provided in the following table:

Hot Mix Asphalt Type	Typical Hot Mix Use and Properties
Superpave 4.75	Fine, surface, and levelling mixes similar to the traditional sand mixes for miscellaneous applications.
Superpave 9.5	Fine, surface, padding, and levelling mixes for Traffic Category A and B roads and driveways.
Superpave 12.5	Surface mix for Traffic Category B and C roads. Superpave 12.5 is similar to the traditional HL 3, HL 3 Fine, and HL 4 mixes according to OPSS 1150.
Superpave 12.5 FC1	Surface mix for use on Traffic Category C roads that provides superior rutting resistance and skid resistance through aggregate selection. Superpave 12.5 FC1 is similar to the traditional HL 1 mix according to OPSS 1150.
Superpave 12.5 FC2	Surface mix for use on Traffic Category D and E roads that provides superior rutting resistance and skid resistance through aggregate selection. Superpave 12.5 FC2 is similar to the traditional DFC mix according to OPSS 1150.
Superpave 19.0	Binder course mix for Traffic Category A, B, C, D, and E roads. Superpave 19.0 is similar to the traditional HL 4, HL 8, and HDBC mixes according to OPSS 1150.
Superpave 25.0 and 37.5	Large stone binder course mixes for use when thicker binder lifts are required.
SMA 9.5 and 12.5	Gap-graded premium surface course mix with high frictional resistance, enhanced rutting resistance, water spray reduction, and potential noise reduction for Traffic Category D and E roads. 100% crushed aggregates from the DSM are used for both fine and coarse fraction.
SMA 19.0	Gap-graded premium binder course mix with enhanced rutting resistance for Traffic Category D and E roads. 100% crushed aggregates are used for both fine and coarse fraction.
Note:	
A. The traffic categories are according to Table 1 of OPSS 1151.	

The designer should specify the following in the Contract Documents:

- Percentage of RAP in excess of 15%. (1151.04.01.01)
- If the designer chooses to use RAP in SMA 12.5 FC1 and 12.5 FC2 mixes it should be specified (1151.04.01.01)
- Supply and use of performance graded asphalt cement. (1151.05.01)

Appendix 1151-A

Coarse graded Superpave mixes generally tend to have lower asphalt cement (AC) contents. To promote adequate compaction in the field and for long-term durability, it is recommended that Superpave mixes be designed below the primary control sieve (PCS), i.e., coarse gradation should be placed with a lift thickness of 3 to 4 times the nominal maximum aggregate size (NMAS). SMA mixes are designed as coarse graded mixes, therefore, SMA should also be placed at 3 to 4 times NMAS.

The designer should specify the minimum suggested lift thickness for each HMA type as provided in the following table:

Asphalt Layer	Hot Mix Asphalt Type	Minimum Suggested Compacted Layer Thickness (Note 1) mm
Surface Course Mixes	Superpave 4.75	25
	Superpave 9.5	30 - 40
	Superpave 12.5, 12.5 FC1, and 12.5 FC2	40 - 50
	SMA 9.5	30 - 40
	SMA 12.5	40 - 50
Base Course Mixes	Superpave 19.0	50 - 80
	Superpave 25.0	60 - 100
	Superpave 37.5	100 - 150
	SMA 19.0	60 - 80
Note:		
1. The designer should be aware that the lower minimum value is for finer graded mixes and the upper minimum value is for coarser graded mixes.		

Mixes with VMA exceeding the minimum value specified in OPSS 1151, Table 4, by more than 2% may be prone to flushing and rutting. Unless, satisfactory experience with high VMA mixes is available, mixes with VMA greater than 2% above the minimum specified should be avoided.

For SMA mixes, the designer should refer to the appropriate guidelines according to National Asphalt Pavement Association (NAPA), QIS 122, Designing and Constructing SMA Mixes, State-of-the-Practice.

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

Appendix 1151-B, Use of over 15% RAP with OPSS.MUNI 1151, April 2018

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

Supplemental Requirements for the PGAC for over 15% RAP in Municipal Contracts

For mixes containing more than 15% RAP by Binder Replacement, Table 1 of LS-307 is modified as follows.

Table 1 - PGAC Selection Guidelines for Hot Mix Asphalt Incorporating RAP

Level	RAP Content	Recommended New PGAC Grade
I	Equal to or Below 15%	Use the same PGAC grade as for a new mix; based on location (zone) and traffic level.
II	16 to 30%	Reduce both the high and low temperature by one grade (e.g. if a PG 58-28 would normally be used, select a PG 52-34)



**MATERIAL SPECIFICATION FOR
SC-800 PATCHING MATERIAL**

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APPENDICES

1152-A	COMMENTARY

1152.01	SCOPE

This specification covers the requirements for the manufacturing of SC-800 patching material.

1152.01.01 Specification Significance and Use

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

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

1152.01.02

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.

1152.02

REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

OPSS 1003	Aggregates - Hot Mix Asphalt
OPSS 1102	Liquid Asphalt
OPSS 1151	Superpave and Stone Mastic Asphalt Mixtures

Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-282	Method of Test for Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures

1152.03 DEFINITIONS

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

SC-800 Patching Material means a mixture of SC-800 liquid asphalt and mineral aggregate for patching holes, depressions, and distressed areas in existing pavements.

1152.04 DESIGN AND SUBMISSION REQUIREMENTS

1152.04.01 Design Requirements

The Contractor shall be responsible for selecting the SC-800 patching material mixture composition. The mixture composition shall meet all the requirements of this specification.

The mix shall maintain its effective properties in stockpile for a minimum period of eight months from the date of supply to the Owner.

1152.04.02 Submission Requirements

The mixture composition shall be submitted to the Owner 7 Days before the start of production. The following items shall also be included in the submission:

- a) The SC-800 supplier, facility type, and location from which the SC-800 is being supplied.
- b) Test results for the SC-800 that demonstrate compliance to the requirements of the Liquid Asphalt subsection of this specification.
- c) The aggregate supplier and location from which the aggregates are being supplied.
- d) Type of aggregate and test results for the aggregates that demonstrate compliance to the requirements of the Aggregates subsection of this specification.
- e) Percent of SC-800 in the mixture, by mass, and test results that demonstrate compliance to the requirements of the Composition of Mixture subsection of this specification.
- f) Residual asphalt content, percent by mass of SC-800 patching mixture, when tested according to LS-282, in the mixture.

1152.05 MATERIALS

1152.05.01 Liquid Asphalt

The liquid asphalt shall be SC-800 and shall be according to OPSS 1102.

1152.05.02 Aggregates

The requirements of OPSS 1003, as detailed for Superpave 12.5, shall apply to this work.

1152.05.03 Composition of Mixture

The patching mixture shall contain between 4.0 and 6.0% of SC-800 by mass. The mixture shall be according to the gradation limits specified for Superpave 12.5 in OPSS 1151.

1152.06 EQUIPMENT

Equipment shall be according to OPSS 1151.

1152.07 PRODUCTION

1152.07.01 Preparation of Liquid Asphalt

The SC-800 liquid asphalt shall be heated at the asphalt plant to a temperature of $105\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$.

1152.07.02 Preparation of Mixture

The mixture shall be prepared according to OPSS 1151 except that the discharge temperature of the mixture shall be $105\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$.

1152.07.03 Tolerances

The test results according to LS-282 shall indicate that the composition of the mixture meets the following tolerances with respect to the submitted mixture composition:

SC-800, Residual:	$\pm 0.3\%$
Retained 4.75 mm sieve:	$\pm 5.0\%$
Passing 75 μm sieve:	$\pm 2.0\%$

**Appendix 1152-A, Commentary for OPSS.MUNI 1152, November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

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

Designer Action/Considerations

Designer should include OPSS 307, Stockpiling of Patching Materials and Patching of Asphalt Pavement, in the Contract Documents for transporting and stockpiling requirements and payment for SC-800 patching material.

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
EMULSIFIED ASPHALT PATCHING MATERIAL**

TABLE OF CONTENTS

1153.01	SCOPE
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1153.09	OWNER PURCHASE OF MATERIAL - Not Used

APPENDICES

1153-A	Commentary

1153.01 SCOPE

This specification covers the requirements for the manufacturing of emulsified asphalt patching material.

1153.01.01 Specification Significance and Use

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

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

1153.01.02

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.

1153.02

REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

OPSS 1003 Aggregates - Hot Mix Asphalt
OPSS 1151 Superpave and Stone Mastic Asphalt Mixtures

Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-282 Method of Test for Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
LS-289 Method of Test for Workability of Cold Bituminous Patching Material by Blade Resistance Method
LS-290 Test Method for Cohesion of Cold Bituminous Patching Material by Rolling Sieve Method

1153.04 DESIGN AND SUBMISSION REQUIREMENTS

1153.04.01 Design Requirements

The Contractor shall be responsible for selecting the emulsified asphalt patching material mixture composition. The mixture composition shall meet all of the requirements of this specification.

The mix shall maintain its effective properties in stockpile for a minimum period of eight months from the date of supply to the Owner.

1153.04.02 Submission Requirements

The mixture composition shall be submitted to the Owner 7 Days before the start of the production. The following items shall also be included in the submission:

- a) Type and grade of asphalt emulsion, supplier and facility type and location from which the asphalt emulsion is being supplied.
- b) Test results for the asphalt emulsion that demonstrate compliance to the requirements of the Asphalt Emulsion subsection of this specification.
- c) The aggregate supplier and location from which the aggregates are being supplied.
- d) Type of aggregate and test results for the aggregate that demonstrate compliance to the requirements of the Aggregates and Composition of Emulsified Asphalt Patching Materials subsections of this specification.
- e) Percent of residual asphalt content, percent by mass of patching mixture, when tested according to LS-282, in the mixture demonstrating compliance to the requirements of the Composition of the Mixture subsection of this specification.

1153.05 MATERIALS

1153.05.01 Asphalt Emulsion

The asphalt emulsion type for emulsified asphalt patching material shall be selected to ensure compatibility with the aggregates to be used.

1153.05.02 Aggregates

Aggregates for emulsified asphalt patching material shall consist of a blend of coarse and fine aggregate such that not less than 85% of the portion passing a 4.75 mm sieve is natural sand.

The aggregates for emulsified asphalt patching material shall consist of clean, hard, durable particles according to the physical requirements for Superpave 12.5 as specified in OPSS 1003.

1153.05.03 Composition of Emulsified Asphalt Patching Material

The patching mixture shall contain between 3.7 to 5.5% residual asphalt content by mass. The percent residual asphalt shall be expressed as a percentage of the total mix.

Gradation of aggregates used in the patching mixture shall be according to the gradation limits specified in Table 1.

1153.06 EQUIPMENT

Equipment shall be according to OPSS 1151.

1153.07 PRODUCTION

1153.07.01 Composition of the Mixture

The mineral aggregates and asphalt emulsion shall be combined and mixed to provide a uniformly coated and homogeneous product according to Table I.

1153.07.02 Preparation of the Mixture

Emulsion temperature: 20 - 60 °C

Mix temperature as
discharged from the plant: As specified by the emulsion supplier

Mixing cycle: 40 - 60 seconds

TABLE 1
Gradation of the Mixture

MTO Sieve Designation	Percentage Passing By Mass
16.0 mm	100
13.2 mm	98 - 100
9.5 mm	85 - 100
4.75 mm	50 - 85
2.36 mm	35 - 65
1.18 mm	25 - 50
600 µm	15 - 40
300 µm	7 - 25
150 µm	2 - 13
75 µm	0 - 7

**Appendix 1153-A, Commentary for OPSS.MUNI 1153, November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

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

Designer Action/Considerations

Designer should include OPSS 307, Stockpiling of Patching Materials and Patching of Asphalt Pavement, in the Contract Documents for transporting and stockpiling requirements and payment for emulsified asphalt patching material.

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

Related Ontario Provincial Standard Drawings

No information provided here



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.MUNI 1202
APRIL 2017**

(Formerly OPSS 1202, November 2008)

Note: The MUNI implemented in April 2017 replaces OPSS 1202 COMMON, November 2008 with no technical content changes.

**MATERIAL SPECIFICATION FOR
BEARINGS - ELASTOMERIC PLAIN AND STEEL LAMINATED**

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APPENDICES

1202-A	Commentary

1202.01 SCOPE

This specification covers the requirements for Materials, design, and fabrication of plain and steel-laminated elastomeric bearings for bridges.

1202.01.01 Specification Significance and Use

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

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

1202.01.02 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.

1202.02 REFERENCES

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

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

Ontario Ministry of Transportation Publications

Laboratory Testing Manual:

- LS-427 Method of Test for Compressive Deformation of Plain Bearings
- LS-428 Method of Test for Compressive Deformation of Laminated Bearings
- LS-429 Method of Test for Parallelism of Steel Laminates of Laminated Bearings

Structural Manual:

Division 1 - Exceptions to the Canadian Highway Bridge Design Code CAN/CSA S6 for Ontario

Canadian Standards Association (CSA)

- S6-06 Canadian Highway Bridge Design Code

ASTM International

- D 395-03 Standard Test Methods for Rubber Property - Compression Set
- D 412-06a Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
- D 429-03e1 Standard Test Methods for Rubber Property - Adhesion to Rigid Substrates
- D 518-99 Standard Test Method for Rubber Deterioration - Surface Cracking
- D 573-04 Standard Test Method for Rubber - Deterioration in an Air Oven
- D 2240-05 Standard Test Method for Rubber Property - Durometer Hardness
- D 4014-03 (2007) Standard Specification for Plain and Steel-Laminated Elastomeric Bearings for Bridges

American Association of State Highway and Transportation Officials (AASHTO)

M251-06-UL Plain and Laminated Elastomeric Bridge Bearings

1202.03 DEFINITIONS

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

Effective Elastomer Thickness means the sum of the thickness of all layers of elastomer, excluding outer layers of laminated bearings.

Elastomer means a compound containing virgin natural polyisoprene (natural rubber) or virgin polychloroprene (neoprene).

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

Laminated Bearing means a bearing composed of elastomer laminates separated by and fully bonded to steel plates.

Plain Bearing means a bearing, which consists wholly of elastomer.

Plan Dimension means the dimensions of an object, when viewed perpendicular to the top of the object.

Proposal means a Contractor's submission for which engineering design is required that provides a written:

- a) alternative to requirements specified by the Owner in the Contract Documents;
- b) course of action or undertaking by the Contractor as delegated by the Owner in the Contract Documents.

Shape Factor means the area of the loaded face of an elastomeric layer divided by the area free to bulge.

1202.04 DESIGN AND SUBMISSION REQUIREMENTS

1202.04.01 Design Requirements

1202.04.01.01 General

Elastomeric bearings shall transmit vertical loads, excluding uplift, and accommodate the rotations and translations of the structure. At serviceability limit states, the design shall be such that the bearings do not suffer damage that would affect their performance. At ultimate limit states, the strength and stability of the bearings shall be adequate to resist the factored load and accommodate movements of the structure.

1202.04.01.02 Design

The bearings shall be proportioned to function satisfactorily under the combination of the maximum and minimum factored loads and factored translations and rotations at the serviceability limit states and the ultimate limit states specified in the Contract Documents.

All steel components of the bearings including any fasteners or dowels shall be proportioned according to CAN/CSA S6 and the Structural Manual, Division 1.

1202.04.01.03 Shape Factor

The shape factors for plain and the inner layers of laminated bearings shall not be less than 1.25 or greater than 12.

1202.04.01.04 Design Bearing Pressure

The average pressure on a plain bearing at serviceability limit state loads shall not exceed the following:

- a) The value corresponding to the shape factor (S) of the bearing is calculated as $0.22S^2$, but not greater than 7.0 MPa.
- b) 4.5 MPa under permanent loads.

The average pressure on a laminated bearing shall not exceed the following values:

- a) Serviceability Limit State loads
 - i. 4.5 MPa under permanent loads.
 - ii. 7.0 MPa under all loading combinations.
- b) Ultimate Limit States
 - i. 7.0 MPa under permanent loads.
 - ii. 10.0 MPa under all loading combinations.

1202.04.01.05 Deflection

The average vertical deformation of plain and laminated bearings at serviceability limit state loads shall not exceed 7% of the effective elastomer thickness.

1202.04.01.06 Translation

Provision for translation shall be through shear deformation of the elastomer.

The shear deformation in any direction of plain and laminated bearings at serviceability limit state loads shall not exceed 50% of the effective elastomer thickness.

1202.04.01.07 Rotation

Provision for rotation shall be through vertical deformation of the elastomer without any uplift at the edge of the bearing at serviceability limit state loads.

The total vertical deformation at the edge of plain and laminated bearings due to the vertical load and rotation at serviceability limit state loads shall not exceed 14% of the effective elastomer thickness.

1202.04.01.08 Elastomer Thickness

The effective elastomer thickness for plain bearings shall be greater than or equal to 15 mm and less than or equal to 25 mm.

1202.04.01.09 Steel Thickness

The thickness of the internal steel plates for laminated bearings shall be greater than 3 mm and less than 5 mm.

1202.04.01.10 Geometric Proportions

The bearings shall have the following proportions to ensure stability:

- a) Plain Bearings
 $L > 5 T_e$ or,
 $R > 3 T_e$
- b) Laminated Bearings
 $L > 3 T_e$ or,
 $R > 2 T_e$

Where:

L = is the lesser plan dimension of a rectangular bearing
R = is the radius of a circular bearing
 T_e = effective elastomer thickness

1202.04.02 Submission Requirements

1202.04.02.01 General

The Contractor shall notify the Contract Administrator in writing of the name and address of the supplier and manufacturer of the bearings within 30 Days of the Contract award.

Proposals shall bear the seal and signature of the design and checking Engineers.

When another authority is involved, all submissions shall be made a minimum of 5 weeks prior to the commencement of work.

1202.04.02.02 Working Drawings

The Contractor shall submit 3 sets of Working Drawings for the bearings to the Contract Administrator at least 1 week prior to commencement of bearing 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.

The Contractor shall have a sealed and signed copy of these drawings at the site prior to and during site installation of the bearings.

These drawings shall clearly indicate the following:

- a) Material properties.
- b) The number and thickness of internal steel plates.
- c) Compressive stiffness.
- d) Shear stiffness.
- e) Bearing alphanumeric identification.

1202.04.02.03 Manufacturer's Certification

Upon completion of fabrication and prior to installation of the bearings, the Contractor shall submit a Certificate of Compliance, signed by the manufacturer, to the Contract Administrator. The certificate shall state that the fabricated bearings are according to the Working Drawings and Contract Documents.

1202.05 MATERIALS

1202.05.01 General

Reclaimed material shall not be incorporated in the finished bearing.

1202.05.02 Steel

Internal steel plates for laminated bearings shall be rolled mild steel with a minimum yield strength of 230 MPa.

1202.05.03 Elastomers

The elastomers shall be according to the following:

- a) Virgin natural polyisoprene or virgin polychloroprene elastomer shall be the only raw polymers permitted.
- b) The physical properties of any polyisoprene and polychloroprene used shall be according to the requirements of Table 1.

1202.07 PRODUCTION

1202.07.01 Plain Bearings

Plain bearing pads shall be moulded individually, cut from moulded strips or slabs of the required thickness, or extruded and cut to length.

1202.07.02 Laminated Bearings

Laminated bearings shall be moulded under pressure as a single unit and heated in moulds that have a smooth surface finish.

Steel plates shall be according to the following:

- a) All steel plates shall be of uniform thickness.
- b) Internal steel plates shall be free from sharp edges.
- c) Steel plates shall be completely bonded on all surfaces to the elastomeric material during molding. The cover on the edges and top and bottom surfaces shall be 5 mm, except that no cover is required over pintle holes.
- d) When pintles are specified in the Contract Documents, the depth of pintle holes shall be such that the pintle engages only one steel plate through the entire thickness of the plate.

Elastomer laminates shall be of uniform thickness.

1202.07.03 Identification

Each laminated elastomeric bearing shall be marked with the date of manufacture (i.e., yyyy-mm-dd) and an individual alphanumeric identification. The latter shall consist of the designated identification letter of the supplier and source followed by the letter I for polyisoprene or C for polychloroprene and a five-digit number. Bearings shall be sequentially numbered. The characters shall be not less than 10 mm in height, stamped or engraved into two adjacent sides, with the indentations or protrusions not less than 1 mm in width and 1 mm in depth.

1202.07.04 Quality Control

1202.07.04.01 Test Specimens

All test specimens of steel laminated bearings used for compression set test ASTM D 395, Method B, shall be prepared from the representative bearing pads and may consist of a single layer or multiple layers of elastomer.

1202.07.04.02 Performance and Testing

1202.07.04.02.01 Compressive Deformation of Laminated Bearings

The bearings shall be tested according to LS-428. The increment in compressive deformation of laminated bearings shall not exceed 0.05 of the effective rubber thickness, when the bearing load is increased from an initial pressure of 1.5 MPa to a pressure of 7 MPa

1202.07.04.02.02 Compressive Deformation of Plain Bearings

Plain bearings shall be tested according to LS-427. The increment in compressive deformation of plain bearings shall not exceed 0.06 of the thickness of the bearing when the bearing load is increased from an initial pressure of 20% of the average pressure to the average pressure.

1202.07.05 Tolerances

Bearing thickness ≤ 40 mm	0 to + 3 mm
Bearing thickness > 40 mm	0 to + 6 mm
Bearing plan dimension	0 to + 6 mm
Thickness of individual layers of elastomer	$\pm 20\%$
Deviation from plane parallel to theoretical surface:	
Top and bottom	1 in 200
Sides	1 in 100
Steel laminates tested according to LS-429.	$0.25 T_e$
Cover to embedded steel	0 to + 2 mm
Pintle hole diameter	0 to + 2 mm
Position of pintle holes relative to each other	± 2 mm

1202.09**OWNER PURCHASE OF MATERIAL****1202.09.01****Measurement and Payment**

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

Payment at the price specified in the purchasing order shall be full compensation for the supply of complete bearings or individual components 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.

TABLE 1
Physical Requirements for Polyisoprene and Polychloroprene

Property	Test	Requirements	
		Polyisoprene	Polychloroprene
Shear modulus G_{RT} , MPa @ 20 °C (Note 1)	ASTM D 4014, Annex A1, as modified by AASHTO M251	0.80 ± 0.15	0.80 ± 0.15
Shear modulus @ - 40 °C (G_{LT}) MP (Note 1)	ASTM D 4014, Annex A1, as modified by AASHTO M251	Not more than 3 times the value at room temperature $G_{LT} \leq 3 G_{RT}$	Not more than 3 times the Value at room temperature $G_{LT} \leq 3 G_{RT}$
Tensile strength, MPa	ASTM D 412, Method A	minimum 17.0	minimum 17.0
Ultimate elongation, %	ASTM D 412, Method A	minimum 400	minimum 400
Heat resistance	ASTM D 573	70 h at 70 °C	70 h at 100 °C
Change in hardness, Shore A	ASTM D 2240	maximum + 10	maximum + 15
Change in tensile strength, %	ASTM D 412, Method A	maximum - 25	maximum - 15
Change in ultimate elongation, %	ASTM D 412, Method A	maximum - 25	maximum - 40
Compression set, %	ASTM D 395, Method B	22 h at 70 °C maximum 25	22 h at 100 °C maximum 35
Ozone	ASTM D 518, Method A 20% strain 40 ± 2 °C	25 pphm, 48 h no cracks	100 pphm 100 h no cracks
Peel bond test, N/mm	ASTM D 429, Method B	minimum 7.0	minimum 7.0
Note: 1. Shear Modulus shall be determined at ambient temperature in accordance with ASTM D 4014 Annex A1 modified as follows: the initial cycles shall be taken to a strain of 0.7 and on the last cycle the shear modulus shall be determined at 0.5 strain.			

Appendix 1202-A, November 2008
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Pintles for laminated bearings. (1202.07.01.02)
- Minimum and maximum factored loads and factored translational and rotational loads at the serviceability limit states and the ultimate limit states. (1202.04.01.02)

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

Related Ontario Provincial Standard Drawings

No information provided here.



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.MUNI 1203**

APRIL 2017

(Formerly OPSS 1203, November 2008)

Note: The MUNI implemented in April 2017 replaces OPSS 1203 COMMON, November 2008 with no technical content changes.

**MATERIAL SPECIFICATION FOR
BEARINGS-ROTATIONAL AND SLIDING SURFACE**

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1203.01 SCOPE

This specification covers the requirements for Materials, design, and fabrication of rotational and sliding surface bearings for bridges.

1203.01.01 Specification Significance and Use

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

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

1203.01.02 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.

1203.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 911 Coating Structural Steel

Ontario Provincial Standard Specifications, Material

OPSS 1202 Bearings - Elastomeric Plain and Steel-Laminated

Ontario Ministry of Transportation Publications

Structural Manual:

Division 1, Exceptions to the Canadian Highway Bridge Design Code CAN/CSA S6 for Ontario

Canadian Standards Association (CSA)

B95-1962 (R2002)	Surface Texture (Roughness, Waviness and Lay)
G40.20/40.21-04	General Requirements for Rolled or Welded Structural Quality Steel /Structural Quality Steel
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
S6-06	Canadian Highway Bridge Design Code
S157-M83 (R2001)	Strength Design in Aluminium
W48-06	Filler Metals and Allied Materials for Metal Arc Welding
W59-03	Welded Steel Construction (metal Arc Welding) (Metric Version)

ASTM International

A 240/A 240M-07e1	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications
A 325-07	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
B 36/B 36M-06	Standard Specification for Brass Plate, Sheet, Strip, and Roller Bar
B 137-95(2004)	Standard Test Method for Measurement of Coating Mass Per Unit Area on Anodically Coated Aluminium
B 487-85(2007)	Standard Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of a Cross Section
D 395-03	Standard Test Method for Rubber Property - Compression Set
D 412-06a	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
D 429-03e1	Standard Test Methods for Rubber Property - Adhesion to Rigid Substrates
D 638-03	Standard Test Method for Tensile Properties of Plastics
D 792-00	Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
D 2240-05	Standard Test Method for Rubber Property - Durometer Hardness
D 4894-07	Standard Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials

American National Standards Institute (ANSI)

B4.1-1967 (R1999)	Preferred Limits and Fits for Cylindrical Parts

U.S. Military Specifications

MIL-S-8660 C	Silicone Compound

1203.03

DEFINITIONS

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

Disc Bearing means a bearing consisting of a single moulded disc of unreinforced elastomer confined by upper and lower steel bearing plates and restricted from horizontal movement by limiting rings and a centrally located shear restriction mechanism.

Elastomer means a compound containing virgin natural polyisoprene (natural rubber) for confined elastomeric bearings or polyether urethane polymer for disc bearings.

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

Plan Dimension means the dimensions of an object, when viewed perpendicular to the top of the object.

Pot Bearing means a bearing consisting of a metal piston supported by a single moulded disc of unreinforced elastomer that is confined within a metal cylinder.

Product Drawings means drawings prepared by the manufacturer that have been approved by the Owner for use with the product.

Proposal means a Contractor's submission for which engineering design is required that provides a written:

- a) alternative to requirements specified by the Owner in the Contract Documents;
- b) course of action or undertaking by the Contractor as delegated by the Owner in the Contract Documents.

Spherical Bearing means a bearing consisting of a curved spherical metal surface in contact with and sliding on a matching curved polytetrafluoroethylene polymer (PTFE) surface.

Substructure means the abutments, piers, columns, and other components of a bridge below the bearings.

Superstructure means all parts of a bridge above the bearings.

1203.04 DESIGN AND SUBMISSION REQUIREMENTS

1203.04.01 Design Requirements

1203.04.01.01 General

The rotational bearings and sliding surfaces shall consist of components arranged so as to transmit all loads, including uplift, and accommodate the rotations and translations of the structure. At serviceability limit states, the design shall be such that the bearings shall not suffer damage that would affect their performance. At ultimate limit states, the strength and stability of the bearings shall be adequate to resist the factored loads and accommodate movements of the structure.

1203.04.01.02 Design

The bearings shall be proportioned to function satisfactorily under the critical combinations of the maximum and minimum factored loads and the factored translations and rotations at the serviceability limit states and the ultimate limit states as shown in the Contract Documents.

Bearings subject to uplift shall limit the separation of the bearing components to the value specified in the Contract Documents.

All steel components of the bearings, including fasteners, shall be proportioned according to the requirements of the CAN/CSA S6 and Structural Manual, Division 1.

Aluminium alloy components of bearing shall be proportioned according to the requirements of CAN-S157M.

The average stress in the elastomer at serviceability limit state loads shall not exceed the following values:

- a) Pot bearings 40 MPa
- b) Disc bearings 35 MPa

1203.04.01.03 Translations and Rotation

Provision for translation shall be through sliding of a stainless steel surface against a mating PTFE element.

The translational capacity in an unrestrained direction shall be as specified in the Contract Documents and the following:

- a) Longitudinal direction ± 25 mm
- b) Transverse direction ± 15 mm

Provision for rotation about any horizontal axis shall be by means of a single disc of confined elastomer for pot bearings, a single disc of polyether urethane polymer compound for disc bearings, and a spherical sliding surface of stainless steel or anodized aluminium alloy against PTFE for spherical bearings.

The rotational capacity about any horizontal axis shall be the rotation caused by ultimate limit states loads plus 1.2° .

The rotational capacity about the vertical axis through the centre of the bearing shall be $\pm 1^\circ$.

Uplift restraint devices shall not restrict rotations.

At serviceability limit states, the shift in the axial load from the centre of bearing shall not exceed the following values:

- a) 4% of the diameter of the confined elastomer for pot bearings.
- b) 10% of the diameter of the polyether urethane polymer compound for disc bearings.
- c) 10% of the plan diameter of the curved PTFE surface for spherical bearings.

Rotational bearings shall be capable of resisting the specified lateral loads in any direction in combination with the applicable vertical loads

The rotation of confined elastomeric bearings about a horizontal axis shall be limited so that the vertical strain at the perimeter of the elastomer, at serviceability limit states loads, does not exceed 0.15 of the elastomer thickness.

Brass sealing rings that are a minimum of 6 mm wide shall be provided at the perimeter of the elastomer to prevent the elastomer from extruding between the piston and the pot wall. The thickness of the brass rings shall be at least 0.2 times the width of the ring. A minimum of three layers of flat sealing rings shall be used with split ends equally positioned around the circumference of the elastomer and shall fit snugly against the surface of the inside perimeter of the pot wall. The sealing rings shall be flat and smooth on all surfaces. The upper edge of the elastomer shall be recessed to accommodate the sealing rings.

The depth of the pot wall shall be such that a minimum vertical distance of 2.5 mm remains between the top of the pot wall and the closest point of contact of the sealing rings with the pot wall upon rotating the piston an amount equal to the required rotation plus 1° .

The pot and piston surfaces in contact with the confined elastomer shall be lubricated with silicone grease. The bearing shall be sealed by a one-piece continuous preformed closed-cell compressible ring against entry of dirt, dust, and moisture between the elastomer and the pot and piston contact surfaces. Any joint in the ring shall be bonded and the strength shall be at least equal to the strength of the ring.

For disc bearings, the upper and lower plates in contact with the elastomer shall be provided with outer limiting rings to restrict the horizontal movement of the elastomer and a centrally located shear restriction mechanism.

1203.04.01.04 Sliding Surfaces

1203.04.01.04.01 General

Sliding surfaces shall allow translation or rotation by sliding of a metal surface against a mating PTFE element. For plane surfaces, the metal surface shall be stainless steel and for spherical surfaces it shall be stainless steel or anodized aluminium alloy. The metal surface shall overlap the PTFE by at least 5 mm at extremes of movement and except for guides for lateral restraint shall be positioned above the PTFE element.

1203.04.01.04.02 Polytetrafluoroethylene Polymer Element

Except when used as mating surfaces for guides for lateral restraint, the PTFE resin shall be virgin material and shall be used as unfilled sheets and shall contain spherical reservoirs for lubricant pressed into its surface. The diameter of the reservoirs shall not exceed 8 mm measured at the surface of the PTFE, and the depth shall not be less than 2 mm or more than half the thickness of the PTFE. The reservoirs shall be evenly distributed across the surface of the PTFE and shall occupy 20 to 30% of the surface.

Material used as mating surface for guides for lateral restraint shall not be dimpled or lubricated.

1203.04.01.04.03 Stainless Steel

For dimensional differences between the stainless steel and the PTFE in the direction of movement, the thickness of the stainless steel sheet shall be as follows:

Dimensional Difference Between Stainless Steel and PTFE, mm	Minimum Thickness of Stainless Steel, mm
≤ 300	1.5
> 300 and ≤ 500	2.0
> 500 and ≤ 1,500	3.0

1203.04.01.04.04 Lubrication

All PTFE surfaces except those that act as mating surfaces for guides for lateral restraint or that are subject to a contact pressure of less than 5 MPa shall be permanently lubricated with silicone grease.

1203.04.01.04.05 Thickness of Polytetrafluoroethylene Polymer and Depth of Recess

The PTFE element shall be fully bonded and recessed in a rigid backing material. The thickness of the PTFE element and the depth of recess shall be as follows:

Maximum plan dimension, mm	≤ 1,200	> 1,200
Thickness, mm	5.0	5.5
Depth of recess, mm	2.5	3.0

1203.04.01.04.06 Contact Pressure

The average contact pressure for unfilled PTFE elements based on the recessed area of the PTFE shall not exceed the following:

Limit State	Dead Load, MPa	Total Load, MPa
Serviceability	30	45
Ultimate	45	65

The maximum contact pressures at the extreme edges of flat and curved PTFE elements shall not exceed 1.2 times the values indicated above.

The average contact pressure at serviceability limit state loads for filled PTFE elements used to face mating surfaces for guides for lateral restraint shall not exceed the following:

- a) PTFE filled with up to 15% by mass of glass fibres 45 MPa.
- b) Lead filled PTFE in a bronze matrix 60 MPa.

1203.04.01.04.07 Coefficient of Friction

The coefficient of friction between stainless steel or anodized aluminium alloy sliding surfaces and lubricated virgin PTFE shall not exceed the following and shall be interpolated linearly for contact pressures within the ranges given:

Contact Pressures, MPa	Coefficient of Friction
3	0.08
7	0.07
14	0.06
≥ 21	0.04

1203.04.01.05 Guides for Lateral Restraint

The guides for lateral restraint shall be arranged to permit the required rotations about both the horizontal and vertical axis.

Translational elements with lateral restraints shall be capable of resisting either of the following lateral loads:

- a) The bearings with a capacity of 5,000 kN or less at serviceability limit state, 10% of the vertical load capacity.
- b) For bearings with a capacity over 5,000 kN at serviceability limit state, 500 kN plus 5% of the vertical load in excess of 5,000 kN.

Unless the guide bars are machined to form an integral part of the top plate, they shall be recessed not less than 5 mm into the plate to which they are attached and fastened with bolts.

The translational elements of guides for lateral restraint shall be faced with stainless steel and shall provide lateral restraint by sliding against mating surfaces faced with PTFE. Lead filled PTFE shall be at least 2 mm thick and shall be mechanically fastened and bonded to the substrate. Glass filled or virgin PTFE shall be recessed and bonded to the substrate according to the Thickness of Polytetrafluoroethylene Polymer and Depth of Recess clause.

1203.04.01.06 Top and Base Plates

The top and base plates that are permanently attached to the structure shall be provided with the bearings and shall be according to the bearing and the structure requirements.

1203.04.01.07 Fasteners and Anchorage

Fasteners used to attach the bearing to the top and base plates and the anchorage devices shall be capable of resisting either of the following the lateral loads:

- a) For bearings with a capacity of 5,000 kN or less at serviceability limit state, 10% of the vertical load capacity.
- b) For bearings with a capacity over 5,000 kN at serviceability limit state, 500 kN plus 5% of the vertical load capacity in excess of 5,000 kN.

The beneficial effect of friction shall be neglected in proportioning the fasteners and anchors.

1203.04.01.08 Deflection

The average vertical deflection at serviceability limit state loads for disc bearings shall not exceed 10% of the elastomer thickness.

1203.04.01.09 Bearing Assembly Replacement

The entire bearing assembly, except for the top plate used to attach it to the superstructure and the base plate used to anchor it to the substructure but including both contact surfaces of the sliding interface, shall be replaceable without damage to the structure and without removal of any concrete, welds, or anchorages permanently attached to the structure and without lifting the superstructure more than 5 mm. Bearings shall not be recessed into plates that are permanently attached to the structure.

1203.04.01.10 Durability

Bearings shall be designed to prevent moisture and dirt from entering the internal surfaces. The bearings shall be fabricated from materials that are durable and are protected against corrosion so as to perform the intended function.

Contact between dissimilar metals that could have corrosion potential and between the aluminium alloy and concrete shall be prevented by use of suitable insulation.

1203.04.01.11 Concrete Bearing Pressure

For bearings subject to compressive loading, the top plate and the base plate shall be proportioned to ensure the average concrete bearing pressure does not exceed 24 MPa at the ultimate limit states providing the following:

- a) Concrete on which the plate is supported has a specified nominal 28-Day compressive strength of at least 30 MPa.
- b) Edges of the plates are located a minimum of 100 mm from the edge of the concrete.
- c) The largest dimension of plate does not exceed 1,000 mm.

Alternatively, the top plate and the base plate of the bearing shall be proportioned to ensure the factored bearing resistance of concrete specified in CAN/CSA S6 and the Structural Manual, Division 1, is not exceeded.

Compressive loads in the vertical direction may be dispersed through the bearing from the edges of the elastomer or PTFE at a slope of 1.5H:1.0V providing that the dispersal lines are not interrupted by discontinuities within the bearing.

1203.04.02 Submission Requirements

1203.04.02.01 General

The Contractor shall notify the Contract Administrator in writing of the name and address of the supplier of the bearings within 30 Days of the Contract award.

Proposals shall bear the seal and signature of the design and checking Engineers.

When another authority is involved, all submissions shall be made a minimum of 5 weeks prior to the commencement of work.

1203.04.02.02 Working Drawings

The Contractor shall submit 3 sets of Working Drawings for the bearings to the Contract Administrator at least 1 week prior to commencement of bearing 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.

The Working Drawings shall be according to the Contract Documents and Product Drawings.

The Working Drawings shall clearly indicate all material properties, dimensions, connection attachments, fasteners and accessories, the bearing alphanumeric identification, and the load capacity at the serviceability and ultimate limit states as follows:

- a) Maximum vertical permanent and total load.
- b) Maximum lateral load and corresponding vertical load.
- c) Maximum rotational capacity about any horizontal axis and about the vertical axis at the centre of the bearing.

The bearing supplier shall have a copy of the Working Drawings at the manufacturing plant prior to and during the bearing fabrication.

1203.04.02.03 Manufacturer's Certification

Upon completion of fabrication and prior to installation of the bearings, the Contractor shall submit to the Contract Administrator a Certificate of Compliance signed by the manufacturer. The certificate shall state that the fabricated bearings are according to the Working Drawings, Product Drawings, and Contract Documents.

1203.05 MATERIALS

1203.05.01 Steel

Mild steel components shall be according to CSA G40.20/40.21, Grade 300 W, except for components permanently attached to steel superstructures, which shall be Grade 350 A.

Stainless steel for sliding surfaces shall have a minimum corrosion resistance according to ASTM A 240M, Type 304.

Steel fasteners shall be according to ASTM A 325 and hot-dipped galvanized according to CAN/CSA G164-M. For guide bars, alternative steel fasteners and corrosion protection systems shall be as specified in the Contract Documents.

1203.05.02 Aluminium Alloy

Aluminium alloy shall be according to CAN/CSA S157-M.

1203.05.03 Brass

Brass sealing rings for confined elastomer bearings shall be according to ASTM B 36M, half-hard.

1203.05.04 Elastomers

Polyisoprene shall be according to OPSS 1202 except that the hardness may be 50 ± 5 .

Polyether urethane polymer shall be according to Table 1.

1203.05.05 Polytetrafluoroethylene Polymer

Material used in sliding surfaces shall be virgin PTFE according to ASTM D 4894. The PTFE shall be unfilled and according to Table 2.

Material used as the mating surface for guides for lateral restraint may be one of the following:

- a) Unfilled PTFE.
- b) PTFE filled with up to 25% by mass of glass fibres.
- c) Lead filled PTFE in a bronze matrix.

1203.05.06 Lubricant

Lubricant shall be silicone grease according to MIL-S-8660C.

1203.05.07 Adhesives

Adhesives for bonding PTFE to metal shall produce a bond with a minimum peel strength of 4 N/mm, when tested according to ASTM D 429, Method B. Adhesives shall not degrade in the service environment.

1203.07 PRODUCTION

1203.07.01 Welding

Welding of structural quality steels shall be according to CSA W59-M.

All welding shall be done with electrodes certified by the Canadian Welding Bureau to the requirements of CSA W48.

The stainless steel sheets that come in contact with PTFE shall be one piece continuously welded around the perimeter to its backing plate to prevent ingress of moisture. The weld shall be clean, uniform, and without overlaps and located outside the area in contact with PTFE.

1203.07.02 Fasteners

The threaded portion of the bolts shall be coated with silicone grease prior to installation.

1203.07.03 Anchors

The top and base plate anchorage to concrete shall be by studs approved by the Owner that are fusion welded to the plates.

1203.07.04 Machining

Metal to metal contact surfaces shall be machined or fine ground. The pots and pistons for confined elastomer bearings and the upper and lower plates with limiting rings for disc bearings shall be machined from solid metal plate or castings. The concave and convex plates for spherical bearings shall be machined from solid metal plate or castings.

There shall be no openings or discontinuities in the metal surfaces in contact with the elastomer or PTFE.

1203.07.05 Roughness of Metal Surfaces

The roughness of sliding stainless steel metallic surfaces in contact with PTFE, measured according to CSA B95, shall not be greater than 0.25 µm arithmetic average for plane surfaces and 0.50 µm arithmetic average for spherical surfaces. The roughness of anodized aluminium metallic surfaces shall not be greater than 0.40 µm arithmetic average.

The roughness of metal surfaces in contact with elastomer measured according to CSA B95 shall not be greater than 3.0 µm arithmetic average.

1203.07.06 Attachment of Polytetrafluoroethylene Polymer

Virgin or glass filled PTFE elements shall be recessed in a rigid backing material and shall be bonded over the entire area with an adhesive. The rigid backing material shall be grit blasted prior to applying the adhesive.

Lead filled PTFE shall be mechanically fastened and bonded to the backing plates.

The PTFE elements used as mating surfaces for guides for lateral restraint shall extend to within 10 mm from the ends of the backing plates.

1203.07.07 Anodizing

Aluminium alloy surfaces shall be anodized using the sulphuric acid process and shall meet the following:

Physical Property of Sealed Anodic Coating	Units	Test Method	Requirements
Thickness, t	µm	ASTM B 487	25 minimum
Mass, w	mg/cm ²	ASTM B 137	5.8 minimum
Apparent density, d	g/cm ³		2.32 minimum

The apparent density shall be determined as: $d = \frac{10 w}{t}$

1203.07.08**Corrosion Protection**

All exposed metal corners that receive corrosion protection shall have a 3 mm rounding. All exposed metal surfaces of the bearings, except stainless steel and components permanently attached to steel superstructures, shall be protected against corrosion by a low volatile organic compound coating system according to OPSS 911. The continuous weld attaching the stainless steel sheet shall be ground smooth and have the same corrosion protection as the bearing. Steel fasteners shall be galvanized or as specified in the Contract Documents.

For corrosion protection purposes, bearing components permanently attached to steel superstructures shall be considered part of the structural steel.

1203.07.09**Identification**

Each bearing shall be marked with the date of manufacture (i.e., yyyy-mm-dd) and an individual alphanumeric identification. The latter shall consist of the designated identification letter of the supplier and source followed by a sequential five digit number. The characters shall be stamped or engraved into two adjacent sides and shall be clearly legible after installation. The characters shall not be less than 10 mm in height with the indentations not less than 1 mm in width and 0.5 mm in depth.

1203.07.10**Tolerances**

The deviation from flatness of PTFE surfaces shall not exceed:

- a) 0.2 mm, when the diameter or diagonal is equal to or less than 800 mm.
- b) 0.00025 of the diameter or diagonal, when the diameter or diagonal is greater than 800 mm.

The deviation from flatness of stainless steel or aluminium alloy surfaces in contact with PTFE for plane surfaces and from the theoretical surface for spherical surfaces shall not exceed:

- a) 0.0003 LH mm for a rectangular PTFE element.
- b) 0.0006 RH mm for a circular PTFE element

where:

L = the greater plan dimension for a rectangular bearing,
R = the radius of a circular bearing, and,
H = the free height of PTFE element

For confined elastomer bearings, the tolerance of fit between the piston and the pot shall be + 0.75 to + 1.25 mm. The inside diameter of the pot cylinder shall be the same as the nominal diameter of the elastomer and shall be machined to a tolerance of:

- a) 0 to + 0.125 mm for diameters up to and including 500 mm.
- b) 0 to + 0.175 mm for diameters over 500 mm.

For disc bearings, the gap between the edge of the polyether urethane polymer disc and the inside face of the limiting ring shall be $1.25\% \pm 0.25\%$ of the diameter of the disc.

The plan dimensions of the recess for PTFE shall be the same as the nominal plan dimensions of the PTFE and shall be machined to a tolerance of 0 to + 0.2% of the diameter or diagonal.

Overall bearing plan dimension	$\pm 3 \text{ mm}$
Overall bearing height	$\pm 3 \text{ mm}$
Machined surface dimensions	$\pm 0.4 \text{ mm}$

Elastomer:

Diameter	a) 0.0 to -1.5 mm for diameters $\leq 500 \text{ mm}$ b) 0.0 to -2.0 mm for diameters $> 500 \text{ mm}$
Thickness	0.0 to + 1.0 mm

Brass rings:

Difference between internal diameter of brass ring and diameter of recess in the moulded elastomer	0 to + 0.5 mm
Difference between sum of thicknesses of brass rings and recess depth in the moulded elastomer	0 to + 0.25 mm

Recessed Guide Bars - American Standard Clearance Locational Fit Class LC3 according to ANSI B4.1.

Guides for Lateral Restraint - Gap between metal restraints surfaces and mating PTFE elements	$0.50 \text{ mm} \pm 0.25 \text{ mm}$

PTFE plan dimension 0 to - 0.2% of diameter or diagonal

PTFE thickness 0 to + 10.0% of thickness

Depth of recess for PTFE 0 to + 0.3 mm

1203.09 OWNER PURCHASE OF MATERIAL

1203.09.01 Measurement and Payment

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

Payment at the price specified in the purchasing order shall be full compensation for the supply of complete bearings or individual components 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.

TABLE 1
Physical Requirements for Polyether Urethane Polymer

Physical Property	ASTM Test Methods	Requirements	
		Minimum	Maximum
Hardness, Scale D	D 2240	60	64
Tensile Stress, MPa @ 100% elongation @ 200% elongation	D 412	14 26	-- --
Tensile Strength, MPa	D 412	35	--
Ultimate Elongation, %	D 412	220	--
Compression Set, % 22 h @ 70 °C	D 395	--	40

TABLE 2
Physical Requirements for Polytetrafluoroethylene Polymer

Physical Property	ASTM Test Method	Requirement
Tensile Strength, MPa	D 638	minimum 20
Elongation, %	D 638	minimum 200
Relative Density	D 792	2.16 ± 0.03

Appendix 1203-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 following shall be specified in the Contract Documents:

- Maximum and minimum factored loads, factored translations and rotations, serviceability limit states and ultimate limit states. (1203.04.01.02)
- Bearing component uplift separation. (1203.04.01.02)
- The rotational and translational capacity in an unrestrained direction or directions. (1203.04.01.03)
- Lateral loads. (1203.04.01.05)
- Guide bar alternative steel fasteners and corrosion protection systems. (1203.05.01)
- Requirements for alternative corrosion protection system to galvanizing for steel fasteners. (1203.07.08)

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

Related Ontario Provincial Standard Drawings

No information provided here.



MATERIAL SPECIFICATION FOR POLYVINYL CHLORIDE WATERSTOPS

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1204-A	Commentary

1204.01	SCOPE

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

1204.01.01 Specification Significance and Use

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

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

1204.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

1204.02 REFERENCES

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

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

ASTM International

D412-16e1	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
D624-00(2020)	Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
D2240-15e1	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 three 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.

$$E = \frac{4P \times L^3}{\Delta \times b \times t^3}$$

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 one 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 D2240.
- 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 one 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 D412 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 weigh-ins 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 ten minutes and weighed. If the tests for tensile strength and elongation cannot be made within one hour after completion of the weigh-ins 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 weigh-ins 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 weigh-ins 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 D412 Die C
Ultimate Elongation, %	minimum 275 average of 5 specimens	ASTM D412 Die C
Tear Resistance, N/mm	minimum 44 average of 3 specimens	ASTM D624 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	minimum 90	See Accelerated Extraction clause
Tensile Strength, MPa Ultimate Elongation, %	minimum 250	
Cold Bend	Pass	See Cold Bend clause
Low Temperature Impact Resistance	Pass	See Low Temperature Impact Resistance clause

Appendix 1204-A, November 2021
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 Actions/Considerations

The designer should specify the following in the Contract Documents:

- Waterstop shape and dimensions. (1204.07.01)

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

Related Ontario Provincial Standard Drawing

OPSD 3950.100 Joints, Concrete Expansion and Construction, on Structure



MATERIAL SPECIFICATION FOR CLAY SEAL

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APPENDICES

1205-A	Commentary

1205.01 SCOPE

This specification covers the requirements of clay seal material for use at the inlet side of culverts and in pipe trenches.

1205.01.01 Specification Significance and Use

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

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

1205.01.02

Appendices Significance and Use

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

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1205.02

REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

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

ASTM International

D 5084-10 Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

1205.03

DEFINITIONS

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

Bentonite means a commercial term applied to clay deposits containing sodium montmorillonite as the essential mineral.

Clay means a fine textured (i.e., grain size smaller than 0.002 mm) sedimentary or residual deposit consisting of hydrated silicates of aluminum mixed with various impurities, but no organics. It is a cohesive and plastic soil within a wide range of water content.

Geosynthetic Clay Liner means sodium bentonite clay sandwiched between two protective geotextiles.

Liquid Limit means the water content between the semi-liquid and the plastic states of the soil.

Plastic Limit means the water content between the plastic and semi-solid states of the soil.

Plasticity Index means the water content range of a soil at which it is plastic, defined numerically as the liquid limit minus the plastic limit.

1205.04 DESIGN AND SUBMISSION REQUIREMENTS

1205.04.01 Submission Requirements

Samples of natural clay material proposed for use in clay seal shall be submitted to the Contract Administrator for approval 3 weeks prior to use.

When clay mixture is proposed for use, a minimum 25 kg sample of the Granular A and a minimum 7 kg sample of Bentonite shall be submitted to the Contract Administrator 3 weeks prior to use.

The clay mixture shall be left to cure at various moisture contents for a minimum period of 24 hours prior to performing standard Proctor density tests and flexible wall permeability tests on samples compacted to 95% of its standard Proctor maximum dry density.

1205.05 MATERIAL

1205.05.01 General

Material used for clay seals shall lie within the hatched area shown in Figure 1 and shall be natural clay or clay mixture. Alternatively, a geosynthetic clay liner as specified in the Geosynthetic Clay Liner subsection may be used.

The coefficient of permeability as determined in the flexible wall permeameter according to ASTM D 5084 shall not exceed 1×10^{-6} cm/s.

1205.05.02 Natural Clay

Clay material for clay seal shall be according to the following:

- a) Liquid limit shall be > 40%.
- b) Plasticity index shall be > $0.73 \times (\text{Liquid Limit} - 20\%)$.

1205.05.03 Clay Mixture

Alternatively, material for clay seal may be made of the following mixture by volume:

- a) 1 part Bentonite powder
- b) 3.5 parts Granular A

The mixing of the material shall be carried out in an approved mechanical mixer.

At placement, the moisture content of the mixture shall be maintained to within $\pm 1\%$ of the optimum moisture content.

1205.05.04 Geosynthetic Clay Liner

Material specifications containing the physical, mechanical, and hydraulic properties of the geosynthetic clay liner shall be obtained from the manufacturer. The material specification shall include a manufacturer's certification and warranty. Installation shall be as per manufacturer's instructions.

1205.05.05 Granular A

Granular A shall be according to OPSS 1010.

1205.08 QUALITY ASSURANCE

1205.08.01 Sampling and Testing

Sampling requirements of clay seal material (e.g., sampling location, intervals, and lot sizes) shall be as specified in the Contract Documents.

The Contract Administrator may elect to carry out testing at the quality assurance laboratory to ensure that clay seal material used in the work conform to the requirements of this specification.

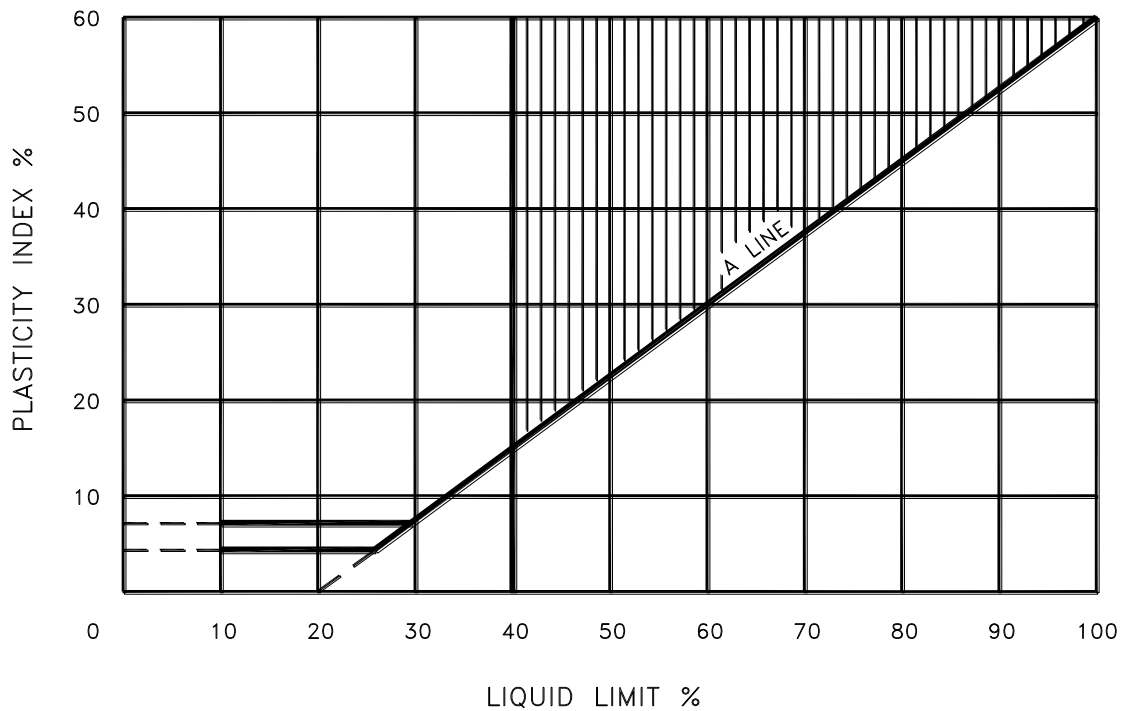


FIGURE 1
Plasticity Chart

NOTES:

- A. Figure 1, Plasticity Chart, originates from early principle soil classification developed by Arthur Casagrande and further enhanced by the Unified Soil Classification System.
- B. Figure 1 is used to distinguish between different fine grained soil types. Only highly plastic clays that fall within the limits of Figure 1 are specified as suitable clay seal materials in this specification.

Appendix 1205-A, April 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Sampling requirements of clay seal material. (1205.08.01)

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

Related Ontario Provincial Standard Drawings

OPSD 802.095 Clay Seal for Pipe Trenches



MATERIAL SPECIFICATION FOR DECK JOINT ASSEMBLIES

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1210.09	OWNER PURCHASE OF MATERIAL - Not Used

APPENDICES

1210-A	Commentary

1210.01 SCOPE

This specification covers the requirements for Materials, design, and fabrication of deck joint assemblies.

1210.01.01 Specification Significance and Use

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

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

1210.01.02 Appendices Significance and Use

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1210.02 REFERENCES

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

Ontario Provincial Standard Specifications, Construction

OPSS 920 Deck Joint Assemblies, Preformed Seals, Joint Fillers, Joint Seals, Joint Sealing Compounds, and Waterstops - Structures

Ontario Provincial Standard Specifications, Material

OPSS 1202 Bearings - Elastomeric and Plain Steel Laminated
OPSS 1203 Bearings - Rotational and Sliding Surface

Ontario Ministry of Transportation Publications

Structural Manual:
Division 1, Exceptions to the Canadian Highway Bridge Design Code CAN/CSA S6 for Ontario

CSA Standards

G30.18-M92 (R2002) Billet - Steel Bars for Concrete Reinforcement
G40.20/G40.21-04 General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
G164-M92 Hot Dip Galvanizing of Irregularly Shaped Articles
S6-06 Canadian Highway Bridge Design Code
W47.1-03 Certification of Companies for Fusion Welding of Steel
W59-03 Welded Steel Construction (Metal Arc Welding)
W186-M1990 (R2007) Welding of Reinforcing Bars in Reinforced Concrete Construction

ASTM International

A 240/A 240M-07e1 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Application
A 325M-05 Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength

D 412-06a	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
D 471-06	Standard Test Method for Rubber Property - Affects of Liquids
D 573-04	Standard Test Method for Rubber Deterioration in an Air Oven
D 832-07	Standard Practice for Rubber Conditioning for Low Temperature Testing
D 1149-07	Standard Test Method for Rubber Deterioration - Cracking in an Ozone Controlled Environment
D 2240-05	Standard Test Method for Rubber Property - Durometer Hardness
F 835-04e1	Standard Specification for Alloy Steel Socket Button and Flat Countersunk Head Cap Screws

Others

U.S. Military Specification:

MIL-A-907D-93 Antiseize Thread Compound, High Temperature

1210.03 DEFINITIONS

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

Armouring Angle means the expansion joint angle at the gap.

Bearing means a structural device that transmits a load while permitting translation or rotation or both.

Elastomer means a compound containing virgin polychloroprene or neoprene.

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

Manufacturer means a fabrication company that is certified by the Canadian Welding Bureau (CWB) according to CSA W47.1, Division 2.1, and supplies deck joint assemblies.

Nosing Angle means the angle that forms the outside edges of the joint blackout.

Preformed Seal means an extruded elastomer that, when retained in recesses in the deck joint assembly, prevents the passage of water and other materials.

Product Drawings means drawings prepared by the manufacturer that have been approved by the Owner for use with the product.

1210.04 DESIGN AND SUBMISSION REQUIREMENTS

1210.04.01 Design Requirements

1210.04.01.01 General

Deck joint assemblies shall be designed to function satisfactorily under the critical combinations of the maximum and minimum factored loads, translations, and rotations at the serviceability and ultimate limit states according to CAN/CSA S6 and the Structural Manual, Division 1.

1210.04.01.02 Fasteners and Anchorage

Fasteners and anchorage devices shall be designed to transfer all the static and dynamic loads from each side of the deck joint assembly to the structure.

1210.04.01.03 Preformed Seal

All deck joint assemblies and the bearings in modular deck joint assemblies shall be designed so that the entire preformed seal is replaceable without damage to the structure and without removal of any concrete, welds, or anchorages permanently attached to the structure.

1210.04.02 Submission Requirements

1210.04.02.01 Product Drawings

The deck joint assembly manufacturer shall submit the product drawings for approval.

The product drawings shall indicate all material properties, dimensions, connection attachments, injection hose system, splices, fasteners and accessories, and the individual alphanumeric identification numbers.

The product drawings for modular joints shall bear the seal and signature of an Engineer.

1210.05 MATERIALS

1210.05.01 Bearings

All material forming parts of the bearing component of the deck joint assembly shall be according to OPSS 1202 and OPSS 1203.

The virgin polytetrafluoroethylene (PTFE) element shall have a minimum thickness of 1.5 mm.

1210.05.02 Preformed Seal

The preformed seal shall be manufactured from an elastomer with physical properties shown in Table 1.

Manufacturer's storage and handling requirements shall be followed. The seal shall not be exposed to ultraviolet rays for more than 3 Days prior to installation.

1210.05.03 Steel

Mild steel components shall be according to CSA G40.20/G40.21, Grade 300 W.

Stainless steel shall have a minimum corrosion resistance according to ASTM A 240M.

Steel fasteners other than stainless steel shall be according to ASTM A 325M or ASTM F 835.

1210.05.04 Anchors

Anchors shall be headed type stud shear connectors according to CSA W59, Appendix H.

1210.05.05 Reinforcing Steel Bars

Reinforcing steel bars shall be according to CAN/CSA G30.18, Grade 400W.

1210.05.06 Antiseize Compound

Antiseize compound shall be according to MIL-A-907D.

1210.05.07 Injection Hose System for Deck Joint Assembly

The injection hose system shall be installed on the deck joint assembly for both nosing and armouring angles. This system shall be long enough to extend between the barrier or parapet walls on each side of the structure, including the sidewalks and curbs.

There shall not be bleeder holes in the nosing and armouring angles.

1210.07 PRODUCTION

1210.07.01 General

The deck joint assembly manufacturer shall have a copy of the deck joint assembly Working Drawings as specified in OPSS 920 at the manufacturing plant during the deck joint assembly fabrication.

1210.07.02 Welding

Welding of structural quality steels shall be according to CSA W59.

Welding of stainless steel shall be according to OPSS 1203.

Welding of reinforcing steel bars shall be according to CSA W186-M.

1210.07.03 Fasteners

All steel bolts shall be zinc phosphate coated.

The threaded portion of bolts and the underside of the bolt heads shall be coated with an antiseize compound prior to installation.

1210.07.04 Steel Fabrication

Machining shall be carried out after welding, whenever possible.

All rough flame cut surfaces and metal-to-metal contact surfaces shall be machined ground smooth.

Re-entrant corners that are cut shall be free from notches and shall have the largest practical radius with a minimum radius of 14 mm. Bearing surfaces shall be in contact over the full area of the mating surfaces.

1210.07.05 Corrosion Protection

All structural steel components of the deck joint assembly shall be hot dip galvanized after fabrication according to CAN/CSA G164-M.

1210.07.06 Preformed Seal

The preformed seal shall exceed the required length by 1 m to permit sampling and testing in the field.

1210.07.07 Marking

Each deck joint section shall be marked with the date of manufacture (i.e., yyyy-mm-dd), an individual alphanumeric identification, and a sequential number. The characters shall be die stamped into an exposed surface at the gutter line at the barrier wall or curb. The characters shall not be less than 10 mm high with the indentations not less than 0.5 mm in width and 0.2 mm in depth.

The preformed seal shall be clearly and indelibly stamped every metre with a lot number, date of manufacture (i.e., yyyy-mm-dd), and model number.

1210.07.08 Designation of Lifting Points

The lifting points shall be clearly marked on the deck joint assembly.

TABLE 1
Preformed Seal Physical Requirements

Property	Physical Requirements	Test Procedure
Tensile Strength	Minimum 13.5 MPa	ASTM D 412 Test Method A
Ultimate Elongation	Minimum 250%	ASTM D 412 Test Method A
Hardness, Type A Durometer	55, + 7, -5	ASTM D 2240
Oven Aging Test, 70 h @ 100 °C Change in Tensile Strength	Maximum 20%	ASTM D 573 ASTM D 412 Test Method A
Change in Elongation	Maximum 20%	ASTM D 412 Test Method A
Change in Hardness	Minimum 10 points	ASTM 2240
Permanent set at break	Maximum 10%	ASTM D 412 Test Method A
Low Temperature Crystallization Hardness, Type A Durometer 7 d @ -10 °C Change in Hardness	Maximum 15 points	ASTM D 832 ASTM D 2240
Oil Swell, ASTM Oil No. 3, 70 h @ 100 °C Weight Change	Maximum 45%	ASTM D 471
Ozone Resistance, 20% Strain, 300 pphm in air 70 h @ 40 °C	No cracks	ASTM D 1149 Specimen A
Notes:		
A. All tests shall be made on specimens prepared from the preformed seals.		

Appendix 1210-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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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.



Note: The MUNI published in November 2021 replaces OPSS 1212 COMMON, November 2003 with no technical content changes.

MATERIAL SPECIFICATION FOR HOT POURED RUBBERIZED ASPHALT JOINT SEALING COMPOUND

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1212.01	SCOPE
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1212.03	DEFINITIONS - Not Used
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1212.10	BASIS OF PAYMENT – Not Used
APPENDICES	
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 Specification Significance and Use

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

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

1212.01.02 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.

1212.02 REFERENCES

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

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

ASTM International

- D6690-01 Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
- D5329 (1996) Test Methods for Sealants and Fillers, Hot-Applied, For Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements
- D5 (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 D6690 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 D5329.
- c) Flow testing shall be carried out according to ASTM D 5329 and ASTM D5.
- 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, November 2021
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:

- Joint sealing compound type. (1212.05.01)

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

Related Ontario Provincial Standard Drawings

No information provided here.



Note: The MUNI published in November 2021 replaces OPSS 1213 COMMON, March 1998 with no technical content changes.

MATERIAL SPECIFICATION FOR HOT APPLIED RUBBERIZED ASPHALT WATERPROOFING MEMBRANE

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1213.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
1213.05	MATERIALS
1213.06	EQUIPMENT - Not Used
1213.07	PRODUCTION - Not Used
1213.08	QUALITY ASSURANCE
1213.09	OWNER PURCHASE OF MATERIALS - Not Used
1213.10	BASIS OF PAYMENT – Not Used

APPENDICES

1213-A	Commentary
1213.01	SCOPE

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

1315.01.01 Specification Significance and Use

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

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

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.

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1213.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Construction:

OPSS 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°C ± 2°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.

Appendix 1213-A, November 2021
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.



Note: The MUNI published in November 2021 replaces OPSS 1215 COMMON, March 1998 with no technical content changes.

MATERIAL SPECIFICATION FOR PROTECTION BOARD

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1215.01	SCOPE
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1215.03	DEFINITIONS - Not Used
1215.04	SUBMISSION AND DESIGN REQUIREMENTS - Not Used
1215.05	MATERIAL
1215.06	EQUIPMENT - Not Used
1215.07	PRODUCTION
1215.08	QUALITY ASSURANCE
1215.09	OWNER PURCHASE OF MATERIAL - Not Used
1215.10	BASIS OF PAYMENT - 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.

1215.01.01 Specification Significance and Use

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

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

1215.01.02 Appendices Significance and Use

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1215.02 REFERENCES

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

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

Ontario Provincial 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.

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.

Appendix 1215-A, November 2021
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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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 CEMENTING MATERIALS

TABLE OF CONTENTS

1301.01	SCOPE
1301.02	REFERENCES
1301.03	DEFINITIONS – Not Used
1301.04	DESIGN AND SUBMISSION REQUIREMENTS
1301.05	MATERIALS
1301.06	EQUIPMENT - Not Used
1301.07	PRODUCTION
1301.08	QUALITY ASSURANCE
1301.09	OWNER PURCHASE OF MATERIAL
1301.10	BASIS OF PAYMENT - Not Used

APPENDICES

1301-A	Commentary

1301.01	SCOPE

This specification covers the requirements for cementing materials together with the method of sampling, testing, delivery, handling and storage, prior to use.

The following types of cementing materials are covered by this specification:

a) Portland and Portland-limestone Cement Types;

Description of Hydraulic Cement	Designation
General Use	Type GU, GUL
Moderate sulphate-resistant	Type MS
Moderate heat of hydration	Type MH, MHL
High early strength	Type HE, HEL
Low heat of hydration	Type LH, LHL
High sulphate resistant	Type HS

b) Blended Hydraulic Cement Types

Description of Blended Hydraulic Cement	Designation
General Use	Type GUb, GULb
Moderate sulphate-resistant	Type MSb, MSLb
Moderate heat of hydration	Type MHb, MHLb
High early strength	Type HEb, HELb
Low heat of hydration	Type LHb, LHLb
High sulphate resistant	Type HSb, HSLb

Supplementary Cementing Materials

Slag - Ground granulated blast furnace slag, Type S

Fly Ash – the finely divided residue that results from the combustion of pulverized coal or a combination of pulverized coal blended with up to 30% by mass of petroleum coke and that is carried from the combustion chamber of a furnace by exhaust gases, Types F, CI or CH.

Silica Fume – the finely divided residue, resulting from the production of silicon or ferrosilicon alloys, that is carried from the burning area of a furnace by exhaust gases. The silica fume shall contain a minimum of 80% SiO₂.

1301.01.01 Specification Significance and Use

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

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

1301.01.02 Appendices Significance and Use

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

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1301.02 REFERENCES

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

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

Canadian Standards Association

CAN/CSA A3000-13 Cementitious Materials Compendium

1301.04 DESIGN AND SUBMISSION REQUIREMENTS

1301.04.01 Submission Requirements

1301.04.01.01 Product Data

When required, the following product data for each cementing material shall be submitted to the Owner for acceptance:

- a) A test certificate from a laboratory, qualified according to the Testing clause, showing compliance of the cementing material with all the physical and chemical test requirements of CAN/CSA A3000, including the Annex A-Optional Requirements and the optional test for early stiffening if the product is Portland or Portland-limestone cement.
- b) The name of the manufacturer and supplier.
- c) Location of mill.
- d) A 5 kg composite sample from current production of the cementing material.
- e) Material Safety Data Sheet.

1301.05 MATERIALS

1301.05.01 Physical and Chemical Requirements

Cementing materials shall conform to the physical and chemical requirements of CAN/CSA A3000. Fly ash, slag and silica fume shall also conform to the optional requirements of CAN/CSA A3000 with the exception of the requirements for "Control of Expansion Due to Alkali-Silica Reactivity".

The cementing material shall be free of undue lumps or partially hydrated material.

At the time of delivery to the concrete producer and at the time of use, the temperature of cementing material shall not exceed 65 °C.

Where Portland or Portland-limestone cement is required to be certified as being free from early stiffening tendencies, the penetration shall be 50% or greater when determined by the method specified in the Annex A of CAN/CSA A3000.

1301.07 PRODUCTION

1301.07.01 Packaging and Delivery

Bags used in the supply of packaged cement shall be of a composition and quality as to provide adequate protection from the elements and to withstand normal handling procedures.

Bagged cementing material shall be suitably protected against the weather and dampness during shipment.

Cementing materials delivered in bulk shall be transported in fully enclosed containers.

1301.07.02 Marking

The name of the supplier and the type of cementing material shall be printed on each bag.

Cementing material delivered in bags or in bulk shall be accompanied by a shipping invoice listing the following information:

- a) Name of supplier
- b) Type of cementing material
- c) Name of manufacturer
- d) Location of mill

1301.07.03 Handling

Equipment used for handling, weighing, and batching the cementing material shall be suitably protected against wind and weather.

Cementing material delivered in bulk shall be unloaded directly into a storage silo, enclosed bin, or weigh hopper and shall be batched directly therefrom without rehandling other than by fully enclosed elevators, conveyors, chutes, or pipes.

1301.07.04 Storage

Cementing material shall be suitably protected from the weather and dampness during storage.

Bagged cementing material shall be stored in a weather-tight building. When storage is for less than one month, temporary protection by complete enclosure within tarpaulins, plastic sheets or the like shall be permitted, however storage in a weather-tight building is preferred for these periods. Bags shall be stacked above the ground or building floor on skids, to provide a space for air circulation. Bagged cement stored in a building shall not be closer than 600 mm to the roof or walls.

Bulk or bagged cementing materials shall be stored separately to prevent contamination and to permit identification of each cementing material at all times.

1301.07.05 Testing

Testing shall be done by a laboratory certified 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 laboratory is the manufacturer's laboratory, an Engineer employed by an independent certified organization shall witness the testing and affix their Engineer's stamp and signature to the test report.

1301.07.06 Acceptance or Rejection

Where there is doubt as to the quality of the cementing material, it shall not be shipped or used in the work until testing has been completed by the supplier to prove the material is acceptable and results have been sent to the Owner and not until notice of acceptance of the results has been received by the supplier in writing from the Owner.

1301.08 QUALITY ASSURANCE

1301.08.01 Inspection, Sampling, and Testing

Inspection, sampling, and testing of the cementing materials shall be done according to the methods and procedures of CAN/CSA 3000 for the cementing material type.

The Owner reserves the right to perform inspections, sampling, and testing at times and locations necessary to determine the acceptability of the cementing material. Access shall be provided to the Owner for inspection and sampling purposes.

1301.08.02 Acceptance or Rejection

Material represented by a sample that does not meet the requirements of this specification shall be considered unacceptable and further material from the same source shall not be used until it is demonstrated by testing by the Owner that the material meets the requirements of this specification.

1301.09 OWNER PURCHASE OF MATERIAL

Cementing materials shall be measured in tonnes or number of bags, as specified in the purchasing order.

Payment at the price specified in the purchasing order shall be for the supply of cementing materials delivered to the destination on the date and time specified. Deductions shall not be made for Owner's samples.

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

Appendix 1301-A, November 2018
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 WATER

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1302.07	PRODUCTION - Not Used
1302.08	QUALITY ASSURANCE
1302.09	OWNER PURCHASE OF MATERIALS - Not Used

APPENDICES

1302-A	Commentary

1302.01 SCOPE

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

1302.01.01 Specification Significance and Use

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

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

1302.01.02 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.

1302.02 REFERENCES

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

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

Provincial Statutes

Safe Drinking Water Act, 2002 S.O. 2002, c. 32

Canadian Standards Association Standards

A23.1-19/A23.2-19	Concrete materials and methods of concrete construction/Test methods and standard practices for concrete
A3000-18	Cementitious Materials Compendium

ASTM International

D 512-12	Chloride Ion in Water
D 516-16	Sulfate Ion in Water
D 4192-15	Potassium in Water by Atomic Absorption Spectrophotometry

American Association of State and Highway Transportation Officials (AASHTO)

T 26-79 (2008)	Quality of Water to Be Used in Concrete

1302.03 DEFINITIONS

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

Potable Water as per the *Safe Drinking Water Act*, 2002

1302.04**SUBMISSION AND DESIGN REQUIREMENTS**

Potable water is acceptable without testing. Water deemed not potable may be used in the manufacture of concrete without testing provided that a satisfactory history of strength and durability of concrete made with the water has been demonstrated.

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, water of unknown quality Table 1 shall apply.

The water shall not change the initial setting time of the test concrete by more than one hour when compared to a reference concrete prepared with potable water.

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 a laboratory certified by the Canadian Council of Independent Laboratories or CCIL.

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

Except for potable water which may be used without testing, the water will be tested according to CSA A23.1 and CSA A3000 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.

TABLE 1
Limits in Water used for making concrete

Parameter	Maximum concentration in mixing water (mg/L)	Test Method
Chlorides	500 (for prestressed concrete)* 1,000 (for other reinforced concrete)*	ASTM D512
Sulphates (as SO ₄)	3,000	ASTM D516
Alkalis (Na ₂ O + 0.658 K ₂ O)	600**	ASTM D4192
Total solids	50,000	AASHTO T 26

*The contribution of the mixing water to the total chloride in the concrete shall not exceed the limits specified in Clause 4.1.1.2 of CSA A23.1.

**The contribution of the mixing water to the total alkali in the concrete shall follow the guidelines in CSA A23.2-27A.

Appendix 1302-A, November 2019
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



MATERIAL SPECIFICATION FOR ADMIXTURES FOR CONCRETE

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1303.05	MATERIALS
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1303.07	PRODUCTION - Not Used
1303.08	QUALITY ASSURANCE
1303.09	OWNER PURCHASE OF MATERIALS - Not Used

APPENDICES

1303-A	Commentary

1303.01 SCOPE

This specification covers the materials for use as air entraining, chemical, and superplasticizing admixtures for concrete.

1303.01.01 Specification Significance and Use

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

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

1303.01.02 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.

1303.02 REFERENCES

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

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

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-422 Method of Test for Evaluation of Air Entraining Admixtures for Concrete
- LS-423 Method of Test for Evaluation of Chemical Admixtures for Concrete
- LS-424 Method of Test for Evaluation of Superplasticizing Admixtures

ASTM International

- C 494-17 Chemical Admixtures for Concrete
- E 70-97 (2002) Test Method for pH of Aqueous Solutions with the Glass Electrode

1303.03 DEFINITIONS

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

Air Entraining Admixture means an admixture that causes development of a system of microscopic air bubbles in concrete during mixing to increase its workability and resistance to freezing and thawing.

Chemical Admixture means Types A, B, C, D, and E admixtures.

Non-Chloride Admixture means an admixture that contains not more than 0.01% chloride by mass of cement.

Superplasticizer means a high range water reducing admixture such as Types F and G.

Type A means a water reducing admixture that reduces the quantity of mixing water required to produce concrete of a given consistency.

Type B means a retarding admixture that retards the setting of concrete.

Type C means an accelerating admixture that accelerates the setting and early strength development of concrete.

Type D means a water reducing and retarding admixture that reduces the quantity of mixing water required to produce concrete of a given consistency and retards the setting of concrete.

Type E means a water reducing and accelerating admixture that reduces the quantity of mixing water required to produce concrete of a given consistency and accelerates the setting and early strength development of concrete.

Type F means a superplasticizing admixture that reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or greater.

Type G means a superplasticizing and retarding admixture that reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or greater and retards the setting of concrete.

1303.04 DESIGN AND SUBMISSION REQUIREMENTS

1303.04.01 Submission Requirements

1303.04.01.01 Admixtures

The supplier shall submit documentation verifying that each admixture used on the Contract is included on the Owner's pre-qualified products list.

1303.05 MATERIALS

Admixtures shall be non-chloride, with the exception of admixtures used for fast track full depth repairs to concrete pavements.

Admixtures shall be in liquid form.

Admixtures shall be according to LS-422, LS-423, or LS-424.

1303.08 QUALITY ASSURANCE

1303.08.01 Sampling

Samples of the admixtures may be taken by the Owner from the concrete batching plant. The frequency of sampling shall be determined by the Owner.

1303.08.02 Testing

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

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

Testing for pH shall be according to ASTM E 70.

1303.08.03 Acceptance or Rejection

Admixture properties shall be according to the product data information submitted to the Owner at the time of material evaluation for inclusion on the Owner's pre-qualified products list.

Material represented by the sample that fails to meet the requirements of this specification shall be rejected.

Acceptance tolerances shall be $\pm 2.5\%$ for non-volatile content and ± 1.0 for pH.

Where relative density is 1.050 or less, the acceptance tolerance shall be ± 0.005 .

Where relative density is greater than 1.050, the acceptance tolerance shall be calculated according to the following formula:

$$\text{Tolerance} = (\text{relative density of acceptance sample} - 1.000) / 10$$

Appendix 1303-A, April 2019
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
PACKAGED SILICA FUME DRY GROUT MIXTURE
FOR POST TENSIONING**

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1304.05	MATERIALS
1304.06	EQUIPMENT - Not Used
1304.07	PRODUCTION
1304.08	QUALITY ASSURANCE
1304.09	OWNER PURCHASE OF MATERIALS - Not Used

APPENDICES

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 Specification Significance and Use

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

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

1304.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

1304.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 910 Stressing Systems for Post Tensioning

Ontario Provincial Standard Specifications, Material

OPSS 1301 Cementing Materials
OPSS 1302 Water

CSA Standards

A23.2-1B Viscosity, Bleeding, Expansion, and Compressive Strength of Flowable Grout [Part of
CSA A23.1-19/A23.2-19, Concrete Materials and Methods of Concrete
Construction/Methods of Test and Standard Practices for Concrete]
A283-19 Qualification Code for Concrete Testing Laboratories
A3000-18 Cementitious Materials Compendium

ASTM International

C1152/C1152M Standard Test Method for Acid-Soluble Chloride in Mortar and Concrete
D962-81(2014) 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 or GUL Portland cement and silica fume.

1304.05 MATERIALS

1304.05.01 Cementing Materials

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.

1304.05.03 Aluminum Powder

Aluminum powder shall be according to ASTM D962 Type 1, Class C. 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.

1304.05.05 Grout

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. Cylinders shall be poured within five minutes of batching.
- 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.
- e) The constituent materials used shall be such that the acid-soluble chloride ion content of the mixed grout shall not exceed 0.08% by weight of the mixed grout as measured by ASTM C1152/C1152M.

1304.07 PRODUCTION

1304.07.01 Dry Grout Mixture

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

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 three 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. Testing shall be according to the Sampling and Testing clause of this specification. A minimum of six cubes shall be tested for each compressive strength determination.

The manufacturer shall establish a new compressive strength development curve every 12 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 to withstand handling and to protect the grout from contamination. Bags shall be shipped and stored with a plastic or other waterproof covering to fully protect the grout from moisture.

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

- a) Name of manufacturer.
- b) Maximum amount of water to be used per bag of dry grout mixture.
- c) 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.

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 a recognized certifying body to the requirement of 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 this specification.

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 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.

Grout cubes shall be cast as specified in OPSS 910. 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, November 2021

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.



Note: The MUNI implemented in April 2019 replaces OPSS 1305 COMMON, November 2008 with no technical content changes.

MATERIAL SPECIFICATION FOR MOISTURE VAPOUR BARRIERS

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1305.03	DEFINITIONS - Not Used
1305.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
1305.05	MATERIALS
1305.06	EQUIPMENT - Not Used
1305.07	PRODUCTION - Not Used
1305.08	QUALITY ASSURANCE
1305.09	OWNER PURCHASE OF MATERIAL - Not Used

APPENDICES

1305-A	Commentary

1305.01	SCOPE

This specification covers the requirements for materials in sheet form used to inhibit moisture loss in concrete during its curing period.

1305.01.01 Specification Significance and Use

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

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

1305.01.02 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.

1305.02 REFERENCES

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

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

ASTM International

C 171-16 Sheet Materials for Curing Concrete

1305.05 MATERIALS

The material shall be a white opaque polyethylene film according to ASTM C 171.

1305.07 PRODUCTION

1305.07.01 Labelling

Each roll shall be labelled with following information:

- a) Name of manufacturer.
- b) Type of material.
- c) Batch number.
- d) Film thickness.
- e) Roll number.

1305.08 QUALITY ASSURANCE

1305.08.01 Sampling

The Owner may take quality assurance samples of film or sheeting from rolls selected at random at the jobsite from each shipment representing material of the same type.

1305.08.02 Testing

Testing of sheeting and film shall be according to ASTM C 171.

1305.08.03 Acceptance or Rejection

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

Appendix 1305-A, April 2019
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

Related Ontario Provincial Standard Drawings

No information provided here.



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

OPSS.MUNI 1306
APRIL 2019
(Formerly OPSS 1306, November 2011)

Note: The MUNI implemented in April 2019 replaces OPSS 1306 COMMON, November 2011 with no technical content changes.

**MATERIAL SPECIFICATION FOR
BURLAP**

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1306.01	SCOPE
1306.02	REFERENCES
1306.03	DEFINITIONS - Not Used
1306.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
1306.05	MATERIALS
1306.06	EQUIPMENT - Not Used
1306.07	PRODUCTION - Not Used
1306.08	QUALITY ASSURANCE
1306.09	OWNER PURCHASE OF MATERIAL - Not Used

APPENDICES

1306-A	Commentary

1306.01	SCOPE

This specification covers the requirements for burlap used for curing concrete and for use in surface texturing of concrete pavement.

1306.01.01 Specification Significance and Use

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

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

1306.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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1306.02 REFERENCES

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

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

American Association of State Highway and Transportation Officials (AASHTO)

M182-05 (2017) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

1306.05 MATERIALS

1306.05.01 Burlap

Burlap shall be according to AASHTO M182, Class 4, and shall be free of substances that are deleterious to concrete. The burlap shall have no tears or holes.

1306.08 QUALITY ASSURANCE

1306.08.01 Sampling

The Owner may take quality assurance samples of the burlap selected at random at the job site from each shipment representing material of the same type.

1306.08.02 Testing

Testing of burlap shall be according to AASHTO M182.

1306.08.03**Acceptance or Rejection**

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

Appendix 1306-A, April 2019
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
JOINT FILLER IN CONCRETE**

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1308.07	PRODUCTION
1308.08	QUALITY ASSURANCE
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APPENDICES

1308-A	Commentary

1308.01 SCOPE

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

1308.01.01 Specification Significance and Use

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

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

1308.01.02 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.

1308.02 REFERENCES

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

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

ASTM International

D 1751-18	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
D 1752-18	Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC 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, November 2019
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Type and size of material to be supplied. (1308.05.01)

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

Related Ontario Provincial Standard Drawings

OPSD 4670.000 Construction and Expansion Joint In Concrete



Note: The MUNI published in November 2021 replaces OPSS 1312 COMMON, November 2008 with no technical content changes.

MATERIAL SPECIFICATION FOR LATEX MODIFIERS FOR USE IN CONCRETE

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

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

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 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 2021
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.



Note: The MUNI published in November 2021 replaces OPSS 1315 COMMON, November 2008 with no technical content changes.

MATERIAL SPECIFICATION FOR WHITE PIGMENTED CURING COMPOUNDS FOR CONCRETE

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1315.09	OWNER PURCHASE OF MATERIALS - Not Used
1315.10	BASIS OF PAYMENT – 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 is written as a municipal-oriented specification. Municipal-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of many municipalities in Ontario.

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

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.

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

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

1315.02 REFERENCES

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

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

Ontario 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 2021
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 CONCRETE - MATERIALS AND PRODUCTION

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APPENDICES

1350-A	Commentary
1350-B	VOC Compliant Concrete Sealers
1350-C	Concrete Patching Materials

1350.01 SCOPE

This specification covers the requirements for Materials; product supply pre-qualification; and mixing, transporting, and delivering concrete.

1350.01.01 Specification Significance and Use

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

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

1350.01.02

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.

1350.02

REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

OPSS 1001	Aggregates - General
OPSS 1002	Aggregates - Concrete
OPSS 1302	Water

Ontario Ministry of Transportation Publications

Designated Sources for Materials (DSM)

CSA Standards

A23.1-19	Concrete Materials and Methods of Concrete Construction *
A23.2-3C	Making and Curing Concrete Compression and Flexural Test Specimens *
A23.2-4C	Air Content of Plastic Concrete by the Pressure Method *
A23.2-5C	Slump and Slump Flow of Concrete *
A23.2-6C	Density, Yield, and Cementing Materials Factor of Plastic Concrete *
A23.2-8C	Flexural Strength of Concrete (Using a Simple Beam with Third-Point Loading) *
A23.2-9C	Compressive Strength of Cylindrical Concrete Specimens *
A23.2-10C	Accelerating the Curing of Concrete Cylinders and Determining Their Compressive Strength *
A23.2-13C	Splitting Tensile Strength of Cylindrical Concrete Specimens *
A283-00 (R2011)	Qualification Code for Concrete Testing Laboratories

A3000-18 Cementitious Materials Compendium
A3001 Cementitious Materials for Use in Concrete**
* [Part of A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete]
**[Part of A3000-18 - Cementitious Materials Compendium]

ASTM International

C157 / C157M 08(2014)e1	Standard Test Method for Length Change of Hardened Hydraulic-Cement, Mortar, and Concrete
C260 / C260M - 10a	Standard Specification for Air-Entraining Admixtures for Concrete
C457 / C457M - 12	Standard Test Method for Microscopical Determination of Parameters of the Air Void System in Hardened Concrete
C494 / C494M - 13	Standard Specification for Chemical Admixtures for Concrete
C1017 / C1017M - 13e1	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
C1202 - 12	Standard Test Method for Electrical Indication of Concretes Ability to Resist Chloride Ion Penetration

Ready Mixed Concrete Association of Ontario Publications (RMCAO)

R1025 Certificate of Ready Mixed Concrete Production Facilities
R1026 Certificate of Mobile Mix Concrete Production Facilities

1350.03 DEFINITIONS

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

Agitator Truck means a vehicle in which freshly mixed concrete can be conveyed from the mixing site to the Work Area while being agitated. The containment vessel can either be stationary with an agitator or it can be mobile with a drum rotated continuously so as to agitate the concrete.

Cementing Material means hydraulic cement with or without a supplementary cementing material.

Confidentiality and Indemnity Agreement means a legal agreement between an Owner and the concrete supplier as obtained from the Municipal Engineers Association (MEA) or the Ready Mixed Concrete Association of Ontario (RMCAO).

Curing means the maintenance of a satisfactory moisture content and temperature in concrete for a period of time immediately following placing and finishing so that the desired concrete properties may develop.

High Volume Supplementary Cementing Materials (HVSCM) Concrete means concrete that contains a level of supplementary cementing materials above that typically used in construction.

Hot Weather means those conditions when the air temperature is at or above 28 °C. It is also considered to exist when the air temperature is likely to rise above 28 °C within 24 hours. Temperature refers to shade temperature.

Inspector means a representative of the Owner to which the concrete is being supplied.

Limestone Filler means divided limestone powder that may be used in concrete as an aggregate in appropriate applications and exposure conditions, after its suitability is determined through physical, chemical and mineralogical testing. Limestone fillers may be used to optimize the aggregate gradation to achieve an improved concrete performance. Limestone fillers are not cementitious materials and should not be used to replace cementing material in concrete. Limestone fillers shall not be included in the calculation of the water-to-cementing materials ratio (w/cm). The water/cement shall not vary significantly with or without the use of limestone fillers. (CSA A23.1) Limestone Filler is added during concrete production.

Mobile Mix Concrete means concrete that is completely batched and mixed by a mobile mixer truck at the site.

Performance Criteria means requirements to be met as specified in the Contract Documents and as shown in form OPSF 1350-1 or OPSF 1350-2.

Portland Cement means the product obtained by pulverizing clinker consisting essentially of hydraulic calcium silicates to which calcium sulphate, limestone, water, and processing additions may be added at the option of the cement manufacturer.

Portland Limestone Cement – means cement obtained by intergrinding limestone with Portland cement clinker, as defined in CSA A3001. The addition of limestone is done at the cement manufacturing process.

Pre-Qualification Performance Criteria means requirements to be met as specified in the Contract Documents and as shown in form OPSF 1350-1 or OPSF 1350-2 and have been demonstrated through trial batches or concrete test data from a similar class of concrete as specified in the Trial Batch clause.

Ready Mixed Concrete means concrete that is completely batched at the plant and completely mixed at the plant or while in transit.

Stationary Mixer means a non-mobile mixer installed at a plant for the purpose of mixing concrete.

Supplementary Cementing Material (SCM) means material that, when used in conjunction with hydraulic cement, contributes to the properties of the hardened concrete through hydraulic or pozzolanic activity or both.

Truck Mixer means a concrete mixer mounted on a truck or other vehicle used for the complete mixing of concrete materials after they have been batched at the plant.

Water-to-Cementing Materials Ratio (W/CM) means the ratio by mass of the amount of water to the total amount of cementing material in a freshly mixed batch of concrete or mortar, stated as a decimal. The amount of water does not include that absorbed by the aggregate.

1350.04 DESIGN AND SUBMISSION REQUIREMENTS

1350.04.01 Design Requirements

1350.04.01.01 Mix Design Alterations

The Contractor may make minor alternations to the stated mix proportions in order to maintain compliance with the overall performance requirements as specified in the Contract Documents. Such deviations shall be according to CSA A23.1.

A minimum of 24 hours notice of deviations in the mix design that alter the sources of supply or the fundamental characteristics of the mix shall be given to the Owner by the Contractor. Resubmission of form OPSF 1350-1 and, if applicable, form OPSF 1350-2, shall be made for such deviations.

1350.04.02 Submission Requirements

Submissions for the performance or prescriptive specification alternative requirements shall be made based on the specification alternative as specified in the Contract Documents.

1350.04.02.01 Performance Specification Alternative

In the case of the performance specification alternative, the Contractor shall be solely responsible for the concrete mix design and to ensure that the requirements of CSA A23.1* and this specification have been met.

At least 14 Days prior to placing any concrete, the Contractor, in concert with the concrete supplier, shall:

- a) Establish the concrete mix properties to meet performance criteria for plastic and hardened concrete, after considering the Contractor's methods for construction and placement and the Owner's performance criteria as specified in the Contract Documents.
- b) Submit documentation demonstrating the Owner's pre-qualification performance criteria can be met.
- c) Prepare, submit, and implement a quality control plan to ensure that the Owner's performance criteria can be met. When specified in the Contract Documents, submit documentation demonstrating that the Owner's performance requirements have been met.
- d) Ensure that the concrete supplier submits the following to the Contractor to forward to the Owner.
 - i. Certification that the plant, equipment, and all materials to be used in the concrete comply with the requirements of this specification.
 - ii. Certification that the mix design satisfies the requirements of this specification.
 - iii. Certification that the production and delivery of concrete will meet the requirements of this specification.
 - iv. Certification that the concrete complies with the specified performance criteria.
- e) Provide documentation verifying that the concrete supplier's plant and equipment meet the plant certification requirements of the RMCAO Approved Quality Program.

1350.04.02.01.01 Performance Based Concrete Mix Data

At least 2 weeks prior to the delivery of concrete, the Contractor shall submit to the Owner the attached form OPSF 1350-1 detailing the material and sources of materials to be used for each class of concrete. The form shall be completed for all concrete supplied to the project.

The quantity of chemical admixtures shall be at least the minimum dose specified in the Contract Documents. The Contractor may deviate from the specified minimum dose due to weather conditions and changes in materials. However, written notification of this change shall be provided to the Contract Administrator at least 24 hours prior to the delivery of the concrete by the Contractor.

1350.04.02.01.02 Mix Design Confidentiality and Indemnity Agreement

The Contractor shall ensure that the concrete supplier submits a confidential concrete mix design for the Contract to the Owner on the attached form OPSF 1350-2, when requested by the Contract Administrator, and only after a confidentiality agreement has been signed between the Owner and the concrete supplier.

At least 2 weeks prior to the placing of any concrete, the Owner and the concrete supplier shall execute a confidentiality agreement to cover the protection of proprietary mix proportion information that is to be released as part of form OPSF 1350-2.

1350.04.02.02 Prescriptive Specification Alternative

In the case of the prescriptive specification alternative, the Owner shall be solely responsible for the concrete mix design and to ensure that the requirements of CSA A23.1 and this specification have been met.

The Contractor, in concert with the concrete supplier, shall:

- a) Plan the construction methods based on the Owner's mix proportions and parameters.
- b) Obtain approval from the Owner for any deviations from the specified mix design or parameters.
- c) Identify to the Owner any anticipated problems or deficiencies with the mix parameters related to construction.
- d) Provide verification that the plant, equipment, and materials to be used in the concrete comply with the requirements of this standard.
- e) Demonstrate that the concrete complies with the prescriptive criteria as supplied by the Owner.

1350.04.02.03 Ready Mixed Concrete Operation or Mobile Mix Concrete Operation

At least 1 week prior to the delivery of concrete to the Work Area, the Contractor shall submit to the Owner a current valid R1025 Certificate of Ready Mixed Concrete Production Facilities or a current valid R1026 Certificate of Mobile Mix Concrete Production Facilities for the plant being used to produce ready mixed concrete, issued under the Approved Quality Program as outlined in the publications, Certificate of Ready Mixed Concrete Production Facilities and Certificate of Mobile Mix Concrete Production Facilities.

1350.04.02.04 Concrete Delivery Ticket

The concrete supplier shall provide 2 copies of the delivery ticket to the Contractor immediately following unloading at the Work Area. The Contractor shall provide one copy of each delivery ticket to the Owner within 1 Business Day of completion of the placement. The concrete delivery ticket shall include:

- a) Name and location of plant.
- b) Date and serial number of the ticket.
- c) Name of Contractor.
- d) Specific designation of the job by name and location.
- e) Specified class or designation of the concrete.
- f) Volume of concrete.
- g) Truck number and cumulative total or load number.
- h) Time stamped when mixing of cement and aggregates commences.
- i) Ordered slump.
- j) Time that the discharge of load was completed.
- k) Amount of water added after batching, authorization, and units used.
- l) Amount and type of admixtures added after batching.

1350.05 MATERIALS

1350.05.01 Materials for Concrete

1350.05.01.01 Cementing Materials

Cementing materials shall be according to CSA A3000.

Portland cement shall be used; however, a portion of it may be replaced by SCM. The SCM shall be ground granulated blast furnace slag, fly ash, or silica fume or any combination of two or all of the materials.

The mass of Portland cement and all SCMs contained in a concrete mix shall be specified on form OPSF 1350-2, if applicable. Furthermore, the Contractor shall disclose on form OPSF 1350-1 and, if applicable, form OPSF 1350-2, when the mix design is classified as a HVSCM as specified in CSA A23.1.

HVSCM 1 concrete shall only be used with prior written approval of the Owner.

Neither slag nor fly ash shall be used for lean concrete base, unless trial mix tests are performed and the results show that the performance requirements of the Owner have been met.

Portland limestone cement may be used in place of Portland cement only when the supplier of the Portland limestone cement is included in the Designated Sources for Material list. Concrete made with Portland cement and Portland limestone cement shall not be used in the same component. Portland limestone cement shall not be used in combination with limestone filler.

1350.05.01.02 Aggregates

Aggregates shall be according to OPSS 1001 and OPSS 1002.

The maximum nominal size of the aggregate shall not exceed 19.0 mm.

Limestone filler shall comply with the following:

- a) The requirements of OPSS 1002 for mineral filler
- b) The requirements of CSA A23.1, Annex L, L2 Organic Impurities, and
- c) The requirements of CSA A3001, Clause 4.4.3 a) for calcium carbonate content

Limestone filler shall be restricted to a maximum of 15% of the cement by mass.

1350.05.01.03 Water

Water for concrete shall be according to OPSS 1302.

1350.05.01.04 Air Entraining and Chemical Admixtures

Air entraining chemical admixtures shall be according to the ASTM C 260.

Chemical admixtures shall be according to ASTM C 494M or when flowing concrete is specified, it shall be according to ASTM C 1017M.

The Contractor shall ensure that the chemical admixtures to be used are compatible with each other and that the performance of the concrete will not be negatively affected.

The Contractor shall use only chemical admixtures specified in the Contract Documents. Specialty chemical admixtures may be used when approved by the Owner.

1350.05.02 Performance Requirements for Concrete

1350.05.02.01 General

In instances where there are conflicts between this specification and other standards, the most stringent performance requirements shall apply.

1350.05.02.02 Exposure Classes of Concrete

Concrete having various exposure classifications shall meet the most stringent requirements of CSA A23.1, Tables 1, 2, and 3.

Classification A exposures do not apply to this specification.

1350.05.02.03 Compressive Strength

The concrete compressive strength shall be according to CSA A23.1, Tables 1, 2, and 3, and as specified in the Contract Documents.

1350.05.02.04 Air Content

The total air content of the concrete, measured with an air meter immediately prior to placing, shall be as shown in CSA A23.1, Table 4. Nominal maximum sizes of coarse aggregate shall be according to CSA A23.1, Table 4 (i.e., 10 mm, 14-20 mm, and 28-40 mm shall be 9.5 mm, 13.2-19.0 mm, and 28-40 mm, respectively).

Air content in hardened concrete shall meet the requirements of CSA A23.1, clauses 4.3.3.2 and 4.3.3.3, and the requirements as shown in Table 3 of this specification.

1350.05.02.05 Slump

Slump shall be consistent with the placement and consolidation methods, equipment, and site conditions.

Slump requirements shall be identified and reviewed by the Contractor and concrete supplier prior to construction. The tolerances for concrete slump acceptance and rejection in the Work Area shall be as follows:

- a) Slumps less than 80 mm - the maximum allowable variation shall be ± 20 mm.
- b) Slumps between 80 to 180 mm - the maximum allowable variation shall be ± 30 mm.
- c) Slumps greater than 180 mm - the maximum allowable variation shall be ± 40 mm.

Slump shall be measured according to CSA A23.2-5C. Maximum slump of concrete shall be 240 mm, provided no segregation of the concrete occurs.

1350.05.02.06 Within Batch Uniformity of Concrete

If, in the opinion of the Contract Administrator, there is evidence of non-uniformity of the mixed concrete from a particular mixer, tests shall be carried out by the Contractor on 3 samples of concrete obtained from widely separate portions of the batch while the mixer is being completely emptied at normal operating rate to evaluate the mixing equipment.

Samples shall not be taken prior to 10% or after 90% of the batch has been discharged.

The minimum size of sample shall be 30 litres.

Between samples, the mixer shall not be allowed to turn in the mixing direction. Water shall not be added to the batch at any time after sampling has started.

The following criteria and that of CSA A23.1, Table 13, shall be used to judge whether or not the equipment under test is producing uniform concrete:

- a) Where the result of each test is equal to or less than the acceptance limit, the concrete shall be considered uniform.
- b) Where the result of any single test is greater than the rejection limit, the concrete shall be considered non-uniform.
- c) If a test result falls between acceptance limit and rejection limit, additional tests shall be made on the next consecutive batch or load delivered by that unit.

If, after testing one additional batch or load, the test falls outside the acceptance limit, the equipment shall be rejected.

1350.06 EQUIPMENT

1350.06.01 Batching Plant

The batching plant and equipment shall be according to the certification requirements of the RMCAO.

The batching plant shall have direct communication with the placement operation.

1350.06.02 Mixing Equipment

All mixers shall be according to the certification requirements of RMCAO and shall be capable of discharging the concrete so that the uniformity requirements of CSA A23.1, Table 13, are met.

1350.06.03 Non-Agitating Delivery Equipment

The concrete containment area of non-agitating delivery equipment shall be a smooth watertight steel container equipped with gates that will permit control of the concrete discharge.

1350.07 PRODUCTION

1350.07.01 General

A manufacturer producing ready mixed concrete shall possess a current valid Certificate of Ready Mixed Concrete Production Facilities or a current valid Certificate of Mobile Mix Concrete Production Facilities for the plant being used to produce ready mixed concrete, issued under the Approved Quality Program as outlined in the publications, Certificate of Ready Mixed Concrete Production Facilities and Certificate of Mobile Mix Concrete Production Facilities.

The entire contents of the truck mixer shall be discharged prior to recharging. When any ingredient is added after initial batching, the volume of material in the drum shall not exceed the mixing capacity of the drum.

Proper facilities shall be provided to enable inspection of the quality of the materials used in the production of the concrete. The inspector shall be provided with all reasonable facilities for securing samples to determine whether the concrete and its materials are being supplied according to this specification. Owners wishing to obtain samples of the various raw materials from the concrete supplier shall provide advance notice to the concrete supplier and comply with all concrete supplier health and safety policies.

Where test results fail to meet the minimum requirements of this specification and the Owner and the concrete supplier have already executed a confidentiality agreement, the Contractor shall ensure that the batch records retained by the concrete supplier under the Approved Quality Program shall be made available to the Owner within 5 Business Days of a written request. The Owner shall treat these records in the same manner as form OPSF 1350-2 and they shall remain the confidential information of the concrete supplier.

1350.07.02 Temperature Control

The concrete temperature at the time of discharge from the truck shall be between 10 and 28 °C.

1350.07.03 Records and Reporting

In addition to the batch records required to conform to the Approved Quality Program, the Contractor shall record the following information on the concrete delivery tickets, when applicable:

- a) The method used to control the temperature of the concrete during hot weather conditions.
- b) The method used to extend the discharge time of the concrete beyond 1.5 hours after introduction of the mix water during hot weather conditions.
- c) The type and quantity of any materials added to the concrete after leaving the batch plant, and the time that each material was added.

1350.07.04 Concrete Strengths 35 MPa or Greater

1350.07.04.01 Trial Batch

The mix properties for concrete with strengths of 35 MPa or greater shall be confirmed by the performance of a trial batch. The trial batch shall confirm all the performance properties identified for a particular class of concrete in CSA A23.1, Table 2, through the following tests:

- a) Slump.
- b) Plastic air content.
- c) Compressive strength.
- d) Hardened Air Void System (AVS).

The testing of the field trial batch of concrete shall be the responsibility of the Contractor.

At least 30 Days prior to placing concrete with strengths of 35 MPa or greater, the Contractor shall mix a full size trial batch of concrete in the proportions stated in the mix design.

When the concrete is mixed within a truck mixer, the volume of the trial batch shall be the same as the volume of concrete normally mixed in the truck.

When the source of concrete is a ready mixed concrete plant, the trial batch of concrete shall originate from the primary plant to be used for the supply of the concrete and be delivered to the Work Area.

When the approved ready mixed concrete operation is currently supplying or has supplied a similar class of concrete within the last 6 months, permission may be given by the Owner to use concrete test data from that operation without the need for full size field trial batch, providing:

- a) There is no change in the source of any material.
- b) The performance characteristics of the aggregates have not changed significantly.
- c) The concrete mix designated and previously used meets the specified performance requirements.
- d) Documentation of this prior approval is submitted to the Owner.

1350.07.04.02 Early Compressive Strength Determination of Mix Design

When approved by the Owner, accelerated compressive strengths shown in Table 1 may be used to predict the 28-Day compressive strength of the proposed concrete mix.

The cylinders shall be tested according to CSA A23.2-10C using the autogenous curing test procedure.

1350.07.05 Ready Mixed Concrete

1350.07.05.01 Delivery of Ready Mixed Concrete

1350.07.05.01.01 General

The concrete shall be delivered to the Work Area without segregation in a thoroughly mixed and uniform mass and be discharged with the uniformity required in CSA A23.1, Table 13.

1350.07.05.01.02 Delivery by Non-Agitating Equipment

Concrete that is completely mixed in a stationary mixer may be transported in non-agitating equipment.

Covers shall be used to provide protection to the concrete during inclement weather.

Discharge of concrete shall be completed within 30 minutes of the introduction of the mixing water to the cement and aggregates.

1350.07.05.01.03 Delivery by Agitator or Mixer Trucks

After completion of mixing, concrete shall be transported to the Work Area by means of agitator trucks or truck mixers. The equipment shall be operated at the agitation speed of rotation designated by the manufacturers of the truck.

When concrete is transported to the site by means of agitating or mixing equipment, discharge of the concrete shall be completed within 1.5 hours after introduction of the mixing water to the cement and aggregates, except when the air temperature exceeds 28 °C and the concrete temperature exceeds 25 °C, the concrete shall be discharged within 1 hour after the introduction of the mixing water.

These times may be extended using a set retarder, provided the Owner approves such use.

1350.07.05.01.03.01 Site Addition of Materials

When a truck mixer is used at agitating capacity, no adjustment shall be made to the load of concrete.

In the case of the performance specification alternative, only the concrete supplier, in concert with the Contractor, shall undertake the site addition of materials to the mixer.

When the measured slump of the concrete is less than that specified in the mix design, water may be added by the concrete supplier, in concert with the Contractor, to bring the concrete up to the designated slump, provided the following criteria are met:

- a) The specified water-to-cementing materials ratio is not exceeded.
- b) No more than 60 minutes has elapsed from the time of batching.
- c) Addition of water is only at the start of discharge (i.e., not more than 10% of the concrete has been discharged).
- d) Not more than the lesser of 16 L/m³ or 10% of the mixing water shall be added.

Air entraining admixture may be added to the load of concrete by the concrete supplier, in concert with the Contractor, prior to discharge, to increase the air content to that specified in the mix design. The use of detraining admixtures to lower the air content of concrete is prohibited.

When any material is added to the concrete, the concrete supplier shall thoroughly mix the load of concrete to meet the uniformity requirements of CSA A23.1, Table 13.

1350.08 QUALITY ASSURANCE

1350.08.01 General

The Owner shall be allowed access to all sampling locations and reserves the right to request a quality assurance (QA) sample at any time from the Contractor. The Contract Administrator may elect to carry out testing of the QA sample to ensure that material used in the Work is according to the requirements of this specification. Testing shall be carried out at a laboratory designated by the Owner. The Owner shall be responsible for all costs associated with QA testing.

Samples of aggregates, cementing materials, water, chemical admixtures, and air entraining admixtures representative of the materials to be used in the work shall be provided, when requested by the Owner.

1350.08.02 Sampling and Testing

1350.08.02.01 General

1350.08.02.01.01 Quality Assurance Testing Staff and Laboratory Requirements

Field sampling and testing of concrete shall be performed by a person holding either of the following certifications:

- a) CCIL Certified Concrete Testing Technician, Concrete Testing and Sampling Certificate, or
- b) ACI Concrete Field Testing Technician - Grade 1.

This person shall have a valid original card issued by the certifying agency in his or her possession at all times.

Laboratory tests shall be completed by a laboratory certified according to CSA A283 for the category appropriate to the test required by CSA.

1350.08.02.01.02 Quality Assurance Test Reporting

Concrete test reports shall be immediately distributed electronically to the Owner, Contractor, and concrete supplier. The test results shall include the following information for each individual mix design:

- a) Project identification.
- b) A graphical representation of the specified and actual compressive strength data.
- c) The average strength value for each age that the concrete is tested.
- d) Average slump value for the mix design.
- e) Average plastic air content for the mix design.

Testing shall be completed as shown in Table 2.

1350.08.02.02 Air Content in Hardened Concrete

The air void system in the hardened concrete may be performed on cast cylinder specimens. The air void system shall be tested according to ASTM C 457.

1350.08.02.03 Testing for Uniformity of Mixed Concrete

When required by the Owner, tests to determine the within-batch uniformity of mixed concrete shall be according to the Within Batch Uniformity of Concrete clause, except the acceptance and rejection limits for uniformity shall be according to CSA A23.1, Table 13.

1350.08.02.04 Strength Tests and Requirements

1350.08.02.04.01 Compressive Strength

For the purpose of concrete acceptance on the basis of concrete strength, cylinders shall be made and cured according to CSA A23.2-3C, under standard moisture and temperature conditions, and tested according to CSA A23.2-9C.

A compressive strength test result is the average strength of two standard 100 x 200 mm or 150 x 300 mm concrete cylinders that are representative of concrete taken from one batch of concrete.

To conform to the specified nominal minimum 28-Day compressive strength requirements:

- a) The average of all groups of 3 consecutive strength tests shall be equal to or greater than the specified strength.
- b) No individual strength test shall be more than 3.5 MPa below the specified strength.

Concrete not meeting these requirements shall be subject to removal and replacement; however the Contractor may submit a proposal in writing for the Owner's consideration for acceptance of such concrete.

1350.08.02.04.02 Flexural Strength

Concrete for pavement and base shall meet the requirements for compressive strength and also flexural strength as stated here. The minimum flexural strength shall be 3.8 MPa at 10 Days.

A flexural strength test is the average of 2 breaks on a standard beam test specimen that is representative of concrete taken from one batch of concrete.

Flexural strength test beams shall be made and cured according to CSA A23.2-3C, depending on the particular circumstances. The method of testing shall be according to CSA A23.2-8C.

Alternatively, a splitting tensile test may be carried out instead of the flexural strength test. One splitting tensile test shall be considered to be the average of 2 standard cylinders that are representative of concrete taken from one batch of concrete. The splitting tensile test cylinders shall be according to CSA A23.2-3C. The method of testing shall be according to CSA A23.2-13C. The minimum splitting tensile strength shall be 2.8 MPa at 10 Days.

To conform to the specified nominal minimum 10-Day strength requirements, the average of all sets of 3 consecutive strength tests shall be equal to or greater than the specified strength.

TABLE 1
2-Day Accelerated Compressive Strengths

Minimum 28-Day Compressive Strengths MPa	Corresponding 2-Day Accelerated Compressive Strengths MPa
20	8.4
25	12.9
30	17.4
35	21.9
40	26.4

TABLE 2
Quality Assurance Tests

Required Test	Test Method
Slump of Concrete	CSA A23.2-5C
Air Content	CSA A23.2-4C
Compressive Strength	CSA A23.2-3C and CSA A23.2-9C
Accelerating the Cure of Concrete Cylinders and Determining Their Compressive Strength (Accelerated Cured)	CSA A23.2-10C
Yield	CSA A23.2-6C
Chloride Ion Penetrability Test	ASTM C 1202
Linear Shrinkage Test	ASTM C 157M (Note 1)
Note: 1. Drying shall commence after 7 Days of wet curing.	

TABLE 3
Hardened Concrete Air Void System Requirements

Class of Exposure	Total Air Content %	Spacing Factor mm
C-XL, C1, C2, and F1	3.0 minimum	0.230 maximum mean 0.260 maximum individual
Concrete with water/cementing ratios of 0.36 or less	3.0 minimum	0.250 maximum mean 0.300 maximum individual

Concrete Mix Design Submission

Contract _____ Date Submitted _____
 Location _____ Submitted To _____
 Contractor _____ Contact _____
 Batch Plants: Primary _____ Secondary _____

Concrete Supplier: Name _____
 Address _____
 City/Province _____
 Telephone _____ Fax _____ Email _____

MIX CODE					
Application / Element / Location					
SPECIFICATION	Structural Requirements				
	- CSA Exposure Class				
	- Maximum W/CM				
	- Minimum Specified Strength, MPa @ Days				
	- Nominal Maximum Aggregate Size, mm				
	- HVSCM Type 1 or 2				
	- Plastic Air Content, %				
	Durability Requirements				
	- Exposure to Sulphate Attack				
	- Alkali Aggregate Reactivity				
	Architectural Requirements				
	- Colour / Texture				
- Other					
CONTRACTOR REQUIREMENTS	Rate, m ³ /h				
	Quantity, m ³				
	Slump Range, mm				
	Strength @ Age, MPa @ Days				
	Other				
	Specialty Information				
	- Concrete Set, Delay, Normal, Accelerated				
	Method of Placement				
MATERIALS SECTION	Material	Source			
	Cement				
	SCM - Slag				
	SCM - _____				
	Water				
	Fine Agg.				
	Coarse Agg.				
	A.E.A.				
	W.R.				
	S.P.				

Form Submitted By:

Print Name: _____ **Signature:** _____ **Date:** _____

Contractor's Representative Receiving Form:

Print Name: _____ **Signature:** _____ **Date:** _____

CONFIDENTIAL - Concrete Mix Design Submission

Contract _____ Date Submitted _____
 Location _____ Submitted To _____
 Contractor _____ Contact _____
 Batch Plants: Primary _____ Secondary _____

Concrete Supplier: Name _____
 Address _____
 City/Province _____
 Telephone _____ Fax _____ Email _____

MIX CODE						
Application / Element / Location						
SPECIFICATION	Structural Requirements					
	- CSA Exposure Class					
	- Maximum W/CM					
	- Minimum Specified Strength, MPa @ Days					
	- Nominal Maximum Aggregate Size, mm					
	- HVSCM Type 1 or 2					
	- Plastic Air Content, %					
	Durability Requirements					
	- Exposure to Sulphate Attack					
	- Alkali Aggregate Reactivity					
	Architectural Requirements					
	- Colour / Texture					
- Other						
CONTRACTOR REQUIREMENTS	Rate, m³/h					
	Quantity, m³					
	Slump Range, mm					
	Strength @ Age, MPa @ Days					
	Other					
	Specialty Information					
	- Concrete Set, Delay, Normal, Accelerated					
	Method of Placement					
MATERIALS SECTION	Material	Source	Unit	Quantity		
	Cement		kg/m³			
	SCM - Slag		kg/m³			
	SCM -		kg/m³			
	Water		L/m³			
	Fine Agg.					
	Coarse Agg.					
	A.E.A.		mL/100 kg			
	W.R.		mL/100 kg			
	S.P.		mL/100 kg			

Form Submitted By:

Print Name: _____ Signature: _____ Date: _____

Municipal Representative Receiving Form:

Print Name: _____ Signature: _____ Date: _____

Appendix 1350-A, November 2019 FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

This specification is intended for use by municipalities requiring ready mixed concrete.

The designer shall specify the following in the Contract Documents:

- The Owner's choice of concrete specification alternatives, either Performance Specifications or Prescriptive Specifications. (1350.04.02)

The designer should specify the following in the Contract Documents:

- Minimum dose of chemical admixtures. (1350.04.02.01.01)
- Chemical admixtures. (1350.05.01.04)

The designer should determine if a quality control program is to be prepared and implemented. If so, the requirement for it should be specified in the Contract Documents. (1350.04.02.01)

The designer may consider the following and specify this requirement for air content in hardened concrete in the Contract Documents:

When the approved ready mixed concrete operation is currently supplying or has supplied a similar class of concrete within the last 6 months, permission may be given to waive this testing requirement, providing that:

- a) There is no change in the source of any material.
- b) The concrete mix designated and used previously meets the specified performance requirements.
- c) Documentation of this prior approval is submitted to the Owner.

Where the designer considers the use of Self-Consolidating Concrete (SCC) a special provision shall be written and provided in Contract Documents.

CSA A23.1, Table 5, lists the alternative methods for specifying concrete. The designer should review this table when determining which concrete specification alternative is to be used in the Contract. CSA A23.1, Annex J, discusses the selection of alternatives for specifying concrete requirements. These alternatives include:

Performance - When the Owner requires the concrete supplier to assume the responsibility for performance of the concrete as delivered and the Contractor to assume responsibility for the concrete in place.

For this alternative, the Owner shall specify the following in the Contract Documents:

- a) Required structural criteria including strength at age.

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- b) Required durability criteria including class of exposure.
- c) Additional criteria for durability, volume stability, architectural requirements, sustainability, and any additional Owner performance, pre-qualification or verification criteria.
- d) Quality management requirements.
- e) Certification of the concrete supplier through the Approved Quality Program.
- f) Any other properties that may be required to meet the Owner's performance requirements.

Prescriptive - When the Owner assumes responsibility for the performance of the concrete.

For this alternative, the Owner shall specify the following in the Contract Documents:

- a) Mix proportions, including the quantities of any or all materials (admixtures, aggregates, cementing materials, and water) by mass per cubic metre of concrete;
- b) The range of air content;
- c) The slump range;
- d) Use of a concrete quality plan, if required;
- e) Other requirements.

CSA A23.1, Annex K, discusses concrete made with a high volume of supplementary concreting materials (HVSCM).

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 Standards Drawings

No information provided here.

Appendix 1350-B, November 2019
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.

TABLE 1
Protection against chloride ion ingress and scaling

Product	Description		Material Type	Source
MasterProtect H 1000	Single component	Clear	100% silane	BASF Master Builders Solutions
Protectosil 300C	Single component	Clear	100% silane w/ corrosion inhibitor	DRE Industries Inc.
1) Sikagard SN40 Lo VOC + 2) Sikagard Color A50 Lo VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	Sika Canada Inc.
1) Sikagard SN 100 + 2) Sikagard Color A50 LoVOC	Two component	Pigmented	1)100% silane and 2) pigmented acrylic top coat	
1) Sikagard SN 100 + 2) Sikagard 550W Elastic	Two component	Pigmented	1) 100% silane and 2) pigmented acrylic top coat	
1) Gem-Gard SL Plus (VOC) + 2) Rain-Shield Stain OP SB VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	W.R. Meadows of Canada/ Gemite

TABLE 2
Protection against scaling

Product	Description		Material Type	Source
MasterProtect H 1000	Single component	Clear	100% silane	BASF Master Builders Solutions
Protectosil 300C	Single component	Clear	100% silane w/ corrosion inhibitor	DRE Industries Inc.
1) Sikagard SN40 Lo VOC + 2) Sikagard Color A50 Lo VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	Sika Canada Inc.
1) Sikagard SN 100 + 2) Sikagard Color A50 LoVOC	Two component	Pigmented	1)100% silane and 2) pigmented acrylic top coat	
1) Sikagard SN 100 + 2) Sikagard 550W Elastic	Two component	Pigmented	1) 100% silane and 2) pigmented acrylic top coat	
Weather Worker S100 (J-29-A)	Single component	Clear	100% silane	Dayton Superior Canada Ltd.
1) Gem-Gard SL Plus (VOC) + 2) Rain-Shield Stain OP SB VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	W.R. Meadows of Canada/ Gemite
Sealmaster 100%	Single component	Clear	100% silane	Technical Barrier Systems Inc.

Appendix 1350-B, November 2019
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.

TABLE 3
For low temperature application - Protection against chloride ion ingress and scaling

Product	Description		Material Type	Min. Rec. Ambient Temperature for Application (°C)	Source
Protectosil 300C	Single component	Clear	100% silane	-6.5	DRE Industries Inc.
1) Sikagard SN40 Lo VOC + 2) Sikagard Color A50 Lo VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	0	Sika Canada Inc.
1) Sikagard SN 100 + 2) Sikagard Color A50 LoVOC	Two component	Pigmented	1)100% silane and 2) pigmented acrylic top coat	0	
1) Gem-Gard SL Plus (VOC) + 2) Rain-Shield Stain OP SB VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	0	W.R. Meadows of Canada/ Gemite

TABLE 4
For low temperature application - Protection against scaling

Product	Description		Material Type	Min. Rec. Ambient Temperature for Application (°C)	Source
Protectosil 300C	Single component	Clear	100% silane	-6.5	DRE Industries Inc.
Weather Worker S100 (J-29-A)	Single component	Clear	100% silane	0	Dayton Superior Canada Ltd.
1) Sikagard SN40 Lo VOC + 2) Sikagard Color A50 Lo VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	0	Sika Canada Inc.
1) Sikagard SN 100 + 2) Sikagard Color A50 LoVOC	Two component	Pigmented	1)100% silane and 2) pigmented acrylic top coat	0	
1) Gem-Gard SL Plus (VOC) + 2) Rain-Shield Stain OP SB VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	0	W.R. Meadows of Canada/ Gemite

Appendix 1350-C, November 2019

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Product	Use for Repairs to: [1]		Applications [2]			High Early Strength [3]	Self Level	Ambient Working Temperature Range (Celsius)	Application Thickness (mm)	Working Time (minutes)	Contains Aggregate [4] Y/N	Option to Extend w/ Aggregate [5] (Y/N)	Binder [6]	Comments from Manufacturers Recommendations
	NC	HPC	OH	V	H									
BASF MasterEmaco N 400	✓	✓	✓	✓	✓	✓		≥ 4	76	> 15	N	N	N-C & P	Two components, (Latex) polymer modified lightweight repair mortar, grey colour, dry cure, single lifts up to 76 mm in thickness on vertical surfaces and up to 38mm in thickness on overhead surfaces (without the use of form work).
BASF MasterEmaco N 400 RS	✓	✓	✓	✓	✓			≥ 7	max 38	< 15	N	N	N-C & P	Two components, (Latex) polymer modified rapid setting repair mortar, grey colour, dry cure, single lifts up to 76 mm in thickness on vertical surfaces and up to 38mm in thickness on overhead surfaces (without the use of form work).
BASF MasterEmaco S 440 MC	✓	✓	✓	✓	✓	✓		≥ 4	19 to full	> 15	Y	N	C	Flowable concrete, self compacting for large volume repairs, grey colour, wet cure, contains #4 aggregate. Form & Pump/Pour material.

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	NC	HPC	OH	V	H									
BASF MasterEmaco T 310 CI	✓	✓			✓			≥ 7	6 to 25	> 15	Y	Y	C	Flowable, lab working time 30 min, dark colour, wet cure for 24h, can be extended with aggregate.
BASF MasterEmaco T 1060	✓	✓			✓	✓		4		< 15	Y	Y	C	Rapid set repair mortar, brown/yellow colour, can be extended with aggregate.
BASF MasterEmaco S 466 CI	✓	✓	✓	✓	✓			≥ 7	25 to 200	> 15	Y	Y	C	Flowable/pourable concrete for large volume repairs, grey colour, wet cure, contains pea size aggregate Extension recommended for placement over 8" thick.
BASF MasterEmaco T 430	✓	✓			✓	✓		-7 to +38	min 13	> 15	Y	Y	C	Yellow/brown colour, wet cure for 24h, contains #4 sand, can be extended with aggregate.
BASF MasterEmaco N 425	✓	✓	✓	✓	✓			4 to 32	max 50	< 15	N	N	C	Polymer modified, silica-fume-enhanced fibre repair mortar, grey colour, wet cure for 3 days.

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	NC	HPC	OH	V	H									
BASF MasterEmaco S 440	✓	✓	✓	✓	✓			≥ 4	25 to full	> 15	Y	N	C	Flowable/pourable concrete for large volume repairs, grey colour, wet cure, contains pea size aggregate
BASF MasterEmaco T 545 S MasterEmaco T 545 HT	✓	✓			✓	✓		Standard: ≤ 29 HW: 29 to 38	13 to 51	< 15	N	Y	N-C & MP	Magnesium Phosphate, rapid set repair mortar (paste), Two types: standard type has a temperature range of less than 29°C , hot weather type has range of +29°C to 38°C , can be extended with aggregate
BASF MasterEmaco T 1060 EX	✓	✓			✓			4 to 29	38 to full	<15	Y	N	C	Rapid set repair mortar pre-extended with coarse aggregate.
CPD FASTCRETE ULTRA	✓	✓	✓	✓	✓	✓			3 to 38	12 - 15	N		N-C & P	All areas to be patched must be pre-dampened with water and receive a slurry bond coat immediately prior to placing the product.

Appendix 1350-C, November 2019

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	NC	HPC	OH	V	H									
CPD FASTCRETE (OH GRADE)	✓	✓	✓	✓	✓	✓		≥ 5	min 6.4	<10	N	N	N-C & P	Fast setting and not recommended for structural grouting applications.
CPD RAPID CRETE	✓				✓			23	min 13	>25	N	Y	C	Wet curing of all patches and exposed grout areas is required as specified. Curing by application of a film forming curing compound is not recommended as a direct substitute for wet curing.
Five Star Structural Concrete	✓			✓	✓	✓	✓	2 to 21	6 to 300	> 15	Y	Y	C	Flowable, Formed (must be moist cured for 1 hour or greater), develops 17.2 MPa in 3 hours.
Five Star Structural Concrete V/O	✓		✓	✓	✓	✓		2	min 6	> 15	N	N	C	Can be trowel overhead (must be moist cured for minimum 30mins after final set), develops 17.2 MPa in 3 hours.

Appendix 1350-C, November 2019

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	NC	HPC	OH	V	H									
Five Star Rapid Repair fiber mortar	✓			✓	✓	✓	✓	-18 to 37	12.7 to 152.3	5 -10	N	Y	P	Flowable, formed (must be moist cured for 1 hour or greater), develops 17 MPa in 3 hours.
Five Star Highway Patch	✓			✓	✓	✓		2 to 21	min 25	10	N	Y	C	Placement shall be continuous to avoid cold joints. Repair material shall be protected from freezing until it reaches 6.9 MPa. Never exceed the maximum water content as stated on the package, as this may lead to segregation.
CTS Rapid set Cement All	✓	✓			✓	✓		7 to 32	max 100	< 15	N	N	C	Water cured. Thickness from featheredge to a maximum of 10cm.
CTS Rapid set Concrete Mix	✓	✓			✓	✓		7 to 32	50 to 610	< 15	Y	N	C	Water cured.
EUCLID VERTICOAT SUPREME	✓		✓	✓	✓			7 to 32	6 to 50	> 15	N	N	C & P	Dry polymer in bag and pre-measured water. Trowel application. Corrosion inhibitor included. Wet cure for 3 days.

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	NC	HPC	OH	V	H									
EUCLID CONCRETE TOP SUPRIME	✓		✓	✓	✓			7 to 32	10 to 50	> 15	Y	Y	C & P	Dry polymer in bag and pre-measured water. Aggregate required for thickness over 50mm up to 200mm. Corrosion inhibitor included.
EUCLID EUCOCRETE	✓	✓		✓	✓			7 to 32	25 to 150	> 15	Y	Y	C & P	Dry polymer in bag and pre-measured water. Aggregate required for thickness over 50mm up to 200mm. Corrosion inhibitor included.
EUCLID EUCOSPEED MP	✓	✓	✓	✓	✓	✓		-17 to 29	12 to 25	< 15	Y	Y	MP	Pea gravel required for thicknesses over 25mm up to 200mm. Do not extend with limestone aggregate. Do not let the product come in contact with galvanized steel. Do not featheredge. Do not place over carbonated concrete.
EUCLID VERSASPEED	✓	✓			✓	✓		-7 to 29	6 to 25	> 15	Y	Y	C	Aggregate required for thicknesses greater than 50 mm up to 152 mm.

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	NC	HPC	OH	V	H			(Celsius)	(mm)	(minutes)	Y/N	(Y/N)		
EUCLID EUCOSPEED	✓	✓			✓			4 to 32	12 to 50	< 15	Y	Y	C	Aggregate required for thicknesses greater than 50 mm up to 150 mm.
EUCLID THINTOP SUPREME	✓				✓			7 to 38	1.6 to 10	> 15	N	N	C & P	Very high shrinkage, use for thin coats only. Dry Polymer in bag and pre-measured water. Corrosion inhibitor included. Trowel application. Do not wet cure.
WEBER.cem HB40	✓		✓	✓	✓			> 5	Min 10 V: max 75 OH: max 50	> 15	N	N	C & P	Contains fibres and spray dried acrylic polymer.
WEBER.cem Mortar	✓			✓	✓			> 5	Min: 10 V: max 20		N	N	N-C	Do not feather edge.
WEBER.cem Lightweight mortar	✓	✓	✓	✓	✓				Min: 10 OH: max 75		N	N	C & P	High build up to 75 mm in overhead patch without formwork. Do not feather edge.
WEBER.cem Pyrapatch					✓			> 5	25 to 100	> 15	Y	Y	P	Pavement repair

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	NC	HPC	OH	V	H									
WEBER.cem Plug 530									25 to 50	< 15	N	N	C & P	<u>Not to be used as a concrete repair material.</u> Working time of 20 seconds. Sets within one minute.
WEBER Five Star repair concrete	✓	✓			✓			> 5	min 15	> 15	Y	N	C	Pavement repair
KING In-Pakt Construction	✓				✓			5 to 30	6 to 50	> 15	N	N	C	Can be troweled or form and pump/pour depending on water content. Grout for precast units, dowels, plates.
KING MS-S10 SCC	✓				✓			5 to 30	50 to full	> 15	Y	N	C	Gravity feed/pump into forms and remove forms after 75% strength is achieved.
KING In-Pakt Precision	✓				✓			5 to 30	6 to 50	> 15	N	N	C	Use in precast units, dowels, and plates.
KING In-Pakt Precision CT	✓				✓			-5 to 30	6 to 50	> 15	N	N	C	Cold Temperature use (up to -5° C). Best used for precast units, dowels, and plates.

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	NC	HPC	OH	V	H									
KING RS-S10	✓				✓	✓		0 to 30	38 to full	20	Y	N	C	High early strength Concrete for horizontal concrete repairs, requiring early return-to-service
KING HP S10	✓				✓			5 to 30	38 to full	> 15	Y	N	C	
MAPEI PLANITOP 15	✓		✓	✓	✓		✓	7 to 35	10 to 100	> 15	Y	Y	C	Form and Pump Only. Do not use with spraying pump or trowel. Formwork must be in place for 3 days of curing. Corrosion inhibitor included.
MAPEI Mapecem 101	✓				✓			7 to 35	max 25	> 15	N	N	C & P	Trowel or screed application only. Used for thin coats. Not to be used where asbestos is present.
MAPEI PLANITOP 23	✓	✓	✓	✓	✓			7 to 35	6 to 50	> 15	N	N	C & P	Apply by trowel. Corrosion inhibitor included.
MAPEI MAPECEM 202	✓	✓			✓			7 to 35	6 to 50	> 15	N	Y	C & P	Corrosion inhibitor included. (name changed - Quickem Top)

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	NC	HPC	OH	V	H									
MAPEI PLANITOP 18	✓	✓			✓	✓		0 to 35	12 to 50	< 15	N	Y	C	Corrosion inhibitor included. Develops 20 MPa in 1.5 hours.
MAPEI PLANITOP X	✓	✓	✓	✓	✓	✓		5 to 29	0 to 100	< 15	N	N	C & P	Can be applied from feather edge to 100 mm per lift. Working time of 5 to 6 minutes. Use for small repairs only (0.001 m3). Avoid use where the substrate contains asbestos. Reaches 25 MPa in 3 hours. Corrosion inhibitor included.
MAPEI Mapecem Quickpatch	✓	✓			✓			7 to 29	1.5 to 38	> 15	N	Y	C	Can be placed up to 75mm thick in areas no larger than 2.23 m ² . Not to be installed with substrates containing asbestos. Do not expose to loads within 24 hours of placement. Self curing.

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	NC	HPC	OH	V	H									
MAPEI PLANITOP 25	✓	✓			✓			7 to 35	6 to 25	> 15	Y	Y	C & P	Form and pump. For exposure to traffic, must be applied at a minimum thickness of 12 mm. Corrosion inhibitor included. High concentration of synthetic polymer.
SIKA SIKATOP 122 PLUS	✓	✓		✓	✓			≥ 7	3 to 38	> 15	Y	Y	C & P	Corrosion inhibitor included.
SIKA SIKATOP 123 PLUS	✓	✓	✓	✓	✓			≥ 7	3 to 38	> 15	N	N	C & P	Corrosion inhibitor included.
SIKA Sika Set 45	✓				✓			-7 to 35	13 to 38	< 15	Y	Y	N-C & MP	Do not extend with limestone aggregates. 20 MPa in 45 minutes. Air cures.
SIKA SIKATOP 121 Plus	✓	✓			✓			≥ 7	max 4	< 15	N	N	C & P	Very high shrinkage, for thin coats only. Corrosion inhibitor included. Application done by trowel.
SIKA SIKACRETE 08-SCC	✓			✓	✓		✓	≥ 7	25 to 450	> 15	N	N	C	Form and pour.

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	NC	HPC	OH	V	H			(Celsius)	(mm)	(minutes)	Y/N	(Y/N)		
AMBEX RS-SCC-10 (Beton)	✓			✓	✓	✓	✓	5 to 30	19 to full	> 15	Y	N	C	Not to be used in thin feather edge applications. Form and pour or hand placement. Trowel finish surfaces. Pumping is not recommended due to short working time. Beige in colour.
AMBEX SCC-10 (Beton)	✓	✓			✓		✓	5 to 30	19 to full	> 15	Y	N	C	Form and pump or form and pour. Trowel finish surfaces.
[1] NC - Normal Concrete, HPC - High Performance Concrete														
[2] OH - Overhead, V - Vertical, H - Horizontal (Based on Manufacturers Literature)													created: June 28, 2018	
[3] HIGH-EARLY STRENGTH > 20 Mpa @ 4 HOURS														
[4] AGGREGATES ARE INCLUDED IN PRODUCT OR INCLUDED PACKAGED SEPERATELY (to be added to the neat material)														
[5] MANUFACTURER HAS GIVEN PERMISSION TO EXTEND PRODUCT (and has submitted separate test results for extended product)														
[6] C - Cementitious, N-C - Non-Cementitious, P - Polymer (polymer or latex is added instead of, or with, water), MP - Magnesium Phosphate														



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

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

Use of this specification or any other specification shall be as specified in 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 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 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

MTO Structural Manual

Canadian Standards Association

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)
S6-14	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

CPCQA Certification Program Requirements Document

Prequalification Requirements for Precast Concrete Drainage Products

1351.03 DEFINITIONS

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

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 be pre qualified and possess a current plant certificate issued under the Canadian Precast Concrete Quality Assurance (CPCQA) Certification Program.

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/m² 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

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 2019
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



Note: The MUNI implemented in November 2021 replaces OPSS 1352 COMMON, November 1989 with no technical content changes.

MATERIAL SPECIFICATION FOR PRECAST CONCRETE BARRIERS

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1352.01 SCOPE

This specification covers the requirements for precast concrete barriers.

1352.01.01 Specification Significance and Use

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

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

1352.01.02

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.

1352.02

REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

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

CSA Standards

CSA G164-M1981	Hot Dip Galvanizing of Irregularly Shaped Articles
CSA G189-1966	Sprayed Metal Coatings for (R1980) Atmospheric Corrosion Protection

American Society for Testing and Materials

ASTM C672-84	Test Method for Scaling Resistance of Concrete Specimens Subjected to Freezing

1352.05 MATERIALS

1352.05.01 Concrete

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

Class of Concrete	30 MPa at 28 Days
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) according 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 be according to OPSS 1301 and it shall constitute not more than 70% by the mass of the total cementing material. Fly ash shall be according 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:

- a) Hook and Eye
- b) Concrete Key
- c) 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 according to CSA G164 providing a minimum zinc coating of 0.61 kg².
- b) Zinc metallizing according to CSA G189 providing a minimum metallized coating of 200 μ m thickness.
- c) Coating with an approved organic coating material according to OPSS 1443.

1352.05.05 Reinforcing Steel

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

1352.07 PRODUCTION

1352.07.01 Curing Methods

Curing shall be according to the method as submitted and approved by the Owner.

1352.07.02 Marking

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

- a) Name or trademark of the manufacturer.
- b) Identification of plant if manufacturer has more than one plant.
- c) 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 according 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 Owner 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/m² 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 °C ± 2 °C.

The thawing and air drying apparatus shall consist of a suitable cabinet or room with controls to maintain an air temperature of 23 °C ± 2 °C and a relative humidity of 50 percent ± 5 percent. The scales or balance shall have a minimum capacity of 5,000 g with an accuracy of 0.1 g. The drying oven shall be capable of maintaining a temperature of 105 °C ± 2 °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 $\pm$ 1 hour freezing followed by 8 hours $\pm$ 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 $-18\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.

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 Owner'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.

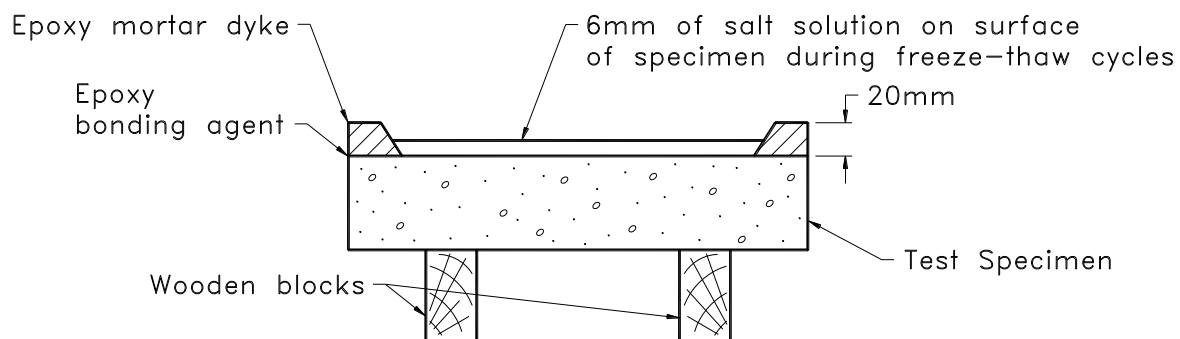


Figure 1

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 $105\text{ }^{\circ}\text{C}$ 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/m^2 .

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:

- a) Identification.
- b) Photographs of the test specimens before and after the 50 cycle freeze-thaw test. Photographs at intermediate stages of the test are optional.
- c) 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 OWNER PURCHASE OF MATERIAL

1352.09.01 Measurement and Payment

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

Payment at the price specified in the purchasing order shall be for the supply of precast barrier units delivered to the destination on the date and time specified.

Appendix 1352-A, November 2021
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 UNSHRINKABLE BACKFILL

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1359-A	Commentary

1359.01 SCOPE

This specification covers the requirements for treated aggregate known as unshrinkable backfill, in underground service and Utility trenches, and around in-ground structures.

1359.01.01 Significance and Use of Appendices

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

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

1359.01.02 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.

1359.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase Select Subgrade, and Backfill Material
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production

Canadian Standards Association

A23.2-3C	Making and Curing Concrete Compression and Flexural Test Specimens [Part of CAN/CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]
A23.2-9C	Compressive Strength of Cylindrical Concrete Specimens [Part of CAN/CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]
A3001-13	Cementitious Materials for Use in Concrete [Part of CAN/CSA A3000-13 Cementitious Materials Compendium]

Ministry of Transportation, Ontario, Publications

MTO Laboratory Testing Manual:

LS-407 Method of Test for Compressive Strength of Moulded Cylinders

1359.03 DEFINITIONS

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

Reclaimed Concrete Material (RCM) means removed or processed old hydraulic cement concrete.

Unshrinkable Backfill means a self-compacting cement treated aggregate with flowable consistency and controlled low strength properties.

1359.04 DESIGN AND SUBMISSION REQUIREMENTS

1359.04.01 Submission Requirements

The unshrinkable backfill mix shall be designed and the unshrinkable backfill mix design data submitted using the Concrete Mix Design Submission forms as specified in the Contract Documents.

The mix design submission shall be accompanied by data on 28-Day compressive strengths of the backfill.

1359.05 MATERIALS

1359.05.01 Cementing Materials

Cementing materials shall be according to OPSS 1301.

1359.05.02 Water

Water shall be according to OPSS 1302.

1359.05.03 Aggregates

Aggregates shall be according to OPSS 1010 Granular A, and shall have a maximum aggregate size of 25 mm.

Coarse aggregate shall be crushed stone, crushed gravel, natural gravel, recycled concrete material (RCM), or a combination thereof. The typical maximum nominal size is 25 mm, or as specified in the Contract Documents. Fine aggregates shall be natural sand, crushed sand, recycled concrete aggregates, or a combination thereof. Coarse and fine aggregate shall meet the requirements in Table 1. Slag aggregate, glass and ceramics shall not be used.

1359.05.03.01 Use of Recycled Concrete Material

The producer shall ensure that the level of RCM used in the fill does not compromise the performance of the fill. Recycled aggregates shall satisfy environmental regulations.

The maximum passing the 75 µm shall be 5% or less of the total aggregate weight.

1359.05.03.02 Grading

The grading of the combined aggregate shall be selected to produce unshrinkable fill that meets the performance requirements of the intended application and the requirements of this Standard.

1359.05.04 Mix Requirements

Mix requirements shall be according to the following:

- a) The unshrinkable backfill shall contain 25 kg/m³ of Type GU Portland cement according to CAN/CSA A3001 and may contain additional supplementary cementing materials.
- b) Slump at point of discharge shall be a minimum of 150 mm and the unshrinkable backfill shall be uniformly mixed throughout.
- c) The material shall be designed so that it can flow into the excavation and fill the entire space without vibration and segregation.
- c) The 28-Day compressive strength shall be a maximum of 0.40 MPa.
- e) The mixture may contain foaming agents.

1359.05.05 Unshrinkable Backfill Material Placement Requirements

The material shall be placed into the excavation so that it fills the entire space without voids being created beneath horizontal projections or in other locations within the excavation.

The unshrinkable backfill material shall be completely placed within a period of 2 hours from the time of the batching.

The unshrinkable backfill material shall be protected from cold weather according to OPSS 350.

When shoring, bracing, or sheeting shall be removed, the support system shall be removed prior to or during the backfilling operation.

When placed behind abutment as backfill, layers of unshrinkable backfill material shall be placed alternately at each abutment. The layers shall not exceed 400 mm and the height of the layers shall be approximately the same. At no time shall the difference in elevation be greater than 400 mm. Each layer shall be allowed to set for a period of minimum of 4 hours before a new layer is placed.

Where vehicular traffic, including construction equipment, shall be accommodated, the unshrinkable backfill shall be protected by covering it with a steel plate suitable for the traffic loading for a minimum of 24 hours.

1359.06 EQUIPMENT

1359.06.01 Mixing Equipment

A central mixing, dry batch plant, or volumetric mixer capable of accurately proportioning aggregate, cement, and water shall be used, according to OPSS 1350.

1359.06.02 Transport Equipment

Unless produced on site with a volumetric mixer, unshrinkable backfill shall be transported to the site by means of ready mix trucks.

Ready mix trucks may be required to meet local environmental requirements as specified in the Contract Documents.

1359.08**QUALITY ASSURANCE****1359.08.01****Testing Requirements**

Compressive strength testing shall be according to CSA-A23.2-3C, CSA-A23.2-9C, and LS-407 and with the following requirements:

- a) Only cardboard moulds shall be used to cast the test cylinders. A disc of wax paper matching the inside diameter of the cylinder mould shall be placed at the base of the cylinder mould prior to casting. The interior sidewalls of the cardboard mould shall be treated with a light coating of release agent to assist in the demoulding operation.
- b) The cylinders shall only be demoulded on the same day of testing for compressive strength.
- c) The load indicating mechanism of the compression testing machine shall be capable of showing load changes of 100 newtons or less. The loading rate shall be 0.11 MPa/s or lower.
- d) The minimum test requirement shall be one set of two test cylinders, per supplier, per day.

1359.08.02**Acceptance**

Unshrinkable backfill shall be accepted when

- a) the material does not deform under traffic loading, and
- b) the compressive strength requirements are met.

Table 1: Requirements for fine and coarse aggregates for use in unshrinkable fill

Test	Coarse	Fine
Micro-Deval abrasion (%) (LS-618 & LS-619)	Max. 25%	Max. 30%
% passing 75 µm* (LS-601)	Max. 3%	Max. 5%
Organic Impurities	N/A	Standard colour No. 3
Sulphate content (SO ₄) ‡ (CSA A23.2-3B or 8B)	Max. 1.5%	Max. 1.5%
Water soluble chloride (ASTM D1411)†	Max. 0.10%	Max. 0.10%
*This requirement may be waived provided that the % passing the 80 micron sieve for the combined aggregate does not exceed 5% of the total. †This requirement is specified if fill is to be in contact with concrete or steel pipe. ‡For unshrinkable fill in contact with permanent concrete elements, the limit of SO₄ in aggregates RCA shall be a maximum of 0.20%, unless the permanent concrete element meets the requirements of S1, S2, or S3 of CSA A23.1-14 Table 3 as appropriate. RCM used in unshrinkable fill to be placed in contact with sulphate-bearing soil or ground water with sulphate shall be produced from sulphate resistant concrete.		

Appendix 1359-A, November 2016

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:

- Concrete Mix Design Submission forms shall be used. (1359.04.01)
- May allow up to 50mm as the nominal size as the application may warrant. (1359.05.03)
- Ready mix truck may be required to have washout systems in order to meet local, environmental requirements (1359.06.02)

For shallow applications within the depth of frost penetration, differential frost heaving may occur.

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

Related Ontario Provincial Standard Drawings

OPSD 509.010 Pavement Reinstatement for Utility Cuts



MATERIAL SPECIFICATION FOR GABION BASKETS AND MATS

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1430-A	Commentary

1430.01 SCOPE

This specification covers the requirements for gabion baskets or gabion mats and related accessories.

1430.01.01 Specification Significance and Use

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

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

1430.01.02

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.

1430.02

REFERENCES

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

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

ASTM International

A 90/A 90M-11	Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
A 313/A 313M-10e1	Stainless Steel Spring Wire
A 370-11a	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
A 641/A 641M-09a	Zinc-Coated (Galvanized) Carbon Steel Wire
A 764-07	Metallic Coated Carbon Steel Wire, Coated at Size and Drawn to Size for Mechanical Springs
A 975-11	Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire with Poly (Vinyl Chloride) (PVC) Coating)

Underwriters Laboratories

746B-96	Polymeric Materials - Long-Term Property Evaluations

1430.03**DEFINITIONS**

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

Gabion Baskets means rectangular containers made of double twisted steel wire mesh produced to the dimensions shown in Table 1.

Gabion Mats means rectangular containers made of double twisted steel wire mesh produced to the dimensions shown in Table 2.

Lacing Wire means a galvanized steel wire or galvanized steel wire with PVC coating used to assemble and interconnect gabion basket or gabion mat containers and to close and secure stone filled containers.

1430.05**MATERIALS****1430.05.01****Gabion Baskets and Gabion Mats**

Gabion baskets shall be manufactured from galvanized steel wire mesh or PVC coated galvanized steel wire mesh as specified in the Contract Documents. When the type of mesh is not specified in the Contract Documents, the gabion baskets shall be manufactured from PVC coated galvanized steel wire mesh.

Gabion mats shall be manufactured from PVC coated galvanized steel wire mesh.

Gabion baskets and the base section of gabion mats shall have all components connected in such a manner that the strength at the point of connection meets the requirements of Table 3 as tested according to ASTM A 975, Section 13.1.

1430.05.02**Wire Mesh**

The mesh shall be woven from wire using a double twist pattern to create uniform hexagonal openings of 83 x 114 mm. The wire mesh shall be non-ravelling and shall provide the strength listed in Table 3 as tested according to ASTM A 975, Section 13.1.

The perimeter edges of the wire mesh shall be woven around a selvage wire in a manner designed to prevent slippage and to create a selvage.

1430.05.02.01**Wire**

The wire for wire mesh, selvage wire, lacing wire, and internal connections shall be galvanized wire, soft temper, Class 3 coating, according to ASTM A 641. The wire diameter shall be according to Table 4. The tensile strength of the wire shall be according to ASTM A 641 as tested according to ASTM A 370. Galvanizing on the wire shall meet the requirements of Table 4 as tested according to ASTM A 90M.

1430.05.02.02**PVC Coating**

PVC coating shall be according to ASTM A 975 and shall have a minimum thickness of 0.38 mm with a nominal thickness of 0.50 mm. Prior to UV and abrasion degradation, the PVC polymer coating shall have a projected durability life of 60 years as tested according to UL 746B.

1430.05.03 Fasteners

1430.05.03.01 General

Fasteners shall be fabricated such that when the ends of the fastener are brought together and properly locked, the fastener forms a closed loop. The inside area of the closed loop shall be at least 325 mm² to enclose up to four selva wires.

Locked fasteners shall be able to resist a minimum direct force across any axis of 3 kN while remaining closed and locked.

1430.05.03.02 Stainless Steel Rings

Stainless steel rings shall be manufactured from 3 mm diameter stainless steel spring wire Type 302, Class 1, according to ASTM A 313M.

1430.05.03.03 Interlocking Wire Fasteners

Interlocking fasteners shall be manufactured from 3 mm diameter steel mechanical spring wire Class 1, Finish 2, Type B, Tensile Class 2, according to ASTM A 764.

1430.07 PRODUCTION

1430.07.01 General

Gabion baskets and gabion mats shall be manufactured so that the sides, ends, lid, base, and diaphragms can be readily assembled into rectangular units.

Where the length of the gabion basket exceeds its horizontal width, the gabion basket shall be divided into equal cells by diaphragms. Cell length shall not exceed its horizontal width. Diaphragms shall be made of wire mesh and shall be secured in the proper position on the base section. Gabion mats shall have diaphragms spaced at 1.0 m across the width of the mat and maximum 3.0 m along the length of the mat.

Gabion baskets or gabion mats shall be manufactured with all components connected at the production facility with the exception of the gabion mat lid. Gabion baskets manufactured from galvanized wire mesh shall be assembled using either lacing wire or fasteners. Gabion baskets and gabion mats manufactured from PVC coated galvanized wire mesh shall be assembled using stainless steel ring fasteners. Fasteners shall be installed at a maximum spacing of 150 mm with at least one fastener per gabion mesh opening.

1430.07.02 Dimensions and Tolerances

Gabion baskets and gabion mats shall be produced to the sizes and dimensions shown in Tables 1 and 2. All dimensions are subject to a tolerance limit of $\pm 5\%$, except depth dimensions, which are subject to tolerance limit of $\pm 5\%$ for gabion baskets and $\pm 10\%$ for gabion mats.

1430.07.03 Packaging and Marking

Each gabion basket and gabion mat shall be clearly colour coded according to Tables 1 and 2 or otherwise suitably identified to indicate its size.

Gabion baskets shall be shipped folded flat in bundles. Each bundle shall contain an equal number of one size of gabion baskets, except as necessary to complete an order. Each bundle shall be clearly

marked to show the size and number of baskets it contains. The maximum weight of one bundle shall be 850 kg.

Gabion mats shall be shipped in rolls with ends, sides, and dividers attached to the base. The gabion mat lid and base units are to be shipped unattached, but rolled together as one. The maximum weight of one roll shall be 850 kg.

1430.08 QUALITY ASSURANCE

1430.08.01 Inspection and Testing

The Owner reserves the right to make inspections and tests and at times the Owner may consider necessary to ensure that the materials supplied are in accordance with this specification.

All materials failing to comply with the requirements of this specification shall be rejected.

1430.09 OWNER PURCHASE OF MATERIAL

1430.09.01 Measurement and Payment

Payment at the price specified in the purchasing order for the number of units of each type and size of gabion basket or gabion mat shall be for the supply of the gabion baskets or gabion mats, including the dividers, diaphragms, connecting wire, and lacing wire or fasteners, 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.

TABLE 1
Gabion Basket Sizes and Dimensions

Size Number	Number of Diaphragms	Approximate Dimensions and Volumes				Colour Code
		Length m	Width m	Depth m	Capacity m ³	
1	1	2.00	1.00	0.30	0.60	Blue/Red
2	1	2.00	1.00	0.50	1.00	Red
3	1	2.00	1.00	1.00	2.00	Blue
4	2	3.00	1.00	0.30	0.90	Blue/Yellow
5	2	3.00	1.00	0.50	1.50	Green
6	2	3.00	1.00	1.00	3.00	White
7	3	4.00	1.00	0.30	1.20	Blue/Green
8	3	4.00	1.00	0.50	2.00	Yellow
9	3	4.00	1.00	1.00	4.00	Black
10	1	2.00	0.50	0.50	0.50	White/Yellow
11	2	3.00	0.50	0.50	0.75	White/Green

TABLE 2
Gabion Mat Sizes and Dimensions

Size Number	Number of Dividers	Number of Diaphragms	Approximate Dimensions and Areas				Colour Code
			Length m	Width m	Depth m	Area m ²	
12	1	18	30	2	0.23	60	Black/Green
13	2	27	30	3	0.23	90	Black/Yellow
14	1	18	30	2	0.30	60	Black/Blue
15	2	27	30	3	0.30	90	Black/White

TABLE 3
Minimum Strength Requirements of Mesh and Connections

Test Description	Galvanized Gabion Basket	PVC Coated	
		Gabion Basket	Gabion Mat
Parallel to Twist	51.1 kN/m	42.3 kN/m	33.6 kN/m
Perpendicular to Twist	26.3 kN/m	20.4 kN/m	13.1 kN/m
Connection to Selvages	20.4 kN/m	17.5 kN/m	10.2 kN/m
Panel to Panel Connection Using Lacing Wire or Fasteners	20.4 kN/m	17.5 kN/m	10.2 kN/m
Punch Test	26.7 kN	23.5 kN	17.8 kN

TABLE 4
Gabion Baskets and Gabion Mats

	Galvanized Gabion Basket	PVC Coated	
		Gabion Basket	Gabion Mat
Mesh Type	80 x 100 mm	80 x 100 mm	80 x 100 mm
Mesh Opening	83 x 114 mm	83 x 114 mm	83 x 114 mm
Wire Diameter for Mesh	3.05 mm	2.70 mm	2.20 mm
Wire Diameter for Selvages and Corners	3.90 mm	3.40 mm	2.65 mm
Wire Diameter for Lacing and Internal Connections	2.20 mm	2.20 mm	2.20 mm
Galvanizing for Mesh Wire	259 g/m ² min	244 g/m ² min	213 g/m ² min
Galvanizing for Selva ge Wire	275 g/m ² min	259 g/m ² min	244 g/m ² min
Galvanizing for Lacing Wire	214 g/m ² min	214 g/m ² min	213 g/m ² min

Appendix 1430-A, November 2017
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should determine which type of mesh is to be used for the gabion baskets and specify it in the Contract Documents. PVC coated gabion baskets are recommended in aggressive environment where road salt may be present and in aquatic and marine applications. (1430.05.01)

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

Related Ontario Provincial Standard Drawings

No information provided here.



MATERIAL SPECIFICATION FOR STEEL REINFORCEMENT FOR CONCRETE

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APPENDICES

1440-A	Commentary

1440.01	SCOPE

This specification covers the requirements for all steel reinforcement used in concrete work.

1440.01.01 Specification Significance and Use

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

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

1440.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

1440.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 905 Steel Reinforcement for Concrete

Ontario Ministry of Transportation Publications

Designated Sources for Materials (DSM)
Structural Manual

CSA Standards

G30.18-09 Carbon Steel Bars for Concrete Reinforcement
G40.21-04 (R2009) Structural Quality Steels
S6-14 Canadian Highway Bridge Design Code

ASTM International

A 82/A 82M-07 Steel Wire, Plain, for Concrete Reinforcement
A 185/A 185-07 Steel Welded Wire Reinforcement, Plain, for Concrete
A 276-10 Stainless Steel Bars and Shapes
A 416/A 416M-12a Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
A 421/A 421M-10 Uncoated Stress-Relieved Steel Wire for Prestressed Concrete
A 496/A 496M-07 Steel Wire, Deformed, for Concrete Reinforcement
A 497/A 497M-07 Steel Welded Wire Reinforcement, Deformed, for Concrete

A 722/A 722M-12 Uncoated High-Strength Steel Bars for Prestressing Concrete
A 955M/A 955M-12e1 Deformed and Plain Stainless Steel Bars for Concrete Reinforcement

International Organization for Standardization/International Electrotechnical Commission

ISO/IEC 17025:1999 General Requirements for the Competence of the Testing and Calibration Laboratories

Others

Reinforcing Steel Institute of Canada - Reinforcing Steel Manual of Standard Practice - 2004

1440.03 DEFINITIONS

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

Heat means a single operation of melting of steel, also called a melt.

Lot means a quantity of steel that can be identified. For each size designation of prestressing steel strand, a lot shall be reels or coils produced from one heat. For each nominal diameter of prestressing steel bar and for each size designation of reinforcing steel bar, a lot shall be all the supplied bars from one heat.

Prestressing Steel means as defined in OPSS 905.

Prestressing Steel Bar means a high strength alloy steel bar having a nominal diameter greater than 9 mm.

Reinforcing Steel Bars means as defined in OPSS 905.

Spacer means a rolled steel shape punched to form hooks that are bent over the spiral to maintain a specified pitch.

Spiral means continuously wound reinforcing steel in the form of a cylindrical helix.

Splice Bar means as defined in OPSS 905.

Stainless Steel Reinforcing Bars means as defined in OPSS 905.

Steel Reinforcement means as defined in OPSS 905.

Strand means as defined in OPSS 905.

1440.04 DESIGN AND SUBMISSION REQUIREMENTS

1440.04.01 Submission Requirements

1440.04.01.01 Mill Certificates for Reinforcing Steel Bars, Stainless Steel Reinforcing Bars, Splice Bars, and Stainless Steel Splice Bars

Two copies of the mill certificates for each lot shall be submitted to the Contract Administrator prior to shipment of reinforcing steel bars, stainless steel reinforcing bars, splice bars, and stainless steel splice bars. The certificates shall show that the material is as specified in the Contract Documents.

1440.04.02**Mill Certificates and Stress-Strain Curves for Prestressing Steel**

Two copies of the mill certificates and stress-strain curves for each lot shall be submitted to the Contract Administrator prior to shipment of prestressing steel. The certificates shall show that the material is as specified in the Contract Documents.

When mill test certificates originate from a mill outside Canada or the United States of America, the Contractor shall have the information on the mill test certificate verified by testing by a Canadian laboratory. This laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply with the requirements of ISO/IEC DIS 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian laboratory and appropriate wording stating that the material is in conformance with the specified Contract requirements. The stamp shall include the appropriate material specification number, testing date (i.e., yyyy-mm-dd), and the signature of an authorized officer of the Canadian laboratory.

1440.05**MATERIALS****1440.05.01****Reinforcing Steel Bars, Splice Bars, Tie Bars, Dowel Bars, Spirals, and Spacers**

Reinforcing steel bars shall be according to CAN/CSA G30.18.

All reinforcing steel bars shall be Grade 400W according to CSA G30.18.

Plain steel wire for spirals shall be according to ASTM A 82. Deformed steel bars for spirals shall be according to CSA G30.18 type W. Steel spacers according to CAN/CSA G40.21, Grade 350 G shall be provided with the spirals.

1440.05.02**Stainless Steel Reinforcing Bars, Stainless Steel Splice Bars, Tie Bars, Dowel Bars, Spirals, Spacers, and Stainless Steel Mechanical Connectors**

Stainless steel reinforcing bars and spirals shall be according to ASTM A 276 and ASTM A955M, minimum Grade 420.

Nominal dimensions, unit masses, and deformation requirements for metric bar sizes shall be according to CAN/CSA G30.18. Stainless spirals shall be provided with stainless spacers in conformance with ASTM A 276.

Stainless steel reinforcing bars, stainless steel spirals, stainless steel spiral spacers, and mechanical connectors shall be of a stainless steel type shown in Table 1.

Imperial and soft-converted metric bar size substitutions for metric bar sizes shall be permitted on a one-for-one basis without adjustment as shown in Table 2.

Other Imperial and soft-converted metric stainless steel reinforcing bar sizes may be substituted for metric bar sizes, subject to the following:

- a) The area of substituted steel reinforcement for the concrete component per linear metre or per gross cross-section area, as applicable, shall not be less than that shown for the concrete component on the Contract Drawings; and,
- b) The spacing of substituted steel reinforcement for the concrete component shall be according to CAN/CSA-S6 and the Structural Manual, Division 1.

Nominal cross-sectional areas of metric and imperial bar sizes used for determining substitutions shall be according to ASTM A 955M and CAN/CSA G30.18, respectively.

1440.05.03 Deformed Steel Wire

Deformed steel wire shall be according to ASTM A 496.

1440.05.04 Welded Smooth Steel Wire Fabric

Welded smooth steel wire fabric shall be according to ASTM A 185.

1440.05.05 Welded Deformed Steel Wire Fabric

Welded deformed steel wire fabric shall be according to ASTM A 497M.

1440.05.06 Prestressing Steel

Prestressing steel strand shall be weldless, low relaxation grade according to ASTM A 416M. Prestressing steel strand shall be certified by its manufacturer to bond to concrete of normal strength and consistency.

Prestressing steel wire shall be according to ASTM A 421M.

Prestressing steel bars shall be according to ASTM A 722M. The bars shall not be welded.

1440.07 PRODUCTION

1440.07.01 Manufacture of Reinforcing Steel Bars

The manufacture of reinforcing steel bars shall be by a manufacturer listed under "Mill" in the Designated Sources for Materials listing for Reinforcing Steel, Uncoated, Fabricators and Mills.

1440.07.02 Manufacture of Stainless Steel Reinforcing Bars

The manufacture of stainless steel reinforcing bars shall be by a manufacturer listed under "Mills" in the Designated Sources for Materials listing for Reinforcing Steel, Stainless, Mills and Fabricators.

1440.07.03 Fabrication of Reinforcing Steel Bar, Stainless Steel Reinforcing Bar, Splice Bar, and Stainless Steel Splice Bars

Bars shall be cold bent at the fabricator's shop.

The standard fabricating tolerances for all bars, straight or bent, shall be according to the Reinforcing Steel Manual of Standard Practice of the Reinforcing Steel Institute of Canada.

Fabrication of stainless steel reinforcing bars shall be so that the bar surfaces are not contaminated with deposits of iron or non-stainless steels, and the bar is not damaged by straightening from coil.

Fabrication of stainless steel reinforcing bars shall be by a fabricator listed under "Fabricators" in the Designated Sources for Materials listing for Reinforcing Steel, Stainless, Mills and Fabricators.

1440.07.04 Identification

1440.07.04.01 Prestressing Steel

All steel strand from each manufactured reel used and all high strength alloy bars used shall be assigned an individual lot number and shall be tagged with the lot number.

1440.07.04.02 Reinforcing Steel Bars, Stainless Steel Reinforcing Bars, Splice Bars, and Stainless Steel Splice Bars

All bars shall be shipped in bundles.

Each lot of reinforcing steel bars, stainless steel reinforcing bars, splice bars, and stainless steel splice bars shall be assigned an individual lot number and shall be tagged with the lot number.

In addition, tags for stainless steel reinforcing bars shall identify the manufacturer, stainless steel type and grade, and bar mark number, including stainless designation.

1440.08 QUALITY ASSURANCE

1440.08.01 Inspection and Testing

The Owner reserves the right to carry out inspections and tests at such times as the Owner may consider necessary to ensure that the materials supplied are according to this specification.

Materials failing to comply with the requirements of this specification shall be rejected.

The Owner's representative shall be permitted free entry to the manufacturing and fabrication plants, as well as the finished product storage and loading areas for inspection purposes.

TABLE 1
Type of Stainless Steel

Common or Trade Name	AISI Type	UNS Designation
Type 316 LN	316 LN	S31653
Type 2205 Duplex	2205	S31803

Note:

- A. Condition/Finish: reinforcing stainless steel bars and shapes shall be hot rolled and pickled, or hot rolled and descaled to the required mechanical properties and dimensions.

TABLE 2
Size Conversions

Metric Bar Size	Imperial Bar Size	Bar Designation No.
15M	# 5	16
25M	# 8	25
35M	# 11	36

Appendix 1440-A, November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should 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 LOAD TRANSFER ASSEMBLIES

TABLE OF CONTENTS

1441.01	SCOPE
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1441.03	DEFINITIONS - Not Used
1441.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
1441.05	MATERIALS
1441.06	EQUIPMENT - Not Used
1441.07	PRODUCTION
1441.08	QUALITY ASSURANCE
1441.09	OWNER PURCHASE OF MATERIAL

APPENDICES

1441-A	Commentary

1441.01 SCOPE

This specification covers the requirements for load transfer assemblies for use in concrete pavement expansion joints.

1441.01.01 Specification Significance and Use

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

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

1441.01.02

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.

1441.02

REFERENCES

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

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

Ontario Provincial Standards Specifications, Materials

OPSS 1442 Epoxy Coated Steel Reinforcing Steel Bar for Concrete

Canadian Standards Association (CSA)

G40.21-04 Structural Quality Steels

ASTM International

A 82/A 82 M-07 Steel Wire, Plain, for Concrete Reinforcement

1441.05

MATERIALS

Dowel bars shall be plain round bars of grade 300 or better according to CSA G40.21.

Dowel caps shall be cold rolled deep drawn quality steel.

Wire shall be according to ASTM A 82M. Wire sizes shall be according to American Steel Wire Gauge.

Materials other than steel may be used as supporting structures, when approved by the Contract Administrator.

1441.07 PRODUCTION

1441.07.01 Fabrication

Dowel bars shall be cut and handled in such a manner as to avoid distortion or burrs that would inhibit free movement in the concrete. Welds shall be resistance or arc type. The assembly shall be readily separable into two parts to permit the greasing of the dowels and the addition of bulkheads and joint fillers.

Dowel bars shall not deviate from the prescribed angle of skew by more than one degree and shall be parallel to each other within a tolerance of zero degrees forty-five minutes. Dowel cap assemblies shall be fabricated with sufficient accuracy to permit the free movement of all dowels within the dowel caps.

Suitable wire ties shall be provided to hold the assembly in normal position during shipping and installation and to permit the fastening and unfastening of the dowel cap assembly.

1441.07.02 Patching

After fabrication, all areas of the dowel bar with damaged epoxy coating shall be cleaned and painted with a patching material according to OPSS 1442.

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.

1441.08 QUALITY ASSURANCE

1441.08.01 Inspection

Delivered units failing to meet the requirements of the Contract Documents shall be either repaired to the satisfaction of the Contract Administrator or removed from the Owner's property and replaced with acceptable units.

Repair or removal and replacement of delivered units that fail to meet the requirements of the Contract Documents shall be at no extra cost to the Owner.

1441.09 OWNER PURCHASE OF MATERIAL

For measurement purposes, a count shall be made of the number of load transfer assembly units supplied and accepted.

Payment at the price specified in the purchasing order shall be for the supply of the load transfer assembly units 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 1441-A, November 2017
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

Related Ontario Provincial Standard Drawings

OPSD 552.050	Load Transfer Device, Skewed Contraction Joint, Concrete or Composite Pavement
OPSD 552.051	Load Transfer Device, Right Angle Contraction Joint, Concrete or Composite Pavement
OPSD 552.060	Load Transfer Device, Skewed Expansion Joint, Concrete or Composite Pavement
OPSD 552.061	Load Transfer Device, Right Angle Expansion Joint, Concrete or Composite Pavement



MATERIAL SPECIFICATION FOR EPOXY COATED REINFORCING STEEL BARS FOR CONCRETE

TABLE OF CONTENTS

1442.01	SCOPE
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1442.03	DEFINITIONS
1442.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
1442.05	MATERIALS
1442.06	EQUIPMENT - Not Used
1442.07	PRODUCTION
1442.08	QUALITY ASSURANCE
1442.09	OWNER PURCHASE OF MATERIAL - Not Used

APPENDICES

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

Use of this specification or any other specification shall be as specified in 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 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

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

A775 / A775M-19 Epoxy Coated Steel Reinforcing Bars

D3963 / D3963M-15 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

Where required, epoxy coating and patching material shall be as specified in Contract Documents.

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 A775M.

1442.07.02 Requirements

The requirements and the test methods for film thickness, continuity, flexibility, and adhesion shall be according to ASTM A775M, ASTM D3963M, 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 D3963M.

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 D3963M. 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 shall 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 2020
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Epoxy coating and patching material. (1442.05.02)

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

Related Ontario Provincial Standard Drawings

No information provided here.



MATERIAL SPECIFICATION FOR CABLE GUIDE RAIL

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1503.03	DEFINITIONS - Not Used
1503.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
1503.05	MATERIALS
1503.06	EQUIPMENT - Not Used
1503.07	PRODUCTION
1503.08	QUALITY ASSURANCE - Not Used
1503.09	OWNER PURCHASE OF MATERIAL

APPENDICES

1503-A	Commentary

1503.01 SCOPE

This specification covers the requirements for cable guide rail and associated components including anchor blocks, fabricated bases, and hardware.

1503.01.01 Specification Significance and Use

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

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

1503.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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1503.02 REFERENCES

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

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

Ontario Provincial Standard Specification, Material

OPSS 1350 Concrete - Materials and Production

CSA Standards

G12-14 (R2019)	Zinc-Coated Steel Wire Strand
G40.20-13/G40.21-13 (R2018)	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels
G164-18	Hot Dip Galvanizing of Irregularly Shaped Articles
W59-18	Welded Steel Construction

ASTM International

A47/A47M-99(2018)e1	Ferritic Malleable Iron Castings
B30-20	Copper Alloys in Ingot and Other Remelt Forms

SAE International

J403-2014-06-30 Chemical Compositions of SAE Carbon Steels

1503.05 MATERIALS

1503.05.01 Cable

Guide rail cable and cable used for the pressed ferrule and cable fittings shall be according to CSA G12, grade 800 steel wire strand and hot zinc-coated or class A electro-zinc-coated. Cable shall be 12 mm diameter, 7-wire strand weighing approximately 760 kg/1000 m with a minimum breaking strength of 74 kN and a maximum breaking strength of 100 kN.

1503.05.02 Fittings

Ferrous castings for the end fitting and splicer shall be according to ASTM A47M, grade 32510 for malleable iron.

The tension bolt for the end fitting shall be SAE 1035 hot rolled fine grained steel and the ferrule shall be SAE 1020 rolled steel according to SAE J403. As an option, the tension bolt may contain a square or hex nut welded as specified in the Contract Documents. All welds shall be according to CSA W59. The ferrous castings, tension bolt, and ferrule shall be hot dip galvanized according to CSA G164. The ferrule shall be galvanized after it has been pressed onto the cable.

Wedges shall be bronze according to ASTM B30 for alloy suitable for sand casting.

1503.05.03 Anchor Blocks

1503.05.03.01 Fabricated Steel Sections

The fabricated steel section and angle iron braces in the precast anchor block shall be according to CSA G40.20/G40.21. After fabrication, the section shall be hot dip galvanized according to CSA G164.

1503.05.03.02 Precast Concrete Anchor Blocks

Precast concrete anchor blocks shall be as specified in the Contract Documents. The concrete shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 30 MPa.

1503.05.04 Cable Clamps and Nails

Nails shall be 65 mm long standard spiralled, flat heads with diamond points. Clamps shall be 2.5 mm minimum thickness mild steel. After fabrication, clamps and nails shall be hot dip galvanized according to CSA G164.

1503.05.05 Fabricated Steel Bases

Fabricated steel bases shall be according to CSA G40.20/G40.21. After fabrication, the steel bases shall be hot dip galvanized according to CSA G164.

All welding shall be according to CSA W59. All welds shall be continuous.

1503.07 PRODUCTION

1503.07.01 Pressed Ferrule and Cable Fitting

The ferrule shall be pressed onto the end of the cable fitting. The ferrule shall not slip from the cable when tested under a tensile static load to the limit of cable breakage.

1503.07.02**Marking**

Coils and reels of guide rail cable shall be identified by an attached durable tag with the following information indelibly recorded:

- a) CSA standard designation.
- b) Grade of steel.
- c) Nominal diameter of strand.
- d) Manufacturer's name and location.
- e) Length of strand in metres.
- f) Weight of strand in kilograms per coil.

1503.09**OWNER PURCHASE OF MATERIAL****1503.09.01****Packaging**

Guide rail cable shall be supplied either in coils or on expendable reels. All reels shall be of sufficient strength to withstand transportation and normal handling. Coils shall be securely and suitably fastened.

The tension bolt and ferrous castings for the end fitting shall be pre-assembled. Splices and end fittings including wedges shall be supplied in cartons containing one type of assembly. Each carton shall be clearly marked as to the number and type of assembly it contains.

Pressed ferrules and cable fittings shall be supplied in bundles of 6 fittings banded with steel straps.

Cable clamps and nails shall be supplied in separate containers having a maximum gross weight of 20 kg. Containers shall be clearly marked with their contents and weight.

1503.09.02**Measurement and Payment**

Guide rail cable and cable clamps and nails shall be measured in the units specified in the purchasing order delivered and accepted.

For measurement purposes, a count shall be made of the number of end fittings, splicers, and pressed ferrule and cable fittings of each type specified in the purchasing order delivered and accepted.

For measurement purposes, a count shall be made of the number of fabricated steel sections delivered and accepted.

For measurement purposes, a count shall be made of the number of fabricated steel bases delivered and accepted.

Payment at the price specified in the purchasing order shall be for the supply of guide rail cable, cable clamps and nails, end fittings, splicers, pressed ferrule and cable fittings, fabricated steel sections, and fabricated steel bases delivered to the destination or destinations at the dates and times specified.

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

Appendix 1503-A, November 2021
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 913.101	Guide Rail System, Cable, Component - Cable Fittings
OPSD 913.102	Guide Rail System, Cable, Component - Concrete Anchor Blocks
OPSD 913.103	Guide Rail System, Cable, Component - Wooden Post Base Plate



MATERIAL SPECIFICATION FOR STEEL BEAM GUIDE RAIL

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1504.03	DEFINITIONS - Not Used
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1504.05	MATERIALS
1504.06	EQUIPMENT - Not Used
1504.07	PRODUCTION
1504.08	QUALITY ASSURANCE - Not Used
1504.09	OWNER PURCHASE OF MATERIAL

APPENDICES

1504-A	Commentary

1504.01 SCOPE

This specification covers the requirements for steel beam guide rail, terminal sections, fabricated bases, and installation hardware.

1504.01.01 Specification Significance and Use

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

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

1504.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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1504.02 REFERENCES

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

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

CSA Standards

G40.20-13/G40.21-13	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
W59-13	Welded Steel Construction (Metal Arc Welding)

ASTM International

A 307-14 Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength

1504.05 MATERIALS

1504.05.01 Rail and Terminal Sections

Rail elements shall have a minimum yield strength of 345 MPa.

After fabrication, all rail elements and terminal sections shall be hot dip galvanized according to CAN/CSA G164.

1504.05.02 Fabricated Steel Bases

Steel bases shall be fabricated according to CSA G40.20/G40.21. After fabrication, steel bases shall be hot dip galvanized according to CAN/CSA G164.

1504.05.03 Installation Hardware

All bolts, nuts, and washers shall be according to ASTM A 307 and hot dip galvanized according to CAN/CSA G164.

1504.07 PRODUCTION

1504.07.01 Steel Beam Guide Rail and Terminal Sections

Steel beam guide rail shall consist of rail elements fabricated to develop continuous beam strength with a cross-section as specified in the Contract Documents.

Bolt holes in rail elements, terminal sections, and fabricated bases shall be perpendicular to the surface and shall not deviate more than 1.0 mm in any direction from the true location. Rail element and terminal section ends shall be cut square.

After fabrication, prefabricated curved steel rail elements shall be galvanized according to CAN/CSA G164.

Steel beam guide rail components furnished under this specification shall be interchangeable with similar components regardless of the source or manufacturer.

1504.07.02 Marking

As a minimum, each rail element shall be marked with the following information:

- a) Name, trademark, or brand of the manufacturer.
- b) Standard designation 1504. M180A2 will be accepted as an equivalent standard designation.
- c) Identification symbols or code for heat.
- d) Week number and year of production.

Markings shall be clearly and permanently stamped in the valley of the centre corrugation, placed at a location clear of the splice overlap, and shall not be obscured after installation. The height of the letters and numerals shall be within the range of 19 to 32 mm.

1504.07.03 Welding

All welds shall be according to CSA W59 and shall be continuous.

1504.09 OWNER PURCHASE OF MATERIAL

1504.09.01 Measurement and Payment

For measurement purposes, a count shall be made of the number of steel beam guide rail elements delivered and accepted.

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

For measurement purposes, a count shall be made of the number of fabricated steel bases for guide rail posts delivered and accepted.

Installation hardware shall be measured in the units specified in the purchasing order, delivered and accepted.

Payment at the price specified in the purchasing order shall be for the supply of steel beam guide rail elements, terminal sections, fabricated steel bases, and installation hardware delivered to the destination or destinations at the dates and times specified.

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

Appendix 1504-A, November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

Related Ontario Provincial Standard Drawings

OPSD 912.101	Guide Rail System, Steel Beam, Rail, Component
OPSD 912.104	Guide Rail System, Steel Beam, Steel Post with Wooden Offset Block, Component
OPSD 912.105	Guide Rail System, Steel Beam, Base Plate, Component



MATERIAL SPECIFICATION FOR CHANNEL COMPONENTS FOR STEEL BEAM GUIDE RAIL

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1505.01	SCOPE
1505.02	REFERENCES
1505.03	DEFINITIONS - Not Used
1505.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
1505.05	MATERIALS
1505.06	EQUIPMENT - Not Used
1505.07	PRODUCTION
1505.08	QUALITY ASSURANCE - Not Used
1505.09	OWNER PURCHASE OF MATERIAL

APPENDICES

1505-A	Commentary

1505.01 SCOPE

This specification covers the requirements for steel channel and installation hardware.

1505.01.01 Specification Significance and Use

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

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

1505.01.02 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.

1505.02 REFERENCES

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

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

CSA Standards

G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
S136-12	Cold-Formed Steel Structural Members

ASTM International

A 307-14	Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength

1505.05 MATERIALS

1505.05.01 Cold Rolled Channel

Channels shall be cold rolled steel sections according to CSA S136 and have a minimum yield strength of 345 MPa. After fabrication, sections shall be hot dip galvanized according to CAN/CSA G164.

1505.05.02 Installation Hardware

All bolts, nuts, and washers shall be according to ASTM A 307 and be hot dip galvanized according to CAN/CSA G164.

1505.07 PRODUCTION

1505.07.01 Fabrication Tolerances and Workmanship

Bolt holes in steel channels shall be perpendicular to the surface and shall not deviate more than 1.0 mm in any direction from the true location. Steel channel ends shall be cut square.

After fabrication, curved steel channels shall be hot dip galvanized according to CAN/CSA G164.

1505.07.02 Marking

As a minimum, each steel channel section shall be marked with the following information:

- a) Name, trademark, or brand of the manufacturer.
- b) Standard designation 1505.
- c) Identification symbols or code for heat.
- d) Week number and year of production.

Markings shall be clearly and permanently stamped in the valley of the steel channel, placed at a location clear of the splice overlap, and shall not be obscured after installation. The height of the letters and numerals shall be within the range of 19 to 32 mm.

1505.09 OWNER PURCHASE OF MATERIAL

1505.09.01 Measurement and Payment

For measurement purposes, a count shall be made of the number of steel channel sections delivered and accepted.

Installation hardware shall be measured in the units specified in the purchasing order, delivered and accepted.

Payment at the price specified in the purchasing order shall be for the supply of steel channels and installation hardware delivered to the destination or destinations at the dates and times specified.

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

Appendix 1505-A, November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

Related Ontario Provincial Standard Drawings

OPSD 912.102 Guide Rail System, Steel Beam, Channel, Component



MATERIAL SPECIFICATION FOR STANDARD HIGHWAY FENCE COMPONENTS

TABLE OF CONTENTS

1540.01	SCOPE
1540.02	REFERENCES
1540.03	DEFINITIONS
1540.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
1540.05	MATERIALS
1540.06	EQUIPMENT - Not Used
1540.07	PRODUCTION
1540.08	QUALITY ASSURANCE - Not Used
1540.09	OWNER PURCHASE OF MATERIAL - Not Used

APPENDICES

1540-A	Commentary

1540.01 SCOPE

This specification covers the requirements for highway fence components and hardware.

1540.01.01 Specification Significance and Use

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

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

1540.01.02

Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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1540.02

REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

OPSS 1601 Wood, Preservation Treatment, and Shop Fabrication

Canadian General Standards Board (CGSB)

138.2-96 Steel Framework for Chain-Link Fence

ASTM International

A 116-11 Metallic-Coated, Steel-Woven Wire Fence Fabric
A 641/A 641M-09a Zinc-Coated (Galvanized) Carbon Steel Wire
A 702-89 (2006) Steel Fence Posts and Assemblies, Hot Wrought

Others

NLGA Standard Grading Rules for Canadian Lumber (2003)

1540.03 DEFINITIONS

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

Chain and Hook means hardware to hold the gate in place when closed.

Hinge Bolt means hardware that attaches to the gatepost and fits into the hinge clip to permit the gate to swing.

Hinge Clip means hardware that attaches to the gate frame and functions with the hinge bolt.

Sweep means the deviation of a wooden brace from straightness.

1540.05 MATERIALS

1540.05.01 Fence Fabric

The fence fabric shall be one type as shown in Table 1.

Locks or fastening at the intersections of the line and stay wires of the woven fence fabric shall prevent longitudinal and vertical slipping.

Fence fabric shall be galvanized prior to fabrication to provide a minimum weight of metallic coating according to ASTM A 641, Class 3.

1540.05.02 Wooden Posts

Wooden posts shall be according to OPSS 1601.

Wooden terminal posts shall have a minimum diameter of 200 mm. Wooden line posts shall have a minimum diameter of 150 mm. The maximum diameter of the large end of any wooden post shall be 330 mm.

1540.05.03 Steel Posts

Steel line posts shall be T-rail posts.

T-rail posts and angle iron posts shall be galvanized and according to ASTM A 702.

T-rail posts shall be 2.4 m long and punched so that the fence fabric can be secured to the broad face of the post. Each post shall be supplied with nine steel wire ties for securing the fence fabric.

1540.05.04 Steel Wire Ties

Steel wire ties shall be galvanized and according to ASTM A 702.

1540.05.05 Diagonal Wooden Braces

Diagonal wooden braces shall be round or sawn Eastern White Cedar, Jack Pine, Red Pine, or Southern Yellow Pine according to OPSS 1601. Round braces shall be a minimum diameter of 110 mm and maximum diameter of 165 mm. Sawn braces shall be a minimum 100 x 100 mm and in sound condition according to NLGA Standard Grading Rules for Canadian Lumber, Utility Light Framing. Diagonal wooden braces shall have a maximum sweep of 25 mm.

1540.05.06 Diagonal Brace Wire

Diagonal brace wire shall consist of four strands of 3.5 mm diameter, galvanized, soft steel.

When installing fence fabric with design number 949-12-12.5, the diagonal brace wire shall consist of four strands of 2.51 mm diameter, Class 3, high tensile wire.

1540.05.07 Staples

Staples for wooden posts shall be 4.0 mm diameter, galvanized, with a minimum driving length of 45 mm.

1540.05.08 Gates

Gates shall be constructed from 43 mm outside diameter galvanized steel pipe for the frame and 32 mm outside diameter galvanized steel pipe for the braces according to the requirements for galvanized standard-weight pipe, CAN/CGSB 138.2. All joints shall be electrically welded and coated with a zinc rich paint.

All required hardware and galvanizing of such parts shall be according to CAN/CGSB 138.2.

1540.05.09 Mechanical Splicing Units and Crimp Sleeves

Mechanical splice units or crimping sleeves shall provide a maximum load carrying capacity that meets or exceeds the minimum breaking strength of the fence fabric line wires. For 3.50 mm and 3.76 mm diameter line wire, the minimum breaking strength of the splice shall be 4,590 N.

For 2.51 mm diameter line wire, the minimum breaking strength of the splice shall be 5,990 N.

1540.07 PRODUCTION

1540.07.01 Gates

Gates shall be supplied completely assembled, including the fence fabric. The fabric and other components used on the gates shall match the adjacent fence.

All gates shall be supplied with galvanized chain and hook, hinge bolts, and hinge clips.

TABLE 1
Fence Fabric

Fence Fabric Design Number	Number of Horizontal Wires	Minimum Height mm	Wire Diameter mm	Stay Wire Spacing mm	Standard
949-12-9	9	1219	3.76	305	ASTM A 116
948-12-9.75	9	1219	3.50	305	ASTM A 641
949-12-12.5	9	1219	2.51	305	ASTM A 116

Appendix 1540-A, November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should 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 971.101	Fence, Highway, in Earth, Shale, Loose Rock or Friable Rock, Installation
OPSD 971.102	Fence, Highway, in Solid Rock, Installation
OPSD 971.103	Fence, Highway, Installation Details



MATERIAL SPECIFICATION FOR CHAIN-LINK FENCE COMPONENTS

TABLE OF CONTENTS

1541.01	SCOPE
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1541.03	DEFINITIONS
1541.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
1541.05	MATERIALS
1541.06	EQUIPMENT - Not Used
1541.07	PRODUCTION
1541.08	QUALITY ASSURANCE - Not Used
1541.09	OWNER PURCHASE OF MATERIAL

APPENDICES

1541-A	Commentary

1541.01 SCOPE

This specification covers the requirements for chain-link fence components and hardware.

1541.01.01 Specification Significance and Use

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

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

1541.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

1541.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 772 Chain-Link Fence

Canadian General Standards Board (CGSB)

138.1-96 Fabric for Chain Link Fence
138.2-96 Steel Framework for Chain Link Fence
138.4-96 Gates for Chain Link Fence

ASTM International

A 27/A 27M-17 Steel Casting, Carbon, for General Application
A 153/A 153M-16 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 824-01 (2017) Metallic-Coated Steel Marcellised Tension Wire for Use With Chain Link Fence
F 626-14 Fence Fittings

1541.03 DEFINITIONS

For the purpose of this specification, the definitions in OPSS 772 apply.

1541.05 MATERIALS

1541.05.01 Fence Fabric

The fence fabric shall be 1,200 or 1,800 mm wide according to the Contract Documents, with a uniform 50 mm diamond pattern chain-link mesh closed at one edge by knuckling and at the other edge by twisting.

The steel wire for chain-link fence fabric shall be according to CAN/CGSB 138.1. The fence fabric shall be one of the types listed in Table 1.

The vinyl coating for wire fabric shall be black in colour.

1541.05.02 Posts and Rails

All posts, post sleeves, and rails shall be galvanized steel pipe and shall be according to CAN/CGSB 138.2.

When vinyl-coated fence fabric is used, all posts, post sleeves, and rails shall be vinyl-coated to match the class and colour of the vinyl-coated fence fabric and shall be according to CAN/CGSB 138.1.

1541.05.03 Diagonal Wire Braces, Top and Bottom Wires for use with Galvanized Steel Fence Fabric

Top wire, bottom wire, and diagonal wire braces shall be 4.50 mm diameter marcelled tension wire Type II according to ASTM A 824 with a minimum Class 5 galvanized coating.

1541.05.04 Diagonal Wire Braces, Top and Bottom Wires for use with Vinyl-Coated Fence Fabric

Top wire, bottom wire, and diagonal wire braces shall be 4.50 mm diameter marcelled tension wire Type II according to ASTM A 824 with a minimum Class 3 galvanized coating. The wire shall be vinyl-coated to match the class and colour of the vinyl-coated fence fabric and shall be according to CAN/CGSB 138.1.

1541.05.05 Gates

Gates shall be constructed from galvanized steel pipe frames and braces according to CAN/CGSB 138.4. All joints shall be electrically welded and coated with a zinc rich paint after welding.

When vinyl-coated fence fabric is used, gate frames and braces shall be vinyl-coated to match the class and colour of the vinyl-coated fence fabric and shall be according to CAN/CGSB 138.1.

1541.05.06 Fittings

Tension bars, tension bands, brace bands, top rail sleeves, and rail ends shall be according to ASTM F 626.

Barbed wire arms shall be fabricated from galvanized pressed steel or cast iron according to CAN/CGSB 138.2 or ASTM F 626.

Terminal and line post caps shall be according to ASTM F 626.

When vinyl-coated fence fabric is used, the fittings shall be vinyl-coated to match the class and colour of the vinyl-coated fence fabric and shall be according to CAN/CGSB 138.1.

1541.05.07 Hardware

All required hardware including, but not limited to carriage bolts and nuts, shall be hot dip galvanized according to ASTM A 153.

1541.05.08 Fasteners

Wire ties for attaching fence fabric to line posts, bottom wires, top rails, and top wires shall be according to ASTM F 626.

1541.05.08.01 Fasteners for Galvanized Steel Fence Fabric

Wire ties for attaching fence fabric to line posts and top rails shall be manually fastened round wire ties, 3.76 mm diameter steel wire, with a minimum 488 g/m² galvanized coating or power fastened round wire ties, 3.76 mm diameter steel wire, with a minimum of 488 g/m² galvanized coating.

Wire ties for attaching fence fabric to bottom or top wires shall be round wire hog rings, 2.69 mm diameter steel wire, with a minimum 488 g/m² galvanized coating.

1541.05.08.02 Fasteners for Vinyl Coated Fence Fabric

Wire ties for attaching fence fabric to line posts and top rails shall be manually fastened round wire ties, 3.76 mm diameter zinc or aluminum coated steel core wire, with a vinyl coating or power fastened round wire ties, 3.76 mm diameter zinc or aluminum coated steel core wire, with a vinyl coating.

Wire ties for attaching fence fabric to bottom or top wires shall be round wire hog rings, 2.69 mm diameter zinc or aluminum coated steel core wire, with a vinyl coating.

Fasteners shall be vinyl-coated to match the class and colour of the vinyl-coated fence fabric and shall be according to CAN/CGSB 138.1.

1541.05.09 Turnbuckles

Turnbuckles shall be drop forged steel according to ASTM A 27 and shall be galvanized according to ASTM A 153.

The average overall length shall be approximately 300 mm with ends in the closed position. Bolt diameter shall be approximately 10 mm and capable of taking up a minimum of 150 mm slack.

1541.05.10 Barbed Wires

Barbed wires shall be according to CAN/CGSB 138.2.

1541.07 PRODUCTION

1541.07.01 Gates

All gates shall be supplied with galvanized malleable iron or pressed steel hinges, latch, and latch catch and shall be capable of opening approximately 180 degrees. Gate latches shall be suitable for use with padlocks that can be attached and operated from either side of the gate.

Gates shall be supplied completely assembled, including the fabric. The gate fabric and wire ties used on the gate shall match the adjacent fence fabric and be subjected to the same quality requirements.

1541.09 OWNER PURCHASE OF MATERIAL

1541.09.01 Measurement and Payment

Measurement of fence fabric shall be by length in metres.

Measurement of barbed wire shall be by length in metres.

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

Diagonal wire brace and top and bottom wires shall be measured in the units specified in the purchasing order.

For measurement purposes, a count shall be made of the gates delivered and accepted, regardless of the size and type of gate. Double gates shall be counted as one gate.

For measurement purposes, a count shall be made of the fittings and hardware of each type specified in the purchasing order delivered and accepted.

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

Payment at the price specified in the purchasing order shall be for the supply of fence fabric, posts and rails, diagonal wire braces, top and bottom wires, gates, fittings and accessories, turnbuckles, and barbed wires 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.

TABLE 1
Fence Fabric

Type	Nominal Diameter of Zinc-Coated Wire mm	Minimum Weight of Galvanized Coating g/m²	Nominal Diameter of Vinyl-Coated Wire mm	Minimum Wire Breaking Strength N	Standard
Class B - Zinc-Coated Galvanized Before Weaving (WGW) Steel Fabric	3.5	488	n/a	5000	CAN/CGSB 138.1
Class D - Vinyl-Coated Steel Fabric	3.5	90	4.26	5000	CAN/CGSB 138.1

Appendix 1541-A, April 2019
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 972.101	Fence, Chain-Link, Component - Barbed Wire
OPSD 972.102	Fence, Chain-Link, Component - Gate
OPSD 972.130	Fence, Chain-Link, Installation - Roadway
OPSD 972.131	Fence, Chain-Link, Installation - Concrete Barrier
OPSD 972.132	Fence, Chain-Link, Details and Table



**MATERIAL SPECIFICATION FOR
WOOD, PRESERVATIVE TREATMENT, AND SHOP FABRICATION**

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1601.07	PRODUCTION
1601.08	QUALITY ASSURANCE
1601.09	OWNER PURCHASE OF MATERIAL

APPENDICES

1601-A	Commentary

1601.01 SCOPE

This specification covers the material requirements for wood used in permanent and temporary structures, posts for signs, highway fence, and guide rail.

1601.01.01 Specification Significance and Use

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

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

1601.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

1601.02 REFERENCES

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

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

CSA Standards

O56:10 (R2020)	Round Wood Piles
O80 Series-15 (R2020)	Wood Preservation
O122-16 (R2021)	Structural Glued-Laminated Timber
O141:05 (R2019)	Softwood Lumber
O177-06 (R2020)	Qualification Code for Manufacturers of Structural Glued-Laminated Timber

American Wood Protection Association (AWPA)

P1/P13-19	Creosote Preservative
P23-14	Standard for Chromated Copper Arsenate Type C (CCA-C)
P28-20	Standard for Alkaline Copper Quat Type C (ACQ-C)
P29-20	Standard for Alkaline Copper Quat Type D (ACQ-D)
P32-19	Standard for Copper Azole Type B (CA-B)
P35-16	Standard for Pentachlorophenol (PCP)

Other

National Lumber Grades Authority (NLGA):
Standard Grading Rules for Canadian Lumber, 2017

1601.03

DEFINITIONS

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

Check means separation of the wood along the grain, the greater part of which occurs across the rings of annual growth. When the depth of a check exceeds half the thickness of the member, it shall be deemed a split.

Decay means a disintegration of the wood substance due to the action of wood-destroying fungi that causes the wood to become unsound. Also known as dote or rot.

Dressed means wood that is surfaced by a planing machine to attain a standard of smoothness and uniformity of size.

Glued-Laminated Wood means a structural wood member produced by gluing together a number of wood pieces according to CSA O122.

Grade means the designation of the size or quality of a piece of wood according to the NLGA Standard Grading Rules for Canadian Lumber.

New Wood means wood that is free from deterioration such as that caused by decay, chemical or insect attack, or physical damage and has not been remanufactured since the time of its original grading.

Preservative Treatment means a pressure process that impregnates wood with registered wood preservatives to prevent decay and insect attack.

Shake means a lengthwise separation of the wood that occurs between or through the rings of annual growth.

Short Crook means a localized deviation from straightness that is more than half the mean diameter of the crooked section within any section 5 feet or less in length.

Species means the tree source from which the wood was taken.

Split means a lengthwise separation of the wood due to the tearing apart of the wood cells that usually extends from surface to surface of a wooden pile.

Sweep means the deviation of a post from straightness.

Used Wood means wood other than that defined as new wood.

Wane means bark or lack of wood from any cause on the edge or corner of a piece of lumber.

Wood means a generic term covering all wood including glued-laminated members, including both new wood and used wood.

1601.05

MATERIALS

1601.05.01

General

All wood in permanent structures shall be new. Grade, species, size, preservative treatment, and surface finish shall be as specified in the Contract Documents. All sizes of sawn wood shall be dressed sizes.

1601.05.02 Wood for Highway Fence, Cable Guide Rail, and Delineator Posts

Allowable species for round wooden posts for highway fence, cable guide rail, and delineators shall be according to CSA O80 Series. Allowable defects shall be according to CSA O56, except that the posts shall be free from loose or unsound knots, short crooks, reverse sweep, shakes, decay, and checks that exceed 6 mm in width. Posts having a sweep exceeding 2% of the length of the post shall be rejected.

1601.05.03 Wood for Steel Beam Guide Rail and Sign Posts

Allowable species for wooden posts and wooden offset blocks for steel beam guide rail shall be according to CSA O80 Series.

Allowable species for wooden posts for signs shall be according to CSA O80 Series. Except for maximum allowable wane, posts and blocks for steel beam guide rail and posts for signs shall be No. 1 Grade according to the NLGA Standard Grading Rules for Canadian Lumber. Structural posts and timber shall be graded according to the NLGA Standard Grading Rules for Canadian Lumber.

Wane on blocks and on the portion of posts to be set above ground shall not exceed a total width of 25 mm on any one face. Wane on the lower 1.2 m or on the portion of posts to be set below ground shall not exceed a total width of 60 mm on any one face. The total width of wane on any face shall be determined by deducting the portion of the face that is entirely free from wane from the minimum permissible dimension as specified in the Contract Documents.

1601.05.04 Round Wooden Piles

Wooden piles shall be cleaned and peeled and according to CSA O56.

1601.05.05 Structural Glued-Laminated Wood

Structural glued-laminated wood shall be according to CSA O122 and shall be produced by a manufacturer certified according to CSA O177.

1601.05.06 Preservatives

Preservatives shall be according to CSA O80 Series and shall be selected from the following:

- a) Creosote shall be according to AWWA P1/P13.
- b) Pentachlorophenol in Type A hydrocarbon solvent. The mixture shall be not less than 5% pentachlorophenol and petroleum solvent and shall be according to AWWA P35.
- c) Chromated Copper Arsenate (CCA) shall be according to AWWA P23.
- d) Alkaline Copper Quaternary Type C (ACQ-C) shall be according to AWWA P28.
- e) Alkaline Copper Quaternary Type D (ACQ-D) shall be according to AWWA P29.
- f) Copper Azole Type B (CA-B) shall be according to AWWA P32.
- g) Micronized Copper Azole (MCA) shall be according to CSA O80 Series

Use of fasteners and hardware shall be as specified in the Contract Documents.

1601.05.07 Painting of Preservative Treated Wood

Only waterborne preservatives CCA, ACQ, CA-B, and MCA shall be permitted for use on wood that is to be painted following preservative treatment.

1601.05.08 Marking of Wood for Identification

All wood shall be marked using a grade stamp of an association or independent grading agency according to CSA O141.

1601.05.09 Marking of Wood for Identification of Preservative Treatment

All wood with preservative treatment shall be marked indicating the CSA Use Category, preservative, and retention.

1601.05.10 Certificates of Compliance

1601.05.10.01 Identification of Wood

When the grade stamp is obscured or is nonexistent, the following certificates shall be provided by the fabricator:

- a) Verification of compliance with grade and species by an agency approved by the Canadian Lumber Standards Accreditation Board (CLSAB).
- b) Verification that all structural glued-laminated wood has been produced by a certified manufacturer.

1601.05.10.02 Preservative Treatment

When the certification mark is obscured or is nonexistent, a certificate shall be provided by the fabricator verifying that the material was treated according to CSA O80 Series.

1601.05.11 Used Wood

Used wood shall not be used as posts for delineator, steel beam guide rail, or cable guide rail installations.

Used wood shall be permitted for use in temporary structures, provided that the wood is of known history and the grade and species are identifiable. The used wood shall be same stress level as new wood of the same grade and species, provided that the previous use has not damaged the used wood in such a way that the grade requirements are no longer met. Where used wood has been damaged, has deteriorated due to decay or to chemical or insect attack, or its planned use is in a structure to which the public has access, the used wood shall not be used, unless it is regraded by a grading agency approved by CLSAB.

1601.07 PRODUCTION

1601.07.01 Preservative Treatment

Proper wood preparation including seasoning, incising and preservative treatment shall be according to CSA O80 Series.

All products shall meet the minimum penetration and retention levels specified for each preservative and species according to CSA O80 Series. Products requiring incising to meet penetration and retention standards shall be incised prior to treatment to the minimum depth specified for that species and preservative combination.

All wood for permanent applications shall be pressure preservative treated except Eastern White Cedar for cable guide rail posts, guide posts, delineator posts, and highway fence posts and Western Red Cedar for sign posts.

All wood, except cedar posts, in temporary structures with an intended service life exceeding 1 year shall be pressure preservative treated.

Wood treated using oil borne preservatives shall be subjected to a vacuum expansion bath at a treatment plant according to CSA O80 Series to produce a material that is free of excessive surface oil. Wood treated using water borne preservatives shall have an average moisture content not exceeding 25% at 25 mm depth below the surface prior to preservative treatment. All other product specific pre-treatment requirements (including conditioning and incising) shall be according to CSA O80 Series.

1601.07.02 Shop Fabrication

Cutting, framing, drilling, and grooving of wood shall be performed prior to preservative treatment.

1601.07.03 Handling, Storage and Care of Wood

Handling and storage of wood shall be according to CSA O80 Series.

Wood shall be kept free of dirt and stored in a location that will not create an excessive increase in temperature through the greenhouse effect resulting in rapid drying of the material. Wood shall be stored in a manner that will prevent ponding or trapping of excess moisture between surfaces where it cannot dry readily.

When oil treatment is used, the wood shall be given three coats of creosote oil to repair all cuts, abrasions, and holes made after the initial pressure preservative treatment. Each coat shall be dry before the next coat is applied.

Repair of cuts, abrasions, and holes in material treated with water-borne preservatives shall be according to CSA O80 Series.

1601.07.04 Quality Control - Wood Preservation

The wood preserving plant shall use quality control procedures according to CSA O80 Series.

1601.07.05 Tolerances

1601.07.05.01 Dimensions

The following tolerances shall apply:

Diameter of round wooden posts for highway fence, cable guide rail, and delineator posts	± 10 mm
Diameter of other round wooden posts	± 6 mm
Dressed cross-sectional dimensions	± 2 mm
Length	± 10 mm

1601.07.05.02 Splits and Checks

Splits and checks in all treated wood shall not exceed the following limits:

Cedar and Treated Posts

- a) The width of splits and checks at the surface shall not exceed 10 mm, regardless of their length or depth.
- b) The depth of splits or checks shall not exceed the depth of 40% of the post diameter or thickness, regardless of their length or width.

Other Treated Wood

- a) The width of splits and checks at the surface shall not exceed 6 mm.
- b) Splits shall not exceed in length any of the following:
 - i. Twice the member thickness.
 - ii. One and one half times the member width.
 - iii. One quarter of the member length.

1601.08 QUALITY ASSURANCE

1601.08.01 Inspection

The quality of all materials and finished products shall be subject to inspection and approval by the Owner. The manufacturer shall afford the Owner reasonable access to facilities to ensure that the wood products furnished are according to this specification.

1601.09 OWNER PURCHASE OF MATERIAL

1601.09.01 Measurement and Payment

For measurement purposes, a count shall be made of the wooden posts or wooden blocks of each size supplied.

For measurement purposes, a count shall be made of the wooden piles of each length supplied.

Measurement of other wood shall be as specified in the purchasing order.

Payment at the price specified in the purchasing order shall be for the supply of the wooden posts, wooden blocks, wooden piles, or other wood 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 1601-A, November 2021
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Grade, species, size, and surface finish of all wood in permanent structures. (1601.05.01)
- Hardware and fasteners to be used with specific preservative treatments (1601.05.06)

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

Related Ontario Provincial Standard Drawings

No information provided here.



Note: The MUNI implemented in November 2018 replaces OPSS 1605 COMMON, November 2010 with no technical content changes.

MATERIAL SPECIFICATION FOR EXTRUDED EXPANDED POLYSTYRENE PAVEMENT INSULATION

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1605-A	Commentary

1605.01 SCOPE

This specification covers extruded expanded polystyrene for use as pavement insulation for frost heave treatment of pavements.

1605.01.01 Specification Significance and Use

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

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

1605.01.02

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.

1605.02

REFERENCES

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

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

Underwriters Laboratories of Canada (ULC)

CAN/ULC S701-11 Thermal Insulation, Polystyrene, Boards and Pipe Covering

1605.03

DEFINITIONS

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

Extruded Expanded Polystyrene Pavement Insulation means insulation in the form of rigid boards made by extrusion of expanded polystyrene beads.

Production Lot means the quantity of insulation boards produced in a continuous period of manufacturing the same grade and thickness of product within the same production day.

Truckload means a truck, including trailer, loaded with rigid insulation boards.

1605.05 MATERIALS

The extruded expanded polystyrene boards shall be according to the requirements of CAN/ULC S701, Type 4, with the exception of the compressive strength.

The minimum compressive strength for each grade shall be according to Table 1.

1605.07 PRODUCTION

Each board of the same production lot shall be stamped with the same production code showing plant identification, type, grade, and date of production (i.e., yyyy-mm-dd).

1605.08 QUALITY ASSURANCE

1605.08.01 Certificate of Compliance

Test certificates for each production lot supplied showing compliance with all requirements of this specification shall be obtained by the Contractor and submitted to the Contract Administrator prior to installation.

1605.08.02 Sampling

One board from each production lot on each truckload shall be selected at random by the Contract Administrator when the material arrives at the job site. The samples shall be tested by a laboratory designated by the Owner for compliance with this specification.

1605.08.03 Testing

All test procedures shall be according to CAN/ULC S701.

The compressive strength shall be the average of 5 specimens taken at different places across the width of the board and determined on the face perpendicular to the extrusion plane.

1605.08.04 Acceptance or Rejection

Failure of any one of the sample boards to comply with any requirement of this specification shall be cause for rejection of the production lot from which it was taken. Culling of the rejected material by the Contractor shall be permitted and a proposal for retesting the remaining material shall be submitted to the Contract Administrator to demonstrate conformance with the specification. Retesting of material remaining from culling rejected material shall be at no cost to the Owner.

1605.09 OWNER PURCHASE OF MATERIAL

1605.09.01 Measurement and Payment

Measurement of extruded expanded polystyrene pavement insulation shall be by area in square metres.

Payment at the price specified in the purchasing order shall be for the supply of extruded expanded polystyrene pavement insulation 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.

TABLE 1
Minimum Compressive Strength

Grade	Minimum Compressive Strength, kPa at 5% Deflection or Yield
A	275
B	400
C	690

Appendix 1605-A, November 2018
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 514.010	Extruded Expanded Polystyrene Frost Heave Treatment, 25 mm Thickness
OPSD 514.020	Extruded Expanded Polystyrene Frost Heave Treatment, 40 mm Thickness



MATERIAL SPECIFICATION FOR PAINT COATING SYSTEMS FOR STRUCTURAL STEEL

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APPENDICES

1704-A	Commentary

1704.01 SCOPE

This specification covers the material requirements of paint coating systems for structural steel. It also covers the procedure to be followed for initial approval and subsequent acceptance testing of paint coatings and paint coating systems.

1704.01.01 Specification Significance and Use

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

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

1704.01.02 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.

1704.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 911 Coating Structural Steel Systems

Ontario Provincial Standard Specifications, Material

OPSS 1714 Field Reacted Polymeric Pavement Marking Materials

CSA Standards

G-164-M92 (R2003) Hot Dip Galvanizing of Irregularly Shaped Articles

Canadian General Standards Board (CGSB)

1-GP-71 No. 5-96 Methods of Testing Paints and Pigments - Drying Times of Paints and Related Coatings

ASTM International

B 117-07a	Standard Practice for Operating Salt Spray (Fog) Apparatus
D 523-08	Standard Test Method for Specular Gloss
D 562-01(2005)	Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using the Stormer-Type Viscometer
D 609-00 (2006)	Standard Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products
D 610-08	Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces
D 660-93 (2005)	Standard Test Method for Evaluating Degree of Checking of Exterior Paints
D 661-93 (2005)	Standard Test Method for Evaluating Degree of Cracking of Exterior Paints
D 714-02e1	Standard Test Method for Evaluating Degree of Blistering of Paints
D 772-86(2005)	Standard Test Method for Evaluating Degree of Flaking (Scaling) of Exterior Paints

D 1210-05	Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
D 1475-98(2008)	Standard Test Method for Density of Liquid Coatings, Inks, and Related Products
D 1654-08	Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environment
D 2369-07	Standard Test Method for Volatile Content of Coatings
D 2371-85(2005)	Standard Test Method for Pigment Content of Solvent-Reducible Paints
D 2621-87(2005)	Standard Test Method for Infrared Identification of Vehicle Solids From Solvent-Reducible Paints
D 3271-87(2006)	Standard Practice for Direct Injection of Solvent-Reducible Paints Into a Gas Chromatograph for Solvent Analysis
D 3723-05	Standard Test Method for Pigment Content of Water-Emulsion Paints by Low-Temperature Ashing
D 3960-05	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
D 4214-07	Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
D 4400-99(2007)	Standard Test Method for Sag Resistance of Paints Using a Multinotch Applicator
D 4451-02(2008)	Standard Test Method for Pigment Content of Paints by Low-Temperature Ashing
D 4541-02	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
D 4587-05	Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
D 5894-05	Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
D 6386-99(2005)	Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
E 1347-06	Standard Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry

ASTM International Manual Series: MNL 17

Paint and Coating Testing Manual, 14th Edition of the Gardner-Sward Handbook

The Society for Protective Coatings (SSPC)

Good Painting Practice, SSPC Painting Manual, Volume 1, 4th Edition, 2002

SP 3-82 (2004) Power Tool Cleaning

VIS 1-02 Visual Standard for Abrasive Blast Cleaned Steel

VIS 3-93(2004) Visual Standard for Power and Hand Tool Cleaned Steel

Joint Publications of the SSPC and National Association of Corrosion Engineers (NACE)

SP 10/NACE No. 2, September 2000 Near-White Blast Cleaning

Others

U.S. General Services Administration:
Federal Standard 595C Colors, 2008

1704.03 DEFINITIONS

For the purpose of this specification, the definitions in the SSPC, Good Painting Practice Manual, and the following definitions apply:

Coating System means as defined in OPSS 911.

Low Volatile Organic Coating Material means coating material that contains not more than 340 g/L of volatile organic compounds (VOC) when tested according to ASTM D 3960.

Marginally Prepared Surface means a steel surface prepared by power tool cleaning according to SSPC-SP 3.

Paint Coating means as defined in OPSS 911.

Paint Coating System means as defined in OPSS 911.

Pot Life means the length of time a multi-component material is usable after all the components are mixed in the recommended portions.

Seal Coat means as defined in OPSS 911.

Structural Steel means as defined in OPSS 911.

Target Value means the value of various properties listed in OPSF 1704-1 submitted by the supplier with the initial submission of material samples for coating system approval.

1704.04 DESIGN AND SUBMISSION REQUIREMENTS

1704.04.01 Submissions for Paint Coatings and Paint Coating System Approval

The supplier shall provide samples and a completed OPSF 1704-1 for each component of the paint coating system for approval and material acceptance testing. The sample shall be accompanied by the manufacturer's instructions for use; material safety data sheets; and material information, including documentation on laboratory and field tests carried out to establish the pot life; physical characteristics; and chemical composition as shown in OPSF 1704-1.

1704.05 MATERIALS

1704.05.01 Coating Material

1704.05.01.01 General

The requirements of the paint coating shall be according to the following:

- a) The concentration of lead in the dry film of each coating shall not exceed 0.01% or 100 ppm.
- b) The components shall be homogenous, well-dispersed to a uniform consistency and, when mixed according to manufacturer's instructions, shall be suitable for application by spray equipment.
- c) Each paint coating shall be a low VOC material.
- d) The paint coating system for marginally prepared surfaces shall be suitable for application over existing coatings of alkyd, vinyl, and currently approved low VOC paint coating systems.

1704.05.01.02 Colour

The prime coat shall be of such a colour as to assist the applicator in distinguishing between primed areas and the uncoated cleaned steel or other prepared surfaces.

Each coat shall be formulated to show a distinct colour difference. With the exception of coal tar epoxies, the colour of the finish coat shall be equivalent to 10045 brown for Atmospheric Corrosion Resistant steel, and a colour equivalent to 16307 grey for all other steels, both according to Federal Standard 595C Colors.

1704.05.01.03 Application Requirements

When applied according to the manufacturer's instructions and to the manufacturer's specified thickness, the paint coating shall show good levelling with no runs, sags, or mud cracks. Applied coatings shall have no pin-holes, holidays, bubbles, or craters.

Each coat shall be capable of application by spray, brush, or roller for a temperature range of 5 to 35 °C, without thinning.

After the components have been combined, multiple component paint coating shall have a minimum pot life of 3 hours at 25 °C.

1704.05.01.04 Performance Requirements

1704.05.01.04.01 General

The entire coating system shall be tested on test panels for adhesion, weathering resistance, and corrosion resistance performance. Testing shall be as shown in Table 1.

1704.05.01.04.02 Accelerated Weathering

After 5,000 hours of exposure, the coating system on the test panel for abrasive blast cleaned surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. Chalk rating shall be 7 or higher, and the colour difference shall not exceed 6 units.

After 2,500 hours of exposure, the coating system on the test panel for marginally prepared surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 5,000 hours of exposure, the coating system on the galvanized test panel shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

1704.05.01.04.03 Cyclic Corrosion Resistance Testing

After 12 cycles of exposure, the coating system on the test panel for abrasive blast cleaned surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. There shall not be any corrosion, except along the score lines. The average value of the rust creepage of all the scored panels tested shall not be more than 4 mm. However, the rust creepage on any individual panel may exceed 4.0 mm, but shall be below 5.0 mm. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 6 cycles of exposure, the coating system on the test panel for marginally prepared surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. There shall not be any corrosion, except along the score lines. The average value of the rust creepage of all the scored panels tested shall not be more than 4 mm.

However, the rust creepage on any individual panel can exceed 4.0 mm, but shall be below 5.0 mm. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 12 cycles of exposure, the coating system on the galvanized test panel shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. There shall not be any corrosion, except along the score lines. The average value of the rust creepage of all the scored panels tested shall not be more than 4 mm. However, the rust creepage on any individual panel can exceed 4.0 mm, but shall be below 5.0 mm. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

1704.05.01.05 Recoat Time

At an ambient temperature of 23 °C and a relative humidity of 80%, a paint coating shall dry or cure sufficiently to receive the next coat satisfactorily within 16 hours of application. It shall remain recoatable for a minimum of 30 Days.

1704.07 PRODUCTION

1704.07.01 Quality Control

1704.07.01.01 Physical Tests and Paint Coating Composition

The results for physical tests and paint coating composition of production batches shall be within the tolerances shown in Table 2, when the results of testing are compared to the respective test results of the sample submitted for the coating system approval.

1704.07.01.02 Chemical Analysis

When the product from production batches of paint coatings is analyzed for chemical composition, the test results shall not vary by more than:

- a) $\pm 5\%$ from the value of the original submission, if the amount of ingredient is greater than 50% by weight of the product
- b) $\pm 10\%$ from the value of the original submission, if the amount of the ingredient is from 5 to 50% by weight of the product.

1704.07.01.03 Infrared Analysis

The infrared spectrum of the product or any product fraction of production batches of paint coatings shall match the corresponding spectrum from the sample submitted for coating system approval.

1704.07.01.04 Gas Chromatogram of Volatiles

The gas chromatogram of production batches of paint coatings shall show the identical volatile components present in the same proportions as in the sample submitted for coating system approval.

1704.07.01.05 Colour Difference

Colour difference of production batches of paint coatings shall be within the tolerances shown in Table 2. The reference colour for the finish coat shall be the appropriate colour specified in the Material Section. For all other coats, the reference colour shall be the colour of the sample submitted for paint coating system approval.

1704.07.02 Packaging and Delivery

The paint shall be delivered in the manufacturer's originally sealed containers.

Containers shall be leak-free and constructed so that the contents can be thoroughly and completely mixed. They shall be provided with triple-tight lids. Containers 4 litres or larger shall have wire bail handles.

Each container and shipping case shall be marked to show the following information:

- a) Identification of the paint coating system.
- b) The contents of container (i.e., prime coat, second coat, third coat, or fourth coat).
- c) The colour and colour code.
- d) The manufacturer's name and address.
- e) The quantity of the contents in litres.
- f) The date of filling the container (i.e., yyyy-mm-dd).
- g) The manufacturer's code and coating batch numbers.

The markings shall be permanent and the coating batch number shall be prominently displayed.

1704.07.02.01 Certificate of Compliance

A certificate of compliance from the manufacturer indicating that the physical properties and chemical composition of the material supplied complies with the requirements of this specification shall be included with each shipment of paint.

1704.08 QUALITY ASSURANCE

1704.08.01 Test Panels

1704.08.01.01 Testing General

For the following tests, the number of panels specified below shall be made for the paint coating system being evaluated and the panels for the approved paint coating system to be used for reference purposes during paint coating operations.

1704.08.01.02 Weathering Resistance and Corrosion Resistance Testing

1704.08.01.02.01 Panel Preparation

1704.08.01.02.01.01 Abrasive Blast Cleaned Surfaces

Panels shall be cold-rolled carbon steel according to ASTM D 609, measuring 75 x 150 x 2.6 mm with rounded edges. Panels shall be blast cleaned to the requirements of SP 10/NACE NO. 2. The pictorial standards as shown in SSPC-VIS 1 shall be used to check conformance of the panel preparation in conjunction with SP 10/NACE NO. 2. The height of the surface profile shall be a minimum of 25 µm and a maximum of 75 µm.

1704.08.01.02.01.02 Marginally Prepared Surfaces

The panels shall be prepared as specified in the Abrasive Blast Cleaned Surfaces clause and then be subjected to 72 hours of salt spray according to ASTM B 117, after which, the rusted panels shall be power-tool cleaned to SSPC SP 3 condition by power wire brush. The pictorial standards as shown in SSPC-VIS 3 shall be used to check conformance of the panel preparation in conjunction with SSPC SP3.

1704.08.01.02.01.03 Galvanized Surfaces

As the first step, cold-rolled carbon steel panels, measuring 75 x 150 x 5 mm with rounded edges shall be hot dip galvanized according to CAN/CSA G164-M. Galvanized panel surfaces shall then be prepared according to ASTM D 6386. Thick edges due to excess zinc run-off, high spots, and rough edges shall be removed by power tools. Surface preparation shall be performed by sweep blasting to roughen the surface using an abrasive of a hardness that does not damage the galvanized coating.

1704.08.01.02.02 Paint Coating Application

The paint coating system shall be spray applied on both faces of the prepared test panels according to the manufacturer's recommendations and to the manufacturer's recommended thickness. When the painted faces are hard dry, the edges of the panels shall be covered with the same coating applied by brush. After the final coat, the panels shall be dried and cured for 7 Days prior to any further handling.

The coating on the panels intended for scoring shall be scored in accordance with CGSB 1-GP-71, Method 129.1, except that each score line shall be only 100 mm long.

1704.08.01.02.03 Test Method for Accelerated Weathering

Test panels shall be prepared and coated as specified in the Panel Preparation clause and the Paint Coating Application clause.

Seven unscored panels shall be prepared for each cleaning requirement for each coating system. One panel from each set shall be set aside as reference for comparison purposes. The other panels from each set shall undergo exposure testing as shown in Table 1. Evaluation shall be done at 500 hour intervals of exposure to the maximum of 5,000 hours for abrasive blast cleaned surfaces and galvanized surfaces and 2,500 hours for marginally prepared surfaces.

1704.08.01.02.04 Test Method for Cyclic Corrosion Resistance of Coatings

Test panels shall be prepared, coated, and scored as specified in the Panel Preparation clause and the Paint Coating Application clause.

Eleven panels shall be prepared for each cleaning requirement for each coating system. One panel from each set shall be set aside as reference for comparison purposes. The other panels, 5 unscored and 5 scored from each set, shall undergo exposure testing as shown in Table 1. Evaluation shall be done after each cycle of exposure. At the completion of testing, the coating between the score lines on the bottom half of the scored panels shall be stripped and the mean rust creepage in millimetres for each panel shall be determined according to ASTM D 1654. The average rust creepage shall be calculated from the mean rust creepage values of the individual panels of the respective paint system.

1704.08.02 Coating System Approval

1704.08.02.01 General

Approval shall only be given for a complete paint coating system and for paint coating to be used as a seal coat for thermal spray metal coating.

Testing shall be performed by the Owner or by an independent laboratory chosen by the Owner.

When an independent laboratory is used, the paint manufacturer shall arrange for testing by the independent laboratory. The independent laboratory shall obtain samples of the approved paint coating and paint coating system to be used for comparison purposes from the Owner.

1704.08.02.02 Testing by Owner

When testing is carried out by the Owner for initial approval, the supplier shall be notified of the sample size, date, labelling, and other details regarding submission of samples, including cost.

1704.08.02.03 Testing for Coating System Approval and Approval of Subsequent Batches

The initial submission shall be evaluated for approval based on the requirements specified in the Materials section, using the testing methods as shown in Tables 1 and 2, and the data submitted on the completed OPSF 1704-1.

For comparison, an approved system from the Owner's list of approved coatings shall be subjected to the tests for accelerated weathering and cyclic corrosion resistance concurrently with the system under evaluation. Where possible, coatings of the same generic type shall be used for comparison.

When the testing is done by the approved independent laboratory, the Owner shall review the test results and may repeat any of the tests.

Subsequent batches of material shall be tested for acceptance as specified in the Quality Assurance section.

1704.08.02.05 Acceptance or Rejection

1704.08.02.05.01 Initial Approval

Approval shall only be given to paint coatings and paint coating systems satisfying the requirements of the Materials section.

1704.08.03 Sampling at Work Site

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

1704.08.03.01 Acceptance or Rejection on Site

Testing shall be done by the Owner according to the methods as shown in Table 2.

Acceptance shall be based on the testing requirements and allowable tolerances as shown in Table 2, when compared to the results of the testing conducted by the Owner on the initially approved material.

Failure to conform to the requirements of the Material section and the tolerances as shown in Table 2, changes made in the formulation after approval, inability to maintain production quality, and unsatisfactory field performance of paint coatings or paint coating systems shall be a cause for rejection.

1704.09 OWNER PURCHASE OF MATERIAL

1704.09.01 Measurement and Payment

Paint coating and paint coating system shall be measured by volume in litres.

Payment at the price specified in the purchasing order shall be for the supply of the paint coating or paint coating system 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.

TABLE 1
Performance Tests for Paint Coating Systems

Type of Test	CGSB 1-GP-71 Method	ASTM Method	Requirements
Pull-Off Adhesion	-	D 4541	2.75 MPa minimum
Accelerated Weathering using Fluorescent UV - Condensation Light- and Water-Exposure Apparatus for evaluation of: Paint coating system on abrasive blast cleaned test panels Paint coating systems on hot dip galvanized test panels Paint coating system on marginally prepared test panels	122.1	D 4587 Test Condition D	Exposed to: 5,000 hours maximum 5,000 hours maximum 2,500 hours maximum
Cyclic Corrosion Resistance Testing by Alternating Exposures in a UV/Condensation Cabinet and a Salt Fog/Dry Cabinet for evaluation of: Paint coating system on abrasive blast cleaned test panels Paint coating systems on hot dip galvanized test panels Paint coating system on marginally prepared test panels	-	D 5894	Exposed to: 12 cycles maximum (Note 1) 12 cycles maximum (Note 1) 6 cycles maximum (Note 1)
Evaluation of Test Panels After Accelerated Weathering Test / Cyclic Corrosion Resistance Test for: Gloss Colour Difference (ΔE) Chalking Checking Cracking Flaking Blistering Rusting Rust Creepage	13.4 12.1 - - - - - - -	D 523 E 1347 D 4214 D 660 D 661 D 772 D 714 D 610 D 1654	Test Method for Accelerated Weathering and the Test Method for Cyclic Corrosion Resistance of Coatings clauses (Note 2)
Notes: 1. One cycle represents a total exposure of 336 hours which comprises 168 hours or 1 week of exposure of test panels in the fluorescent UV condensation cabinet, followed by 168 hours of exposure of the test panels in the cyclic salt fog or dry exposure cabinet. 2. Clauses in this specification.			

TABLE 2
Test Methods for Physical Testing and Compositional Analysis of Paint Coatings
and Acceptance Criteria for Field Samples and Production Batches

	CGSB 1-GP-71 Method	ASTM	Acceptance Criteria (Note 1)	
			Tolerance (Note 2)	Others
Physical Tests on Mixed Coating:				
Density	2.1	D 1475	5%	-
Consistency, Krieb Units (KU)	4.5	D 562	± 10 or 25% (Note 3)	-
Dry Time:	5-96	-		
To Touch		-	± 30%	-
Hard Dry		-	± 30%	-
Hiding Power Determination Using Pfund Black and White Cryptometer		Paint and Coating Testing Manual	± 1.5 (Note 4)	-
Skimming	10.1	-	-	-
Fineness of Grind, Hegman Units (HU)		D 1210	± 2	-
Sag Resistance		D 4400	± 20%	-
Coating Composition:				
Pigment Content by % mass	21.1	D 4451, D 2371, D 3723	± 5%	-
Vehicle Solids Content by % mass @ 24 hours	19.1	-	± 5%	-
Volatile Content by % mass @ 2 hours and 24 hours	17.1	D 2369	± 5%	-
Pigment Composition by Chemical and Instrumental Analysis	-	-	-	Chemical Analysis clause (Note 5)
VOC Content	-	D 3960	± 10% but the total not exceeding 340 g/L	-
Vehicle Solids Identification by Infrared Analysis	-	D 2621	-	Infrared Analysis clause (Note 5)
Determination of Paint Volatiles Composition by Gas Chromatography	-	D 3271	-	Gas Chromatogram of Volatiles clause (Note 5)
Determination of Thinner Composition by Gas Chromatography	-	D 3271	-	Gas Chromatogram of Volatiles clause (Note 5)
Tests on Cured Paint Coating:				
Gloss	13.4	D 523	± 30%	-
Colour Difference (ΔE)	12.1	E 1347	± 4 units	-
IR Fingerprinting	-	Paint and Coating Testing Manual	-	Infrared Analysis clause (Note 5)
Notes:				
1. Acceptance criteria for field samples and production batches.				
2. Allowable tolerance for field samples or production batches based on the Owner's test results for the initially approved paint coating material.				
3. Whichever is less.				
4. Pfund black and white cryptometer, wedge #3.5.				
5. Clause in this specification.				

PAINT COATING DATA FORM

STRUCTURAL STEEL COATING SYSTEM and COATING GALVANIZED SURFACES

A. MANUFACTURER INFORMATION

Name:
Address:
Telephone:
Fax:
Email:

B. SAMPLE IDENTIFICATION

Manufacturer's Code No.:	Coating Batch No.:
Colour of Coating:	Production Date:

C. TEST DATA OF MIXED COATING

	Test Method	Manufacturer's Test Results
Density, kg/L	ASTM D 1475	
VOC, g/L	ASTM D 3960	
Viscosity, KU	ASTM D 562	
Pot Life, hours @ 25 °C	Manufacturer's Procedure	
Sag Resistance, mm	ASTM D 4400	
Dry Time, hours @ 25 °C		
To touch	CGSB 1-GP-71 No. 5-96	
Hard dry		

D. COMPOSITION OF MIXED COATING

	Test Method	% by Mass
Pigment and Fillers	ASTM D 2371, D 4451, D 3723	
Non Volatile	-	
Volatile	ASTM D 2369	

E. COMPOSITION OF PIGMENTS AND FILLERS IN EACH COMPONENT % BY MASS - List % lead to three decimal places

	Component A	%	Component B	%	Component C	%
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

F. PAINT VOLATILE COMPOSITION BY GAS CHROMATOGRAPHY - Attach chromatogram with peaks identified

	Chemical Name	%
1		
2		
3		
4		
5		

G. COMPOSITION OF THINNER BY GAS CHROMATOGRAPHY - Attach chromatogram with peaks identified

	Chemical Name	%
1		
2		
3		
4		
5		

H. VEHICLE SOLIDS IDENTIFICATION by Infrared Analysis - Attach spectrum with major peaks identified

I. MIXING RATIO OF COMPONENTS A, B, and C by weight _____

J. IR FINGERPRINT OF MIXED, CURED COATING - Attach Spectrum with major peaks identified

OPSF 1704-1

Appendix 1704-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.



Note: The MUNI implemented in November 2021 replaces OPSS 1712 COMMON, February 1991 with no technical content changes.

MATERIAL SPECIFICATION FOR ORGANIC SOLVENT BASED TRAFFIC PAINT

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1712-A	Commentary

1712.01	SCOPE

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

1712.01.01 Specification Significance and Use

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

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

1712.01.02 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.

1712.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

OPSS 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 means the procedure and requirements for establishing an approved source for materials.

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

No Tracking Time means 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 means 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 means a material formulated for application onto bituminous or concrete pavement in order to delineate vehicle operating limits.

Reflectorization means 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 means the evaluation of pavement marking materials on a test deck and performance rating prior to compliance certification.

Traffic Paint means 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.

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 be according 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 according 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 - 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 Owner.

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 according 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 according to OPSS 1750 may be obtained from the Owner 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 be according to Table 1.

Samples are required by the Owner 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, according to subsection 1712.05.05 and Table 1 shall be submitted for service test when requested by the Owner.

Organic solvent based traffic paints shall be service tested according to the following:

- a) Test deck location, time, and procedure of application shall be as specified by the Owner.
- 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 microns $\pm$ 25 microns on bituminous or concrete pavement with about 20,000 AADT and the subsequent application of overlay glass beads according 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 Owner, as specified 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 subsection 1712.09.02.

1712.07 PRODUCTION

1712.07.01 Plant Inspection

In order to qualify as a supplier of organic solvent based traffic paints, 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 paints conform to this specification.

1712.08 QUALITY ASSURANCE

1712.08.01 Acceptance Criteria

The Owner may request samples to be taken from the shipments of organic solvent based traffic paints at any time for quality assurance testing. Samples shall be taken from each batch produced for delivery to the Owner. 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 according 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 according to ASTM D711.
- f) Hiding power with minimum value of 8.4 m²/l.
- g) Bleeding with minimum value of 5.0.
- h) Directional reflectance with:
 - i) Minimum value of 70% white.
 - ii) 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 Owner'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 Owner 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 OWNER PURCHASE OF MATERIAL

1712.09.01 Trial Batch Application

A trial batch of organic solvent based traffic paints according to this specification may be purchased by the Owner for evaluation of application properties using the Owner'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 paints according to this specification which exhibit satisfactory loading and application properties when used with the Owner'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 Owner shall conform to this specification and shall not deviate from the allowable tolerances, unless approved by the Owner.

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 Owner'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

Measurement of organic solvent based traffic paint shall be by litres.

Payment at the price specified in the purchasing order shall be for the supply of organic solvent based traffic paint.

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		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		
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/m²/lux						Mirolux 12
White	**	**	**	**	**	
Yellow	**	**	**	**	**	
Black	**	**	**	**	**	
No Tracking Time, mins.	≤ 2					
Durability						MTO***
White and Yellow		≥ 90	≥ 85	≥ 75	≥ 70	
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 Owner.

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.

Appendix 1712-A, November 2021
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

Related Ontario Provincial Standard Drawings

No information provided here.



ONTARIO PROVINCIAL STANDARD SPECIFICATION

**OPSS.MUNI 1713
NOVEMBER 2021**
(Formerly OPSS 1713, February 1991)

Note: The MUNI implemented in November 2021 replaces OPSS 1713 COMMON, February 1991 with no technical content changes.

MATERIAL SPECIFICATION FOR THERMOPLASTIC PAVEMENT MARKING MATERIALS

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APPENDICES

1713-A	Commentary

1713.01	SCOPE

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

1713.01.01 Specification Significance and Use

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

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

1713.01.02 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.

1713.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

OPSS 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 means the procedure and requirements for establishing an approved source for materials.

Fingerprinting means the testing of thermoplastic pavement marking materials by gas chromatographic and infrared spectrosopic techniques for verification purposes.

Hot Applied Thermoplastic Pavement Marking Material means 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 means 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.

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

Reflectorization means 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 means the evaluation of pavement marking materials on a test deck and performance rating prior to compliance certification.

Thermoplastics means 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 be according 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 according 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 Owner.

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 according to OPSS 1750, with the exception of the requirement of silicone coating.

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

1713.05.05 Physical Property Requirements

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

Samples are required by the Owner 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 according to the qualifications of section 1713.05 and Table 1, shall be supplied for service test when requested by the Owner.

Thermoplastic pavement marking material shall be service tested according to the following:

- a) Test deck location and time for application shall be determined by the Owner.
- 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 shall be made by the supplier/manufacturer or their 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 Owner as specified in Table 2.
- f) Susceptibility to snow plow damage and chipping will be assessed.
- g) Approval will be given after two years of service rating, providing the material conforms to Table 2 and meets the conditions of subsection 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.
- 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 materials conform to this specification.

1713.08 QUALITY ASSURANCE

1713.08.01 Acceptance Criteria

The Owner 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 Owner. 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:
 - i) Minimum value of 70% white.
 - ii) 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 Owner 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 Owner.

1713.08.03 Storage

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

1713.09 OWNER PURCHASE OF MATERIAL

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 materials for the Owner shall conform to this specification and shall not deviate from the allowable tolerances, unless approved by the Owner.

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 Owner. 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

Measurement of thermoplastic pavement marking material shall be by metres.

Payment at the price specified in the purchasing order shall be for the supply of thermoplastic pavement marking material.

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						
	Newly Installed Thermo- Plastics	Service Life Ratings of					Test Method
		1 yr	2 yrs	3 yrs	4 yrs	5 yrs	
Directional Reflectance % White Yellow	≥ 70 ≥ 45	≥ 50 ≥ 35	≥ 50 ≥ 35	≥ 50 ≥ 35	≥ 50 ≥ 35	≥ 50 ≥ 35	ASTM E97*
Retroreflectance mcd/m²/lux White Yellow	** **	** **	** **	** **	** **	** **	Instrument Mirolux 12
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 Owner.

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 according 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.

Appendix 1713-A, November 2021
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

Related Ontario Provincial Standard Drawings

No information provided here.



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**OPSS.MUNI 1714
NOVEMBER 2021**
(Formerly OPSS 1714, February 1991)

Note: The MUNI implemented in November 2021 replaces OPSS 1714 COMMON, February 1991 with no technical content changes.

**MATERIAL SPECIFICATION FOR
FIELD REACTED POLYMERIC PAVEMENT MARKING MATERIALS**

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1714-A	Commentary

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.

1714.01.01 Specification Significance and Use

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

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

1714.01.02 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.

1714.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

OPSS 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 D713-87	Conducting Road Service Tests on Traffic Paint
ASTM D868-85	Degree of Bleeding of Traffic Paint
ASTM D869-85	Degree of Settling of Traffic Paint
ASTM D1415-88	Rubber Property - International Hardness
ASTM D1644-88	Non-Volatile Content of Varnishes
ASTM D1652-88	Epoxy Content of Epoxy Resins
ASTM D2074-66 (1987)	Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D2240-86	Rubber Property - Durometer Hardness
ASTM D2244-85	Calculation of Colour Differences from Instrumentally Measured Colour Coordinates
ASTM D4060-84	Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM E97-82 (1987)	Test for 45-deg, 0-deg, Directional Reflectance Factor of Opaque Specimens by Broad Band Filter

ASTM E298-84 Assay of Organic Peroxides
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

1714.03 DEFINITIONS

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

Compliance Certification means the procedure and requirements for establishing an approved source of materials.

Field Reacted Polymeric Pavement Marking Material means 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 means the testing of field reacted polymeric pavement marking materials by infrared spectroscopy and other techniques for verification purposes.

No Tracking Time means 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 means a material formulated for application onto bituminous or concrete pavement in order to delineate vehicle operating limits.

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

ReflectORIZATION means 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 means 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 be according 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 according 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

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 Owner.

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 be according to OPSS 1750, with the exception of the requirement of silicone coating.

Test samples of glass beads according to the above requirements may be obtained from the Owner.

1714.05.05 Physical Property Requirements

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

Samples are required by the Owner 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 according to the qualifications of section 1714.05 and Table 1 shall be submitted for service tests when requested by the Owner.

The field reacted polymeric pavement marking material shall be service tested according to the following:

- a) Test deck location and time for application shall be determined by the Owner.
- b) The test stripes shall be 10 cm in width and applied transversely across the lanes of the road. The application shall 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 Owner as specified in Table 2.
- f) Approval will be given after two years of service rating, providing the material conforms to Table 2 and meets the conditions of subsection 1714.05.05.

1714.07 PRODUCTION

1714.07.01 General

In order to qualify as a supplier of field reacted polymeric pavement marking materials, 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.
- 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 materials conform to this specification.

1714.08 QUALITY ASSURANCE

1714.08.01 Acceptance Criteria

The Owner may request samples to be taken from the shipments of field reacted polymeric pavement marking materials at any time for quality assurance testing. Samples shall be taken from each batch produced for delivery to the Owner. 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 according to the applicable ASTM specification from ASTM D1644, ASTM D1652, ASTM D2074, and ASTM E298.
- 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:
 - i) Minimum value of 70% white.
 - ii) 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 Owner for laboratory testing.

1714.08.03 Storage

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

1714.09 OWNER PURCHASE OF MATERIAL

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 Owner shall conform to this specification and shall not deviate from the allowable tolerances, unless approved by the Owner.

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 Owner. 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

Measurement of field reacted polymeric pavement marking material shall be by kilograms.

Payment at the price specified in the purchasing order shall be for the supply of field reacted polymeric pavement marking material.

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		D869	MTO
Pot Life min. at 25 °C		20		
Bleeding	5		D868	
Directional Reflectance %			E97	
White Paint	70			
Yellow Paint	45			
Black		12		
Hardness IRHD	90	98	D1415	
Abrasion Resistance 1000 cycles/g	*		D4060 CS-17	
Skid Resistance BPN Units	*		E303	

* 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							
	Newly Installed Marking	Service Life Ratings of						Test Method
		3 mths	1 yr	2 yr	3 yrs	4 yrs	5 yrs	
Directional Reflectance %								
White	≥ 70		≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	ASTM E97*
Yellow	≥ 45		≥ 35	≥ 35	≥ 35	≥ 35	≥ 35	
Black	≤ 12	≤ 12						
Retroreflectance								Instrument Mirolux
mcd/m²/lux								
White	**		**	**	**	**	**	
Yellow	**		**	**	**	**	**	
Black	**	**						
No Tracking Time, mins.	≤ 15							
Durability								MTO***
White & Yellow			≥ 95	≥ 90	≥ 80	≥ 75	≥ 70	
Black		≥ 90						
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 Owner.

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 D869	
Component A		_____
Component B		_____
Bleeding, mixed material	ASTM D868	_____
Pot Life at 25°C min.	MTO	_____

Hardness*, IRHD	ASTM D1415	_____
Shore A° or D°	ASTM D2240	_____

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 according to ASTM D2240.

** 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.

Appendix 1714-A, November 2021
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

Related Ontario Provincial Standard Drawings

No information provided here.



ONTARIO PROVINCIAL STANDARD SPECIFICATION

**OPSS.MUNI 1715
NOVEMBER 2021**
(Formerly OPSS 1715, February 1991)

Note: The MUNI implemented in November 2021 replaces OPSS 1715 COMMON, February 1991 with no technical content changes.

MATERIAL SPECIFICATION FOR PREFORMED PLASTIC PAVEMENT MARKING TAPE

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1715-A	Commentary

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.

1715.01.01 Specification Significance and Use

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

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

1715.01.02 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.

1715.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Materials

OPSS 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

1715.03 DEFINITIONS

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

Compliance Certification means the procedure and requirements for establishing an approved source of materials.

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

Fingerprinting means the testing of preformed plastic pavement marking tape by gas chromatographic method and other techniques for verification purposes.

Preformed Plastic Pavement Marking Tape means 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 means 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 means the evaluation of pavement marking materials on a test deck and performance rating prior to compliance certification.

Temporary Preformed Plastic Pavement Marking Tape means preformed plastic pavement marking tape with a limited service life and a minimum service period of three months when placed according to 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 according 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 be according 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 according 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

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 Owner.

1715.05.05 Physical Property Requirements

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

Samples are required by the Owner 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 according to subsection 1715.05.06 and Table 1 shall be submitted for service test when requested by the Owner.

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

- a) Test deck location and time for installation shall be determined by the Owner.
- 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 shall 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 tapes, 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 Owner as specified 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 subsection 1715.05.05.

Temporary preformed plastic pavement marking tapes of removable type shall be according to this specification and also to ASTM D4592 except that the required minimum service life is three 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.
- 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 tapes conform to this specification.

1715.08 QUALITY ASSURANCE

1715.08.01 Acceptance Criteria

The Owner 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 Owner. 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 ± 10 mcd/m²/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 Owner 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 Owner.

1715.08.03 Storage

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

1715.09 OWNER PURCHASE OF MATERIAL

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 Owner shall conform to this specification and shall not deviate from the allowable tolerances, unless approved by the Owner.

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 Owner'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

Measurement of preformed plastic pavement marking tapes shall be by metres.

For measurement purposes, a count shall be made of the number of legends and symbols.

Payment at the price specified in the purchasing order shall be for the supply of preformed plastic pavement marking tape.

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					D523	
White		10		10		
Yellow		10		10		
Black Temporary				5		
Skid Resistance BPN Units	**		**		E303	

* 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 %							
White	≥ 65	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	E97
Yellow	≥ 45	≥ 35	≥ 35	≥ 35	≥ 35	≥ 35	
Black Temporary	≤ 12						
Retroreflectance							
mcd/m²/lux							
White	*	*	*	*	*	*	Instrument
Yellow	*	*	*	*	*	*	Mirolux
Black Temporary	*						12
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 Owner.

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
 at 24 °C

ASTM D638
 0.6 cm/min

b. Elongation and Break %

ASTM D638
 0.6 cm/min

c. Adhesion at 10 °C
 g/25.4 mm at 24 °C

ASTM D1000

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.

Appendix 1715-A, November 2021
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.



Note: The MUNI implemented in November 2021 replaces OPSS 1716 COMMON, February 1991 with no technical content changes.

MATERIAL SPECIFICATIONS FOR WATER-BORNE TRAFFIC PAINT

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1716.08	QUALITY ASSURANCE
1716.09	OWNER PURCHASE OF MATERIAL

APPENDICES

1716-A	Commentary

1716.01	SCOPE

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

1716.01.01 Specification Significance and Use

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

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

1716.01.02 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.

1716.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

OPSS 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 means the procedure and requirements for establishing an approved source for materials.

Fingerprinting means the testing of water-borne by gas chromatographic and infrared spectroscopic techniques for verification purposes.

No Tracking Time means 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.

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

Reflectorization means 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 means the evaluation of pavement marking materials on a test deck and performance rating prior to compliance certification.

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

Water-Borne Traffic Paint means 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 Owner.

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 according 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 according to OPSS 1750 may be obtained from the Owner 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 Owner 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, according to subsection 1716.05.05 and Table 1 shall be submitted for service test when requested by the Owner.

Water-borne traffic paints will be service tested according to the following:

- a) Test deck location, time, and procedure of application shall be as specified by the Owner.
- 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 microns $\pm$ 25 microns on bituminous or concrete pavement with about 20,000 AADT and application of overlay glass beads according 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 Owner as specified 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 subsection 1716.09.02.

1716.07 PRODUCTION

1716.07.01 Plant Inspection

In order to qualify as a supplier of water-borne traffic paints, 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 paints conform to this specification.

1716.08 QUALITY ASSURANCE

1716.08.01 Acceptance Criteria

The Owner may request samples to be taken from the shipments of water-borne traffic paints at any time for quality assurance testing. Samples shall be taken from each batch produced for delivery to the Owner. 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 according 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 according to ASTM D711.
- h) Directional Reflectance with:
 - i) Minimum value of 70% white.
 - ii) 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 Owner'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 Owner 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 OWNER PURCHASE OF MATERIAL

1716.09.01 Trial Batch Application

A trial batch of water-borne traffic paints conforming to this specification may be purchased by the Owner for evaluation of application properties using the Owner'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 conforming to this specification which exhibit satisfactory loading and application properties when used with the Owner'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 Owner 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 Owner's purchase order.

The water-borne traffic paint shall be furnished in returnable drums with airtight 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 20-litre containers. The quantity will be specified on the purchase order.

1716.09.04 Measurement and Payment

Measurement of water-borne traffic paint shall be by litres.

Payment at the price specified in the purchasing order shall be for the supply of water-borne traffic paint.

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 % White Yellow Black	≥ 70 ≥ 50 ≤ 12	≥ 70 ≥ 50 ≤ 12	≥ 50 ≥ 35	≥ 50 ≥ 35	≥ 50 ≥ 35	ASTM E-97*
Retroreflectance mcd/m²/lux White Yellow Black	** ** **	** ** **	** **	** **	** **	Instrument Mirolux 12
No Tracking Time, mins.	≤ 2					MTO
Durability White and Yellow Black		≥ 90 ≥ 90	≥ 85	≥ 75	≥ 70	ASTM D913 & MTO***
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 Owner.

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.

Appendix 1716-A, November 2021
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

Related Ontario Provincial Standard Drawings

No information provided here.



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**OPSS.MUNI 1750
NOVEMBER 2021**
(Formerly OPSS 1750, December 1983)

Note: The MUNI implemented in November 2021 replaces OPSS 1750 COMMON, December 1983 with no technical content changes.

**MATERIAL SPECIFICATION FOR
TRAFFIC PAINT REFLECTORIZING GLASS BEADS**

TABLE OF CONTENTS

1750.01	SCOPE
1750.02	REFERENCES
1750.03	DEFINITIONS - Not Used
1750.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
1750.05	MATERIALS
1750.06	EQUIPMENT - Not Used
1750.07	PRODUCTION
1750.08	QUALITY ASSURANCE - Not Used
1750.09	OWNER PURCHASE OF MATERIAL

APPENDICES

1750-A	Commentary

1750.01	SCOPE

This specification covers the requirements for glass beads for use with traffic paint and requirements for Owner purchase of reflectorizing glass beads.

1750.01.01 Specification Significance and Use

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

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

1750.01.02 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.

1750.02 REFERENCES

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

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

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 OWNER PURCHASE OF MATERIAL**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 Owner. 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 1,000 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 minutes. 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 minutes. 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:

- a) Overlay Type Glass Beads
- b) Moisture Proof Grade
- c) MTC
- d) Batch number
- e) Manufacturer's name (marked in 25 mm 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 x 0.66 m with the 50 µm polyethylene insert being 0.35 x 0.96 m.

All bags shall be subject to prior approval by the Owner and shall be or be equal in quality to either:

- a) 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
- b) 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 Owner's purchase order.

1750.09.04 Quality Assurance

Any shipment or shipments of this material supplied to the Owner shall 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 Owner.

1750.09.05 Measurement and Payment

Measurement of beads shall be by kilograms.

Payment at the price specified in the purchasing order shall be for the supply of beads.

Appendix 1750-A, November 2021
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 CORRUGATED STEEL PIPE (CSP) PRODUCTS

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1801.01	SCOPE
1801.02	REFERENCES
1801.03	DEFINITIONS
1801.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
1801.05	MATERIALS
1801.06	EQUIPMENT - Not Used
1801.07	PRODUCTION
1801.08	QUALITY ASSURANCE
1801.09	OWNER PURCHASE OF MATERIAL

APPENDICES

1801-A	Commentary

1801.01	SCOPE

This specification covers the requirements for all corrugated steel pipe products to be used for storm sewers, pipe culverts, and subdrains.

1801.01.01 Specification Significance and Use

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

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

1801.01.02 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.

1801.02 REFERENCES

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

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

Corrugated Steel Pipe Institute

Bulletin 18	Certification Program for Corrugated Steel Pipe Institute Members & Products CSA G401 Protocol
Bulletin 19	Certification Program for Structural Plate Corrugated Steel Pipe Products and Deep Corrugated Structural Plate Products

CSA Standards

G401-14	Corrugated Steel Pipe Products

1801.03 DEFINITIONS

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

Certification Body means an independent 3rd party agency accredited by the Standards Council of Canada that has the qualifications, skills, and expertise required to confirm that a pipe manufacturer produces pipe products to the quality and requirements of an accepted standard and that has the mandate to certify the pipe products produced.

Certified means pipe products that have been marked with a certification body's logo confirming that the production of the pipe product is in accordance with the quality and requirements of CSA G401.

Corrugated Steel Pipe Products means any one or any combination of the following products:

- round corrugated steel pipe with an end finish
- corrugated steel pipe arch with an end finish
- round structural plate corrugated steel pipe with an end finish
- structural plate corrugated steel pipe arch with an end finish
- round spiral rib pipe with an end finish
- spiral rib steel pipe arch with an end finish
- perforated corrugated steel pipe
- corrugated steel pipe coupler bands with or without gasket
- corrugated steel pipe end sections
- corrugated steel pipe safety slope end treatments
- corrugated steel pipe saddle branches

Delivered Quality means the pipe products' physical condition upon arrival at the construction site in terms of the extent and degree of dents, scratches, cracks, pipe coating integrity, etc., that appear on the pipe products delivered.

1801.05 MATERIALS

1801.05.01 Corrugated Steel Pipe Products

Corrugated steel pipe products shall be according to CSA G401 and Appendix A of the same standard. CSP coating shall be galvanized, aluminized Type 2, or polymer laminated and structural plate culvert coating shall be galvanized or thermoplastic co-polymer as specified in the Contract Documents.

1801.07 PRODUCTION

1801.07.01 Fabrication

The pipe diameter, wall thickness, coating, and type of all corrugated steel pipe products shall be as specified in the Contract Documents.

All corrugated steel pipe products used on the Contract shall be supplied from a manufacturer that is certified to produce corrugated steel pipe products in accordance with CSA G401. Refer to the Corrugated Steel Pipe Institute's technical bulletins 18 for CSP and 19 for SPCS plant CSA certification programs.

When the delivered quality of certified corrugated steel pipe products is deemed to be unacceptable by the Contract Administrator, the products shall be rejected.

1801.08 QUALITY ASSURANCE

1801.08.01 Inspection, Testing, and Record Keeping

Inspection, testing, and record keeping for corrugated steel pipe products shall be according to CSA G401.

1801.08.02 Markings

Certified corrugated steel round pipe and pipe arch and certified spiral rib round pipe and pipe arch shall be marked according to CSA G401, along with the logo of the certification body and name of the pipe manufacturer.

Certified structural plate corrugated steel pipe plate shall be marked according to CSA G401, along with the logo of the certification body and name of the pipe manufacturer.

Accepted certification body logos confirming certified corrugated steel pipe products shall be as shown in Figures 1 and 2.

1801.08.03 Certificate of Compliance

When requested by the Owner, the Contractor shall provide a certificate of compliance for subdrains and the corrugated steel pipe products used for eccentric loader assemblies to indicate that the product was produced and tested according to the appropriate specification requirements.

When requested by the Owner, the Contractor shall provide a copy of the certificate of compliance from the manufacturer for storm sewers and pipe culverts. The manufacturer's certificate of compliance shall be issued by the certification body confirming that the manufacturer produces certified corrugated steel pipe products in accordance with CSA G401.

1801.09 OWNER PURCHASE OF MATERIAL

Measurement of corrugated steel pipe with corrugated steel coupler bands shall be by length in metres along the centreline of the pipe.

For measurement purposes, a count shall be made of all other corrugated steel pipe products.

Payment at the price specified in the purchasing order shall be for the supply of corrugated steel pipe with coupler bands and other corrugated steel pipe products 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
CSA Standards Certification Logo



FIGURE 2
Canadian Welding Bureau Certification Logo

Appendix 1801-A, November 2019
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:

- Coating type. (1801.05.01)
- Pipe diameter, wall thickness, coating, and type. (1801.07.01)

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

Related Ontario Provincial Standard Drawings

OPSD 800.010	Concrete Pipe Culvert and Sewer Extensions Using Corrugated Steel Pipe
OPSD 800.011	Concrete Rigid Frame Box and Open Culvert Extensions Using Corrugated Steel Pipe
OPSD 801.010	Cut End Finish, Circular Pipe and Pipe-Arch Corrugated Steel Pipe
OPSD 801.020	End Section Details, Corrugated Steel Pipe
OPSD 801.030	Bevel Details, Circular and Pipe-Arch Structural Plate, Corrugated Steel Pipe
OPSD 801.040	Culvert and Sewer Safety Slope End Treatment, Notes and Tables
OPSD 801.041	Culvert and Sewer Safety Slope End Treatment, Assembly Details
OPSD 801.042	Culvert and Sewer Safety Slope End Treatment, Connection Details
OPSD 801.043	Culvert and Sewer Safety Slope End Treatment, Installation Details
OPSD 805.010	Height of Fill Table, Round Corrugated Steel Pipe and Structural Plate Corrugated Steel Pipe
OPSD 805.020	Height of Fill Table, Corrugated Steel Pipe-Arch and Structural Plate Corrugated Steel Pipe-Arch
OPSD 805.030	Height of Fill Table, Spiral Rib Round Pipe
OPSD 805.040	Height of Fill Table, Spiral Rib Pipe-Arch



MATERIAL SPECIFICATION FOR SMOOTH WALLED STEEL PIPE

TABLE OF CONTENTS

1802.01	SCOPE
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1802.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
1802.05	MATERIAL - Not Used
1802.06	EQUIPMENT - Not Used
1802.07	PRODUCTION
1802.08	QUALITY ASSURANCE
1802.09	OWNER PURCHASE OF MATERIAL

APPENDICES

1802-A	Commentary

1802.01 SCOPE

This specification covers the requirements for smooth walled steel pipe to be used for the installation of pipes or casings.

1802.01.01 Specification Significance and Use

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

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

1802.01.02 Appendices Significance and Use

Appendices are 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.

1802.02 REFERENCES

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

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

CSA Standards

Z662:19 Oil & Gas Pipeline Systems

ASTM International

A252-19 Welded and Seamless Steel Pipe Piles

American Water Works Association (AWWA)

C200-17 Steel Water Pipe-6 in. (150 mm) and Larger

1802.07 PRODUCTION

1802.07.01 Requirements

All pipe shall be new and manufactured from steel according to ASTM A252, Grade 2, with a minimum yield strength of 240 MPa.

Production welding shall be according to AWWA C200. Welder qualification shall meet Canadian Welding Bureau (CWB) requirements, unless otherwise approved by the Contract Administrator, prior to the manufacturing and installation.

Pipe ends shall be according to AWWA C200 Section 4.11.

Pipe wall thickness shall be according to Table 1, except as amended below:

- a) The least nominal wall thickness for pipe with outside diameters from 88.9 to 141.3 mm shall be 4.8 mm.
- b) When protective coating, lining, or cathodic protection for steel casing or carrier pipe is not specified in the Contract Documents, the pipe wall thickness shall be increased to the nearest standard size that is a minimum of 1.6 mm greater than the least nominal wall thickness shown.

1802.07.02 Identification

The following information shall be clearly marked by stencilling, stamping, or painting of each section of pipe:

- a) Name or trademark of the manufacturer.
- b) Heat number.
- c) Outside diameter.
- d) Nominal wall thickness.
- e) Length of pipe.
- f) Weight per unit length.
- g) Standard designation.
- h) Grade of steel.

Where the pipe is coated or lined by the manufacturer prior to shipping, such marking shall be transferred to the coating or lining.

1802.08 QUALITY ASSURANCE

1802.08.01 Certificate

Upon request, suppliers shall provide a certificate to indicate that the product was produced and tested according to the appropriate standard requirements.

1802.08.02 Storage and Delivery

Storage and delivery shall be according to AWWA C200.

1802.08.03 Inspection and Testing

Inspection and testing shall be according to AWWA C200.

Owner reserves the right to make inspections and tests at such time as the Owner may consider necessary to ensure the materials supplied shall be according to this specification. All materials failing to comply with the requirements of this specification shall be rejected.

1802.09 OWNER PURCHASE OF MATERIAL

1802.09.01 Measurement and Payment

Measurement of smooth wall steel pipe shall be by length in metres along the centreline of the pipe.

Payment at the price specified in the purchasing order shall be for supply of the pipe and jointing devices 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.

TABLE 1
Least Nominal Wall Thickness for Steel Casing Pipe
in Cased Crossings and Carrier Pipe in Uncased Crossings

Pipe Outside Diameter mm	Least Nominal Wall Thickness mm	
	Roads	Railways
88.9	3.2	3.2
101.6	3.2	3.2
114.3	3.2	3.2
141.3	4.0	4.0
168.3	4.8	4.8
219.1	4.8	4.8
273.1	4.8	4.8
323.9	4.8	4.8
355.6	4.8	5.6
406.4	4.8	5.6
457.0	4.8	6.4
508.0	4.8	7.1
559.0	5.6	7.9
610.0	6.4	8.7
660.0	6.4	9.5
711.0	6.4	10.3
762.0	6.4	10.3
813.0	6.4	11.1
864.0	6.4	11.9
914.0	6.4	11.9
965.0	7.9	12.7
1016.0	7.9	12.7
1067.0	7.9	12.7
1118.0	7.9	14.3
1168.0	7.9	15.9
1219.0	8.3	15.9
1270.0	8.7	15.9
1321.0	9.5	19.1
1372.0	9.5	19.1
1422.0	9.5	19.1
1524.0	10.3	20.6

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Appendix 1802-A, November 2021
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

Designer should specify if the steel pipe is to be lined, cathodically protected or coated or uncoated in the Contract Documents. (1802.07.01)

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

Related Ontario Provincial Standard Drawings

No information provided here.



MATERIAL SPECIFICATION FOR CIRCULAR AND ELLIPTICAL CONCRETE PIPE

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1820.01	SCOPE
1820.02	REFERENCES
1820.03	DEFINITIONS - Not Used
1820.04	DESIGN AND SUBMISSION REQUIREMENTS
1820.05	MATERIALS
1820.06	EQUIPMENT - Not Used
1820.07	PRODUCTION
1820.08	QUALITY ASSURANCE - Not Used
1820.09	OWNER PURCHASE OF MATERIAL

APPENDICES

1820-A	Commentary

1820.01 SCOPE

This specification covers the requirements for reinforced and non-reinforced non-pressure circular concrete pipe with rubber gasket joints, and for non-gasketed reinforced elliptical concrete pipe.

1820.01.01 Specification Significance and Use

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

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

1820.01.02 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.

1820.02 REFERENCES

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

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

CSA Standards

A257.1-14	Non-Reinforced Circular Concrete Culvert, Storm Drain, Sewer Pipe, and Fittings [Part of A257 Series-09, Standards for Concrete Pipe and Manhole Sections]
A257.2-14	Reinforced Circular Concrete Culvert, Storm Drain, Sewer Pipe, and Fittings [Part of A257 Series-09, Standards for Concrete Pipe and Manhole Sections]
A257.3-14	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]
A3000-13	Cementitious Materials Compendium

ASTM International

C 507M-16	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe (Metric)

CPCQA Certification Program Requirements Document

Prequalification Requirements for Precast Concrete Drainage Products

1820.04 DESIGN AND SUBMISSION REQUIREMENTS

1820.04.01 Design Requirements

1820.04.01.01 Concrete Pipe

Non-reinforced circular concrete pipe shall be according to CAN/CSA A257.1.

Reinforced circular concrete pipe shall be according to CAN/CSA A257.2.

Reinforced elliptical concrete pipe shall be according to ASTM C 507M.

1820.04.01.02 Joints and Gaskets

Joints and gaskets for circular concrete pipe shall be according to CAN/CSA A257.3.

Joints for elliptical concrete pipe shall be according to ASTM C 507M, and according to the requirements outlined in the publication, Prequalification Requirements for Precast Concrete Drainage Products.

Elliptical concrete pipe produced with non-gasketed joints shall be used for storm pipe sewers only.

1820.04.01.03 Jacking Pipe

Jacking pipe shall be according to CAN/CSA A257.2 with a minimum class of 65-D and a minimum concrete strength of 40MPa.

1820.04.01.04 Elliptical Reinforcing

Elliptical reinforcing for circular concrete pipe is not permitted for pipes up to and including 900 mm nominal internal diameter.

1820.04.01.05 Lift Holes and Anchors

Lift holes are not permitted for pipes. Lift anchors are not permitted for pipes up to and including 900 mm nominal internal diameter.

1820.05 MATERIALS

1820.05.01 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.

1820.07 PRODUCTION

1820.07.01 General

A manufacturer producing circular concrete pipe or elliptical concrete pipe or both shall be pre qualified and possess a current plant certificate, issued under the Canadian Precast Concrete Quality Assurance (CPCQA) Certification Program.

1820.07.02 Markings

Markings for circular concrete pipe shall be according to CAN/CSA A257.2.

Markings for elliptical concrete pipe shall be according to ASTM C 507M.

In addition, all pipe shall be marked with the CPCQA Certification Logo shown in Figure 1 and as outlined in the publication, Prequalification Requirements for Precast Concrete Drainage Products.

1820.09 OWNER PURCHASE OF MATERIAL

1820.09.01 Measurement and Payment

Circular concrete pipe and elliptical concrete pipe shall be measured in metres along the length of the pipe.

Payment at the price specified in the purchasing order shall be for the supply of the circular concrete pipe and elliptical concrete pipe including gaskets, 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
CPCQA Certification Logo

Appendix 1820-A, November 2020
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 802.030	Rigid Pipe Bedding, Cover, and Backfill, Type 1 or 2 Soil - Earth Excavation
OPSD 802.031	Rigid Pipe Bedding, Cover, and Backfill, Type 3 Soil - Earth Excavation
OPSD 802.032	Rigid Pipe Bedding, Cover, and Backfill, Type 4 Soil - Earth Excavation
OPSD 802.033	Rigid Pipe Bedding, Cover, and Backfill, Rock Excavation
OPSD 802.034	Rigid Pipe Bedding and Cover in Embankment, Original Ground: Earth or Rock
OPSD 802.050	Horizontal Elliptical Rigid Pipe Bedding, Cover, and Backfill Type 1 or 2 Soil - Earth Excavation
OPSD 802.051	Horizontal Elliptical Rigid Pipe Bedding, Cover, and Backfill Type 3 Soil - Earth Excavation
OPSD 802.052	Horizontal Elliptical Rigid Pipe Bedding, Cover, and Backfill Type 4 Soil - Earth Excavation
OPSD 802.053	Horizontal Elliptical Rigid Pipe Bedding, Cover, and Backfill Rock Excavation
OPSD 802.054	Horizontal Elliptical Rigid Pipe Bedding and Cover in Embankment Original Ground: Earth or Rock
OPSD 807.010	Height of Fill Table, Reinforced Concrete Pipe - Confined Trench, Class 50-D, 65-D, 100-D, and 140-D
OPSD 807.030	Height of Fill Table, Reinforced Concrete Pipe - Embankment, Class 50-D, 65-D, 100-D, and 140-D
OPSD 807.040	Height of Fill Table, Non-Reinforced Concrete Pipe, Class 3
OPSD 807.050	Height of Fill Table, Horizontal Elliptical Concrete Pipe, Class HE-A, HE-I, HE-II, HE-III, and HE-IV



Note: The MUNI published in November 2021 replaces OPSS 1821 COMMON, November 2015 with no technical content changes.

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

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 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 2021
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 $< 0.6\text{m}$



MATERIAL SPECIFICATION FOR NON-PRESSURE POLYETHYLENE PLASTIC PIPE PRODUCTS

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APPENDICES

1840-A	Commentary

1840.01 SCOPE

This specification covers the requirements for non-pressure polyethylene (PE) plastic pipe products to be used for sanitary or storm sewers, pipe culverts, and subdrains.

1840.01.01 Specification Significance and Use

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

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

1840.01.02 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.

1840.02 REFERENCES

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

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

CSA Standards

B182.6-18	Profile Polyethylene (PE) Sewer Pipe and Fittings for Leak-Proof Sewer Applications [Part of B1800-18, Thermoplastic Nonpressure Piping Compendium]
B182.8-18	Profile Polyethylene (PE) Storm Sewer and Drainage Pipe and Fittings [Part of B1800-18, Thermoplastic Nonpressure Piping Compendium]

ASTM International

F714-13	Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
F894-19	Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe

American Association of State Highway and Transportation Officials (AASHTO)

M 252-09 (2012)	Corrugated Polyethylene Drainage Pipe
M 294-18	Corrugated Polyethylene Plastic Pipe, 300 to 1,500 mm Diameter

Bureau De Normalisation Du Québec (BNQ)

3624-110(2016) Polyethylene (PE) Pipe and Fittings - Flexible Corrugated Pipes for Drainage - Characteristics and Test Methods

1840.03 DEFINITIONS

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

Certification Body means an independent 3rd party agency, accredited by the Standards Council of Canada that has the qualifications, skills, and expertise required to confirm that a pipe manufacturer produces pipe products to the quality and requirements of an accepted standard and that has the mandate to certify the pipe products produced.

Certified means pipe products that have been marked with a certification body's logo confirming that the production of the pipe product is in accordance with the quality and requirements of CSA B182.6, CSA B182.8, AASHTO M 294 Type S, or ASTM F894.

Closed Profile Pipe means a pipe product that has a hydraulically smooth waterway reinforced circumferentially or spirally with corrugations that are joined integrally by an essentially smooth outer wall.

Corrugated Pipe means a single-walled pipe where the wall is formed into a series of alternating crests and valleys.

Delivered Quality means the pipe products' physical condition upon arrival at the construction site in terms of the extent and degree of dents, scratches, cracks, pipe coating integrity, etc., that appear on the pipe products delivered.

Open Profile Pipe means a pipe product that has a hydraulically smooth waterway reinforced circumferentially or spirally with outside corrugations.

Polyethylene Plastic means plastics based on virgin polymers made with ethylene as essentially the sole monomer.

Profile means a pipe wall construction that presents an essentially smooth surface in the waterway but includes ribs or other shapes, which can be either solid or hollow that helps brace the pipe against diametrical deformation.

1840.05 MATERIALS

1840.05.01 Polyethylene Plastic Pipe Products

The moulding and extrusion material shall be polyethylene plastic according to:

- a) AASHTO M 252 Type C, or BNQ 3624-115 for corrugated sub-drainage tubing.
- b) CSA B182.6, CSA B182.8, or AASHTO M 294 Type S for open profile sewer and drainage pipe.
- c) ASTM F894 for closed profile sewer and drainage pipe.
- d) ASTM F714 for solid wall pipe.

1840.07 PRODUCTION

1840.07.01 Requirements

The pipe diameter, stiffness, material, and type for all polyethylene plastic pipe products shall be as specified in the Contract Documents.

Polyethylene plastic pipe products shall be produced according to the following:

- a) AASHTO M 252 Type C, or BNQ 3624-115 for corrugated sub-drainage tubing and fittings.
- b) AASHTO M252 for corrugated interior flexible culvert pipe.
- c) CSA B182.6, CSA B182.8, or AASHTO M294 Type S for open profile sewer and drainage pipe and fittings.
- d) ASTM F 894 for closed profile sewer and drainage pipe.
- e) ASTM F 714 for solid wall pipe.

All polyethylene plastic pipe products used on the Contract for sewers and culverts shall be certified and supplied from a manufacturer that produces the polyethylene plastic pipe products according to CSA B182.6, CSA B182.8, AASHTO M294 Type S, ASTM F 894 or ASTM F 714.

When the delivered quality of certified polyethylene plastic pipe products is deemed to be unacceptable by the Contract Administrator, the products shall be rejected.

1840.08 QUALITY ASSURANCE

1840.08.01 Testing

Test methods for corrugated polyethylene plastic pipe products shall be according to AASHTO M 252 Type C, BNQ 3624-115 or AASHTO M252, as applicable.

Test methods for open and closed profile polyethylene plastic pipe products shall be according to CSA B182.6, CSA B182.8, AASHTO M294 Type S, ASTM F 894, or ASTM F 714 as applicable.

1840.08.02 Markings

Markings for certified polyethylene plastic pipe products shall be according to CSA B182.6, CSA B182.8, AASHTO M294 Type S, ASTM F 894, or ASTM F 714 as applicable.

As a minimum, the following markings shall be placed, notwithstanding any other required markings, in accordance with the applicable standard:

- a) Pipe nominal size.
- b) Pipe or ring stiffness.
- c) Standard designation (e.g., CSA B182.6).
- d) Manufacturer.
- e) Accredited certification body's logo.

Accepted certification body logos confirming certified polyethylene plastic pipe products shall be as shown in Figures 1, 2, and 3.

1840.08.03 Certificate of Compliance

When requested by the Owner, the Contractor shall provide a certificate of compliance for subdrains to indicate that the product was produced and tested according to the appropriate specification requirements.

When requested by the Owner, the Contractor shall provide a copy of the certificate of compliance from the manufacturer for storm sewers and pipe culverts. The manufacturer's certificate of compliance shall be issued by the certification body confirming that the manufacturer produces certified polyethylene plastic pipe products.

1840.09 OWNER PURCHASE OF MATERIAL

Measurement of non-pressure polyethylene plastic pipe shall be by length in metres along the centreline of the pipe.

For measurement purposes, a count shall be made of the non-pressure polyethylene plastic pipe fittings supplied and delivered as noted on the purchasing order.

Payment at the price specified in the purchasing order shall be for the supply of non-pressure polyethylene plastic pipe products 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.



FIGURE 1
CSA Standards Certification Logo

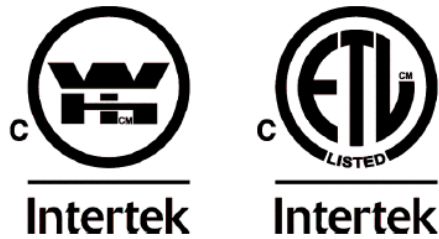


FIGURE 2
Warnock Hersey - Intertek Certification Logo



FIGURE 3
NSF International Certification Logo
(Note: Different variations of the NSF logo will also be accepted)

**Appendix 1840-A, November 2019
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Pipe diameter, stiffness, material, and type. (1840.07.01)

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

Related Ontario Provincial Standard Drawings

OPSD 802.010	Flexible Pipe Embedment and Backfill, Earth Excavation
OPSD 802.013	Flexible Pipe Embedment and Backfill, Rock Excavation
OPSD 802.014	Flexible Pipe Embedment in Embankment, Original Ground: Earth or Rock
OPSD 806.020	Height of Fill Table, Dual Wall Corrugated Polyethylene Gravity Sewer Pipe, 210 and 320 kPa
OPSD 806.021	Height of Fill Table, Closed Profile Wall Polyethylene Pipe, RSC 160 and RSC 250
OPSD 806.022	Height of Fill Table, Dual Wall Corrugated Polyethylene Gravity Sewer Pipe RSC 100 and RSC 160



MATERIAL SPECIFICATION FOR NON-PRESSURE POLYVINYL CHLORIDE PIPE PRODUCTS

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APPENDICES

1841-A	Commentary

1841.01	SCOPE

This specification covers the requirements for non-pressure polyvinyl chloride (PVC) plastic pipe products to be used for sanitary and storm sewers, service connections, and pipe culverts.

1841.01.01 Specification Significance and Use

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

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

1841.01.02 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.

1841.02 REFERENCES

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

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

CSA Standards

B182.1-11	Plastic Drain and Sewer Pipe and Pipe Fittings [Part of B1800-11, Plastic Nonpressure Pipe Compendium]
B182.2-11	PSM Type Polyvinylchloride (PVC) Sewer Pipe and Fittings [Part of B1800-11, Plastic Nonpressure Pipe Compendium]
B182.4-11	Profile Polyvinylchloride (PVC) Sewer Pipe and Fittings [Part of B1800-11, Plastic Nonpressure Pipe Compendium]

ASTM International

D 3034-14	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
F 679-15	Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
F 794-14	Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
F 949-15	Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
F 1760-01(2011)	Coextruded Poly (Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
F 1803-19	Poly (Vinyl Chloride) (PVC) Closed Profile Gravity Pipe and Fittings Based on Controlled Inside Diameter

Uni-Bell PVC Pipe Association

UNI-B-9-90 Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 4 - 48-inch)

1841.03 DEFINITIONS

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

Certification Body means an independent 3rd party agency, accredited by the Standards Council of Canada that has the qualifications, skills, and expertise required to confirm that a pipe manufacturer produces pipe products to the quality and requirements of an accepted standard and that has the mandate to certify the pipe products produced.

Certified means pipe products that have been marked with a certification body's logo confirming that the production of the pipe product is in accordance with the quality and requirements of CSA B182.1, CSA B182.2, or CSA B182.4.

Delivered Quality means the pipe products' physical condition upon arrival at the construction site in terms of the extent and degree of dents, scratches, cracks, pipe coating integrity, etc., that appear on the pipe products delivered.

Pipe Products means pipe lengths and associated pipe fittings that are needed to construct a pipe sewer run or a pipe culvert.

1841.05 MATERIAL

1841.05.01 Polyvinyl Chloride Pipe Products

The extruded, moulded, and fabricated material shall be polyvinyl chloride plastic according to CSA B182.1, CSA B182.2, CSA B182.4, ASTM D 3034, ASTM F 679, ASTM F 794, ASTM F 949, ASTM F 1760, ASTM F 1803, or UNI-B-9, as applicable, for the appropriate type of polyvinyl chloride plastic pipe products.

1841.07 PRODUCTION

1841.07.01 Requirements

The pipe diameter, stiffness, material, and type of all polyvinyl chloride plastic pipe products shall be as specified in the Contract Documents.

The requirements for profile polyvinyl chloride plastic pipes and associated fittings shall be according to CSA B182.4, ASTM F 794, ASTM F 949, ASTM F 1803, or UNI-B-9, as applicable.

The requirements for smooth interior and exterior wall polyvinyl chloride plastic pipe and associated fittings shall be according to either:

- a) ASTM D 3034 or ASTM F 679 for pipes manufactured without reprocessed-recycled material.
- b) CSA B182.2 for pipes manufactured that may have multilayer construction and the middle layer may have reprocessed-recycled material.
- c) CSA B182.2 or ASTM F 1760 for pipes manufactured having reprocessed-recycled material.

Polyvinyl chloride service connection pipe shall be according to CSA B182.1 and have bell and spigot joints with elastomeric gaskets.

All polyvinyl chloride plastic pipe products used on the Contract shall be certified and supplied from a manufacturer that produces the polyvinyl chloride plastic pipe products according to CSA B182.1, CSA B182.2, CSA B182.4, ASTM D 3034, ASTM F 679, ASTM F 794, ASTM F 949, ASTM F 1760, ASTM F 1803, or UNI-B-9, as applicable, for the appropriate type of polyvinyl chloride plastic pipe products.

1841.07.02 Testing

Testing of polyvinyl chloride plastic pipe products shall be according to the appropriate standard for which the product was produced.

1841.08 QUALITY ASSURANCE

1841.08.01 Inspection and Testing

The Owner reserves the right to make inspections and tests at such times as the Owner may consider necessary to ensure that the materials supplied are in accordance with this specification.

All materials failing to comply with the requirements of this specification shall be rejected.

1841.08.02 Markings

Markings for certified polyvinyl chloride plastic pipe products shall be according to the appropriate standard for which the product was produced.

As a minimum, the following markings shall be placed, notwithstanding any other required markings, in accordance with the applicable standard:

- a) Pipe diameter.
- b) Pipe stiffness.
- c) Standard designation (e.g., CSA B182.2).
- d) Manufacturer.
- e) Accredited certification body's logo.

Accepted certification body logos confirming certified polyvinyl chloride plastic pipe products shall be as shown in Figures 1, 2 and 3.

1841.08.03 Certificate of Compliance

When requested by the Owner, the Contractor shall provide a copy of the certificate of compliance from the manufacturer for sanitary and storm sewers, service connections, and pipe culverts. The manufacturer's certificate of compliance shall be issued by the certification body confirming that the manufacturer produces certified polyvinyl chloride plastic pipe products.

1841.09 OWNER PURCHASE OF MATERIAL

1841.09.01 Measurement and Basis of Payment

Measurement of non-pressure polyvinyl chloride plastic pipe shall be by length in metres along the centreline of the pipe.

For measurement purposes, a count shall be made of the non-pressure polyvinyl chloride plastic pipe fittings supplied and delivered as noted on the purchasing order.

Payment at the price specified in the purchasing order shall be for the supply of non-pressure polyvinyl chloride plastic pipe products 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
CSA Standards Certification Logo



FIGURE 2
Warnock Hersey - Intertek Certification Logo



FIGURE 3
NSF International Certification Logo
(Note: Different variations of the NSF logo will also be accepted)

Appendix 1841-A, November 2019
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 pipe diameter, stiffness, material, and type in the Contract Documents.
(1841.07.01)

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

Related Ontario Provincial Standard Drawings

No information provided here.



MATERIAL SPECIFICATION FOR PRESSURE POLYETHYLENE PIPE PRODUCTS

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APPENDICES

1842-A	Commentary

1842.01 SCOPE

This specification covers the requirements for pressure polyethylene pipe products to be used for sewage forcemains, watermains, and associated service connections.

1842.01.01 Specification Significance and Use

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

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

1842.01.02 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.

1842.02 REFERENCES

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

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

Canadian Standards Association (CSA)

B137.1-13 Polyethylene (PE) Pipe, Tubing, and Fittings for Cold Water Pressure Services
[Part of B137 Series-05, Thermoplastic Pressure Piping Compendium]

American Water Works Association (AWWA)

C901-17 Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm), for Water Service
C906-15 Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission

1842.05 MATERIALS

1842.05.01 Polyethylene Pipe Products

The moulding and extrusion material used to manufacture polyethylene pipe shall be polyethylene according to the requirements of AWWA C901 or AWWA C906.

The moulding and extrusion material used to manufacture polyethylene fittings shall be polyethylene according to the requirements of AWWA C906 for fittings 100 mm through 1,600 mm and CSA B137.1 for fittings less than 100 mm diameter.

1842.07 PRODUCTION

1842.07.01 Requirements

The requirements for the production of polyethylene pipe and tubing shall be according AWWA C901 or AWWA C906.

The requirements for the production of polyethylene pipe fittings shall be according to AWWA C906 for fittings 100 mm through 1,600 mm diameter and CSA B137.1 for fittings less than 100 mm diameter.

1842.07.02 Markings

Markings for polyethylene pipe and tubing shall be placed so that the intervals between markings are no greater than 1.5 m.

For polyethylene pipe and tubing according to AWWA C901, minimum markings shall be as follows:

- a) Nominal size.
- b) Standard material code designation (e.g., PE 2406).
- c) On pipe, the dimension ratio and diameter base (e.g., DR 11).
- d) On tubing, the word "Tubing" and dimension ratio.
- e) Pressure class (e.g., PC 160).
- f) Standard designation (e.g., AWWA C901).
- g) Manufacturer's name or trademark.
- h) Production record code.

For polyethylene pipe according to AWWA C906, minimum markings shall be as follows:

- a) Nominal size and OD base.
- b) Standard material code designation (e.g., PE 3408).
- c) Dimension ratio (e.g., DR 17).
- d) Pressure class (e.g., PC 100).
- e) Standard designation (e.g., AWWA C906).
- f) Manufacturer's name or trademark.
- g) Production record code.

Markings shall be applied in a manner that will not reduce the strength or damage the pipe and shall remain legible during normal handling and storage.

1842.08 QUALITY ASSURANCE

1842.08.01 Certificate

Upon request, suppliers shall provide a certificate to indicate that the product was produced and tested according to the appropriate specification requirements.

1842.08.02 Inspection and Testing

The Owner may make inspections and tests at such times as considered necessary to ensure that the material supplied is according to this specification.

All materials failing to comply with the requirements of this specification shall be rejected.

1842.08.03 Transporting, Unloading, Storing, and Handling

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

1842.09 OWNER PURCHASE OF MATERIAL

Measurement of pressure polyethylene pipe and tubing shall be by length in metres along the centreline of the pipe.

For measurement purposes, a count shall be made of the pressure polyethylene pipe fittings supplied and accepted as specified on the purchasing order.

Payment at the price specified in the purchasing order shall be for the supply of the pressure polyethylene pipe products 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 1842-A, November 2020
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 NON-PRESSURE POLYPROPYLENE (PP) PLASTIC PIPE PRODUCTS

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1843.09	OWNER PURCHASE OF MATERIAL

APPENDICES

1843-A	Commentary

1843.01	SCOPE

This specification covers the requirements for non-pressure polypropylene (PP) plastic pipe products to be used for sanitary or storm sewers and pipe culverts.

1843.01.01 Specification Significance and Use

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

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

1843.01.02 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.

1843.02 REFERENCES

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

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

CSA Standards

B182.13-18 Profile Polypropylene (PP) Sewer Pipe and Fittings for Leak-Proof Sewer Applications
[Part of B1800-15, Thermoplastic Non-Pressure Piping Compendium]

1843.03 DEFINITIONS

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

Certification Body means an independent 3rd party agency, accredited by the Standards Council of Canada that has the qualifications, skills, and expertise required to confirm that a pipe manufacturer produces pipe products to the quality and requirements of an accepted standard and that has the mandate to certify the pipe products produced.

Certified means pipe products that have been marked with a certification body's logo confirming that the production of the pipe product is in accordance with the quality and requirements of CSA B182.13.

Closed Profile Pipe means a pipe product that has a hydraulically smooth waterway reinforced circumferentially or spirally with corrugations that are joined integrally by an essentially smooth outer wall.

Delivered Quality means the pipe products' physical condition upon arrival at the construction site in terms of the extent and degree of dents, scratches, cracks, pipe coating integrity, etc., that appear on the pipe products delivered.

Open Profile Pipe means a pipe product that has a hydraulically smooth waterway reinforced circumferentially or spirally with outside corrugations.

Polypropylene Plastic means a material made with virgin polymers in which propylene is essentially the sole monomer.

Profile means a pipe wall construction that presents an essentially smooth surface in the waterway but includes ribs or other shapes, which can be either solid or hollow that helps brace the pipe against diametrical deformation.

1843.05 MATERIALS

1843.05.01 Polypropylene Plastic Pipe Products

The moulding and extrusion material shall be polypropylene plastic according to CSA B182.13 for profile sewer and drainage pipe.

1843.07 PRODUCTION

1843.07.01 Requirements

The pipe diameter, stiffness, material, and type for all polypropylene plastic pipe products shall be as specified in the Contract Documents.

Polypropylene plastic pipe products shall be produced according to CSA B182.13 for profile sewer and drainage pipe and fittings.

All polypropylene plastic pipe products used on the Contract for sewers and culverts shall be certified and supplied from a manufacturer that produces the polypropylene plastic pipe products according to CSA B182.13.

When the delivered quality of certified polypropylene plastic pipe products is deemed to be unacceptable by the Contract Administrator, the products shall be rejected.

1843.08 QUALITY ASSURANCE

1843.08.01 Testing

Test methods for profile polypropylene plastic pipe products shall be according to CSA B182.13.

1843.08.02 Markings

Markings for certified polypropylene plastic pipe products shall be according to CSA B182.13.

As a minimum, the following markings shall be placed, notwithstanding any other required markings, in accordance with the applicable standard:

- a) Pipe nominal size.
- b) Standard designation (e.g., CSA B182.13).
- c) Manufacturer.

d) Accredited certification body's logo.

Accepted certification body logo confirming certified polypropylene plastic pipe products shall be as shown in Figure 1.

1843.08.03 Certificate of Compliance

When requested by the Owner, the Contractor shall provide a copy of the certificate of compliance from the manufacturer for storm sewers and pipe culverts. The manufacturer's certificate of compliance shall be issued by the certification body confirming that the manufacturer produces certified polypropylene plastic pipe products.

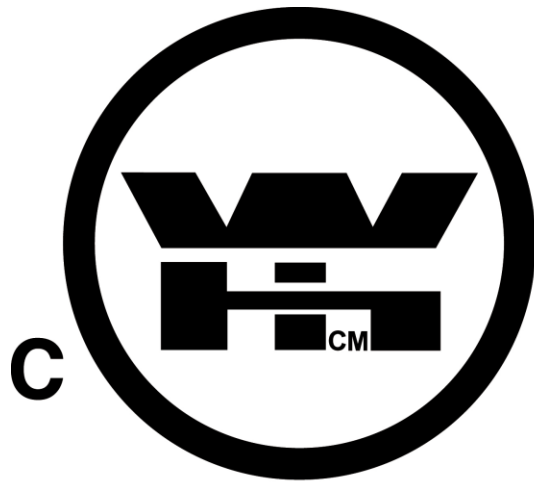
1843.09 OWNER PURCHASE OF MATERIAL

Measurement of non-pressure polypropylene plastic pipe shall be by length in metres along the centreline of the pipe.

For measurement purposes, a count shall be made of the non-pressure polypropylene plastic pipe fittings supplied and delivered as noted on the purchasing order.

Payment at the price specified in the purchasing order shall be for the supply of non-pressure polypropylene plastic pipe products 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.



Intertek



Intertek

FIGURE 1
Warnock Hersey - Intertek Certification Logo

Appendix 1843-A, November 2019
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Pipe diameter, stiffness, material, and type. (1843.07.01)

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

Related Ontario Provincial Standard Drawings

OPSD 802.010	Flexible Pipe Embedment and Backfill, Earth Excavation
OPSD 802.013	Flexible Pipe Embedment and Backfill, Rock Excavation
OPSD 802.014	Flexible Pipe Embedment in Embankment, Original Ground: Earth or Rock
OPSD 806.030	Height of Fill Table, Dual and Triple Wall Corrugated Polypropylene Gravity Sewer Pipe 320 kPa



MATERIAL SPECIFICATION FOR FRAMES, GRATES, COVERS, AND GRATINGS

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1850-A	Commentary

1850.01 SCOPE

This specification covers the requirements for frames with grates or covers for catch basins, maintenance holes, and valve chambers; ditch inlet gratings; and locking devices.

1850.01.01 Specification Significance and Use

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

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

1850.01.02 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.

1850.02 REFERENCES

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

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

CSA Standards

G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
W59-13	Welded Steel Construction (Metal Arc Welding)
CSA S6: 19	Canadian Highway Bridge Design Code

ASTM International

A36M-14	Carbon Structural Steel
A48M-03 (2016)	Gray Iron Castings
A536-84 (2009)	Ductile Iron Castings
F738M-02 (2014)	Stainless Steel Metric Bolts, Screws, and Studs
F836M-02 (2010)	Style 1 Stainless Steel Metric Nuts

Society of Automotive Engineers (SAE)

J403-2014	Chemical Compositions of SAE Carbon Steels

National Association of Architectural Metal Manufacturers (NAAMM)

Metal Bar Grating Manual

1850.03

DEFINITIONS

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

Cover means a cast iron or ductile iron casting to allow access into a maintenance hole or valve chamber.

Frame means a cast iron or ductile iron casting to support a cover or grate.

Grate means a cast iron or ductile iron casting with parallel or lattice of cross bars to allow water flow and access into a catch basin or ditch inlet.

Grating means a fabricated lattice of steel bars covering a drain, ditch inlet, or pipe outlet.

Locking Device means a device consisting of a cast iron or ductile iron-locking lug and stainless steel bolt, nut, and washer to secure a cover to a frame.

Reticuline Bar means a sinuously bent connecting bar extending between two adjacent bearing bars, alternately contacting and being riveted to each other.

1850.04

DESIGN AND SUBMISSION REQUIREMENTS

1850.04.01

Design Requirements

Frames, grates, covers, and gratings shall be designed to an ultimate limit state of 166.6 kN wheel load. This load includes a live load factor and a dynamic load allowance specified in CSA S6. The load application shall be distributed over an area of 250 x 250 mm.

1850.05

MATERIALS

1850.05.01

Frames With Grates or Covers

1850.05.01.01

Castings

Castings shall be according to ASTM A48M, Class No. 30B, or ASTM A536, Grade 65-45-12.

1850.05.01.02

Bolts and Nuts

All bolts, nuts, and washers shall consist of stainless steel Type 304. Bolts shall be according to ASTM F738M and nuts shall be according to ASTM F836M.

1850.05.01.03

Locking Devices

All components shall be manufactured from material compatible with the associated frame and cover.

Locking lugs shall be cast according to ASTM A48M, Class No. 30B, or ASTM A536, Grade 65-45-12.

1850.05.01.04

Hinge Pins

Steel for hinge pins shall be according to ASTM A36M.

Steel pins shall be cast into the grate during the pouring and filling operation. Pins shall not be added after the grate is cast.

1850.05.02 Gratings

1850.05.02.01 Welded Steel Gratings

Steel for bearing bars and cross bars shall be according to ASTM A36M.

1850.05.02.02 Riveted Steel Gratings

Steel for bearing bars shall be according to ASTM A36M.

Steel for reticuline bars shall be according to ASTM A36M.

Rivets shall be flat-headed according to SAE J403, Grade No. 1015.

1850.05.02.03 Fasteners

Fasteners, except for the bolts, shall be hot dipped galvanized according to CSA G164-M. The bolt thread shall be coated with white non-staining grease after galvanizing.

1850.07 PRODUCTION

1850.07.01 Frames, Grates, and Covers

The castings shall be produced as specified in the Contract Documents.

The castings shall be sound, free from pouring faults, sponginess, cracks, blowholes, and other defects.

Circular frames, covers, and grates shall be furnished with machined horizontal bearing surfaces as specified in the Contract Documents. All square and rectangular frames and grates shall be furnished with an as-cast bearing surface.

1850.07.01.01 Tolerances

- a) For the rectangular frame with two piece cover for meter and valve chambers, tolerances shall be as specified in the Contract Documents.
- b) For all other castings, the overall casting dimensions shall conform to the following tolerances:
 - i. 300 mm or less, ± 3 mm
 - ii. Up to and including 900 mm, ± 6 mm

1850.07.01.02 Markings

The initials or trademark of the manufacturer, product code, year of manufacture, and additional lettering, logos, or markings as specified in the Contract Documents shall be distinctly cast in raised letters on the top side of the frame and the grate or cover.

The word DANGER shall be distinctly cast in the centre portion of the top side of all maintenance hole covers and shall be a minimum of 50 mm in height and a minimum of 6 mm in depth.

If iron for the casting is melted and poured at one foundry and labelled with the name of another organization, manufacture, or foundry, the castings shall include both the name of the producing foundry and the organization for which the casting is produced. This lettering shall be cast so that the producing foundry and the organization for which the casting is produced can be easily identified on the same side of the casting.

The initials or trademark of the manufacturer, country of manufacture, and date of manufacture (yyyy/mm/dd) shall be cast on the underside of the grate or cover, and as well, on either the top side of the frame flange or on the inside of the frame.

1850.07.01.03 Finish

All surfaces shall be bare, without any coating. The surfaces of castings shall be uniform and free of flaking rust or mounds of rust or debris.

When specified in the Contract Documents, all surfaces shall be painted in the shop with one coat of asphalt or tar base black paint having a minimum softening point of 71 °C. All joints shall be thoroughly coated.

1850.07.02 Gratings

Gratings shall be produced as specified in the Contract Documents.

1850.07.02.01 Welded Gratings

The end bearing bars shall be welded to the angle bars along both legs with a 5 mm fillet weld. Other bearing bars shall be spot welded on each end to the angle bar. Crossbars shall be spot welded at each point of contact with the bearing bars. Welding shall be according to CSA W59.

1850.07.02.02 Reticuline Bars

The section of reticuline bar parallel to the bearing bar at each rivet shall not exceed 40 mm.

1850.07.02.03 Tolerances

All tolerances shall be within the limits specified in the NAAMM Metal Bar Grating Manual.

1850.07.02.04 Finish

Gratings shall be hot dipped galvanized according to CSA G164-M.

1850.07.03 Locking Devices

Locking devices shall be produced as specified in the Contract Documents.

1850.08 QUALITY ASSURANCE

1850.08.01 Certificate

When requested by the Owner, the Contractor shall provide a certificate from the manufacturer to indicate that the product was produced and tested according to the appropriate specification requirements. The certificate shall be from an independent testing laboratory currently accredited by the Standards Council of Canada.

1850.08.02 Inspection and Testing

When requested by the Owner, 2 Type B test bars for each lot of castings as described in ASTM A48M shall be supplied for tension testing. Test results for the test bars shall be reported within 2 weeks from receipt of the test bars. Testing shall be completed by an independent testing laboratory currently accredited by the Standards Council of Canada.

Additionally, when requested by the Owner, an independent testing laboratory currently accredited by the Standards Council of Canada shall perform load testing and dimensioning of sample castings.

The Owner reserves the right to make inspections and tests at such time as the Owner may consider necessary to ensure the materials are in accordance with this specification. All materials failing to comply with the requirements of this specification shall be rejected.

1850.09 OWNER PURCHASE OF MATERIAL

For measurement purposes, a count shall be made of the number of grates covers and gratings with their associated frames and locking devices accepted.

Payment at the price specified in the purchasing order shall be for the supply of catch basin grates, maintenance hole and valve chamber covers, ditch inlet gratings, drain inlet gratings, pipe outlet gratings, and their associated frames and locking devices 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 1850-A, November 2020
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

- Additional lettering, logos, and markings on the top side of the frames, grates, and/or covers. (1850.07.01.02)
- If the surfaces of castings are to be painted in the shop. (1850.07.01.03)

The designer should include OPSD 402.030, Cast Iron, Rectangular Frame with Two-Piece Cover for Meter and Valve Chambers, in the Contract Documents for the tolerances shown on the drawing, as the tolerances for these frames and covers are more restrictive than other castings for frames with grates or covers. (1850.07.01.01)

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

Related Ontario Provincial Standard Drawings

OPSD 400.001	Hoisting Hook Rib for Cast Iron Frames for Catch Basins, Maintenance Holes, and Valve Chambers
OPSD 400.010	Cast Iron, Square Frame with Square Overflow Type Dished Grate for Catch Basins, Herring Bone Openings
OPSD 400.020	Cast Iron, Square Frame with Square Flat Grate for Catch Basins, Herring Bone Openings
OPSD 400.030	Cast Iron, Square Frame with Square V Grate for Catch Basins, Herring Bone Openings
OPSD 400.040	Cast Iron, One-Piece Frame and Flat Square Grate for Temporary Installation, Herring Bone Openings
OPSD 400.070	Cast Iron, Raised Square Frame with Circular Flat Grate for Catch Basins, Herring Bone Openings
OPSD 400.080	Cast Iron, Side Inlet for Catch Basins
OPSD 400.081	Cast Iron, Curb Inlet Frame with Two-Piece Raised Cover for Catch Basins Out of Roadway
OPSD 400.082	Cast Iron, Raised Curb Inlet Frame with Cover for Catch Basins Out of Roadway
OPSD 400.090	Cast Iron, Curb Inlet Overflow for Catch Basins
OPSD 400.100	Cast Iron, Square Frame with Square Flat Grate for Catch Basins, Perforated Openings
OPSD 400.110	Cast Iron, Square Frame with Square Overflow Type Flat Grate for Catch Basins, Perforated Openings
OPSD 400.120	Cast Iron, Square Frame with Birdcage Grate for Catch Basins
OPSD 401.010	Cast Iron, Square Frame with Circular Closed or Open Cover for Maintenance Holes
OPSD 401.020	Cast Iron, Circular Frame with Circular 745 mm Cover for Maintenance Holes
OPSD 401.030	Cast Iron, Square Frame with Circular Watertight Cover for Maintenance Holes

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OPSD 401.040	Cast Iron, Raised Square Frame with Circular Closed or Open Cover for Maintenance Holes
OPSD 401.050	Cast Iron, Raised Square Frame with Circular Watertight Cover for Maintenance Holes
OPSD 401.060	Cast Iron, Circular Locking Cover for Maintenance Holes
OPSD 402.010	Cast Iron, Square Frame with Circular Cover and Plug for Valve Chambers
OPSD 402.011	Cast Iron, Square Frame with Vented Circular Cover and Plug for Valve Chambers
OPSD 402.020	Cast Iron, Raised Square Frame with Circular Cover and Plug for Valve Chambers
OPSD 402.021	Cast Iron, Raised Square Frame with Vented Circular Cover and Plug for Valve Chambers
OPSD 402.030	Cast Iron, Rectangular Frame with Two Piece Cover for Meter and Valve Chambers
OPSD 403.010	Galvanized Steel Honey Comb Grating for Ditch Inlets
OPSD 403.011	Raised Bar Grate for Ditch Inlet, 600 x 600 mm
OPSD 804.050	Grating for Concrete Endwall



**MATERIAL SPECIFICATION FOR
RUBBER ADJUSTMENT UNITS FOR MAINTENANCE HOLES,
CATCH BASINS, AND VALVE CHAMBERS**

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APPENDICES

1853-A	Commentary

1853.01 SCOPE

This specification covers the material and performance requirements for rubber adjustment units for maintenance holes, catch basins, and valve chambers.

1853.01.01 Specification Significance and Use

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

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

1853.01.02 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.

1853.02 REFERENCES

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

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

CSA Standards

S6-06 Canadian Highway Bridge Design Code

ASTM International

D 412-06a	Vulcanized Rubber and Thermoplastic Elastomers – Tensile Strength
D 2240-05	Rubber Property - Durometer Hardness
D 3574-05a	Density – Lbs. per Cubic Foot
D 573-04	Heat Aged Properties

1853.03 DEFINITIONS

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

Flat Profile means not having more than 0.25 mm deviation lineally in 305 mm.

1853.04 DESIGN AND SUBMISSION REQUIREMENTS

1853.04.01 Design Requirements

The maximum thickness of any rubber adjustment unit shall not be greater than 75 mm, and stack height to be in accordance with manufacturer's recommendations.

Rubber adjustment units shall not be adversely affected by exposure to salt, gasoline, antifreeze, or motor oil when tested for resistance to chemical agents.

Thickness of the rubber adjustment units shall be within 3 mm of the manufacturer's stated dimension. All other dimensions shall be within 5 mm of manufacturer's stated dimensions.

1853.05 MATERIALS

1853.05.01 Rubber

Rubber adjustment units shall be made of recycled or virgin rubber - most preferably Styrene-Butadiene Rubber (SBR).

1853.07 PRODUCTION

1853.07.01 Requirements

Adjustment units shall be manufactured using production compression moulding, tooling, and manufacturing practices to be consistent with current technology used for that type of material.

Manufactured rings shall be compressed to a minimum of 300 psi / 20.68 bar.

Adjustment units to be supplied in round, square, and rectangular shapes, and in flat and tapered profiles up to a maximum of 75 mm (3") per ring. Stacking height per manufacturer's recommendation.

1853.07.02 Quality Control

The manufacturing process shall be such that individual units will be consistent in quality and appearance. All rough edges shall be trimmed of excess flash, each ring to be checked for thickness, and flatness.

1853.07.02.01 General

Testing shall be conducted on production run rubber adjustment units not less than 24 hours old and not more than 60 Days old. The temperature of the test specimens shall be maintained at $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for at least 12 hours prior to and during the test period.

1853.07.02.02 Hardness

The moulded surface and interior hardness measurements of the adjustment unit material shall not vary more than 15 points Shore A for any single unit when measured according to ASTM D 2240. The readings shall be taken within 1 second after the presser foot is in firm contact with the specimen, unless the durometer has a maximum indicator, in which case the maximum indicated reading shall be recorded within 1 second of the cessation of the indenter travel.

1853.07.02.02.01 Moulded Surface Hardness

A minimum of 6 measurements for hardness shall be taken on each moulded surface of the adjustment unit. Each measurement shall be at different positions evenly spaced along the adjustment unit surfaces and shall be at least 12 mm from any edge of the adjustment unit.

1853.07.02.02.02 Interior Hardness

The adjustment units selected for testing shall be cut into a minimum of 3 equal size pieces providing a minimum of 6 cut surfaces. A total of 15 evenly spaced interior hardness measurements shall be taken of each cut surface. Each measurement shall be at least 6 mm apart and shall be at least 12 mm from any edge of the specimen.

1853.07.02.03 Tensile Strength

A minimum of 3 test specimens shall be cut from each adjustment unit selected for testing. The tensile strength of each specimen shall be a minimum of 1 MPa when tested according to ASTM D 412, Test Method A, using straight specimens.

1853.07.02.04 Compression Deformation and Compression Set

1853.07.02.04.01 Specimens

A minimum of 3 test specimens shall be cut from each adjustment unit selected for testing. The same samples shall be used for the compression deformation and compression set testing. Each specimen shall have a minimum thickness of 25 mm and a minimum top and bottom surface area of 2,500 mm². The top and bottom surfaces shall not be larger than the plates of the compression equipment.

1853.07.02.04.02 Testing Procedure

Each specimen shall be tested for initial compression deformation, final compression deformation, and compression set.

1853.07.02.04.03 Initial Compression Deformation

The initial compression deformation for each specimen shall be 6% ± 2% when tested in the following manner:

- a) The dimensions of each specimen shall be recorded to the nearest 0.02 mm prior to being subjected to any testing.
- b) Place the specimen in the compression equipment, using extreme care to place it exactly in the centre between the plates to avoid tilting. Apply an initial constant load to achieve 0.05 MPa stress to the specimen. Immediately determine the thickness of the specimen by measuring the distance between the top and bottom plates. This value will represent the initial thickness of the specimen prior to compression.
- c) Over a period of 30 seconds or less, apply and maintain a constant load to achieve 1 MPa stress to the specimen.
- d) Immediately after the required load has been achieved, determine the initial compression deformation thickness of the specimen by measuring the distance between the top and bottom plates and calculate the percentage of compression as follows:

$$C_{d1} = [(D_1 - D_2) / D_1] \times 100$$

where:

- C_{d1} = initial compression deformation as a percentage of the initial thickness
 D_1 = initial thickness
 D_2 = initial compression deformation thickness

1853.07.02.04.04 Final Compression Deformation

The final compression deformation for each specimen shall be $6\% \pm 2\%$ when tested in the following manner:

- a) Maintain the load required to achieve the 1 MPa stress for a period of 30 minutes.
- b) At the end of the 30-minute period, determine the final compression deformation thickness of the specimen by measuring the distance between the top and bottom plates and calculate the percentage of compression as follows:

$$C_{d2} = [(D_1 - D_3) / D_1] \times 100$$

where:

C_{d2} = final compression deformation as a percentage of the initial thickness
 D_1 = initial thickness, as derived during the initial compression deformation testing
 D_3 = final compression deformation thickness

1853.07.02.04.05 Compression Set

The maximum compression set for each specimen shall be 4% when tested in the following manner:

- a) Remove the load on the specimen and allow it to rest undisturbed for a period of 30 minutes.
- b) At the end of the 30-minute period, apply a constant load to achieve 0.05 MPa stress to the specimen. Immediately determine the compression set thickness of the specimen by measuring the distance between the top and bottom plates and calculate the percentage of compression set as follows:

$$C_s = [(D_1 - D_4) / D_1] \times 100$$

where:

C_s = compression set as a percentage of the initial thickness
 D_1 = initial thickness
 D_4 = compression set thickness

1853.07.03 Tolerances

The thickness of the adjustment unit shall be within 3 mm of manufacturer's stated dimensions. All other dimensions shall be within 5 mm.

Except for shim or wedge units, the deviation from a plane parallel to theoretical surface shall not be greater than 1 in 500.

1853.07.04**Minimum Physical Requirements**

TEST / STANDARD	PROPERTIES
Hardness - ASTM D 2240	Maximum 15 Shore A variance
Tensile Strength - ASTM D 412	220 psi. 1.5 Mpa 1 Mpa minimum (145 PSI)
Compression Deformation - OPSS 1853	6% $\pm$ 2%
Compression Set - OPSS 1853	4% maximum
Density - ASTM D3574-05 Test A	64.214 Lbs./Cu. Ft. $\pm$ 3%
Heat Aged Properties -ASTM D573	3Hrs. @ 148• C (300• F)
Tensile, Hardness, Compression Deformation	100% Retained
Low Temperature Brittleness - 24 Hrs. @ -40	No signs of cracks, ruptures, or degradation

1853.07.05**Markings**

Each adjustment unit shall be clearly marked on the inside or top surface with the following information:

- a) Manufacturer's name.
- b) Product trade name/catalogue number, if applicable.
- c) Origin of manufacture.
- d) Dimensions of the adjustment unit including:
 - i. thickness,
 - ii. inside dimensions, and
 - iii. outside dimensions.

1853.08**QUALITY ASSURANCE****1853.08.01 Certificate**

Supplier shall provide a certificate upon request to indicate that the product was produced and tested in accordance with this specification.

1853.08.02**Inspection and Testing**

The Owner may make inspections and tests at such times as necessary to ensure that the material supplied is according to this specification.

1853.09**OWNER PURCHASE OF MATERIAL**

For measurement purposes, a count shall be made of the rubber adjustment units supplied and delivered as noted on the purchasing order.

Payment at the price specified in the purchasing order shall be for the supply of the rubber adjustment units delivered to the destination on the date and time specified.

Appendix 1853-A, November 2018
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 704.013



**MATERIAL SPECIFICATION FOR HIGH DENSITY POLYETHYLENE (HDPE) AND
EXPANDED POLYSTYRENE (EPS) ADJUSTMENT UNITS FOR MAINTENANCE
HOLES, CATCH BASINS, AND VALVE CHAMBERS**

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1854-A	Commentary

1854.01 SCOPE

This specification covers the material and performance requirements for high density polyethylene (HDPE) and expanded polystyrene (EPS) adjustment units used for maintenance holes, catch basins, and valve chambers.

1854.01.01 Specification Significance and Use

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

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

1854.01.02 Appendices Significance and Use

Appendices are 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.

1854.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 905 Steel Reinforcement for Concrete

CSA Standards

S6-14 Canadian Highway Bridge Design Code

ASTM International

C 578-12b	Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
D 543-06	Evaluating the Resistance of Plastics to Chemical Reagents
D 638-10	Standard Test Method for Tensile Properties of Plastics
D 1308-02 (2013)	Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
D 1248-05	Polyethylene Plastics Extrusion Materials for Wire and Cable

1854.03 DEFINITIONS

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

Flat Surface means not having more than 0.25 mm deviation lineally in 305 mm.

1854.04 DESIGN AND SUBMISSION REQUIREMENTS

1854.04.01 Design Requirements

Both high density polyethylene (HDPE) and expanded polystyrene (EPS) adjustment units shall meet the following requirements, unless otherwise specified.

Adjustment rings shall not be adversely affected by exposure to salt, gasoline, antifreeze, or motor oil when tested for resistance to chemical reagents.

The maximum allowable deviation from dishing or bowling, as measured at the outer edge with the adjustment ring turned top down on a known flat surface shall be 6 mm.

The thickness of the adjustment units shall be within 3 mm of the manufacturer's stated dimension. All other dimensions shall be within 5 mm of manufacturer's specified dimension.

The appearance of the adjustment units shall be such that it shall have no voided areas, cracks, separations, or protrusions. Ripples or sags on vertical walls shall not cover more than 10% of the surface area. The colour of the adjustment ring shall be consistent.

1854.05 MATERIALS

1854.05.01 High Density Polyethylene (HDPE)

The injection molding material shall be either recycled or virgin high density polyethylene or a combination of both. The properties of the injection molding material shall be according to ASTM D 1248, Type III, Class B, Category 3.

Adjustment units shall be manufactured from injection molding material that is recyclable as a high density polyethylene product.

The maximum allowable bulging between webs as measured around the largest outside diameter and the points where the outer wall intersects the web sections shall be 3 mm.

The HDPE material shall be tested for resistance to chemical reagents according to ASTM D 543, Practice A.

1854.05.02 Expanded Polystyrene (EPS)

EPS adjustment units shall be manufactured using high density expanded polystyrene with minimum density of 80.1 kg/m³. Core material of both round and square adjustment units shall be made of virgin expanded polystyrene that is polymerized during pre-expansion and aging. Recycled EPS material shall not be used.

EPS adjustment units shall be coated with a highly cross linked plural component polyurea sprayable system. The coating shall be 0.0762 to 0.127 mm thick.

The polyurea coating shall be tested for resistance to chemical reagents according to ASTM D 1308.

1854.07 PRODUCTION

1854.07.01 General

Adjustment units shall be manufactured using production type injection moulding, tooling, and manufacturing practices consistent with current technology being used for the type of material.

All rough edges shall be trimmed prior to shipping.

1854.07.02 Testing During Production

Testing shall be conducted on production run units not less than 24 hours old and not more than 60 Days old.

For each production run, the tests to confirm dimensions, flatness, and to ensure consistent appearance shall occur at a minimum rate of once every 500 adjustment units with the first test being conducted between the 5th and 10th adjustment ring.

1854.07.03 Markings

Each adjustment ring shall be clearly marked on the inside or top surface with the following information:

- a) Manufacturer's name or logo.
- b) Product trade name or catalogue number, if applicable.
- c) Location of manufacture.
- d) Date of manufacture (i.e., yyyy-mm-dd).
- e) Dimensions of the adjustment units, including:
 - i. Thickness
 - ii. Inside dimensions
 - iii. Outside dimensions
- f) If the top and bottom surfaces are different, the side that is to be installed upwards.

1854.07.04 Proof Testing Procedures

1854.07.04.01 General

The adjustment ring shall meet or exceed the design load requirements as specified in CAN/CSA S6, for a CL-625-ONT Truck.

This testing procedure is intended to determine if a product line of similar material strength and structural design meets the performance requirements of Ontario Provincial Standards for Roads and Public Works (OPS) by testing the catch basin units, which are usually one of the smallest adjustment units and therefore under the greatest stress. If the catch basin ring passes, it can then be assumed that larger maintenance hole units of equal material strength and structural design shall also pass. If there are material or structural differences between the sizes, separate tests shall then need to be conducted for the different materials and types.

Proof testing shall be conducted on production run units not less than 24 hours old and not more than 60 Days old.

1854.07.04.02 Sample Sizes

The manufacturer shall have the option of conducting tests on either a full size 50 mm high catch basin adjustment units for a 600 x 600 mm precast concrete catch basin or 50 mm high mini specimens cut from these units.

When mini specimens are used, the stress that would have been applied to the full size ring shall be the same as applied to the mini specimen.

1854.07.04.03 Maximum Bearing Surface Area

For the purpose of determining the maximum bearing surface area, only the area of the catch basin adjustment ring in contact with the top of a 600 x 600 mm precast concrete catch basin shall be used. Any excess material not in contact shall be removed.

The area of the full size catch basin adjustment ring in contact with the top of a 600 x 600 mm precast concrete catch basin box after removal of excess shall not exceed 0.28 m², which is the calculated area of the top of the catch basin box.

1854.07.04.04 Static Design Full Load Testing Procedure

The static design full load shall be the design load requirements as specified in CAN/CSA S6, determined to be 166.6 kN, as per the calculations below.

CSA S6-14 (CHBDC) states in clause 3.8.4.3 to design manhole covers to axle number 2 of the CL-625-ONT truck. The wheel associated with axle number 2 of the CL-625-ONT truck is 70 kN. Applying a dynamic load allowance of 1.4 for single axle loading (CHBDC clause 3.8.4.5.3) and a live load factor of 1.7:

$$\begin{aligned}\text{Design Live Load} &= 70 \text{ kN} \times 1.4 \times 1.7 \\ &= 166.6 \text{ kN}\end{aligned}$$

This load shall be used for full size testing or the steps for equivalent stress for specimens shall be followed.

1854.07.04.04.01 Specimens

For testing, a minimum of 9 full size 50 mm catch basin adjustment units for specimens or a minimum of 9 mini test specimens cut from a 50 mm catch basin adjustment ring shall be selected. These specimens shall be the same size and be divided into 3 specimens for each of the 3 temperature groupings. The same samples for each temperature groupings shall be used for the compression deformation and compression set testing. For adjustment units using a web design, each mini specimen shall be cut as close to opposing sides of adjacent webs as possible without removing mass from those webs and shall be full thickness of the adjustment ring. The top and bottom surfaces shall not be larger than the plates of the compression equipment.

1854.07.04.04.02 Equivalent Stress and Design Load for Mini Specimens

A_f = the area of the full size catch basin adjustment unit in contact with the top of the catch basin.

A_{ms} = load bearing surface area of the mini specimens

S_i = initial stress on the adjustment ring = 14 kN / A_f

S_f = final stress on the adjustment ring = 166.6 kN / A_f

L_{mi} = initial load on the mini specimens = $S_i \times A_{ms}$

L_{mf} = final load on the mini specimens = $S_f \times A_{ms}$

1854.07.04.04.03 Testing Procedure

Compression deformation and compression set testing shall be as shown in Table 1.

All specimens shall be tested for initial compression deformation, final compression deformation, and compression set. Three samples shall be tested for each of the 3 temperature groupings: -20 °C, +23 °C, and +30 °C.

The specimens shall be maintained at the specified test temperatures for a minimum of 2 hours, immediately prior to the test period.

1854.07.04.04.04 Initial Compression Deformation

The initial compression deformation for each specimen shall be tested in the following manner:

- a) The thickness of each specimen in 4 equally spaced locations around the frame shall be recorded to the nearest 0.02 mm prior to being subjected to any testing. The average of these values shall be recorded as average thickness prior to test (D_0). If D_0 is not between 47 and 53 mm, the specimen shall be replaced.
- b) The specimen shall be placed in the compression equipment using care to place it exactly in the centre between the plates to avoid tilting.
- c) An initial constant load of 14 kN shall be applied on the full size specimens or initial load (L_{mi}) on the mini specimens. Immediately, determine the thickness of the specimen by measuring the distance between the frame and bottom plate in the same 4 equally spaced locations around the frame. The average of these values (D_1) represents the initial thickness of the specimen prior to compression.
- d) Over a period of 30 seconds or less, apply and maintain a constant load of 166.6 kN on the full size specimen or final load (L_{mf}) on a mini specimen.
- e) Immediately after the required load has been achieved, determine the initial compression deformation thickness of the specimen by measuring the distance between the frame and bottom plate in the same 4 locations. Using the average of these measurements (D_2) calculate the average initial compression deformation as follows:

$$C_{d1} = D_1 - D_2$$

Where:

C_{d1} = average initial compression deformation

D_0 = average thickness prior to test

D_1 = average initial thickness

D_2 = average initial compression deformation thickness

1854.07.04.04.05 Final Compression Deformation

The final compression deformation for each specimen shall be tested in the following manner:

- a) Maintain the load of 166.6 kN in step d) of the Initial Compression Deformation clause for a period of 30 minutes.

- b) At the end of the 30-minute period, determine the final compression deformation thickness of the specimen by measuring the distance between the top and bottom plates at the same 4 locations, average the measurements, and calculate the average final compression deformation as follows

$$C_{d2} = D_1 - D_3$$

Where:

C_{d2} = average final compression deformation

D_1 = average initial thickness, as determined in step c) of the Initial Compression Deformation clause

D_3 = average final compression deformation thickness

1854.07.04.04.06 Compression Set

The average compression set for each specimen shall be tested in the following manner:

- a) Remove the load on the specimen and allow it to rest undisturbed for a period of 30 minutes.
- b) At the end of the 30-minute rest period, apply a constant 14 kN load to the specimen. Immediately determine the compression set thickness of the specimen by measuring the distance between the frame and bottom plates at the same 4 locations, average the measurements, and calculate the average compression set as follows:

$$C_s = D_1 - D_4$$

Where:

C_s = average compression set

D_1 = average initial thickness, as determined in step c) of the Initial Compression Deformation clause

D_4 = average compression set thickness

1854.07.04.05 Fatigue Load Test

A single full size catch basin ring of area A_f shall be tested to 1,000,000 cycles of 1 second duration for the fatigue load requirements as specified in CAN/CSA-S6, determined to be 98 kN at 23 °C.

At the end of the fatigue testing, the adjustment ring shall perform without failure. Failure of this test is defined as deformation or cracking that would compromise the structural integrity or water tightness of the installation when it is subjected to the specified loads, seasonal temperatures, and placement of hot mix asphalt.

1854.08 QUALITY ASSURANCE

1854.08.01 Certificate

Suppliers shall provide a certificate upon request to indicate that the product was produced and tested in accordance with this specification. Included with the certificate shall be reports from qualified independent third party laboratories proving that the product meets the requirements of this specification.

1854.08.02 Inspection and Testing

The Owner may make inspections and tests at such times as considered necessary to ensure that the material supplied is according to this specification.

All material failing to comply with the requirements of this specification shall be rejected.

1854.09 OWNER PURCHASE OF MATERIAL

For measurement purposes, a count shall be made of the high density polyethylene and high density expanded polystyrene adjustment units supplied and accepted as specified on the purchasing order.

Payment at the price specified in the purchasing order shall be for the supply of the high density polyethylene and high density expanded polystyrene adjustment units 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.

TABLE 1
Maximum Allowable Percentage Compression Deformation and Compression Set
For a Single 50 mm Thick Adjustment Unit or Equivalent Sample

Temperature of Adjustment Ring °C	Maximum Average Initial Compression Deformation (C_{d1} / D_1)*100% %	Maximum Average Final Compression Deformation (C_{d2} / D_1)*100% %	Maximum Allowable Average Compression Set (C_s / D_1)*100% %
30	3.3	7.4	1.3
23	1.9	3.0	0.8
-20	1.1	0.8	0.5

Appendix 1854-A, November 2019
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 704.011	High Density Polyethylene Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers
OPSD 704.012	Expanded Polystyrene (EPS) Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers
OPSD 705.010	Precast Concrete Catch Basin, 600 x 600 mm



MATERIAL SPECIFICATION FOR GEOTEXTILES

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APPENDICES

1860-A	Commentary

1860.01 SCOPE

This specification covers the material requirements for geotextiles.

1860.01.01 Specification Significance and Use

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

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

1860.01.02 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.

1860.02 REFERENCES

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

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

ASTM International

D 4354-12	Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products (RECPs) for Testing
D 4355/D 4355M-14	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
D 4491/D 4491M-17	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
D 4533/D 4533M-15	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
D 4873-16	Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
D 4632/D 4632M-15a	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
D 6241-14	Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50 mm Probe

Canadian General Standards Board (CGSB)

148.1 No. 10-94	Methods of Testing Geosynthetics - Geotextiles - Filtration Opening Size

Bureau de Normalisation du Québec (BNQ)

BNQ 7009-910	Geotextiles - Quality of Geotextiles Used in Road Engineering - Certification Protocol

1860.03

DEFINITIONS

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

Duplicate Samples means two samples taken at the same time and location, one to be used for quality assurance testing and the other for referee testing.

Filtration Opening Size (FOS) means the opening size of a geotextile in microns corresponding to 95% by mass particle diameter passing through the geotextile in the hydrodynamic sieving test CAN/CGSB 148.1, Method No. 10.

Geosynthetic means a synthetic material used in geotechnical engineering applications. Geosynthetics may include such items as geotextiles, geomembranes, geocells, geogrids, geonets, and geocomposites.

Geotextile means a permeable synthetic textile material that is used in association with foundation, soil, rock, earth, or other geotechnical related material for one or more of the following functions: separation, filtration, drainage, or protection. They may be woven, non-woven, or knitted.

Lat means a length equal to the circumference of a full geotextile roll provided by the manufacturer.

Minimum Average Roll Value (MARV) means the average value minus two standard deviations of a given property established by the manufacturer during production. The average roll value for a given property must meet or exceed this value.

Quality Assurance (QA) means a system or series of activities carried out by the Owner to ensure that materials received from the Contractor meet the specified requirements.

Quality Control (QC) means a system or series of activities carried out by the Contractor, Subcontractor, supplier, and manufacturer to ensure that materials supplied to the Owner meet the specified requirements.

Referee Testing means testing of a material attribute for the purpose of resolving acceptance issues at the request of the Contractor or the Owner.

1860.04

DESIGN AND SUBMISSION REQUIREMENTS

1860.04.01

Submission Requirements

Prior to the use of a geotextile in the Work, a certificate from the manufacturer stating the name of the manufacturer, product name, style number, chemical composition, and other pertinent information required to fully describe the geotextile as evaluated under the manufacturer's QC program, shall be submitted to the Contract Administrator. The certificate shall identify the name of the supplier of the geotextile covered pipe or tubing. A person having legal authority to bind the manufacturer or supplier shall attest to this certificate.

Upon request, documentation describing the manufacturer's QC program shall be made available to the Contract Administrator.

The requirements stated above shall be waived for geotextiles certified according to BNQ 7009-910.

1860.05

MATERIALS

Geotextile fibre or yarn shall be composed of at least 95% by mass of polypropylene, polyethylene, polyester, or other synthetic polymers, excluding polyamides.

Geotextiles shall contain stabilizers or inhibitors, if necessary, to make the filaments resistant to deterioration by excessive ultraviolet (UV) light and heat exposure. Geotextiles shall be resistant to acid and alkali action and shall be unaffected by micro-organisms and insects.

1860.07 PRODUCTION

1860.07.01 Woven Geotextiles

Woven geotextiles shall be produced by interlacing two or more sets of filaments, yarns, fibres, film, tape, or other elements in such a way that the elements pass each other, essentially at right angles and with one set of elements parallel to the fabric axis. The edge of woven geotextiles shall be finished to prevent the outer yarn from pulling away.

1860.07.02 Non-Woven Geotextiles

Non-woven geotextiles shall consist of a manufactured sheet, web, or batt of directionally or randomly-oriented fibres, filaments, or other elements produced by bonding or interlocking the elements by mechanical, thermal, or chemical means.

1860.07.03 Knitted Sock Geotextiles

Knitted sock geotextiles shall be produced by interlooping one or more yarns, fibres, or filaments in a continuous tube. Knitted sock geotextiles are suitable only for wrapping of subdrain pipe.

1860.07.04 Seams

When sections of geotextile are joined by sewing, the seam strength shall be at least 90% of the minimum tensile strength requirement for the class of geotextile specified in the Contract Documents.

Seams joining two sections of geotextile shall be sewn with thread meeting the material requirements for the geotextile or, shall be bonded by thermal or chemical means.

1860.07.05 Physical Requirements

1860.07.05.01 Woven and Non-Woven Geotextiles

Woven and non-woven geotextiles are classified as either Class I or Class II and shall meet the physical property requirements shown in Table 1.

1860.07.05.02 Knitted Sock Geotextiles

Knitted sock geotextiles shall meet the physical property requirements shown in Table 2.

1860.07.05.03 Temporary Silt Fence

Geotextiles for temporary silt fence shall be woven or non-woven and shall meet the physical property requirements shown in Table 3.

1860.07.06 Protection during Shipment and Storage

Geotextiles shall be protected against excessive UV exposure and contamination from dirt, dust, moisture, and any other deleterious materials, until they are installed. All geotextiles shall be wrapped in an opaque protective covering from the time of manufacture to the time of installation. The geotextiles and protective wrapping shall be free of tears and punctures, upon delivery to the work.

Geotextiles intended to be covered by soil, rock, earth, or other materials shall not be exposed to direct sunlight for more than 72 hours following the removal of the protective wrap.

Geotextiles shall be protected from temperatures greater than 60 °C.

1860.07.07 Identification

Each roll of geotextile or geotextile-covered pipe or tubing shall be clearly marked according to ASTM D 4873 with a permanent, legible identification tag or label either on the protective wrap or the inner core as applicable, or affixed to a geotextile-covered pipe or tubing. Product labels shall show the name of the manufacturer or supplier, product number, type, Class, roll number, and date of manufacture.

For Class I and Class II geotextiles, the product label requirements stated in the paragraph above, shall be waived for geotextiles certified by the BNQ according to BNQ 7009-910 for the requirements specified in the Materials and Production sections. BNQ-certified geotextiles shall bear the "BNQ" mark of conformity, the BNQ Product Designation, as specified in Table 1, as well as all other identification marks specified by BNQ.

1860.08 QUALITY ASSURANCE

1860.08.01 General

When the Owner has elected to carry out QA testing to ensure that material used in the Work is according to the requirements of this specification, applicable geotextiles shall be sampled and tested according to the methods identified in Tables 1, 2, or 3, at the following rates:

- a) For Class I or II geotextile, one sample per 10,000 m² of installed product.
- b) For knitted sock geotextile, one sample per 10,000 m of installed subdrain pipe wrapped with knitted sock geotextile.
- c) For temporary silt fence geotextile, one sample per 10,000 m of silt fence barrier installed.

When the quantity of a geotextile is less than the lot size specified above, a minimum of one QA sample per each geotextile type shall be tested to verify that the material meets the requirements of this specification.

As specified elsewhere in the Contract Documents, the Contract Administrator shall be allowed access to all sampling locations and reserves the right to request a QA sample at any time without notice to the Contractor.

Testing shall be carried out at a laboratory designated by the Owner. The Owner shall be responsible for all costs associated with QA testing.

1860.08.02 Sampling

1860.08.02.01 General

QA sampling shall be carried out by the Contractor, in the presence of the Contract Administrator.

Sampling shall be according to ASTM D 4354 and as specified in the Contract Documents.

All QA samples shall be duplicate samples with both samples taken side-by-side.

Each sample shall be rolled and placed into separate UV-protective containers (e.g., sealed cardboard box or opaque plastic bag). If a rolled sample is too large to fit within a UV-protective container, it may be folded in a manner that minimizes the number of folds required to fit the sample into the container.

Each sample shall be accompanied with a copy of the roll label or identification tag, as well as the appropriate contract-related information and testing requirements, as specified in the Contract Documents. All such information shall be placed in a moisture-proof envelope directly attached to each UV-protective container.

Where security bags and seals are required, each UV-protective container shall be placed within a separate security bag sealed by the Contract Administrator.

1860.08.02.02 Sample Size, Preparation, and Marking

Samples of Class I and Class II geotextiles shall be the full width of the roll and at least 2.0 meters in length in the machine direction.

Samples of temporary silt fence geotextile and knitted socks shall be a minimum of 3.0 m² in area.

When samples are taken from a roll of material for testing, at least a full lat of the material from that roll shall be discarded prior to sampling.

All samples shall be completely dry, free of damage, dust, or other contamination, at all times. Any samples that have been allowed to become moist or wet shall be air-dried in a protected place, away from direct sunlight until they are completely dry, prior to packaging.

All samples shall be permanently marked with the machine direction.

For temporary silt fence geotextile that is attached to wooden stakes, the wooden stakes shall be carefully removed to avoid any tearing of the geotextile and the stakes discarded. The area within 150 mm of each of the stakes that were removed, shall then be permanently marked by crosshatching, to ensure that such areas are not used for testing.

1860.08.03 Acceptance

When QA testing has been carried out, QA test results shall be used for acceptance purposes.

1860.08.04 Referee Testing

When QA test results do not meet the requirements of this specification, the Contractor has the option of invoking referee testing for the test result or results that failed to meet the requirements, as long as a duplicate QA sample is available for testing.

The Contractor shall notify the Contract Administrator, in writing, invoking this option within 5 Business Days following notification of unacceptable material. The notification shall include the type and, where applicable, the class of geotextile, as well as the specific attribute or attributes for which the referee testing is being requested.

Referee testing shall be carried out, as specified herein and elsewhere in the Contract Documents.

The Owner shall select a referee laboratory, within 5 Business Days following the Contractor's notification to invoke referee testing.

The Contractor may observe the testing, at no additional cost to the Owner. The Contract Administrator shall notify the Contractor a minimum of 5 Business Days in advance of the date of referee testing. Provided that such notice was given, referee testing shall be carried out regardless of the absence of observers.

Observers shall follow the referee laboratory protocols for access to the premises and testing equipment and shall not unnecessarily impede the progress of the testing. Observers shall be permitted to validate sample identification and view sample condition. Subject to safety requirements, test method, and equipment limitations, Observers shall be permitted to observe test procedures, take notes, view equipment readings, and review completed work sheets while in attendance.

Concerns with sample condition or sample identification shall be made known prior to commencement of the referee testing. Comments on deviations from the applicable test method shall be made at the time of testing. Unresolved concerns shall be specific in nature and submitted, in writing, to the laboratory's designated representative and other observers, at the time of testing.

Referee test results shall be binding on both the Owner and the Contractor.

When a referee test result shows that the materials are in accordance with the physical property requirements of this specification, then the material represented by that test result shall be accepted.

When a referee test result shows that the material does not meet the physical property requirements of this specification, then the material represented by that test result, including any material already in the Work, shall be considered rejectable.

The Owner shall be responsible for the cost of referee testing, provided that the referee test results show that the geotextile meets the applicable requirements of this specification. Otherwise, the Contractor shall be responsible for the cost of referee testing.

1860.09 OWNER PURCHASE OF MATERIAL

1860.09.01 General

Geotextiles supplied to the Owner under this specification shall be of the type, Class, and FOS range as specified in the Contract Documents. Material not meeting the requirements of this specification may be rejected by the Owner.

1860.09.02 Measurement and Payment

Payment at the price specified in the Contract Documents, in square metres, shall be for the supply of geotextiles delivered to the destination on the date and time specified.

Rejected material shall be replaced at no additional cost to the Owner.

TABLE 1
Physical Property Requirements for Woven and Non-Woven Geotextiles

Property	Test Method	Unit	Geotextile Class			
			Class I		Class II*	
			Woven	Non-Woven	Woven	Non-Woven
			BNQ Product Designation			
			OPSS 1860-I-W	OPSS 1860-I-N	OPSS 1860-II-W	OPSS 1860-II-N
Tensile strength, MARV, minimum	ASTM D 4632/D 4632M	N	800	350	1100	700
Tear strength, MARV, minimum	ASTM D 4533/D 4533M	N	300	180	400	250
Puncture strength, MARV, minimum	ASTM D 6241	N	1650	990	2200	1375
Permittivity, minimum	ASTM D 4491/D 4491M, Method A	s ⁻¹	0.05			
Filtration opening size (FOS)	CAN/CGSB 148.1, Method No. 10	μ	As specified in the Contract Documents			
Ultraviolet stability, minimum	ASTM D 4355	%	50% retained tensile strength at 500 hours			

**Note: A Class II Woven geotextile may be used to replace a Class I Woven geotextile or a Class II Non-Woven geotextile may be used to replace a Class I Non-Woven geotextile, as long as the geotextile being proposed for use meets the requirements for Filtration Opening Size (FOS), according to CAN/CGSB 148.1, Method No. 10, as specified in the Contract Documents.*

TABLE 2
Physical Property Requirements for Knitted Sock Geotextiles

Property	Test Method	Acceptance Requirements
Puncture resistance, N	ASTM D 6241	800
FOS, maximum, μm	CAN/CGSB 148.1, Method No. 10	As specified in the Contract Documents
Permittivity, minimum, s ⁻¹	ASTM D 4491/D 4491M, Method A	2.75

TABLE 3
Physical Property Requirements for Temporary Silt Fence Geotextiles

Property	Test Method	Unit	Supported Silt Fence	Unsupported Silt Fence	
				Woven	Non-Woven
Maximum post spacing	-	m	1.2	2.0	1.2
Tensile strength, MARV, minimum	ASTM D 4632/D 4632M	N	400	550	
Permittivity, minimum	ASTM D 4491/D 4491M	s ⁻¹	0.05		
Filtration Opening Size (FOS), maximum	CAN/CGSB 148.1, Method No. 10	µm	As specified in the Contract Documents		
Ultraviolet stability, minimum	ASTM D 4355/D 4355M	%	70% retained tensile strength at 500 hours		

Appendix 1860-A, November 2018
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 Owner should specify the following in the Contract Documents:

- Class, type (e.g., woven or non-woven), and FOS range of the geotextile. (1860.09.01)

The designer may consider reducing the sampling frequency for larger quantities of geotextile. (1860.08.01)

The designer should be aware that higher strength materials than those specified in Table 1 are available for specific applications.

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

Related Ontario Provincial Standard Drawings

OPSD 206.050	Subdrain Pipe Connection and Outlet
OPSD 207.030	Concrete and Composite Pavement on Open Graded Drainage Layer
OPSD 207.041	Subdrain Pipe Open Graded Drainage Layer
OPSD 207.044	Subdrain Pipe Connection and Outlet Open Graded Drainage Layer
OPSD 216.021	Subdrain Pipe Connection and Outlet
OPSD 219.110	Light-Duty Silt Fence Barrier
OPSD 219.130	Heavy-Duty Silt Fence Barrier
OPSD 219.131	Heavy-Duty Wire-Backed Silt Fence Barrier
OPSD 219.210	Temporary Rock Flow Check Dam
OPSD 219.211	Temporary Rock Flow Check Dam Flat Bottom Ditch
OPSD 219.231	Temporary Berm Barrier for Slope Drain
OPSD 219.240	Sediment Trap for Dewatering
OPSD 219.260	Turbidity Curtain
OPSD 219.261	Turbidity Curtain Seam Detail
OPSD 802.013	Flexible Pipe Embedment and Backfill Rock Excavation
OPSD 802.014	Flexible Pipe Embedment in Embankment Original Ground: Earth or Rock
OPSD 802.023	Flexible Pipe Arch Embedment and Backfill Rock Excavation
OPSD 802.024	Flexible Pipe Arch Embedment in Embankment Original Ground: Earth or Rock
OPSD 802.033	Rigid Pipe Bedding, Cover, and Backfill rock Excavation
OPSD 802.034	Rigid Pipe Bedding and Cover in Embankment Original Ground: Earth or Rock
OPSD 802.053	Horizontal Elliptical Rigid Pipe Bedding, Cover, and Backfill Rock Excavation
OPSD 802.054	Horizontal Elliptical Rigid Pipe Bedding and cover in Embankment Original Ground: Earth or Rock
OPSD 810.010	General Rip-Rap Layout for Sewer and Culvert Outlets
OPSD 810.020	General Rip-Rap Layout for Ditch Inlets



MATERIAL SPECIFICATION FOR SIGNS

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2001.01	SCOPE
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2001.03	DEFINITIONS - Not Used
2001.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
2001.05	MATERIALS
2001.06	EQUIPMENT - Not Used
2001.07	PRODUCTION
2001.08	QUALITY ASSURANCE
2001.09	OWNER PURCHASE OF MATERIAL

APPENDICES

2001-A	Commentary

2001.01 SCOPE

This specification covers the requirements for signs.

2001.01.01 Specification Significance and Use

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

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

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 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

A653/A653M-20	Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
A792/A792M-10(2015)	Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
B209-14	Aluminum and Aluminum-Alloy Sheet and Plate
D4956-19	Retroreflective Sheeting for Traffic Control

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 B209, 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 A653M, regular type, coating designation Z275.

Galvalume steel shall be according to ASTM A792M, 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 D4956.

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, April 2021
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 ELECTRICAL HANDHOLES

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2401.02	REFERENCES
2401.03	DEFINITIONS - Not Used
2401.04	DESIGN AND SUBMISSION REQUIREMENTS
2401.05	MATERIALS
2401.06	EQUIPMENT - Not Used
2401.07	PRODUCTION
2401.08	QUALITY ASSURANCE - Not Used
2401.09	OWNER PURCHASE OF MATERIAL

APPENDICES

2401-A	Commentary

2401.01 SCOPE

This specification covers the material requirements for electrical handholes.

2401.01.01 Specification Significance and Use

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

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

2401.01.02 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.

2401.02 REFERENCES

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

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

CSA Standards

A23.1-14/A23.2-14	Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete
G40.20-13/G40.21-13 (R2018)	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
G164-18	Hot Dip Galvanizing of Irregularly Shaped Articles

ASTM International

A 48/A 48M-03 (2016)	Grey Iron Castings
C 857-16	Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
F 593-17	Stainless Steel Bolts, Hex Cap Screws, and Studs

American National Standard Institute (ANSI)

SCTE 77-2017	Underground Enclosure Integrity

2401.04 DESIGN AND SUBMISSION REQUIREMENTS

2401.04.01 Design Requirements

All material for non-concrete and semi-concrete handholes shall have a minimum compressive strength of 135 MPa and shall be suitable for installation and use through a temperature range of -40 to +70 °C.

2401.05 MATERIALS

2401.05.01 General

All concrete shall be according to CSA A23.1 and CSA A23.2.

All electrical handholes shall be according to ASTM C 857 and ANSI/SCTE 77.

As a minimum, all non-concrete and semi-concrete electrical handholes consisting of cover and box shall be according to ANSI/SCTE 77 TIER 22.

The thickness of each electrical handhole cover shall be minimum 10 mm.

Each electrical handhole cover shall be galvanized steel according to CAN/CSA G40.20/G40.21 and CAN/CSA G164 or cast ferrous alloy according to ASTM A 48, Class No. 30 C. The top side of each metallic electrical handhole cover shall have a checkered tread.

Non-concrete and semi-concrete electrical handholes installed in earth or sidewalk may have non-metallic covers. The top side of each non-metallic cover shall have a checkered tread or a surface with a static coefficient of friction that is a minimum of 0.5, as determined using the tests specified in ANSI/SCTE 77.

All electrical handholes shall have welded studs or other means of bonding all metallic components to ground.

2401.05.02 Fastening Material

All bolts, studs, screws, nuts, washers and other fastening material shall be stainless steel and shall be according to ASTM F 593.

2401.07 PRODUCTION

2401.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

Electrical handholes shall be produced as specified in the Contract Documents.

2401.07.02 Marking

Each handhole shall have identification markings located on the outside vertical surfaces of the handhole showing the manufacturer's name or trademark and the date of manufacture (i.e., yyyy-mm-dd).

The top surface of the handhole cover shall be permanently marked, showing the manufacturer's name or trademark, the date of manufacture (i.e., yyyy-mm-dd), and the designation OPSS 2401. These markings shall be located on the top surface of the handhole cover or embossed into a corrosion-resistant metal plate securely cemented to the top surface of the handhole cover.

2401.07.03 Shipping

The supplier shall advise the Owner 3 Business Days prior to the shipping date of the intent to deliver.

2401.09 OWNER PURCHASE OF MATERIAL

2401.09.01 Measurement and Payment

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

Payment at the price specified in the purchasing order shall be for the supply of electrical handholes delivered to the destination at the date and time specified.

Appendix 2401-A, November 2019
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

Designer should specify the following the Contract Documents:

- Handhole requirements. (2401.07.01)

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

Related Ontario Provincial Standard Drawings

OPSD 2112.010	Electrical Handhole, Precast Concrete with Cover, 300 mm Diameter
OPSD 2112.020	Electrical Handhole, Precast Concrete with Cover, 460 mm Diameter
OPSD 2112.030	Electrical Handhole, Precast Concrete, 675 mm Diameter
OPSD 2112.040	Electrical Handhole, Precast Concrete, 600 x 600 mm
OPSD 2112.050	Electrical Handhole, Precast Concrete with Cover, 300 x 500 mm
OPSD 2113.010	Electrical Handhole, Non and Semi-Concrete, General Requirements
OPSD 2117.020	Electrical Handholes, General Installation Requirements



Note: The MUNI implemented in November 2018 replaces OPSS 2409 COMMON, November 2014 with no technical content changes.

MATERIAL SPECIFICATION FOR TRAFFIC SIGNAL CABLE

TABLE OF CONTENTS

2409.01	SCOPE
2409.02	REFERENCES
2409.03	DEFINITIONS
2409.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
2409.05	MATERIALS
2409.06	EQUIPMENT - Not Used
2409.07	PRODUCTION
2409.08	QUALITY ASSURANCE - Not Used
2409.09	OWNER PURCHASE OF MATERIAL

APPENDICES

2409-A	Commentary

2409.01	SCOPE

This specification covers the requirements for traffic signal runner cable and traffic signal riser cable.

2409.01.01 Specification Significance and Use

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

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

2409.01.02

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.

2409.02

REFERENCES

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

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

CSA Standards

C22.2 No. 239-09 Control and Instrumentation Cables

2409.03

DEFINITIONS

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

Traffic Signal Runner Cable means the polyethylene insulated polyvinyl chloride jacketed multi-conductor cable, for use in traffic signal systems, suitable for direct burial or aerial installation and rated at 600 volts.

Traffic Signal Riser Cable means the polyethylene insulated polyethylene jacketed multi-conductor cable, for use in traffic signal systems, suitable for use on traffic signal pole installation and rated at 600 volts.

2409.05 MATERIALS

2409.05.01 Cable

Traffic signal cable shall be according to CSA C22.2 No. 239, rated 600 volts.

Conductors of the traffic signal runner cable shall be #14 AWG solid copper.

Conductors of the traffic signal riser cable shall be #14 AWG, minimum of 19 strands or #14 AWG solid copper.

2409.05.02 Insulation

Insulation of the conductors shall be according to CSA C22.2 No. 239.

2409.05.03 Jacket

Outside jacket of the traffic signal runner cable shall be as shown in Table 1 and the polyvinyl chloride shall be according to CSA C22.2 No. 239.

2409.05.04 Conductor Identification

Conductor identification shall be according to CSA C22.2 No. 239.

Colour coding and printing of the conductors shall be as shown in Table 2 to 7.

2409.07 PRODUCTION

2409.07.01 General

Traffic signal runner cable and traffic signal riser cable shall be according to CSA C22.2 No. 239.

2409.07.02 Marking

Cable shall be permanently marked according CSA C22.2 No. 239.

2409.09 OWNER PURCHASE OF MATERIAL

2409.09.01 Packaging and Shipment

Traffic signal runner cable and the traffic riser cable shall be shipped on returnable reels, in continuous lengths specified in the purchasing order. Each reel of cable shall be tagged or marked according to CSA C22.2 No. 239.

The supplier shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2409.09.02**Measurement and Payment**

Measurement of traffic signal runner cable and traffic signal riser cable shall be by length in metres along the cable.

Payment at the price specified in the purchasing order shall be for the supply of the traffic signal runner cable and the traffic signal riser cable 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.

TABLE 1
Traffic Signal Runner Cable Outside Jacket Thickness

Diameter of Completed Conductor Assembly mm	Average Jacket Thickness mm	Minimum Jacket Thickness mm
0 - 10.9	2.0	1.6
11 - 17.9	2.4	2.0
18 - 26.9	2.8	2.2
27 - 38.9	3.2	2.6
39 - 50.9	3.6	3.0
51 - 75.9	4.0	3.2
76 and over	4.8	4.0

TABLE 2
4 Conductor Runner Cable

Conductor	Insulation Colour
#1	White
#2	Red
#3	Yellow
#4	Blue

TABLE 3
7 Conductor Runner Cable

Conductor	Insulation Colour	Lettering
#1	White	-
#2	Red	Red one
#3	Red	Red two
#4	Yellow	Amber one
#5	Yellow	Amber two
#6	Blue	Green one
#7	Blue	Green two

TABLE 4
12 Conductor Runner Cable

Conductor	Insulation Colour	Lettering
#1	White	-
#2	Black	-
#3	Orange	-
#4	Red	Red one
#5	Red	Red two
#6	Red	Red three
#7	Yellow	Amber one
#8	Yellow	Amber two
#9	Yellow	Amber three
#10	Blue	Green one
#11	Blue	Green two
#12	Blue	Green three

TABLE 5
19 Conductor Runner Cable

Conductor	Insulation Colour	Lettering
#1	White	White one
#2	White	White two
#3	Black	-
#4	Orange	-
#5	Red	Red one
#6	Red	Red two
#7	Red	Red three
#8	Red	Red four
#9	Red	Red five
#10	Yellow	Amber one
#11	Yellow	Amber two
#12	Yellow	Amber three
#13	Yellow	Amber four
#14	Yellow	Amber five
#15	Blue	Green one
#16	Blue	Green two
#17	Blue	Green three
#18	Blue	Green four
#19	Blue	Green five

TABLE 6
5 Conductor Riser Cable

Conductor	Insulation Colour
#1	White
#2	Red
#3	Yellow
#4	Blue
#5	Green with Yellow Tracer

TABLE 7
7 Conductor Riser Cable

Conductor	Insulation Colour	Lettering
#1	White	-
#2	Red	-
#3	Yellow	Amber one
#4	Yellow	Amber two
#5	Blue	Green one
#6	Blue	Green two
#7	Green with Yellow Tracer	-

Appendix 2409-A, November 2018
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

For Owner purchase of material, the following information should be given to the supplier in the purchasing order:

- a) Number of conductors.
- b) Colour of conductors.
- c) Length of cable.
- d) Length per reel.

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 EXTRA LOW-VOLTAGE CABLE

TABLE OF CONTENTS

2410.01	SCOPE
2410.02	REFERENCES
2410.03	DEFINITIONS - Not Used
2410.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
2410.05	MATERIALS
2410.06	EQUIPMENT - Not Used
2410.07	PRODUCTION
2410.08	QUALITY ASSURANCE - Not Used
2410.09	OWNER PURCHASE OF MATERIAL

APPENDICES

2410-A	Commentary

2410.01	SCOPE

This specification covers the requirements for extra low-voltage cables suitable for underground or aerial installation.

2410.01.01 Specification Significance and Use

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

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

2410.01.02 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.

2410.02 REFERENCES

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

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

International Municipal Signal Association

- 19-5 1997 Polyethylene Insulated, Polyethylene Belted, Copper Shielded, Polyvinyl Chloride Jacketed Signal Cable
- 50-2 1997 Polyethylene Insulated, Polyethylene Jacketed, Loop Detector Lead-in Cable

2410.05 MATERIALS

2410.05.01 Conductors

Conductors of all cables shall be according to IMSA 19-5 and shall be #14 AWG stranded tinned copper. The number of conductors shall be as specified in the Contract Documents.

2410.05.02 Communication Cables

2410.05.02.01 General

Communication cable shall be polyethylene insulated, polyethylene belted, and polyvinyl chloride jacketed.

2410.05.02.02 Insulation

Insulation and inner belt insulation shall be according to IMSA 19-5.

2410.05.02.03 Shielding

Shielding shall be according to IMSA 19-5.

2410.05.02.04 Jacket

Overall jacket shall be according IMSA 19-5.

2410.05.02.05 Fillers

Fillers shall be according to IMSA 19-5.

2410.05.03 Lead-In Cables

2410.05.03.01 General

Lead-in cables shall be polyethylene insulated and polyethylene jacketed.

2410.05.03.02 Insulation

Insulation shall be according to IMSA 50-2.

2410.05.03.03 Shielding

Shielding shall be according IMSA 50-2.

2410.05.03.04 Jacket

Overall jacket shall be according to IMSA 50-2.

2410.05.03.05 Drain Wire

Drain wire shall be according to IMSA 50-2.

2410.07 PRODUCTION

2410.07.01 Communication Cables

Communication cables shall be according to IMSA 19-5.

2410.07.01.01 Marking

Cable shall be permanently marked according to IMSA 19-5, at intervals not exceeding one metre, showing the following:

- a) Size of conductor.
- b) Voltage rating.
- c) Year of manufacture.
- d) IMSA specification number.

2410.07.02 Lead-In Cables

Lead-in cables shall be according to IMSA 50-2.

2410.07.02.01 Marking

Cable shall be permanently marked according to IMSA 50-2, at intervals not exceeding one metre, showing the following:

- a) Size of conductor.
- b) Voltage rating.
- c) Year of manufacture.
- d) IMSA specification number.

2410.09 OWNER PURCHASE OF MATERIAL

2410.09.01 Packaging and Shipment

Extra low-voltage cable shall be shipped on returnable reels, in continuous lengths specified in the purchasing order. Each reel of cable shall be tagged to indicate the length of the cable and information shown under the Production, Marking clause.

The supplier shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2410.09.02 Measurement and Payment

Measurement of extra low-voltage cable shall be by metres along the cable length.

Payment at the price specified in the purchasing order shall be for the supply of the extra low-voltage cable 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 2410-A, November 2017
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

For Owner purchase of material, the following information should be given to the supplier in the purchasing order:

- a) Number of conductors.
- b) Colour of conductors.
- c) Length of cable.
- d) Length per reel.

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.



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) Distribution assembly - 347/600 V.
- b) Supply control cabinet assembly Type 1 - 120/240 V, 100 A, 1-phase, 3-wire.
- c) Supply control cabinet assembly Type 2A - 120/208 V, 100 A, 3-phase, 4-wire.
- d) Supply control cabinet assembly Type 2B - 347/600 V, 100 A, 3-phase, 4-wire.
- e) Supply control cabinet assembly Type 3 - 120/240 V, 100 A, 1-phase, 3-wire, no lighting contactor.
- f) Service supply pedestal - 120/240 V.
- g) Service supply pedestal - 347/600 V.
- h) Service box Type 3R - 120/240 V, 100 A, 1-phase, 3-wire.

2414.01.01 Specification Significance and Use

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

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

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 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

C9-2017	Dry-Type Transformers
C22.2 No. 0.12-M1985 (R2016)	Wiring Space and Wire Bending Space in Enclosures for Equipment Rated 750 V or Less
C22.2 No. 0.17-00 (R2018)	Evaluation of Properties of Polymeric Materials
C22.2 No. 0.4-2017	Bonding of Electrical Equipment
C22.2 No. 5-2016	Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures
C22.2 No. 9.0-1996 (R2016)	General Requirements for Luminaires
C22.2 No. 14-2018	Industrial Control Equipment
C22.2 No. 18.1-2013 (R2018)	Metallic Outlet Boxes
C22.2 No. 29-2015	Panelboards and Enclosed Panelboards
C22.2 No. 38-2018	Thermoset-Insulated Wires and Cables
C22.2 No. 41-2013 (R2017)	Grounding and Bonding Equipment
C22.2 No. 45.1-2007 (R2017)	Electrical Rigid Metal Conduit - Steel

C22.2 No. 45.2-2008 (R2013)	Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel
C22.2 No. 55-2015	Special Use Switches
C22.2 No. 65-2018	Wire Connectors
C22.2 No. 66.1-2006 (R2015)	Low Voltage Transformers - Part 1: General Requirements
C22.2 No. 66.2-2006 (R2015)	Low Voltage Transformers - Part 2: General Purpose Transformers
C22.2 No. 76-2014	Splitters
C22.2 No. 83-M1985 (R2017)	Electrical Metallic Tubing
C22.2 No. 94.1-2015	Enclosures for Electrical Equipment, Non-Environmental Considerations
C22.2 No. 94.2-2015	Enclosures for Electrical Equipment, Environmental Considerations
C22.2 No. 106-2005 (R2014)	HRC - Miscellaneous Fuses
C22.2 No. 144.1-16	Ground-Fault Circuit-Interrupters
C22.2 No. 227.2.1-2014	Liquid-Tight Flexible Nonmetallic Conduit
C227.5-2008 (R2018)	Three-Phase Live-Front Pad-Mounted Distribution Transformers
G40.20-13/G40.21-13 (R2018)	General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel
G164-2018	Hot Dip Galvanizing of Irregularly Shaped Articles
W59.2-M1991 (R2013)	Welded Aluminum Construction

Electrical Safety Authority (ESA)

Ontario Electrical Safety Code

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)

B18.15-2008 Forged Eyebolts

ASTM International

A 480/A 480M-18	General Requirements for Flat-Rolled Stainless Steel and Heat-Resisting Steel Plate, Sheet and Strip
A 489-18	Carbon Steel Lifting Eyes
A 666-15	Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
B 209-14	Aluminum and Aluminum-Alloy Sheet and Plate
G 34-01(2018)	Test Method for Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Test)

IEEE

C62.11-2012 Metal-Oxide Surge Arresters for AC Power Circuits (>1 kV)

National Equipment Manufacturers Association (NEMA)

NEMA 250-2014 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, distributions assemblies, service supply pedestals, and service boxes shall be according to the Contract Documents. All types of power supply equipment shall be "service entrance ready." Complete assemblies 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 according to the Ontario Electrical Safety Code.

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 a reviewed stamp with his or her signature on the Working Drawings verifying that the drawings are consistent with the Contract Documents and sound engineering practices.

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.

As a minimum, the Working Drawings for service supply pedestals shall include the following information:

- a) Plans, elevations, sections, and details to show enclosures, 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 Distribution Assemblies

Exterior cubicles shall be according to CSA C22.2 No. 94.1 and CSA C22.2 No. 94.2, enclosure NEMA 250, Type 3.

Enclosures for electrical equipment inside the cubicle shall be according to CSA C22.2 No. 94.1 and CSA C22.2 No. 94.2, 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.

2414.05.01.01.01 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.

2414.05.01.02 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.

2414.05.01.03 Service Supply Pedestals

Enclosures shall be:

- a) Welded 14 gauge stainless steel type 304 and shall have a No. 2B finish outside according to ASTM A 666 and ASTM A 480; or
- b) 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.

All mounting hardware shall be stainless steel.

2414.05.01.04 Service Boxes

Enclosures shall be welded galvanized steel with gray baked enamel electrodeposited over cleaned phosphatized steel.

Enclosures shall be suitable for outdoor use with weatherproof rating according to CSA C22.2 No. 94.1 and CSA C22.2 No. 94.2, enclosure NEMA 250, Type 3R, complete with pad lock hasp for locking.

Enclosure shall be a complete load centre having a 100 A main breaker, complete with the number of circuits to accommodate the number of standard-sized single-pole branch circuit breakers as specified in the Contract Documents.

Bus bars shall be tin plated copper and accept branch breakers as specified in the Contract Documents, main wire size shall suit #4 to 2/0 AWG copper, and a ground bar kit suitable for #2/0 AWG copper.

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 CSA 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. 144.1.

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 Distribution Cabinet Assemblies

2414.07.02.01 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 CSA C22.2 No. 94.1 and CSA C22.2 No. 94.2. 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.

2414.07.02.02 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.

2414.07.02.03 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.

2414.07.02.04 Welding

All welding shall be according to CSA W59.2. Welding on aluminum shall be done by the gas metal arc process.

2414.07.02.05 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.

2414.07.02.06 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.

2414.07.02.07 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.

2414.07.02.08 Metering

Distribution assemblies shall have meter sockets acceptable to the power supply authority and mounted on a removable backplate in the metering cabinet cubicle.

2414.07.02.09 Warning Signs

Warning signs shall be as specified in the Contract Documents and be prominently displayed on the outside of each exterior door.

2414.07.02.10 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.

2414.07.02.11 Electrical Components

The electrical components shall be as shown in Table 1.

2414.07.02.11.01 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.

2414.07.02.11.02 Nameplates for Electrical Components

The following nameplates shall be engraved lamaroid 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 lamaroid with black letters on white background.

2414.07.02.11.03 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.

2414.07.03 Supply Control Cabinet Assemblies

2414.07.03.01 Cabinet Fabrication

Supply control cabinet assemblies shall be assembled and wired according to the Contract Documents.

2414.07.03.02 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.

2414.07.04 Service Supply Pedestals

Service supply pedestals shall be assembled according to the Contract Documents.

2414.07.05 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 2019 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)
- Number of circuits to accommodate the number of standard-sized single-pole branch circuit breakers for service box enclosures with complete load centre having a 100 A main breaker. (2414.05.01.04)
- Description of equipment served for printed schedule. (2414.07.02.11.03)
- Assembly and wiring requirements for supply control cabinets. (2414.07.03.01)

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 2130.013	Supply Control Cabinet Installation
OPSD 2135.010	Service Supply Pedestal For Traffic Signal And Street Lighting
OPSD 2140.010	Service Box Installation, Overhead Services
OPSD 2200.050	Precast Pedestal Foundation For Metering Or Street Lighting
OPSD 2400.000 to 2400.030	Distribution Assembly
OPSD 2400.100 to 2400.101	Warning Signs
OPSD 2440.010 to 2441.030	Supply Control Cabinet Assembly
OPSD 2443.010	Service Supply Pedestal For Traffic Signal And Street Lighting, Layout And Wiring Schematic, 120/240V, 100A, 1-Phase, 3-Wire



MATERIAL SPECIFICATION FOR WOODEN POLES

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2420.09	OWNER PURCHASE OF MATERIAL

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2420-A	Commentary

2420.01 SCOPE

This specification covers the requirements for wooden poles and reinforcing stubs.

2420.01.01 Specification Significance and Use

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

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

2420.01.02 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.

2420.02 REFERENCES

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

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

CSA Standards

O15-15	Wood Utility Poles and Reinforcing Stubs
O80 Series-15	Wood Preservation

2420.05 MATERIALS

2420.05.01 Wood Species

Wood species of poles and reinforcing stubs shall be western red cedar, red pine, jack pine, lodgepole pine, and southern yellow pine (i.e., long leaf, short leaf, loblolly, and slash).

2420.05.02 Quality of Poles Before Treatment

Physical properties of western red cedar, red pine, jack pine, lodgepole pine, and southern yellow pine shall be according to CAN/CSA O15.

2420.05.03 Dimensions

Pole dimensions shall be according to CAN/CSA O15.

Pole class and length shall be as specified in the Contract Documents and the Pole Substitution subsection.

2420.05.04 Pole Substitution

If a pole of the desired class and length is not available, a pole of equal or greater ground line circumference may be substituted, provided any excess length is cut from the top.

2420.05.05 Preservatives

Preservatives shall be according to CAN/CSA O80 Series.

2420.07 PRODUCTION

2420.07.01 Preservation Treatment

2420.07.01.01 Preparation of Poles

Preparation of poles and reinforcing stubs for the preservative treatment shall be according to CAN/CSA O80 Series.

2420.07.01.02 Preservation Options

Western red cedar shall be butt treated according to CAN/CSA O80 Series to a length that brings the treatment to 300 mm above the ground line.

Red pine, jack pine, lodgepole pine, and southern yellow pine shall be full length treated according to CAN/CSA O80 Series.

2420.07.01.03 Preservative Retention

Penetration of the preservative shall be according to CAN/CSA O80 Series.

2420.07.02 Marking

Each pole shall have an identification marking. For poles up to 15.0 m in length, the marking shall be located 3 m from the butt of the pole. For poles greater than 15.0 m in length, the marking shall be located 5 m from the butt of the pole. Poles shall be legibly and permanently marked with the following information in letters a minimum of 16 mm high:

- a) Class and length.
- b) Species.
- c) Manufacturer identification.
- d) Year in which pole was treated (i.e., yyyy).

2420.07.03 Shipping

The Contractor shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2420.08 QUALITY ASSURANCE

2420.08.01 Inspection

All work is subject to an inspection by the Owner's representative prior to shipment.

The Owner shall be notified a minimum of 1 Business Day in advance of the date that the fabrication of the poles is to commence.

The Owner's representative shall have free access to the place of fabrication for the purpose of inspecting and examining plant records; certificates; materials used; fabrication process; and to make any tests as may be considered necessary, while work on the poles is being performed.

2420.09 OWNER PURCHASE OF MATERIAL

2420.09.01 Shipment

The supplier shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2420.09.02 Measurement and Payment

For measurement purposes, a count shall be made of the number of wooden poles and reinforcing stubs delivered and accepted.

Payment at the price specified in the purchasing order shall be for the supply of wooden poles and reinforcing stubs 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 2420-A, April 2019
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:

- Class and length of poles. (2420.05.03)

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 2238.010 Wooden Pole in Earth



MATERIAL SPECIFICATION FOR SPUN CONCRETE POLES

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2421-A	Commentary

2421.01 SCOPE

This specification covers the requirements for round spun concrete poles, maximum 21.3 metres in length.

2421.01.01 Specification Significance and Use

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

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

2421.01.02 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.

2421.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 906 Structural Steel for Bridges

Ontario Provincial Standard Specifications, Material

OPSS 1301 Cementing Materials
OPSS 1302 Water
OPSS 1303 Admixtures for Concrete

CSA Standards

A14-07 (R2017) Concrete Poles
A3001-08 Cementitious Materials for Use in Concrete
G30.18-09 (R2019) Carbon Steel Bars for Concrete Reinforcement

2421.04 DESIGN AND SUBMISSION REQUIREMENTS

2421.04.01 Design Requirements

2421.04.01.01 General

All poles shall be of proper class according to CAN/CSA A14 and the Contract Documents.

If poles are not specified by class, the Owner shall provide the manufacturer with the load that the poles must resist and other sufficient information to allow the producer to determine the loads.

Extra stiff poles shall be manufactured according to CAN/CSA A14.

2421.04.02 Submission Requirements

2421.04.02.01 Working Drawings

Working Drawings shall be prepared for the fabrication of concrete poles.

The Contractor shall submit 3 sets of Working Drawings to the Contract Administrator at least 14 Days prior to the commencement of fabrication of the concrete poles for information purposes only. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings.

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

As a minimum, the Working Drawings shall include the following information:

- a) Detailed dimensions.
- b) Plans, elevations, sections, and details to show pole structural details.
- c) Equipment and hardware layout.
- d) Pole weight.
- e) List of hardware items.
- f) Nameplate details.

2421.04.02.02 Certification

The Contractor shall submit a certificate signed by the manufacturer's Engineer that all steel and cementing materials used in the production of spun concrete poles supplied meet the requirements of this specification. This certificate shall be submitted along with the Working Drawings.

2421.05 MATERIALS

2421.05.01 Cementing Materials

Cementing materials shall be according to OPSS 1301 and CAN/CSA A3001.

Silica fume or blended cement containing silica fume shall not be used.

2421.05.02 Water

Water used in the production of spun concrete poles shall be according to OPSS 1302.

2421.05.03 Air Entraining, Chemical, and Superplasticizing Admixtures

Air entraining, chemical, and superplasticizing admixtures shall be according to OPSS 1303. Relative density and pH of air entraining admixtures and non-volatile content and relative density of chemical and superplasticizing admixtures shall be within tolerances stated in OPSS 1303, and to the requirements shown in the MTO's pre-qualified products list or, when specified in the Contract Documents, the Owner's pre-qualified products list.

2421.05.04 Reinforcement

Mill test certificates for reinforcement shall be according to OPSS 906.

2421.05.04.01 Non-Prestressed Longitudinal Reinforcing Steel

Non-prestressed longitudinal reinforcing steel shall be according to CAN/CSA A14 and shall be weldable according to CSA G30.18.

2421.05.04.02 Prestressed Longitudinal Reinforcing Steel and Helical Reinforcement

Prestressed longitudinal reinforcing steel and helical reinforcement shall be according to CAN/CSA A14.

2421.05.05 Apertures and Handholes

Apertures and handholes shall be according to CAN/CSA A14 and the Contract Documents.

2421.07 PRODUCTION

2421.07.01 General

Dimensions and class of the pole shall be as specified in the Contract Documents.

Concrete for poles shall be placed monolithically.

The pole top shall have a smooth finish plane at right angles to the axis of the pole.

Apertures in poles shall be of a size and if necessary, shall be locally reinforced or framed so that the required bending capacity at the aperture is sustained.

Apertures shall have a smooth inside finish without sharp corners.

The handhole cover plate shall be formed to suit the contour of the pole.

2421.07.02 Concrete

Concrete shall be produced to meet the compressive strength as specified in CAN/CSA A14.

Sufficient cylinders shall be cast to verify the 28-Day compressive strength of the poles supplied to the Contract. Compressive strength testing shall be according to CAN/CSA A14.

Concrete shall be tested according to the frequency and requirements of CAN/CSA A14.

2421.07.03 Grounding

A stranded #6 AWG bare copper grounding conductor shall be attached to the non-prestressed longitudinal reinforcing steel rod brazed to the zinc cast handhole frame with a 13 mm standard lug.

2421.07.04 Marking

Each pole shall have the following identification markings located approximately 100 mm above the top of the handhole:

- a) Manufacturer's name or trademark.
- b) Year of manufacture.
- c) Overall length.
- d) Class identification number.
- e) Prestressed poles shall be marked and identified by the letter P.

These markings shall be on a corrosion-resistant metal plate securely attached to the surface of the pole.

The pole shall have the pick-up point or points for unloading purposes marked with black tape around the complete circumference.

2421.07.05 Packaging and Shipping

Each pole shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity.

The Contractor shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2421.08 QUALITY ASSURANCE

2421.08.01 General

All work is subject to an inspection by the Owner's representative prior to shipment.

Poles not meeting the requirements of this specification shall be rejected by the Owner.

The Owner shall be notified a minimum of 1 Business Day in advance of the date that the fabrication of the poles is to commence.

The Owner's representative shall have free access to the place of fabrication for the purpose of inspecting and examining plant records; certificates; materials used; fabrication process, including welding and galvanizing; and to make any tests as may be considered necessary, while the poles are being fabricated.

The manufacturer's Engineer shall provide a stamped certification that the poles supplied to the Work meet the requirements of the Contract Documents and the requirements of CAN/CSA A14.

2421.08.02 Acceptance or Rejection

2421.08.02.01 Structural Testing

Acceptance shall be according to a stamped certification by the manufacturer's Engineer that ongoing testing has been performed and evaluated according to CAN/CSA A14 and that the most recent two tests for classification, torsion, and transverse testing meet the requirements of the Contract Documents and the requirements of CAN/CSA A14. All required supporting test data and certificates shall be less than 12 months old at the time of submission.

2421.08.02.02 Marking

Markings not meeting the requirements of the Marking subsection shall be rejected by the Owner.

2421.09 OWNER PURCHASE OF MATERIAL

2421.09.01 Packaging

The supplier shall provide 3 copies of the outline specification and preliminary layout drawings.

If the supplier has previously submitted this information and the Owner has previously approved it, only the reference to the original submission is required.

2421.09.02 Working Drawings and Shipment

Within 30 Days of receipt of a purchasing order to supply concrete poles, the supplier shall submit 3 copies of Working Drawings, as described in the Submission Requirements subsection, to the Owner.

The supplier shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2421.09.03 Measurement and Payment

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

Payment at the price specified in the purchasing order shall be full compensation for the supply of the spun concrete poles 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.

Appendix 2421-A, November 2021
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:

- Dimensions and class of poles. (2421.07.01)

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

Related Ontario Provincial Standard Drawings

OPSD 2410.010	Spun Concrete Pole
OPSD 2410.020	18.3 m Spun Concrete Pole for TV Camera Mounting



**MATERIAL SPECIFICATION FOR
HEAVY CLASS STEEL AND
SECTIONAL STEEL POLES, BASE MOUNTED**

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APPENDICES

Appendix 2422-A	Commentary

2422.01	SCOPE

This specification covers the requirements for base mounted galvanized heavy class steel and sectional steel poles 6.0, 7.5, 9.0, and 10.50 metres in height.

2422.01.01 Specification Significance and Use

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

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

2422.01.02

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.

2422.02

REFERENCES

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

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

Ontario Ministry of Transportation Publications

Structural Manual

CSA Standards

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
S6-14	Canadian Highway Bridge Design Code
W59-13	Welded Steel Construction (Metal Arc Welding)

American Association of State Highway and Transportation Officials (AASHTO)

LTS-5-M	Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 5 th Edition, Interim Revisions (2010)

2422.03**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.

Product Drawings means drawings prepared by the manufacturer that have been approved by the Owner for use with the product.

2422.04**DESIGN AND SUBMISSION REQUIREMENTS****2422.04.01****Design Requirements**

All poles shall be designed to support the required traffic signal and lighting system components and shall be according to CSA S6 and MTO Structural Manual. All poles shall be according to CSA S6 and AASHTO LTS-5-M for fatigue requirements, AASHTO Fatigue Importance Category 2.

2422.04.01.01**Wind Loading**

Wind loading shall be based on the maximum wind pressure for Ontario according to CSA S6.

2422.04.01.02**Ice Loading**

Ice loading shall be based on the maximum ice loading for Ontario according to CSA S6.

2422.04.01.03**Geometric Parameters**

Latitude of design and fabrication details is at the discretion of the supplier and is subject to approval of the design by the Owner.

2422.04.01.04**Supported Load Parameters**

Design calculations shall employ force and dimensions for various items of equipment to be mounted on the poles as shown in Table 1.

2422.04.01.05**Heavy Class Steel and Sectional Steel Pole**

Heavy class steel and sectional steel poles used for traffic signal or combination traffic signal and lighting system shall be capable of bearing the loads associated with configurations shown in Table 2.

2422.04.01.06**Location of Equipment**

Mast arms shall be to be solidly attached to the pole at a height above the pole base plate as given by:

$$H_A = 5,650 \text{ mm} - H$$

where: H_A = mast arm height above the pole base plate
 H = mast arm height from Table 1

Where more than one mast arm is considered, the shorter arm shall be attached to the pole at a point 300 mm above that of the longer arm.

Pedestrian heads shall be mounted at a height of 2,750 mm above the pole base plate.

Luminaire brackets shall be mounted at a point 150 mm from the top of the pole.

2422.04.02 Submission Requirements

2422.04.02.01 Product Drawings

The heavy class steel and sectional steel pole manufacturer shall submit the product drawings and the design assumptions and calculations for the poles to the Owner for approval.

As a minimum, the product drawings shall include the following information:

- a) Material properties and standards.
- b) Dimensions.
- c) Hardware requirements.
- d) Plans, elevations, sections, and details to show pole structural details.
- e) Anchor bolt locations.
- f) Welds.
- g) Joining method for heavy class steel poles sections.

The product drawings and calculations shall bear the seals and signatures of the design and checking Engineers.

2422.04.02.02 Working Drawings

Working Drawings shall be prepared for the fabrication of heavy class steel and sectional steel poles.

The Contractor shall submit 3 sets of Working Drawings to the Contract Administrator at least 14 Days prior to the commencement of fabrication of the heavy class steel and sectional steel poles for information purposes only. An Engineer shall affix his or her seal and signature on the Working Drawings verifying that the Working Drawings are consistent with the Contract Documents and sound engineering practices.

Where 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 shall include the following information:

- a) Detailed dimensions.
- b) Plans, elevations, sections, and details to show pole structural details.
- c) Equipment layout.
- d) Anchor bolt locations.
- e) Exact pole weight.
- f) Detailed bill of materials.
- g) Details of equipment nameplates.

A copy of the Working Drawings shall be retained at the fabricator's plant during and after the heavy class steel and sectional steel pole fabrication.

2422.05 MATERIALS

2422.05.01 General

All steel used in the production of poles shall be according to CAN/CSA G40.21, Grade 300WT, for pole shafts, base plates, and gussets.

All galvanized steel shall be according to CSA G164.

All welding shall be according to CSA W59.

2422.07 PRODUCTION

2422.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

All welds, except for fillet welds, shall be ground smooth.

The pole base plate for any height of pole shall be made with mounting holes suitable for the anchor rod or anchorage assembly. The pole base plate shall be reinforced with four welded gussets equally spaced around the pole or with a welded collar or combination of both welded collar and gussets.

The underside of the anchor base shall be true, distortion free, and perpendicular to the centreline of the pole shaft after fabrication.

A waterproof, removable galvanized steel top cap shall be furnished with the pole. The cap shall blend with the general pole design to present a neat overall appearance. The cap shall be rigidly secured to the top of the pole by a hexagonal head stainless steel set screw.

Wiring apertures at the bracket mounting level and at the handhole shall be accurately positioned on the pole. The wiring apertures shall provide a smooth cable entrance.

For lighting applications, a wiring aperture, complete with rubber grommet, shall be provided.

Handholes, complete with covers, shall be reinforced with a steel handhole frame of such strength and cross-section that the strength of the pole is not reduced.

2422.07.02 Heavy Class Steel Poles

The poles, as specified in the Contract Documents, shall be round or octagonal in cross-section and shall taper uniformly inwards from the base for the height of the pole.

Poles shall have one or two longitudinal automatically electrically welded joints from top to bottom.

The maximum permitted number of circumferential (transverse) welded joints shall be as shown in Table 3.

The pole sections shall be joined by an electrical weld before galvanizing.

Sweep shall not exceed 3.2 mm per 4.57 m, and the overall sweep shall not be greater than:

$$(\text{Pole height (m)} / 4.57 \text{ m}) \times 3.2 \text{ mm}$$

In all cases, the base shall telescope the butt end of the pole and be secured with one continuous weld on the inside of the base at the end of the pole and another continuous weld on the outside at the top of the base. All welding at base shall be made in such a manner as to ensure that the welded connection shall develop the same strength of the adjacent pole section to resist any bending action.

2422.07.03 Heavy Class Sectional Steel Poles

The pole sections shall be of round tapered construction so that a number of sections may be assembled by means of an overlapping press fit to form a tapered steel pole of the height specified in the Contract Documents.

Each section shall have one longitudinal automatically electrically welded joint from top to bottom.

Each section shall be stencilled with O-L (nominal overlap requirement) and graduations in one-inch increments.

2422.07.04 Ground Bar

A ground bar with a bronze ground connector suitable for No. 6 AWG wire shall be welded to the inside of each pole. The bronze ground connector shall be attached to the ground bar before shipment.

2422.07.05 Marking

Each pole shall have identification marking located approximately 300 mm above the top of the handhole showing the following:

- a) Manufacturer's name or trade mark.
- b) Height of pole.
- c) Gauge of steel.
- d) Bolt circle diameter.
- e) Designation OPSS 2422.
- f) Date of manufacture (i.e., yyyy-mm-dd).

This marking shall be on a corrosion-resistant metal plate securely attached to the surface of the pole.

2422.07.06 Packaging and Shipping

Each pole shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity.

The Contractor shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2422.08 QUALITY ASSURANCE

2422.08.01 Inspection

All work is subject to an inspection by the Owner's representative prior to shipment.

The supplier shall notify the Owner of the date that the fabrication of the poles is to commence.

The Owner's representative shall have free access to the place of fabrication of the poles for the purpose of inspecting and examining plant records and certificates while work on the poles is being performed; materials used; process of fabrication, including welding and galvanizing; and to make any tests as may be considered necessary.

2422.09 OWNER PURCHASE OF MATERIAL

2422.09.01 Working Drawings

Within 30 Days of receipt of a purchasing order to supply heavy class steel and sectional steel poles, the supplier shall submit 4 copies of pole Working Drawings, as described in the Submission Requirements subsection, to the Owner, for approval.

Working Drawings shall be given final approval by the Owner, if found to be acceptable, or shall be marked with deficiencies, if unacceptable.

Unacceptable drawings shall be returned to the supplier for correction. The supplier shall resubmit 4 copies of corrected Working Drawings within 14 Days. When the resubmitted drawings are acceptable to the Owner, they shall be given final approval.

One copy of the final approved drawings shall be returned to the supplier along with written notification to commence fabrication. Within 14 Days of receipt of the notification to commence fabrication, the supplier shall submit 4 copies of all final approved Working Drawings to the Owner.

Fabrication of the equipment shall not commence until the supplier has received final approved Working Drawings and written notification to commence fabrication from the Owner. All fabrication shall conform to the dimensions indicated on the final approved Working Drawings.

The supplier shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2422.09.02 Measurement and Payment

For measurement purposes, a count shall be made of the number of heavy class steel and sectional steel poles supplied and accepted.

Payment at the price specified in the purchasing order shall be for the supply of the heavy class steel and sectional steel poles 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
Supported Load Parameters

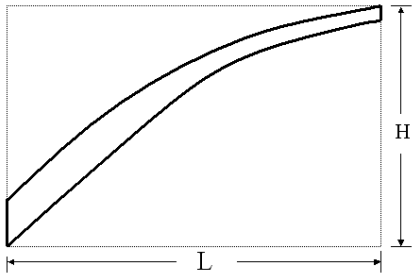
Item of Equipment	Dimensions mm	Projected Area m ²	Weight N
Roadway Lighting Luminaire (Ovuloid)	990 L x 380 H	0.22	107
Roadway Lighting Bracket (Aluminum)	2400 L x 1200 H (tapered)	0.15	112
Double Arm Brackets (Aluminum)	400 L x 42 Dia. (2 per set)	0.04	24
Mast Arm (Aluminum) 	610 L x 250 H (tapered)	0.04	78
	1200 L x 530 H (tapered)	0.10	91
	1800 L x 610 H (tapered)	0.15	114
	2400 L x 840 H (tapered)	0.19	65
	3000 L x 610 H (tapered)	0.23	94
	3600 L x 840 H (tapered)	0.38	113
	4600 L x 1070 H (tapered)	0.47	216
	5500 L x 910 H (tapered)	0.70	324
	6100 L x 1070 H (tapered)	0.79	307
	6700 L x 1150 H (tapered)	0.85	354
	7600 L x 1140 H (tapered)	1.10	504
Traffic Signal Heads (Aluminum: 4-Section)	1650 H x 610 W	1.01	123
Pedestrian Heads (Aluminum: 2-Section)	690 H x 345 W	0.23	78
Traffic Signs	Varies: see Table 2	1.50	23

TABLE 2
Heavy Class Steel and Sectional Steel Pole Configurations

Pole Height m	Luminaire and Bracket set	Longest Mast Arm with Head m	Maximum Mast Arm Total Length (Note 1) m	Number of Pedestrian Heads (Note 2)	Traffic Signs (Note 3) m ²
10.5	1	7.6	13.1	2	0.75
9.0	1	7.6	13.1	2	0.75
7.5	1	7.6	13.1	2	0.75
6.0	0	7.6	13.1	2	0.75
Notes: 1. Mast arm total length applies to the sum of the lengths of two mast arms at 90-degree orientation. 2. Two pedestrian heads at 90-degree orientation include a set of double arm brackets for each. 3. Traffic signs shall be split to give 0.25 m ² mounted on the mast arm beside the signal head and 0.5 m ² mounted at 2.75 m height above the pole base plate.					

TABLE 3
Circumferential Welded Joints

Pole Height m	Maximum Number of Welds
6.0	1
7.5	1
9.0	1
10.5	2

Appendix 2422-A: November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.



MATERIAL SPECIFICATION FOR STEEL POLES, BASE MOUNTED

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2423.01	SCOPE
2423.02	REFERENCES
2423.03	DEFINITIONS - Not Used
2423.04	DESIGN AND SUBMISSION REQUIREMENTS
2423.05	MATERIALS
2423.06	EQUIPMENT - Not Used
2423.07	PRODUCTION
2423.08	QUALITY ASSURANCE
2423.09	OWNER PURCHASE OF MATERIAL

APPENDICES

2423-A	Commentary

2423.01 SCOPE

This specification covers the requirements for base mounted galvanized steel poles maximum 15.1 m in length.

2423.01.01 Specification Significance and Use

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

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

2423.01.02

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.

2423.02

REFERENCES

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

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

Ontario Ministry of Transportation Publication

Structural Manual

CSA Standards

G40.20-13/G40.21-13	General Requirements for Rolled or Welded Structural Quality Steels/Structural Quality Steel
S6-14	Canadian Highway Bridge Design Code
W59-13	Welded Steel Construction (Metal Arc Welding)

American Association of State Highway and Transportation Officials (AASHTO)

LTS-5-M	Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 5 th Edition, Interim Revisions (2010)

ASTM International

A123/A123M-15	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

2423.04 DESIGN AND SUBMISSION REQUIREMENTS

2423.04.01 Design Requirements

All poles shall be designed to support the required traffic signal and lighting system components and shall be according to CSA S6 and MTO Structural Manual. All poles shall be according to CSA S6 and AASHTO LTS-5-M for fatigue requirements, AASHTO Fatigue Importance Category 2.

2423.04.01.01 Wind Loading

Wind loading shall be based on the maximum wind pressure for Ontario according to CSA S6.

2423.04.01.02 Ice Loading

Ice loading shall be based on the maximum ice loading in Ontario according to CSA S6.

2423.04.01.03 Supported Load Parameters

Design calculations shall employ force and dimensions for various items of equipment to be mounted on the poles as shown in Table 2 and 3.

2423.04.02 Submission Requirements

2423.04.02.01 Working Drawings

Working Drawings shall be prepared for the fabrication of steel poles.

The Contractor shall submit 3 sets of Working Drawings to the Contract Administrator at least 14 Days prior to commencement of fabrication of the steel poles, for information purposes only. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

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

As a minimum, the Working Drawings shall include the following information:

- a) Detailed dimensions.
- b) Plans, elevations, sections, and details to show pole structural details.
- c) Equipment layout.
- d) Anchor bolt locations.
- e) Exact pole weight.
- f) Detailed bill of materials.
- g) Details of equipment nameplates.

A copy of the Working Drawings shall be retained for 7 years.

2423.05 MATERIALS

2423.05.01 General

All steel used in the production of poles shall be according to CSA G40.21, grade 300W, for pole shafts, and grade 300WT, for base plates.

All steel shall be galvanized according to ASTM A 123.

2423.07 PRODUCTION

2423.07.01 General

The length of poles shall be as specified in the Contract Documents.

Shafts shall be round or octagonal in cross-section as specified in the Contract Documents and taper uniformly inwards from the base for the length of the pole.

Shafts shall have one or two longitudinal automatically electrically welded joints from top to bottom.

All welding shall be according to CSA W59.

All welds, except for fillet welds, shall be ground smooth.

The maximum permitted number of circumferential welded joints shall be as shown in Table 1.

The pole sections shall be joined by an electrical weld.

After fabrication, poles shall be galvanized.

Sweep shall not exceed 3.2 mm per 4.57 m, and the overall sweep shall not be greater than:

$(\text{Pole length (m)} / 4.57 \text{ m}) \times 3.2 \text{ mm}$

The pole shall be supplied with a one-piece fabricated rolled steel base plate.

The base shall telescope the butt end of the shaft and be secured with one continuous weld on the inside of the base at the end of the shaft and another continuous weld on the outside at the top of the base. All welding at the base shall be made in such a manner that the welded connection develops the same strength of the adjacent shaft section to resist any bending action.

After fabrication, the underside of the base plate shall be true, distortion free, and perpendicular to the centreline of the pole shaft.

A removable galvanized steel or aluminum top cap shall be supplied with the shaft. The cap shall blend with the general pole design to present an overall neat appearance. The cap shall be secured rigidly to the shaft by a hexagonal head stainless steel set screw.

Wiring apertures at the bracket mounting level and at the handhole shall be accurately positioned on the pole. Wiring apertures, complete with neoprene grommets, shall provide a smooth cable entrance.

Handholes shall be complete with covers and shall be reinforced with a steel handhole frame of such strength and cross section that the strength of the shaft is not reduced.

2423.07.02 Mounting Plate for Grounding

The mounting plate for the grounding post shall be welded to the shaft in such a manner as to present a smooth surface on the exterior of the shaft.

A mounting plate with a bronze split-bolt type ground connector suitable for 2 No. 6 AWG wires shall be welded to the inside of each pole. The bronze ground connector shall be attached to the mounting plate prior to shipment.

2423.07.03 Marking

Each pole shall have the following identification markings located approximately 100 mm above the top of the handhole:

- a) Manufacturer's name or trade mark.
- b) Length.
- c) Gauge of steel.
- d) Bolt circle diameter.
- e) Designation OPSS 2423.
- f) Date of manufacture (i.e., yyyy-mm-dd).

These markings shall be on a corrosion-resistant metal plate securely attached to the surface of the pole.

2423.07.04 Packaging and Shipping

Each pole shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity.

The grounding connector shall be assembled inside the pole prior to shipment.

The Contractor shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2423.08 QUALITY ASSURANCE

2423.08.01 Inspection

All work is subject to an inspection by the Owner's representative prior to shipment.

The Owner shall be notified a minimum of 1 Business Day in advance of the date that the fabrication of the poles is to commence.

The Owner's representative shall have free access to the place of fabrication for the purpose of inspecting and examining plant records; certificates; materials used; fabrication process, including welding and galvanizing; and to make any tests as may be considered necessary, while the poles are being fabricated.

2423.09 OWNER PURCHASE OF MATERIAL

2423.09.01 Working Drawings and Shipment

Within 30 Days of receipt of a purchasing order to supply steel poles, the supplier shall submit 3 copies of Working Drawings, as described in the Submission Requirements subsection, to the Owner.

The supplier shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2423.09.02 Measurement and Payment

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

Payment at the price specified in the purchasing order shall be for the supply of the steel poles 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.

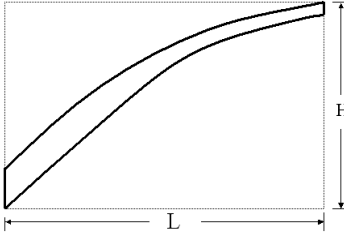
TABLE 1
Circumferential Welded Joints

Pole Length m	Maximum Number of Welds
6.0	1
7.5	1
9.0	1
10.5	2
12.0	2
13.6	2
15.1	3

TABLE 2
Lighting Poles

Item of Equipment	Dimensions mm	Projected Area m²	Weight N
Roadway Lighting Luminaire	990 L x 380 H	0.22	107
Roadway Lighting Bracket (Aluminum)	1800 L x 909 H	0.15	112
	2400 L x 1200 H	0.15	112
Bracket (Steel)	1965 L x 837 H	0.12	378
	2865 L x 990 H	0.15	556
Notes: 1. Each pole shall accommodate two brackets at 90-degree orientation. L = Total Length H = Total Height			

TABLE 3
Joint Use Poles (Lighting and Signals)

Item of Equipment	Dimensions mm	Projected Area m ²	Weight N
Roadway Lighting Luminaire	990 L x 380 H	0.22	107
Roadway Lighting Bracket (Aluminum)	2400 L x 1200 H (tapered)	0.15	112
Double Arm Brackets (Aluminum)	400 L x 42 Dia. (2 per set)	0.04	24
Mast Arm (Aluminum) 	610 L x 250 H (tapered)	0.04	78
	1200 L x 530 H (tapered)	0.10	91
	1800 L x 610 H (tapered)	0.15	114
	2400 L x 840 H (tapered)	0.19	65
	3000 L x 610 H (tapered)	0.23	94
	3600 L x 840 H (tapered)	0.38	113
	4600 L x 1070 H (tapered)	0.47	216
	5500 L x 910 H (tapered)	0.70	324
Traffic Signal Heads (Aluminum: 4-Section)	1650 H x 610 W	1.01	123
Pedestrian Heads (Aluminum: 2-Section)	690 H x 345 W	0.23	78
Traffic Signs	Varies	1.50 (Note 1)	23
Street Name Sign	Varies	0.97 (Note 2)	54
Notes: 1. Traffic signs shall be split to give 0.25 m ² mounted on the mast arm beside the signal head and 0.5 m ² mounted at 2.75 m height above the pole base plate. 2. Street name or roadway identification sign shall have a maximum height of 0.45 m and a maximum size of 0.97 m ² . The sign shall be mounted on each mast arm or pole and the distance between the centre of the sign and the surface of the pole shall not exceed half the length (L) of the mast arm. Pole mounted street name signs shall be mounted at the same height as the mast arm mounted signs or at the top of the pole, whichever is less.			

Appendix 2423-A, April 2017
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Steel pole lengths and round or octagonal shafts. (2423.07.01)

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

Related Ontario Provincial Standard Drawings

OPSD 2415.011	Steel Pole, Base Mounted
OPSD 2416.011	Steel Pole, Concrete Barrier Base Mounted



MATERIAL SPECIFICATION FOR STEEL TRUSS BRACKETS

TABLE OF CONTENTS

2426.01	SCOPE
2426.02	REFERENCES
2426.03	DEFINITIONS - Not Used
2426.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
2426.05	MATERIALS
2426.06	EQUIPMENT - Not Used
2426.07	PRODUCTION
2426.08	QUALITY ASSURANCE
2426.09	OWNER PURCHASE OF MATERIAL

APPENDICES

2426-A	Commentary

2426.01 SCOPE

This specification covers the requirements for steel truss brackets for use with spun concrete poles and metal poles and associated hardware.

2426.01.01 Specification Significance and Use

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

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

2426.01.02 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.

2426.02 REFERENCES

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

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

CSA Standards

G40.21-13	Structural Quality Steels
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
W59-13	Welded Steel Construction (Metal Arc Welding)

ASTM International

A 53/A 53M-12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

2426.05 MATERIALS

2426.05.01 Brackets

Brackets shall be fabricated from Schedule 40 steel pipe and according to ASTM A 53, Grade B.

2426.05.02 Steel Bracket Clamp Plates

Steel shall be according to CSA G40.21, Grade 38WT.

2426.07 PRODUCTION

2426.07.01 General

Steel truss brackets shall be fabricated according to the Contract Documents.

All welding shall be continuous and according to CSA W59.

When fabricating the steel truss bracket, the manufacturer shall make provision between members to ensure good internal flow and adequate drainage during the process of hot dip galvanizing the assembled steel truss bracket. Hot dip galvanizing shall be according to CAN/CSA G164.

Galvanized steel bracket mounting plates shall be supplied complete with stainless steel hardware and two fabricated galvanized steel bracket clamp plates according to the Contract Documents.

A galvanized steel or aluminum end cap shall be fastened on the end of the lower member.

2426.07.02 Marking

Each steel truss bracket shall have identification markings in a visible location indicating the following:

- a) Manufacturer's name or trademark.
- b) Bracket length.
- c) Date of manufacture.
- d) Designation OPSS 2426.

Identification markings shall be embossed on the steel truss bracket or on a corrosion-resistant metal plate securely attached to the steel truss bracket.

2426.07.03 Packaging and Shipment

Each steel truss bracket shall be shipped complete with mounting hardware, suitably packaged to ensure that all parts are delivered as a complete unit. A complete parts list shall be included in the shipment.

2426.08 QUALITY ASSURANCE

2426.08.01 Inspection

All steel truss brackets are subject to an inspection by the Contract Administrator prior to shipment.

2426.09**OWNER PURCHASE OF MATERIAL****2426.09.01****Packaging and Shipment**

When required by the Owner, the supplier shall provide 4 copies of the following information:

- a) Detailed dimensions.
- b) Plans, elevations, sections, and details to show steel truss bracket structural details.
- c) Exact weight.
- d) Detailed bill of materials.
- e) Details of equipment nameplates.

If the supplier has previously submitted this information and the Owner has previously approved it, only the reference to the original submission is required.

Each steel truss bracket shall be shipped complete with hardware.

Bracket clamp plates shall be suitably packaged and identified with the type of pole, the length of pole, and cross section of pole for which the clamp plates have been fabricated.

The supplier is responsible for loading, delivery, and off-loading of steel truss brackets to designated areas. Steel truss brackets shall be subject to inspection during and on completion of off-loading. If any damage to the steel truss bracket is encountered during the inspection, the supplier shall be responsible for the necessary corrective measures 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 to confirm that arrangements for off-loading have been made.

2426.09.02**Measurement and Payment**

For measurement purposes, a count shall be made of the number of steel truss brackets complete with mounting hardware delivered and accepted.

Payment at the price specified in the purchasing order shall be for the supply of steel truss brackets delivered to the destination at 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 2426-A, November 2017
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

For Owner purchase of material, the following technical information should be given to the supplier in the purchasing order:

- a) Length of brackets.
- b) Single or double bracket mounting.

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 2225.010	Concrete Lighting Pole, Direct Buried
OPSD 2228.010	Metal Lighting Pole, Base Mounted
OPSD 2418.010	1.8 m and 2.7 m Steel Truss Bracket for Steel Poles



MATERIAL SPECIFICATION FOR ALUMINUM TAPERED ELLIPTICAL BRACKETS

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2428.01	SCOPE
2428.02	REFERENCES
2428.03	DEFINITIONS - Not Used
2428.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
2428.05	MATERIALS
2428.06	EQUIPMENT - Not Used
2428.07	PRODUCTION
2428.08	QUALITY ASSURANCE
2428.09	OWNER PURCHASE OF MATERIAL

APPENDICES

2428-A	Commentary

2428.01 SCOPE

This specification covers the requirements for aluminum tapered elliptical brackets and associated hardware.

2428.01.01 Specification Significance and Use

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

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

2428.01.02 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.

2428.02 REFERENCES

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

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

CSA Standards

W59.2-M1991 (R2013) Welded Aluminum Construction

ASTM International

B 221-14 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

2428.05 MATERIALS

2428.05.01 Aluminum Alloy

Aluminum alloy shall be according to ASTM B 221, Type 6063-T6.

2428.07 PRODUCTION

2428.07.01 General

All welding shall be continuous and according to CSA W59.2.

Brackets shall be fabricated according to the Contract Documents.

2428.07.02 Marking

A permanent label shall be attached to the tapered elliptical bracket in a visible location indicating the following:

- a) Manufacturer's name or trademark.
- b) Bracket length.
- c) Date of manufacture.
- d) Designation OPSS 2428.

2428.07.03 Packaging and Shipment

Each tapered elliptical bracket shall be shipped complete with mounting hardware, suitably packaged to ensure that all parts are delivered as a complete unit. A complete parts list shall be included in the shipment.

2428.08 QUALITY ASSURANCE

2428.08.01 Inspection

All tapered elliptical brackets may be subject to an inspection by the Contract Administrator prior to shipment.

2428.09 OWNER PURCHASE OF MATERIAL

2428.09.01 Packaging and Shipment

When required by the Owner, the supplier shall provide 4 copies of the following information:

- a) Detailed dimensions.
- b) Plans, elevations, sections, and details to show tapered elliptical bracket structural details.
- c) Exact weight.
- d) Detail bill of materials.
- e) Details of equipment nameplates.

If the supplier has previously submitted this information and the Owner has previously approved it, only the reference to the original submission is required.

Each aluminum tapered elliptical bracket shall be shipped complete with hardware.

The supplier is responsible for loading, delivery, and off-loading of tapered elliptical brackets to designated areas. Tapered elliptical brackets shall be subject to inspection during and on completion of off-loading. If any damage to the tapered elliptical brackets is discovered during the inspection, the supplier shall be responsible for the necessary corrective measures 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 to confirm that arrangements for off-loading have been made.

2428.09.02**Measurement and Payment**

For measurement purposes, a count shall be made of the number of aluminum tapered elliptical brackets complete with mounting hardware delivered and accepted.

Payment at the price specified in the purchasing order shall be for the supply of aluminum tapered elliptical brackets delivered to the destination at 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 2428-A, November 2017
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

For Owner purchase of material, the length of bracket should be given to the supplier in the purchasing order.

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 2225.010	Concrete Lighting Pole, Direct Buried
OPSD 2228.010	Metal Lighting Pole, Base Mounted
OPSD 2232.010	Sectional Steel Pole with Brackets, Luminaire, and Traffic Signal Head
OPSD 2240.010	Wooden Pole with Elliptical Bracket, Overhead and Underground Circuits
OPSD 2250.010	Aluminum Tapered Elliptical Brackets on Metal and Concrete Poles, Mounting Details
OPSD 2420.010	1.8 m and 2.4 m Aluminum Tapered Elliptical Bracket



Note: The MUNI implemented in November 2017 replaces OPSS 2432 COMMON, November 2015 with no technical content changes.

MATERIAL SPECIFICATION FOR HIGH PRESSURE SODIUM LUMINAIRES FOR HIGHWAY LIGHTING

TABLE OF CONTENTS

2432.01	SCOPE
2432.02	REFERENCES
2432.03	DEFINITIONS - Not Used
2432.04	DESIGN AND SUBMISSION REQUIREMENTS
2432.05	MATERIALS
2432.06	EQUIPMENT - Not Used
2432.07	PRODUCTION
2432.08	QUALITY ASSURANCE
2432.09	OWNER PURCHASE OF MATERIAL

APPENDICES

2432-A	Commentary

2432.01 SCOPE

This specification covers the requirements for highway lighting luminaires with integral ballasts for use in conventional and high mast lighting.

2432.01.01 Specification Significance and Use

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

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

2432.01.02 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.

2432.02 REFERENCES

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

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

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

CSA Standards

C22.2 No. 9.0-96 (R2011)	General Requirements for Luminaires
C653-13	Photometric Performance of Roadway and Street Lighting Luminaires
C811-13	Performance of Highmast Luminaires for Roadway Lighting
C863-11	Energy Efficiency of High-Intensity Discharge (HID) and Low-Pressure Sodium (LPS) Lamp Ballasts

2432.04 DESIGN AND SUBMISSION REQUIREMENTS

2432.04.01 Design Requirements

2432.04.01.01 Photometric Requirements

As a minimum, the photometric performance of the luminaires for conventional lighting shall be according to CSA C653.

As a minimum, the photometric performance of the luminaires for high mast lighting shall be according to CSA C811.

Photometric test results shall be provided for the luminaires supplied and shall include the following data:

- a) Isolux curves and mounting height correction factors.
- b) Utilization charts or graphs.
- c) Candlepower distribution curves indicating peak intensity.
- d) Luminous intensity tables to Illuminating Engineering Society format (I-tables).
- e) Luminaire efficiency values.
- f) Luminous outputs above and below horizontal.
- g) Lamp lumen outputs and wattages.

2432.04.01.02 Electrical Requirements

All electrical components and assembled luminaires shall be according to CSA C22.2 No. 9.0.

Ballasts, lamp sockets, ground connectors, internal wiring, and all other components shall be suitable for the supply voltage as specified in the Contract Documents and the maximum temperature encountered in totally enclosed outdoor weatherproof luminaires.

Ballasts shall be constant wattage auto-transformer or isolated secondary transformer type for grounded systems. Auto-transformer type ballasts shall have a maximum tolerance of 12% variation in lamp wattage for a 5% variation in line voltage. Isolated secondary transformer type ballasts shall have a maximum tolerance of 12% variation in lamp wattage for a 10% variation in line voltage.

Ballasts shall be Class H, 180 °C insulation; 60 hertz; and low temperature, -35 °C with a power factor not less than 0.90.

The minimum nominal secondary open circuit voltage of the ballast for various lamps shall be sufficient to provide reliable starting at -35 °C.

Ballasts shall be suitable for the lamp's nominal operating voltage. Terminal blocks shall be held rigidly and shall provide a positive connection for terminating the field wiring.

The current crest factor of the ballast shall not exceed 1.8 for high pressure sodium lamps.

Energy efficiency of lamp ballasts shall be according to CAN/CSA C863.

2432.04.01.03**Mechanical Requirements**

The luminaire shall be comprised of a cast aluminum ballast housing, spun or formed aluminum optical housing with a glass lens or refractor, and stainless steel hardware.

The ballast housing shall form a watertight enclosure for the ballast components that shall be readily interchangeable without removing the luminaire from the mounting bracket. The ballast housing shall be either integral or modular design. If it is of modular design, it shall be attached to the housing using stainless steel hardware.

Mounting arrangements shall consist of a slip fitter assembly for a 50 mm diameter internal pipe size tenon. The slip fitter shall be secured using stainless steel hardware with an independent levelling device. Adjustment of the luminaire in the vertical plane shall be 3 degrees minimum.

The lamp socket shall be a mogul type with a porcelain-enclosed, nickel-plated brass shell rated for 4,000 volts, and spring-loaded centre contact. The lamp holder shall have an electrically insulated lamp stabilizer and shall hold the lamp's outer envelope to precise alignment with suitable means for vibration damping.

The optical assembly shall consist of a precision formed specular aluminum reflector with an anodized finish and accurately positioned within the luminaire outer housing. The assembly shall be sealed at the top by a high temperature neoprene or silicone rubber gasket between the ballast casting and reflector and at the bottom by a hinged door assembly.

Alternatively, the optical assembly shall consist of a pressed borosilicate glass reflector and refractor of open ventilated design. The reflector shall have a smooth non-porous inner surface and be encased within the luminaire outer housing. The refractor shall be attached to the reflector using stainless steel hardware. The reflector or refractor assembly shall be readily removable without removing the luminaire from the mounting bracket.

The door assembly shall consist of a gasketed doorframe and a clear tempered shock-resistant glass lens and shall be attached to the reflector housing using stainless steel toggle latches, one of which shall be hinged.

2432.04.02**Submission Requirements****2432.04.02.01****Working Drawings**

Three copies of Working Drawings shall be submitted to the Contract Administrator a minimum of 14 Days prior to the commencement of fabrication.

As a minimum, the Working Drawings shall include the following information:

- a) All mechanical details, including dimensions, layouts, weights, and mounting arrangements for components.
- b) All electrical details, including wiring diagrams and component ratings.
- c) All photometric information regarding the luminaires, including, but not limited to lamp position and photometric data sheets.
- d) Shield details.
- e) Certification by an Engineer that the luminaires for conventional lighting comply with CSA C653.
- f) Certification by an Engineer that the luminaires for high mast lighting comply with CSA C811.

Each Working Drawing shall be sealed and stamped by an Engineer certifying that the Working Drawings comply with the Contract Documents.

One copy of the final accepted Working Drawings shall be returned to the supplier, along with written notification to commence fabrication. Within 14 Days of receipt of notification to commence fabrication, the supplier shall submit 3 copies of all final accepted Working Drawings to the Contract Administrator.

Fabrication of the equipment shall not commence until the Working Drawings have been accepted by the Contract Administrator.

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

2432.05 MATERIALS

2432.05.01 Marking

A permanent label shall be attached to the interior of the luminaire indicating the manufacturer's name or trademark, catalogue number, date of manufacture, and the American National Standards Institute (ANSI) or Illuminating Engineering Society (IES) photometric classification and distribution type; the suitable supply voltage and frequency; the lamp type; the lamp wattage; and the nominal operating voltage of the lamp so that it is clearly visible during maintenance operations.

A label including a wiring diagram shall be attached to each ballast showing the ballast schematic wiring diagram and shall be visible during maintenance operations.

For asymmetrical luminaires with adjustable optical systems, a permanent embossed identification mark shall be located on the luminaire that is clearly visible and identifiable as an orientation mark.

2432.07 PRODUCTION

2432.07.01 Ballast Assemblies

Ballast assemblies shall be factory pre-wired with all connections clearly marked and identified.

2432.07.02 Lamp Socket Positions

The lamp socket position shall be pre-set at the factory for the specified distribution.

2432.08 QUALITY ASSURANCE

2432.08.01 Inspection

The supplier shall notify the Owner of the date that the fabrication of the luminaires is to commence.

The Owner's representative shall have free access to the place of fabrication for the purpose of inspecting and examining plant records, certificates, materials used, fabrication process, and to make any tests as may be considered necessary, while the luminaires are being fabricated.

All luminaires are subject to an inspection by the Owner's representative prior to shipment.

2432.09**OWNER PURCHASE OF MATERIAL****2432.09.01****Packaging and Shipment**

The supplier shall provide 3 copies of the luminaire ballast engineering data and shielding data such as material type, gauge thickness, and mounting arrangement to the Owner.

Each luminaire shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity. A complete parts list shall be included in the shipment. All cartons shall be marked with the ANSI or IES luminaire classification and distribution types.

The supplier is responsible for loading, delivery, and off-loading of luminaires to designated areas. Luminaires shall be subject to inspection during and on completion of off-loading. If any damage to the luminaires is encountered during the inspection, the supplier shall be responsible for the necessary corrective measures subject to the approval of the Owner.

The supplier shall advise the Owner 3 Working Days prior to the shipping date of the intent to deliver and confirm that arrangements for off-loading have been made.

2432.09.02**Measurement and Payment**

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

Payment at the price specified in the purchasing order shall be full compensation for the supply and delivery of the luminaires to the destination at 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 2432-A, November 2017
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Supply voltage to the luminaires. (2432.04.01.02)

For Owner purchase of material, the following technical information should be given to the supplier in the purchasing order:

- a) Nominal line voltages.
- b) Lamp wattages.
- c) Lamp types and ANSI designations.
- d) Ballast types.
- e) ANSI or IES luminaire classifications and distribution types.
- f) Photometric curves or test report numbers.
- g) Shielding requirements.

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

Related Ontario Provincial Standard Drawings

OPSD 2418.010	1.8m and 2.7m Steel Truss Bracket For Steel Poles
OPSD 2420.01	1.8m and 2.4m Aluminum Tapered Elliptical Bracket
OPSD 2421.010	Lamp Wattage Label For Luminaire
OPSD 2453.000	High Mast Lighting Pole, Luminaire And Handhole Orientation
OPSD 2453.070	High Mast Lighting Pole, Luminaire Support Ring
OPSD 2453.080	High Mast Lighting Pole, Head Frame And Ring Assembly
OPSD 2453.090	High Mast Lighting Pole, Luminaire Shroud
OPSD 2453.091	High Mast Lighting Pole, Luminaire Shroud Details



MATERIAL SPECIFICATION FOR HIGH PRESSURE SODIUM LUMINAIRES FOR UNDERPASS LIGHTING

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2434-A	Commentary

2434.01 SCOPE

This specification covers the requirements for underpass luminaires with integral ballast for use with 70 to 400 watt high pressure sodium lamps.

2434.01.01 Specification Significance and Use

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

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

2434.01.02 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.

2434.02 REFERENCES

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

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

CSA Standards

C22.2 No. 89-15	Swimming-Pool Luminaires, Submersible Luminaires and Accessories
C863-16	Energy Efficiency of High-Intensity Discharge (HID) and Low-Pressure Sodium (LPS) Lamp Ballasts

American National Standards Institute (ANSI)

C136.31-2010	Roadway and Area Lighting Equipment - Luminaire Vibration

ASTM International

B 117-11	Standard Practice for Operating Salt Spray (Fog) Apparatus
D 1654-08	Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

International Electrotechnical Commission (IEC)

60598 (2014-05)	Luminaires
62262 (2002-02)	Degrees of Protection Provided by Enclosures for Electrical Equipment Against External Mechanical Impacts (IK code)

2434.04 DESIGN AND SUBMISSION REQUIREMENTS

2434.04.01 Design Requirements

2434.04.01.01 Photometric Requirements

Photometric test results shall be provided for the luminaires supplied and shall include the following data:

- a) Isolux curves and mounting height correction factors.
- b) Utilization charts or graphs.
- c) Candlepower distribution curves indicating peak intensity.
- d) Luminous intensity tables to Illuminating Engineering Society format (I-tables).
- e) Luminaire efficiency values.
- f) Luminous outputs above and below horizontal.
- g) Lamp lumen outputs and wattages.

2434.04.01.02 Electrical Requirements

All electrical components and assembled luminaires shall be according to CSA C22.2 No. 89.

Ballasts, lamp sockets, ground connectors, internal wiring, and all other components shall be suitable for the supply voltage as specified in the Contract Documents and the maximum temperature encountered in totally enclosed, outdoor, weatherproof luminaires.

Ballasts shall be constant wattage auto-transformer or isolated secondary transformer type for grounded systems. Auto-transformer type ballasts shall have a maximum tolerance of 12% variation in lamp wattage for a 5% variation in line voltage. Isolated secondary transformer type ballasts shall have a maximum tolerance of 12% variation in lamp wattage for a 10% variation in line voltage.

Ballasts shall be Class H, 180 °C insulation; 60 hertz; and low temperature, -35 °C with a power factor not less than 0.90.

The minimum nominal secondary open circuit voltage of the ballast for various lamps shall be sufficient to provide reliable starting at -35 °C.

Ballasts shall be suitable for the lamp's nominal operating voltage. Terminal blocks shall be held rigidly and shall provide a positive connection for terminating the field wiring.

The current crest factor of the ballast shall not exceed 1.8 for high pressure sodium lamps.

Energy efficiency of lamp ballasts shall be according to CAN/CSA C863.

All wiring within fixture shall have a minimum temperature rating of 125 °C.

2434.04.01.03**Mechanical Requirements**

The luminaire shall be comprised of a polycarbonate, aluminum, or stainless steel enclosure with a specular reflector and a glass prismatic refractor. Enclosure shall meet a scribe creepage rating of 7 according to ASTM D 1654, when tested for 5,000 hours according to ASTM B 117.

The luminaire shall be provided with a 20 mm threaded duct entry in each end of the enclosure and a cable entry hole in the rear of the enclosure together with a suitable waterproof gasket.

The luminaire shall have continuous captive gasket between the door and enclosure and between the refractor and the enclosure to provide a weatherproof seal.

All fixture hardware shall be Type 316 stainless steel and shall be captive. Proper dielectric insulation shall be provided between luminaire housing and fixture hardware of dissimilar metals, to prevent galvanic reaction.

The luminaire shall be provided with a ground terminal or lug for a single conductor #12 AWG stranded copper wire.

All unused cable and duct entry holes shall be plugged with approved filler caps.

The lamp socket shall be a porcelain-enclosed, nickel-plated brass shell rated for 4,000 volts, and spring-loaded centre contact. The lamp holder shall have an electrically insulated lamp stabilizer and shall hold the lamp's outer envelope to precise alignment with suitable means for vibration damping.

The refractor shall be heat-resistant and non-discolouring, with high resistance to breakage from thermal shock. It shall be securely attached to the housing by hinges and a safety device to hold it in the open position.

The reflector shall be fabricated of polished, chemically brightened, anodized aluminum not subject to distortion and shall be readily removable.

The luminaire shall be accessible with tool-less entry.

The luminaire shall not be subject to damage by vibration when closed and in the operating position.

2434.04.01.04**Other Requirements**

Certified test results shall be provided for the luminaires supplied and shall include the following data:

- a) UL/CSA Listing Report according to CSA C22.2 No. 89.
- b) Minimum IP65 Rating according to IEC 60598.
- c) Minimum IK08 Rating according to IEC 62262.
- d) 1.5G Vibration Test Report according to ANSI C136.31.

2434.04.02 Submission Requirements

2434.04.02.01 Working Drawings

Three copies of Working Drawings shall be submitted to the Contract Administrator a minimum of 14 Days prior to the commencement of fabrication.

As a minimum, the Working Drawings shall include the following information:

- a) All mechanical details, including dimensions, layouts, weights, shield details, and mounting arrangements for components.
- b) All electrical details and certified test reports, including wiring diagrams and component ratings.
- c) All photometric information and certified test reports regarding the luminaires, including, but not limited to lamp position, photometric data sheets, and photometric test reports.
- d) Certified Test Reports for UL/CSA listing, IP rating, IK rating, and ANSI C136.31 vibration.

2434.05 MATERIALS

2434.05.01 Marking

A permanent non-corrosive nameplate shall be attached to the exterior of the luminaire and located so that the marking is clearly visible after installation. The nameplate shall indicate the manufacturer's name or trademark, catalogue number, lamp wattage, and nominal voltage.

A permanent label shall be attached to the interior of the luminaire indicating the manufacturer's name or trademark, catalogue number, date of manufacture, and the American National Standards Institute (ANSI) or Illuminating Engineering Society (IES) photometric classification and distribution type; the suitable supply voltage and frequency; the lamp type; the lamp wattage; and the nominal operating voltage of the lamp so that it is clearly visible during maintenance operations.

A label including a wiring diagram shall be attached to each ballast showing the ballast schematic wiring diagram and shall be visible during maintenance operations.

For asymmetrical luminaires with adjustable optical systems, a permanent embossed identification mark shall be located on the luminaire that is clearly visible and identifiable as an orientation mark.

2434.07 PRODUCTION

2434.07.01 Ballast Assemblies

Ballast assemblies shall be factory pre-wired with all connections clearly marked and identified.

2434.07.02 Lamp Socket Positions

The lamp socket position shall be pre-set and legibly marked at the factory for the specified distribution.

2434.08 QUALITY ASSURANCE

2434.08.01 Inspection

The supplier shall notify the Owner of the date that the fabrication of the luminaires is to commence.

The Owner's representative shall have access to the place of fabrication for the purpose of inspecting and examining plant records, certificates, materials used, fabrication process, and to make any tests as may be considered necessary, while the work is being performed.

All luminaires are subject to an inspection by the Owner's representative prior to shipment.

2434.09 OWNER PURCHASE OF MATERIAL

2434.09.01 Packaging and Shipment

The supplier shall provide 3 copies of the luminaire ballast engineering data and shielding data such as material type, gauge thickness, and mounting arrangement to the Owner.

Each luminaire shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity. A complete parts list shall be included in the shipment. All cartons shall be marked with the ANSI or IES luminaire classification and distribution types.

The supplier is responsible for loading, delivery, and off-loading of luminaires to designated areas. Luminaires shall be subject to inspection during and on completion of off-loading. If any damage to the luminaires is encountered during the inspection, the supplier shall be responsible for the necessary corrective measures subject to the approval of the Owner.

The supplier shall advise the Owner 3 Working Days prior to the shipping date of the intent to deliver and confirm that arrangements for off-loading have been made.

2434.09.02 Measurement and Payment

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

Payment at the price specified in the purchasing order shall be full compensation for the supply and delivery of the underpass lighting luminaires to the destination at 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 2434-A, November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Supply voltage to the luminaires. (2434.04.01.02)

For Owner purchase of material, the following technical information should be given to the supplier in the purchasing order:

- a) Nominal line voltages.
- b) Lamp wattages.
- c) Lamp types and ANSI designations.
- d) Ballast types.
- e) ANSI or IES luminaire classifications and distribution types.
- f) Photometric curves or test report numbers.
- g) Shielding requirements.

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

Related Ontario Provincial Standard Drawings

OPSD 2305.020	Underpass Luminaires, Wall Mounted Installation
OPSD 2310.010	Underpass Luminaire, Ceiling Mounted Installation With T Bracket
OPSD 2310.020	T Bracket For Ceiling Mounted Underpass Luminaire
OPSD 2310.030	Wedge Mounting Bracket For Underpass Luminaire
OPSD 2310.040	Support Bracket For Column Mounted Underpass Luminaire
OPSD 2315.010	Underpass Luminaire, Wiring Detail



MATERIAL SPECIFICATION FOR ALUMINUM POLES, BASE MOUNTED

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2452-A	Commentary

2452.01 SCOPE

This specification covers the requirements for base mounted aluminum poles maximum 15.1 m in length with cast shoe bases.

2452.01.01 Specification Significance and Use

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

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

2452.01.02 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.

2452.02 REFERENCES

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

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

CSA Standards

S6-19	Canadian Highway Bridge Design Code
W47.2-11 (R2015)	Certification of Companies for Fusion Welding of Aluminum

Ontario Ministry of Transportation Publication

Structural Manual

American Association of State Highway and Transportation Officials (AASHTO)

LTS-5-M	Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 5 th Edition, Interim Revisions (2010)

ASTM International

B108/B108M-19	Aluminum-Alloy Permanent Mold Castings
B221-14	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes

2452.04 DESIGN AND SUBMISSION REQUIREMENTS

2452.04.01 Design Requirements

All poles shall be designed to support the required traffic signal and lighting system components and shall be according to CSA S6 and MTO Structural Manual. All poles shall be according to CSA S6 and AASHTO LTS-5-M for fatigue requirements, AASHTO Fatigue Importance Category 2.

2452.04.01.01 Wind Loading

Wind loading shall be based on the maximum wind pressure for Ontario according to CSA S6.

2452.04.01.02 Ice Loading

Ice loading shall be based on the maximum ice loading in Ontario according to CSA S6.

2452.04.01.03 Supported Load Parameters

Design calculations shall employ force and dimensions for various items of equipment to be mounted on the poles as shown in Table 1 and 2.

2452.04.02 Submission Requirements

2452.04.02.01 Working Drawings

Working Drawings shall be prepared for the fabrication of aluminum poles.

The Contractor shall submit 3 sets of Working Drawings to the Contract Administrator at least 14 Days prior to commencement of fabrication of the aluminum poles, for information purposes only. Prior to making a submission, the Contractor shall ensure the seals and signatures of a design Engineer and a design-checking Engineer are affixed on the Working Drawings.

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

As a minimum, the Working Drawings shall include the following information:

- a) Detailed dimensions.
- b) Plans, elevations, sections, and details to show pole structural details.
- c) Equipment layout.
- d) Anchor bolt locations.
- e) Exact pole weight.
- f) Detailed bill of materials.
- g) Details of equipment nameplates.

A copy of the Working Drawings shall be retained for 7 years.

2452.05 MATERIALS

2452.05.01 General

Aluminum used in the production of pole shafts shall be according to ASTM B221, alloy 6063-T4.

Aluminum used in the production of base castings shall be according to ASTM B108, alloy A 356.0-T6.

2452.07 PRODUCTION

2452.07.01 General

The length of the poles shall be as specified in the Contract Documents.

The completed pole assembly shall be tempered to T6 condition and have a minimum yield strength of 165 MPa and a minimum ultimate tensile strength of 193 MPa.

Shafts shall be round in cross-section and taper from bottom to top.

Shafts shall be fabricated from a single tube with a wall thickness suitable to meet the supported load parameters.

Welded joints shall not be permitted for shafts.

Sweep shall not exceed 3.2 mm per 4.57 m, and the overall sweep shall not be greater than:

$(\text{Pole length (m)} / 4.57 \text{ m}) \times 3.2 \text{ mm}$

The pole shall be supplied with a one-piece cast shoe base complete with 8 gussets and a factory installed dampener for poles over 9.0 m in length.

After fabrication, the underside of the cast shoe base shall be true, distortion free, and perpendicular to the centreline of the pole shaft. When the cast shoe base is in contact with concrete, a cold tar epoxy coating shall be applied to the underside.

A removable aluminum top cap shall be supplied with the shaft. The cap shall be secured rigidly to the shaft by a hexagonal head stainless steel set screw.

Wiring apertures at the bracket mounting level and at the handhole shall be accurately positioned on the pole. Wiring apertures, complete with neoprene grommets, shall provide a smooth cable entrance.

All welding shall be according to CSA W47.2.

The handhole shall be formed by extrusion or other appropriate method and be designed such that the strength and cross-section of the shaft is not reduced.

Handhole covers shall be provided complete with a neoprene gasket, secured with stainless steel fasteners, aluminum back bar, and stainless steel inserts.

The shaft shall be rotary sanded and protective wrapped for shipment.

2452.07.02 Mounting Plate for Grounding

The mounting plate for the grounding post shall be welded to the shaft in such a manner as to present a smooth surface on the exterior of the shaft.

A mounting plate with a bronze split-bolt type ground connector suitable for 2 No. 6 AWG wires shall be welded to the inside of each pole. The bronze ground connector shall be attached to the mounting plate prior to shipment.

2452.07.03 Marking

Each pole shall have the following identification markings located approximately 100 mm above the top of the handhole:

- a) Manufacturer's name or trademark.
- b) Length.
- c) Wall thickness.
- d) Bolt circle diameter.
- e) Designation OPSS 2452.
- f) Date of manufacture (i.e., yyyy-mm-dd).

These markings shall be on an aluminum plate securely attached to the surface of the pole.

2452.07.04 Packaging and Shipping

Each pole shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity.

The grounding connector shall be assembled inside the pole prior to shipment.

The Contractor shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2452.08 QUALITY ASSURANCE

2452.08.01 Inspection

All work is subject to an inspection by the Owner's representative prior to shipment.

The Owner shall be notified of the date that the fabrication of the poles is to commence.

The Owner's representative shall have free access to the place of fabrication for the purpose of inspecting and examining plant records; certificates; materials used; fabrication process, including welding; and to make any tests as may be considered necessary, while the poles are being fabricated.

2452.09 OWNER PURCHASE OF MATERIAL

2452.09.01 Working Drawings and Shipment

Within 30 Days of receipt of a purchasing order to supply the aluminum poles, the supplier shall submit 3 copies of Working Drawings, as described in the Submission Requirement subsection, to the Owner.

The Owner shall be notified of the shipping date 3 Business Days prior to delivery.

2452.09.02 Measurement and Payment

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

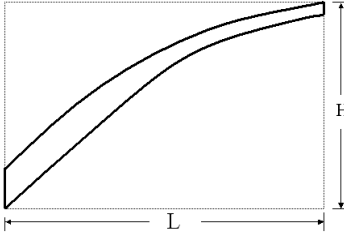
Payment at the price specified in the purchasing order shall be for the supply of aluminum poles delivered to the destination on the date and time specified.

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

TABLE 1
Lighting Poles

Item of Equipment	Dimensions mm	Projected Area m ²	Weight N
Roadway Lighting Luminaire	990 L x 380 H	0.22	107
Roadway Lighting Bracket (Aluminum)	1800 L x 909 H 2400 L x 1200 H	0.15 0.15	112 112
Bracket (Steel)	1965 L x 837 H 2865 L x 990 H	0.12 0.15	378 556
Notes: 1. Each pole shall accommodate two brackets at 90-degree orientation. L = Total Length H = Total Height			

TABLE 2
Joint Use Poles (Lighting and Signals)

Item of Equipment	Dimensions mm	Projected Area m ²	Weight N
Roadway Lighting Luminaire	990 L x 380 H	0.22	107
Roadway Lighting Bracket (Aluminum)	2400 L x 1200 H (tapered)	0.15	112
Double Arm Brackets (Aluminum)	400 L x 42 Dia. (2 per set)	0.04	24
Mast Arm (Aluminum) 	610 L x 250 H (tapered)	0.04	78
	1200 L x 530 H (tapered)	0.10	91
	1800 L x 610 H (tapered)	0.15	114
	2400 L x 840 H (tapered)	0.19	65
	3000 L x 610 H (tapered)	0.23	94
	3600 L x 840 H (tapered)	0.38	113
	4600 L x 1070 H (tapered)	0.47	216
	5500 L x 910 H (tapered)	0.70	324
Traffic Signal Heads (Aluminum: 4-Section)	1650 H x 610 W	1.01	123
Pedestrian Heads (Aluminum: 2-Section)	690 H x 345 W	0.23	78
Traffic Signs	Varies	1.50 (Note 1)	23
Street Name Sign	Varies	0.97 (Note 2)	54
Notes: 1. Traffic signs shall be split to give 0.25 m ² mounted on the mast arm beside the signal head and 0.5 m ² mounted at 2.75 m height above the pole base plate. 2. Street name or roadway identification sign shall have a maximum height of 0.45 m and a maximum size of 0.97 m ² . The sign shall be mounted on each mast arm or pole and the distance between the centre of the sign and the surface of the pole shall not exceed half the length (L) of the mast arm. Pole mounted street name signs shall be mounted at the same height as the mast arm mounted signs or at the top of the pole, whichever is less.			

Appendix 2452-A, November 2021
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:

- Aluminum pole lengths. (2452.07.01)

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

Related Ontario Provincial Standard Drawings

OPSD 2428.010	Frangible Bases
OPSD 2432.010	Aluminum Pole, Base Mounted



MATERIAL SPECIFICATION FOR SECTIONAL STEEL POLES

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2453-A	Commentary

2453.01 SCOPE

This specification covers the requirements for sectional steel poles.

2453.01.01 Specification Significance and Use

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

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

2453.01.02

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.

2453.02

REFERENCES

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

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

Ontario Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 12 - Traffic Signals

Structural Manual

CSA Standards

G40.21-13	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
S6-14	Canadian Highway Bridge Design Code
W59-13	Welded Steel Construction (Metal Arc Welding)

American Association of State Highway and Transportation Officials (AASHTO)

LTS-5-M Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 5th Edition, Interim Revisions (2010)

ASTM International

A 123/A 123M-15 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

2453.03**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.

Product Drawings means drawings prepared by the manufacturer that have been approved by the Owner for use with the product.

2453.04**DESIGN AND SUBMISSION REQUIREMENTS****2453.04.01****Design Requirements**

All poles shall be designed to support the required traffic signal and lighting system components and shall be according to CSA S6 and MTO Structural Manual. All poles shall be according to CSA S6 and AASHTO LTS-5-M for fatigue requirements, AASHTO Fatigue Importance Category 2.

2453.04.01.01**Wind Loading**

Wind loading shall be based on the maximum wind pressure for Ontario according to CSA S6.

2453.04.01.02**Ice Loading**

Ice loading shall be based on the maximum ice loading in Ontario according to CSA S6.

2453.04.01.03**Geometric Parameters**

Latitude of design and fabrication details is at the discretion of the supplier and is subject to approval of the design by the Owner.

2453.04.01.04**Supported Load Parameters**

Design calculations shall employ force and dimensions for various items of equipment to be mounted on the poles as shown in Table 1.

2453.04.01.05**Sectional Steel Poles**

Sectional steel poles used for traffic signal or combination of traffic signal and lighting system shall be base mounted and shall be capable of bearing the loads associated with configurations shown in Table 2.

Direct buried sectional steel poles shall be capable of bearing the loads associated with the equipment shown in Table 3.

Flasher/sign poles shall be capable of bearing the loads associated with the equipment shown in Table 4.

2453.04.01.06 Location of Equipment

Mast arms shall be solidly attached to the pole at a height above the pole base plate as given by:

$$H_A = 5,650 \text{ mm} - H$$

Where:

H_A = mast arm height above the pole base plate

H = mast arm height from Table 1

When more than one mast arm is considered, the shorter arm shall be attached to the pole at a point 300 mm above that of the longer arm.

Pedestrian heads shall be mounted as specified in the Contract Documents.

Luminaire brackets shall be mounted at a point 150 mm from the top of the pole.

2453.04.02 Submission Requirements

2453.04.02.01 Product Drawings

The sectional steel pole manufacturer shall submit the product drawings and the design assumptions and calculations for the poles to the Owner for approval.

As a minimum, the product drawings shall include the following information:

- a) Material properties and standards.
- b) Dimensions.
- c) Hardware requirements.
- d) Plans, elevations, sections, and details to show pole structural details.
- e) Anchor bolt locations.
- f) Welds.
- g) Joining method for sectional steel poles sections.

The product drawings and calculations shall bear the seals and signatures of the design and checking Engineers.

2453.04.02.02 Working Drawings

Working Drawings shall be prepared for the fabrication of sectional steel poles.

The Contractor shall submit 3 sets of Working Drawings to the Contract Administrator at least 14 Days prior to the commencement of fabrication of the sectional steel poles for information purposes only. An Engineer shall affix his or her seal and signature on the Working Drawings verifying that the Working 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 shall include the following information:

- a) Detailed dimensions.
- b) Plans, elevations, sections, and details to show pole structural details.
- c) Equipment layout.
- d) Anchor bolt locations.
- e) Exact pole weight.
- f) Detailed bill of materials.
- g) Details of equipment nameplates.

2453.05 MATERIALS

2453.05.01 General

All steel used in the production of poles shall be according to CAN/CSA G40.21, Grade 300WT, Category 2, for pole shafts, base plates, and gussets.

All welding shall be according to CSA W59.

2453.07 PRODUCTION

2453.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

The pole base plate for any height of pole shall be made with mounting holes suitable for the anchor rod or anchorage assembly.

The underside of the anchor base shall be true, distortion free, and perpendicular to the centreline of the pole shaft after fabrication.

A waterproof, removable galvanized steel top cap shall be furnished with the pole. The cap shall blend with the general pole design to present a neat overall appearance. The cap shall be rigidly secured to the top of the pole by a hexagonal head stainless steel set screw.

Wiring apertures at the bracket mounting level and at the handhole shall be accurately positioned on the pole.

All wiring apertures shall provide a smooth cable entrance and be complete with rubber grommets.

Handholes, complete with covers, shall be reinforced with a steel handhole frame of such strength and cross-section that the strength of the pole is not reduced.

2453.07.01.01 Galvanizing

All components shall be hot dip galvanized according to ASTM A 123.

2453.07.02 Steel Sections

2453.07.02.01 General

The following covers types and lengths of sectional steel poles:

- a) Base mounted: 7.00, 8.70, and 10.50 m
- b) Direct buried: 5.25, 7.00, 8.70, 10.25, and 12.00 m
- c) Flasher/sign: 3.30 m

Pole sections shall be of round tapered construction so that a number of sections may be assembled by means of an overlapping press fit to form a tapered steel pole of the desired length.

Each section shall have one longitudinal automated electrically welded joint from top to bottom.

Each section shall be stencilled with O-L and graduations in one inch increments. O-L represents the nominal overlap requirement for each section.

2453.07.02.02 Base Mounted and Direct Buried Poles, 5.25 m and Longer

For lighting applications, a wiring aperture, complete with 28.5 mm ID rubber grommet shall be drilled 300 mm from the top of the pole.

Each base mounted pole shall be supplied with a reinforced 180 x 300 mm handhole, complete with cover. Each direct buried pole shall be supplied with a reinforced 100 x 200 mm handhole, complete with cover. A 6 x 38 x 250 mm long plate shall be welded inside the pole opposite the handhole. A ground connector shall be mounted on the plate. The ground connector shall be suitable for No. 6 AWG wire.

The centre of the handhole on base mounted poles shall be 1.1 m from the bottom of the pole and on direct buried poles the centre of the handhole shall be 2.75 m from the bottom of the pole.

Base mounted poles shall have a steel plate anchor base with 4 holes on a 449 mm bolt circle, suitable for mounting on 32 mm diameter studs.

Direct buried sectional steel poles shall have 65 x 300 mm wiring apertures on each side of the pole, the centre of the apertures shall be 1.25 m from the bottom of the pole.

2453.07.02.03 Flasher Poles

The flasher pole shall be comprised of two pole sections totalling 2.3 m in length with a 1.2 m length of 50 mm IPS Schedule 40 pipe inserted 230 mm into the top and welded in place to provide a total length of 3.3 m.

The top end of the extension shall be threaded and the thread cleaned after galvanizing.

Each pole shall be supplied with a 75 x 100 mm handhole, complete with cover. The bottom edge of the handhole shall be 150 mm from the bottom of the pole.

A ground terminal shall be provided in the handhole.

The flasher pole shall be supplied with a steel plate anchor base with 4 holes on a 150 mm bolt circle, suitable for mounting on 16 mm diameter studs.

2453.07.03 Marking

Each pole shall have identification marking located approximately 100 mm above the top of the handhole showing the following:

- a) Manufacturer's name or trademark.
- b) Length.
- c) Designation OPSS 2453.
- d) Manufacturer's catalogue number.
- e) Date of manufacture (i.e., yyyy-mm-dd).

This marking shall be on a corrosion-resistant metal plate securely attached to the surface of the pole.

2453.07.04 Ground Bar

A ground bar with a bronze ground connector suitable for No. 6 AWG wire shall be welded to the inside of each pole. The bronze ground connector shall be attached to the ground bar before shipment.

2453.07.05 Packaging and Shipping

Each pole shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity.

The Contractor shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2453.08 QUALITY ASSURANCE

2453.08.01 Inspection

All work is subject to an inspection by the Owner's representative prior to shipment.

The supplier shall notify the Owner of the date that the fabrication of the poles is to commence.

The Owner's representative shall have free access to the place of fabrication of the poles for the purpose of inspecting and examining plant records and certificates while work on the poles is being performed; materials used; process of fabrication, including welding and galvanizing; and to make any tests as may be considered necessary.

2453.09 OWNER PURCHASE OF MATERIAL

2453.09.01 Working Drawings and Shipment

Within 30 Days of receipt of a purchasing order to supply sectional steel poles, the supplier shall submit 3 copies of pole Working Drawings, as described in the Submission Requirements subsection, to the Owner.

The supplier shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2453.09.02**Measurement and Payment**

For measurement purposes, a count shall be made of the number of sectional steel poles supplied and accepted.

Payment at the price specified in the purchasing order shall be for the supply of the sectional steel poles 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
Supported Load Parameters

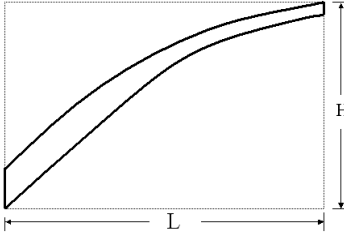
Item of Equipment	Dimensions mm	Projected Area m ²	Weight N
Roadway Lighting Luminaire (Ovuloid)	990 L x 380 H	0.22	107
Roadway Lighting Bracket (Aluminum)	2400 L x 1200 H (tapered)	0.15	112
Double Arm Brackets (Aluminum)	400 L x 42 Dia. (2 per set)	0.04	24
Mast Arm (Aluminum) 	610 L x 250 H (tapered)	0.04	78
	1200 L x 530 H (tapered)	0.10	91
	1800 L x 610 H (tapered)	0.15	114
	2400 L x 840 H (tapered)	0.19	65
	3000 L x 610 H (tapered)	0.23	94
	3600 L x 840 H (tapered)	0.38	113
	4600 L x 1070 H (tapered)	0.47	216
	5500 L x 910 H (tapered)	0.70	324
Traffic Signal Heads (Aluminum: 4-Section)	1650 H x 610 W	1.01	123
Pedestrian Heads (Aluminum: 2-Section)	690 H x 345 W	0.23	78
Traffic Signs	Varies: see Table 2	1.50	23

TABLE 2
Base Mounted Sectional Steel Pole Configurations

Pole Height m	Luminaire and Bracket set	Longest Mast Arm with Head m	Maximum Mast Arm Total Length (Note 1) m	Number of Pedestrian Heads (Note 2)	Traffic Signs (Note 3) m ²	Street Name Sign (Note 4) m ²
7.00	1	5.5	11.0	2	0.75	0.97
8.70	1	5.5	11.0	2	0.75	0.97
10.50	1	5.5	11.0	2	0.75	0.97

Notes:

1. Mast arm total length applies to the sum of the lengths of two mast arms at 90-degree orientation.
2. Two pedestrian heads at 90-degree orientation include a set of double arm brackets for each.
3. Traffic signs shall be split to give 0.25 m² mounted on the mast arm beside the signal head and 0.5 m² mounted at 2.75 m height above the pole base plate.
4. Street name or roadway identification sign shall have a maximum height of 0.45 m and a maximum length of 2.10 m. The sign shall be mounted on each mast arm or pole and the distance between the centre of the sign and the surface of the pole shall not exceed half the length (L) of the mast arm. Pole mounted street name signs shall be mounted at the same height as the mast arm mounted signs or at the top of the pole, whichever is less.

TABLE 3
Direct Buried Sectional Steel Pole Configurations

Pole Height m	Luminaire and Bracket (Note 1) set	Supply Control Cabinet Type 1 (Note 2) each
5.25	2	N/A
5.25	N/A	2
7.00	2	N/A
7.00	N/A	2
8.70	2	N/A
8.70	N/A	2
10.25	2	N/A
10.25	N/A	2
12.00	2	N/A
12.00	N/A	2
Notes: 1. See Table 1. 2. Each supply control cabinet shall have maximum dimensions of 865 mm H x 465 mm W x 250 mm D and a maximum weight of 700 N.		

TABLE 4
Flasher/Sign Pole Configurations

Pole Height m	Beacons (Note 1) each	Traffic Signal Head (3 display sections) (Note 1) each	Traffic Signs m²
3.3	2	N/A	0.5
3.3	N/A	1	0.5
Note: 1. Each beacon or traffic signal display shall be a 300 mm display according to OTM Book 12 and the total weight of the beacons or the three section traffic signal head shall be a maximum of 200 N.			

Appendix 2453-A, November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.



**MATERIAL SPECIFICATION FOR
TRAFFIC SIGNAL ARMS, BRACKETS,
HANGERS, FITTINGS, AND HARDWARE**

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2460-A	Commentary

2460.01 SCOPE

This specification covers the requirements for single member arms, aluminum pipe arms, double arm brackets, traffic signal hanger assemblies, and traffic signal mounting hardware and accessories.

2460.01.01 Specification Significance and Use

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

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

2460.01.02 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.

2460.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Material

OPSS 2461 Signal Heads

CSA Standards

G40.20-13/G40.21-13	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
S157-05/S157.1-05 (R2015)	Strength Design in Aluminum
W47.2-11 (R2015)	Certification of Companies for Fusion Welding of Aluminum
W59-13	Welded Steel Construction (Metal/Arc Welding)

American National Standards Institute (ANSI)

B18.2.1-2012	Square, Hex, Heavy Hex, and Asken Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
B18.2.2-2015	Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
B18.21.1-2009	Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)

ASTM International

A 123/A 123M-15	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 307-14e1	Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
A 563-15	Carbon and Alloy Steel Nuts
B 108/B108M-15	Aluminum-Alloy Permanent Mold Castings
F 593-13ae1	Stainless Steel Bolts, Hex Cap Screws, and Studs
F 594-09 (2015)	Stainless Steel Nuts

2460.04 DESIGN AND SUBMISSION REQUIREMENTS

2460.04.01 Design Requirements

2460.04.01.01 Traffic Signal Arms, Brackets, Hangers, Fittings, and Hardware

All traffic signal equipment shall be designed to accommodate a five section signal head with 300 mm lenses complete with backboard according to OPSS 2461.

2460.04.01.02 Aluminum Components

Structural design shall be according to CAN/CSA S157.

2460.04.02 Submission Requirements

2460.04.02.01 Working Drawings

When specified in the Contract Documents, the Contractor shall submit 4 sets of Working Drawings to the Contract Administrator at least 14 Days prior to the commencement of fabrication operations, for information purposes only. Prior to making a submission, an Engineer's seal and signature shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

Where 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 sealed and signed by as many additional Engineers as necessary.

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

2460.05 MATERIALS

2460.05.01 Structural Steel

Structural steel shall be according to CSA G40.20/G40.21, minimum yield strength 300 MPa.

2460.05.02 Steel Hardware

Steel bolts shall be according to ANSI B18.2.1 and ASTM A 307, Grade A, minimum yield strength 400 MPa. Steel nuts shall be according to ANSI B18.2.2 and ASTM A 563, Grade A, minimum yield strength 400 MPa. Steel washers shall be according to ANSI B18.21.1.

Stainless steel bolts shall be according to ASTM F 593 with head marking F593C. Stainless steel nuts shall be according to ASTM F 594. Stainless steel washers shall be fabricated from 18.8 alloy.

2460.05.03 Cast Alloy Materials

Fittings cast from non-ferrous alloys shall be according to ASTM B 108 and strength requirements compatible with other components and the design requirements. Fittings shall be cast with aluminum alloy, grade A356.2 or G6290. Castings shall be F or T6.

2460.05.04 Aluminum Pipe and Tube

Aluminum pipe shall be 38 mm (1½") diameter, schedule 40, 6061-T6, and strength requirements compatible with other components and the design requirements.

Aluminum tubes shall be fabricated from 6063 alloy.

2460.07 PRODUCTION

2460.07.01 General

2460.07.01.01 Galvanizing

All structural steel, steel hardware, and cast ferrous components shall be hot dip galvanized according to ASTM A 123.

2460.07.01.02 Welding

All welding of steel shall be according to CSA W59.

All welding of aluminum shall be according to CSA W47.2.

2460.07.02 Single Member Arms

Single member arms shall be fabricated by tapering and bending aluminum tube to the required dimensions. The end of the arm shall be provided with a 50 mm IPS (iron pipe size) tenon, 100 mm long for mounting of a hanger. The tenon shall be horizontal when the arm is mounted on a vertical surface. After fabrication, arms shall be heat treated to T-6 temper.

The vertical rise of the mast arm shall be according to Table 1.

The pole attachment assembly shall be fabricated from structural steel complete with:

- a) Flat steel pole straps with four hex head bolts, nuts, and lock washers for mounting on metal or concrete poles.
- b) Four 20 mm diameter bolt holes for mounting on wooden poles.

The pole plate collar attachment to the aluminum arm shall be retained by hex head bolts with nuts and lock washers. The number of hex head bolts shall be according to Table 1.

Pole attachment assemblies for use with wooden, metal, or concrete poles shall be fabricated to suit arms and pole diameters.

Pole plate assemblies for use with wooden poles shall be fabricated to suit arms and pole diameters.

The completed aluminum signal member arm shall be as specified in the Contract Documents.

2460.07.03**Aluminum Pipe Arms**

Aluminum pipe arms shall be fabricated from 50 mm IPS aluminum pipe. The pipe shall be bent such that the tenon end is horizontal when the arm is mounted on a vertical surface to give the vertical rise, as measured from the top of the pole plate to the centre of the tenon according to Table 2.

The pole plate for attachment of the mast arm shall be a cast alloy universal plate with adjustment set screws permitting adjustment of the angle of the mast arm over a range of 15° and shall be complete with two 20 mm diameter bolt holes for mounting on wooden poles and with a lipped portion, top and bottom, suitable for attachment of pole attachments.

Pole attachment assemblies shall be fabricated from flat structural steel complete with pole plate straps, 12.7 mm diameter U bolts, nuts, lock washers, and round washers for mounting on metal or concrete poles. Pole attachment assemblies shall be provided for aluminum pipe arm pole plates and be fabricated to suit pole diameters.

2460.07.04**Double Arm Brackets**

Double arm brackets shall be fabricated from 38 mm IPS schedule 40, aluminum pipe to the length specified in the Contract Documents. Each bracket shall consist of a cast aluminum 90° flanged street elbow, pole plate, and hexagonal or octagonal locknut and a neoprene washer. The cast pole plate shall be provided with four 16 mm diameter bolt holes for mounting on wooden poles and with lipped edges, top and bottom, suitable for use with 16 mm wide stainless steel strapping. The completed double arm bracket shall be as specified in the Contract Documents.

2460.07.05**Traffic Signal Hanger Assemblies**

Traffic signal hanger assemblies shall be of the following types, as specified in the Contract Documents:

- a) cushion hanger
- b) adjustable mid-section hanger
- c) dual-end hanger

Traffic signal hanger assemblies shall be fully adjustable to provide the required signal visibility.

2460.07.06**Signal Mounting Hardware, Fittings, and Accessories**

Signal mounting hardware, fittings, and accessories for aerial installation shall be as specified in the Contract Documents.

2460.07.07**Packaging**

Aluminum arms shall be wrapped in heavy paper to protect the finish.

Steel components shall be strapped together with external corners protected with packing material. Small components, hardware, fittings, and accessories shall be packaged securely in cardboard containers and protected with packing material.

2460.08 QUALITY ASSURANCE

2460.08.01 Inspection

The Contract Administrator shall be notified a minimum of 3 Business Days prior to the start of fabrication for the traffic signal arms, brackets, and hangers.

The Contract Administrator shall have free access to the place of manufacture of the traffic signal arms, brackets, and hangers 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 traffic signal arms, brackets, and hangers are being fabricated.

The Contract Administrator shall be notified when the traffic signal arms, brackets, and hangers are ready for inspection.

All traffic signal arms, brackets, and hangers may be subject to an inspection by the Contract Administrator prior to shipment.

2460.09 OWNER PURCHASE OF MATERIAL

2460.09.01 Packaging and Shipment

The supplier shall provide 4 sets of Working Drawings, when required by the Owner. Working Drawings shall include all detailed dimensions and a complete list of components, materials, and accessories.

If the supplier has previously submitted this information and the Owner has previously approved it, only reference to the original submission is required.

The supplier is responsible for loading, delivery, and off-loading of traffic signal arms, brackets, and hangers to designated areas. Traffic signal arms, brackets, and hangers shall be subject to inspection during and on completion of off-loading. If any damage to the traffic signal arms, brackets, and hangers 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 have been made.

2460.09.02 Measurement and Payment

For payment purposes, a count shall be made of the number of traffic signal arms complete with brackets, hangers, fittings, and hardware delivered and accepted.

Payment at the price specified in the purchasing order shall be for the supply of traffic signal arms delivered to the destination at the date and time specified.

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

TABLE 1
Aluminum Single Member Arm Requirements

Arm Length m (Note 1)	Arm Rise m	Number of Hex Head Bolts for Pole Plate Collar Attachment
1.2	0.53	2
1.8	0.61	2
2.4	0.84	2
3.0	0.61	3
3.6	0.84	3
4.6	1.07	3
5.5	0.91	3
6.1	1.07	3
6.7	1.14	3
7.6	1.20	3
Notes: 1. Measured from the centre of the pole plate to the centre of the tenon.		

TABLE 2
Aluminum Pipe Arm Dimensions

Arm Length m	Arm Rise m
0.6	0.25
1.2	0.25

Appendix 2460-A, November 2018 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:

- Details of the completed aluminum signal member arms. (2460.07.02)
- Length of double arm brackets. (2460.07.04)
- Details of the completed double arm brackets. (2460.07.04)

The designer should ensure the traffic signal arms and arm lengths being specified are compatible with the poles.

For Owner purchase of material, the following technical information should be given to the supplier in the purchasing order:

- a) Type and length of mast arm.
- b) Type and diameter of pole for mast arm mounting.
- c) Length of double arm brackets.
- d) General description of aerial hardware, fittings, and accessories.

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 2502.010	Traffic Signal, Adjustable Mid-Section Hanger
OPSD 2502.011	Traffic Signal, Dual-End Hanger
OPSD 2522.010	Traffic Signal, Cushion Hanger
OPSD 2524.010	Traffic Signal, Double Arm Bracket
OPSD 2540.100	Aerial Suspension Mounting Bracket, Pre-Emption Unit



MATERIAL SPECIFICATION FOR SIGNAL HEADS

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2461-A	Commentary

2461.01 SCOPE

This specification covers the requirements for traffic signal heads and associated components and accessories.

2461.01.01 Specification Significance and Use

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

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

2461.01.02

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.

2461.02

REFERENCES

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

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

Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 12 - Traffic Signals

CSA Standards

C22.2 No. 0.4-04 (R2013)	Bonding of Electrical Equipment
C22.2 No. 127-15	Equipment and Lead Wires
S157-05 (R2015)	Strength Design in Aluminum

Institute of Transportation Engineers

ST-017B Equipment and Material Standards of the Institute of Transportation Engineers, April 3, 2006
ST-052 Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Circular Signal Supplement, June 27, 2005
ST-054 Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement, January 2008
Pedestrian Traffic Control Signal Indications - Part 2: Light Emitting Diode (LED) Pedestrian Traffic Signal Modules, March 19, 2004

ASTM International

D 4956-13 Retroreflective Sheeting for Traffic Control

Others

Federal Specification Colour Yellow 595B-33538
Federal Specification Colour Gray MVCL-14187
Ontario Highway Traffic Act, R.S.O. 1990, Chapter H.8

2461.03 DEFINITIONS

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

Backboard means a panel surrounding a signal head used for the purpose of increasing the attention value of the signal.

Chromaticity means the colour quality of light that is defined by the wavelength (hue) and saturation.

Lamp means a light emitting diode (LED) circular signal module, LED arrow signal module, LED pedestrian signal module, or incandescent bulb.

LED Arrow Signal Module means a signal unit comprised of an array of LEDs, lens, and related power supply that provides an arrow traffic signal indication.

LED Pedestrian Signal Module means a signal unit comprised of an array of LEDs, lens, and related power supply that provides a pedestrian signal indication consisting of a walking pedestrian or hand icon.

LED Signal Module means a signal unit comprised of any array of LEDs and related power supply and any required lenses that provides a circular traffic signal indication when connected to appropriate power.

Programmable Visibility Head means the traffic signal head that can be programmed to limit the visible area of the indication.

2461.04 DESIGN AND SUBMISSION REQUIREMENTS

2461.04.01 Design Requirements

2461.04.01.01 Signal Head Requirements

Signal heads shall be designed to be attached to the traffic signal hanger assemblies using cushion hangers, adjustable mid-section hangers, or dual-end hangers with standard 38 mm internal pipe size gusseted pipe and fittings. Structural design of aluminum shall be according to CAN/CSA S157.

2461.05 MATERIALS

2461.05.01 General

Signal heads, components, and accessories shall be according to ITE ST-017B and the Contract Documents.

2461.05.02 Signal Head Housings

Signal head housings shall be a die-cast aluminum or a moulded polycarbonate body with hinged door assembly to provide a water and dust tight enclosure. Openings of the signal head housing shall be provided with a removable sealing device. Aluminum alloy shall be according to CSA S157. The polycarbonate signal head shall be moulded, ultraviolet and heat stabilized, flame retardant resin, and shall be yellow according to Federal Specification Colour Yellow 595B-33538.

When specified in the Contract Documents, the colour of the signal head housing with grey body and the back of the aluminum or polycarbonate backboard shall be according to Federal Specification Colour Gray MVCL-14187.

Stainless steel reinforcing plates shall be provided according to the manufacturer's recommendation for the mounting arrangement specified in the Contract Documents for the signal head.

2461.05.03 Visors

Each section of a traffic signal head shall be provided with a removable visor as specified in the Contract Documents.

2461.05.04 Wiring

Wiring shall be #18 AWG stranded copper type TEW and according to CSA C22.2 No. 127.

2461.05.05 Ground Terminals

Metallic traffic signal heads shall be provided with a ground lug to accommodate a #14 AWG bonding wire.

2461.05.06 Backboards

As a minimum, backboards shall be fabricated from 1.00 mm thick aluminum sheets or 3.00 mm thick high-density polyethylene (HDPE) sheets and shall project a minimum of 125 mm all around beyond the signal head housing. The signal head backboard shall be yellow according to Federal Specification Colour Yellow 595B-33538.

All backboards shall be opaque.

When specified in the Contract Documents, the backboard shall be outfitted with a strip of 75 mm wide fluorescent yellow prismatic retroreflective sheeting according to ASTM D 4956, Type XI, around the front facing border.

When specified in the Contract Documents, the colour of the heads with gray body and the back of the aluminum or polycarbonate backboard shall conform to Federal Specification Colour Gray MVCL-14187.

2461.05.07 Paint

Paint shall be synthetic resin enamel and according to Federal Standard Colour Yellow 595B-33538.

2461.05.08 LED

2461.05.08.01 LED Modules

LED circular modules at minimum shall be according to ITE ST-052 and the Contract Documents.

As a minimum, LED arrow signal modules shall be according to ITE ST-054 and the Contract Documents.

Each LED module shall have a single lens with a smooth outer surface. All circular red lenses shall be tinted red and all circular amber lenses shall be tinted amber. The use of tinting or other materials to enhance ON/OFF contrasts shall not affect chromaticity and shall be uniform across the face of the lens. The LED module lens shall be UV stabilized and shall be capable of withstanding direct ultraviolet sunlight exposure for a minimum period of 60 months without exhibiting evidence of deterioration or colour change.

All circular red, amber, and green LED modules shall have an incandescent look that provides a softened and uniform appearance.

LED modules shall be capable of retrofitting and replacing incandescent lamps without modifications to a standard ITE traffic signal housing. Installation shall only require the removal of the existing lens, lamp reflector assembly, and gasket. Each LED module shall have secured jacketed and colour coded cables for connecting to power and for bonding to system ground. The connecting cable shall be rated 600 volts. All wire leads shall be one metre in length, pre-stripped, and tinned.

Each LED module shall be a sealed unit that includes all parts necessary for operation (e.g., printed circuit board, power supply, lens, and gasket) and shall be weatherproof after installation and connection. A one-piece 12.5 mm wide neoprene gasket shall be provided and installed on the LED module prior to delivery.

All LED modules shall be according to the size, colour, and design specified in the Ontario Highway Traffic Act and the OTM Book 12.

LED pedestrian displays shall be the single unit with the walking pedestrian and hand superimposed in the same unit according to the Ontario Highway Traffic Act and the OTM Book 12.

All LED modules shall be approved by the Electrical Safety Authority or by an organization accredited by the Standards Council of Canada.

LED modules for use in programmable visibility head shall comply with the general requirements for LED circular modules. Modules shall be designed and constructed to be installed in a programmable visibility head without modification to the housing.

2461.05.08.02 Electrical Requirements

Electrical requirements for LED circular modules shall be according to ITE ST-052; the LED arrow modules shall be according to ITE ST-054; and the LED pedestrian modules shall be according to ITE Pedestrian Traffic Control Signal Indications - Part 2: Light Emitting Diode (LED) Pedestrian Traffic Signal Modules.

Maximum power consumption for LED modules shall be according to Table 1 and 2.

Power factor shall be a minimum of 0.95.

2461.05.08.03 Photometric Requirements

Photometric requirements for LED circular modules shall be according to ITE ST-052. Photometric requirements for LED arrow modules shall be according to ITE ST-054.

All circular LED modules shall be the expanded view type.

2461.05.08.04 Physical and Mechanical Requirements

Physical and mechanical requirements for LED circular modules shall be according to ITE ST-052; the LED arrow modules shall be according to ITE ST-054; and the LED pedestrian modules shall be according to ITE Pedestrian Traffic Control Signal Indications - Part 2: Light Emitting Diode (LED) Pedestrian Traffic Signal Modules.

2461.05.08.05 LED Module Identification

Each module shall have the manufacturer's name, trademark, model number, serial number, and date of manufacture (i.e., month-year) marked on the back of the module.

The following operating characteristics shall be permanently marked on the back of the module: nominal operating voltage; power consumption, in watts; and volt-amperes.

Each module shall have a symbol of the type of module (e.g., circle or arrow) in the colour of the module marked on the back of the module. The colour of the module shall be written out next to the symbol.

When specific mounting orientation is required, each module shall have prominent and permanent marking consisting of an up arrow or the word UP or TOP.

2461.05.08.06 LED Module Warranty

A warranty shall be provided on all LED modules. This warranty shall be in addition to any other warranty specified in the Contract Documents. The warranty on all LED modules shall be according to ITE ST-052.

The warranty period for each LED module shall be 60 months, commencing from the date of Switch On for operation of the traffic signals in which the LED module is used. Any LED module deemed to have a visual or operational deficiency shall be replaced within 30 days. The warranty shall cover all delivery, parts, and material costs.

2461.07 PRODUCTION

2461.07.01 General

Sectional signal heads consisting of one to six sections shall be supplied as specified in the Contract Documents. Where multiple sections are specified, lenses shall be arranged in the following order commencing from the top of the signal head to the bottom:

- a) Red
- b) Amber
- c) Green
- d) Straight Through Green Arrow
- e) Left Turn Green / (Amber) Arrow
- f) Right Turn Green Arrow

When any of the foregoing indications are not required, the order of arrangement shall be maintained by omitting those sections, which are not required.

Each section shall consist of a signal head housing, wiring, and visor as specified in the Contract Documents. Each section shall consist of LED modules or incandescent lampholders, reflectors, and lens as specified in the Contract Documents. Each complete assembly shall consist of a ground terminal and, when specified in the Contract Documents, a backboard.

Pedestrian signal heads shall consist of one or two housing sections suitable for rectangular signals. One display shall be a translucent lunar orange hand and the other display shall be a translucent lunar white walking pedestrian. Standard square visors shall be provided.

2461.07.02 Wiring

Loops of 150 mm length of wire shall be left in each section.

2461.07.03 Bonding

Metallic components shall be bonded together and grounded to the ground terminal according to CAN/CSA C22.2 No. 0.4.

2461.07.04 Assembly

All components shall be factory assembled using mechanical devices according to the strength requirements of ITE ST-017B.

2461.07.05 Painting

All externally visible portions or components of the metal signal heads, with the exception of lenses and the underside of visors, shall be painted yellow. The underside of the visors of the metal signal heads and the visors of the polycarbonate signal heads shall be painted matte black.

2461.07.06 Signal Head Identification

Each signal head shall have identification markings in a visible location indicating the manufacturer's name or trademark, date of manufacture, and standard designation OPSS 2461.

Identification markings shall be embossed on the signal head or on a corrosion-resistant metal plate securely attached to the signal head.

2461.07.07 Packaging

Each signal head shall be packaged securely in cardboard cartons. Backboards and separately ordered components may be packaged separately.

2461.08 QUALITY ASSURANCE

2461.08.01 Inspection

All signal heads may be subject to an inspection by the Contract Administrator prior to shipment.

2461.09**OWNER PURCHASE OF MATERIAL****2461.09.01****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 signal heads to designated areas. Signal heads shall be subject to inspection during and on completion of off-loading. If any damage to the signal heads 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 have been made.

2461.09.02**Measurement for Payment**

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

All signal heads shall be complete with components and accessories and, when specified, backboards.

Payment at the price specified in the purchasing order shall be for the supply of the signal heads 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
LED Modules Maximum Power Consumption
watts

LED Signal Modules						
	Red		Amber		Green	
Temperature, °C	25	74	25	74	25	74
Circular 300 mm	11	17	22	25	15	15
Circular 200 mm	8	13	13	16	12	12
300 mm Arrow	9	12	10	12	11	11
Programmable Visibility Indication	11	17	22	25	15	15

TABLE 2
LED Modules Maximum Power Consumption
watts

LED Pedestrian Signal Modules		
Temperature, °C	25	74
Hand	10	12
Walking Pedestrian	9	12

Appendix 2461-A, November 2017
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Type of removable visor (i.e., cowl, tunnel, open bottom, louvre) (2461.05.03)
- LED circular module requirements. (2461.05.08.01)
- LED arrow module requirements. (2461.05.08.01)
- Sectional signal head requirements. (2461.07.01)

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

- Signal head housing colour requirements. (2461.05.02)
- Retroreflective boarder requirements. (2461.05.06)
- Backboard requirements. (2461.07.01)

For Owner purchase of material, the following technical information should be given to the supplier in the purchasing order:

- a) Type of signal heads.
- b) Number and size of sections.
- c) Number, size, colour, and type of lenses.
- d) Number and type of visors.
- e) Backboards, if required.
- f) Components and accessories, if required.

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

Related Ontario Provincial Standard Drawings

None



MATERIAL SPECIFICATION FOR SECTIONAL STEEL HIGH MAST LIGHTING POLES

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APPENDICES

2471-A	Commentary

2471.01 SCOPE

This specification covers the requirements for base mounted sectional steel high mast lighting poles 25, 30, 35, 40, and 45 metres in height with a multisided cross-section.

2471.01.01 Specification Significance and Use

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

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

2471.01.02 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.

2471.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 906	Structural Steel
OPSS 911	Coating Structural Steel Systems

Ontario Ministry of Transportation Publications

Structural Manual

CSA Standards

B95-1962 (R2002)	Surface Texture (Roughness, Waviness and Lay)
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
S6-14	Canadian Highway Bridge Design Code
W47.1-09 (R2014)	Certification of Companies for Fusion Welding of Steel
W59-13	Welded Steel Construction (Metal Arc Welding)
W178.1-14	Certification of Welding Inspection Organizations
W178.2-14	Certification of Welding Inspectors

ASTM International

A 500/A 500M-13	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

Canadian General Standards Board (CGSB)

48.9712-2014 Non-Destructive Testing - Qualification and Certification of NDT Personnel

American Association of State Highway and Transportation Officials (AASHTO)

LTS-5-M Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 5th Edition, Interim Revisions (2010)

International Organization for Standardization/International Electrotechnical Commission(ISO/IEC)

17025:2005 General Requirements for the Competence of the Testing and Calibration Laboratories

Others

Federal Standard 595C Color Standards

2471.03 DEFINITIONS

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

CWB means Canadian Welding Bureau.

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

Multisided means having either eight or twelve sides as specified in the Contract Documents.

NACE CIP means National Association of Corrosion Engineers Coating Inspection Program.

SSPC means The Society for Protective Coatings.

2471.04 DESIGN AND SUBMISSION REQUIREMENTS

2471.04.01 Design Requirements

Sectional steel high mast lighting poles shall be according to CSA S6; MTO Structural Manual; AASHTO LTS-5M; and as specified in the Contract Documents. Each pole shall be capable of supporting a total maximum load of 2,000 kg with a combined effective projected area of all the luminaires, shroud, and shields not exceeding 4.0 m².

2471.04.02 Submission Requirements

2471.04.02.01 Working Drawings

Working Drawings shall be prepared for the fabrication of the sectional steel high mast lighting poles.

The Contractor shall submit 3 sets of Working Drawings to the Contract Administrator 14 Days prior to commencement of fabrication of the sectional steel high mast lighting poles, for information purposes only. An Engineer shall affix his or her seal and signature on the Working Drawings verifying that the Working Drawings are consistent with the Contract Documents and sound engineering practices.

Where multi-discipline engineering work is depicted on the same Working Drawing and a single engineer is unable to seal and sign the Working Drawings for all aspects of the work, the drawing shall be signed and sealed by as many additional engineers as necessary.

A copy of the Working Drawings shall be retained at the fabricator's plant during and after pole fabrication.

The Working Drawings shall contain all information necessary to fabricate the sectional steel high mast lighting poles including:

- a) Dimensioned drawings, including lengths, sizes, cross-sections, and details of the sectional steel pole, and exact weights of pole sections.
- b) Final forces for field assembly of pole sections.
- c) Details for the mounting supports of the winch assembly, the head frame assembly, and the electrical panel assembly.
- d) Details of access opening and of access door.
- e) Welding details, including welding procedures to be used for each joint.
- f) Detailed bill of materials.
- g) Details of identification nameplates.

2471.04.02.02 Mill Test Certificates

Mill test certificates shall be submitted according to OPSS 906.

2471.04.02.03 Welding Procedures

Welding procedure data sheets for each joint configuration to be welded shall be prepared according to CSA W59, stamped with CWB's acceptance, and available for review during fabrication of the sectional steel high mast lighting poles. The Contractor shall submit 3 sets of welding procedures to the Contract Administrator 14 Days prior to commencement of fabrication of the sectional steel high mast lighting poles, for information purposes only.

2471.04.02.04 Welder's Qualification

Welders shall have valid CWB issued qualification cards indicating the welding processes and the positions for which they are qualified to weld. Prior to the commencement of fabrication, the Contractor shall submit 3 copies of the Welders' and Welding Operators' current qualification cards to the Contract Administrator.

2471.05 MATERIALS

2471.05.01 Steel

All structural steel shall be CSA G40.20/G40.21, Grade 350 WT, Category 3.

Steel for tenon pipe shall be CSA G40.20/G40.21, Grade 300W, or A 500M Grade C.

For pole masts, silicon content shall be less than or equal to 0.06%.

2471.05.02 Electrodes

Electrodes and flux used for welding shall have a low hydrogen content and shall be as specified in the fabricator's CWB approved welding procedures.

2471.05.03 Paint Coatings

Paint coatings shall be according to OPSS 911 and the Contract Documents.

The colour of the finish coat shall be equivalent to 16307 grey according to Federal Standard 595C.

2471.07 PRODUCTION

General requirements for electrical work shall be as specified in the Contract Documents.

Fabrication shall be according to CSA S6 and CSA W59 and the Working Drawings.

2471.07.01 Tolerances

Fabrication shall be according to the dimensions on the sealed and signed Working Drawings.

The dimensions of the assembled high mast lighting pole shall be within the following tolerances:

- a) Overall height of pole mast: 5 mm for every 1 m in height.
- b) Cross-sectional width of shaft across flats:
 - i) 1.0%, for widths less than 500 mm,
 - ii) 0.75% for widths greater than 500 mm.
- c) Maximum sweep of the pole mast on its overall length measured from a chord joining the extremities and the centreline of the mast shall not exceed 0.2% of its overall length.
- d) Maximum deviation from straight of the shaft wall on any 3 m length of pole mast shall not exceed 5 mm.
- e) Offset between the centreline of the top section of the pole and the centreline of the bottom section of the pole shall not exceed 150 mm.
- f) Offset between the centreline of the base plate and the centre of the pole mast at base shall not exceed 5 mm.
- g) Wall thickness shall be within the tolerance permitted in CSA G40.20/G40.21 and ASTM A 500M.

2471.07.02**Fabrication**

The pole mast shall be cold formed from steel plate and each section shall be fabricated with one or two continuous longitudinal welds. If two welds are used, they shall be on opposite sides of the pole shaft.

One circumferential shop splice per section shall be permitted. Where possible, the shop splice shall be completed prior to forming the pole cross-section.

In the area of the lap splice there shall be no protrusions preventing proper alignment of one section with the next. Any excess weld material shall be removed by grinding to form a smooth surface maintaining a uniformly tapered section.

Each pole shall be supplied with a reinforced handhole complete with a cover. The cover shall have provision for padlocking and shall be fitted with a silicone rubber gasket such that, upon locking, the cover shall be tightly fitted to the handhole.

Each pole shall be supplied with the appropriate mounting plate, brackets, and other attachments required for the installation of the raising and lowering equipment. The mounting plate, brackets, and other attachments shall be attached to the shaft wall by welds as specified in the Contract Documents. Nuts for securing the electrical panel shall be welded to the back of the mounting plate at each mounting hole as specified in the Working Drawings.

The head frame shall be assembled to the pole by means of a tenon mounting system. The tenon shall be compatible with the head frame and raising and lowering device.

In the tenon mounting system, a circular plate with nominal thickness of 12 mm shall be welded to the top of pole as specified in the Contract Documents. The plate shall have a circular opening through its centre, equal to the outside diameter of the tenon, through which the tenon shall be inserted.

The pole section joints shall be slip fitted connections as specified in the Contract Documents. Joint details shall not interfere with the raising or lowering of the luminaire assembly.

The maximum overlap shall be such that the height of the completed mast complies with the permitted overall tolerances.

Shop trial-assembly shall be carried out to check the fit of the sections. The manufacturer shall determine the necessary compressive assembly forces and lap lengths to be achieved during the pre-assembly operation to ensure the final field assembly shall meet the requirements of the Contract Documents. Sections shall be match-marked to facilitate the field assembly. The markings shall be permanent and the location, size, and marking medium shall not interfere with the slip joint.

All cut edges of the base plate shall have a surface finish not greater than 1,000 as defined in CSA B95. All corners shall be ground to a radius of 3 mm.

2471.07.03**Welding**

All welding shall be according to CSA W59, including its provisions for cyclically loaded structures, and shall be undertaken by a manufacturer certified by CWB according to CSA W47.1, division 2.1 or better.

During fabrication, upon request the Contractor shall make available to the inspector the CWB approved qualification cards for each, Welder and Welding Operator to be employed on the work.

Welds for circumferential splices shall be full strength complete joint penetration.

The longitudinal seam welds shall be single V and shall be made from the outside of the structure. Throat thickness shall be according to CSA W59, to ensure a minimum of 60% joint penetration.

Welds within the lap of the slip joints plus an additional 150 mm extending from the slip joint shall be full strength complete penetration groove welds, and shall be ground smooth.

The section of weld that does not meet the acceptance standards shall be removed, re-welded, and re-examined.

2471.07.04 Coating

2471.07.04.01 Galvanizing

All steel components of sectional steel high mast lighting poles shall be hot dip galvanized according to OPSS 911.

2471.07.04.02 Paint Coating

After galvanizing and prior to paint coating, each component of the sectional steel high mast lighting pole shall be checked for continuity and smoothness of the galvanized coating. Any deficiencies in galvanized coating shall be corrected according to OPSS 911.

Components specified to be paint coated shall then be paint coated after surface preparation according to OPSS 911, using one of the paint coating systems specified in the Contract Documents. The dry film thickness of galvanized coating after surface preparation by sweep blasting shall be at least 87 µm.

During trial-assembly care shall be taken not to damage the coatings of the pole. Any damage to the coatings that occur during the trial-assembly or any other operations shall be repaired according to OPSS 911.

2471.07.05 Identification Nameplate

Each sectional steel high mast lighting pole shall have an identification nameplate as specified in the Contract Documents.

The nameplate shall be made of stainless steel and shall be securely attached to the outside upper part of the handhole cover by rivets. A neoprene or rubber gasket shall be placed between the handhole cover and the nameplate to prevent corrosion effects.

2471.07.06 Quality Control

The Contractor shall notify the Contract Administrator of the fabrication, testing, and delivery dates.

The manufacturer shall issue a certificate of compliance certifying that the sectional steel high mast lighting poles comply with the Contract Documents.

2471.07.06.01 Inspection, Testing, and Reporting

The manufacturer's welding inspector shall inspect and test the sectional steel high mast lighting poles as follows:

(a) Visual Inspection

The fabrication of steel components shall be visually inspected to ensure material, dimensions, fit-up, and welding are according to specifications. Certification of conformance by the inspector for each phase of the fabrication shall be based on the applicable Working Drawings, codes, and specifications.

The manufacturer's inspector shall witness the trial assembly of the pole sections to ensure compliance with contract requirements.

Each phase of the cleaning and coating work shall be inspected to ensure conformity to the Contract Documents prior to proceeding to the next phase. Acceptance of the surface preparation and coating thickness measurements shall be according to OPSS 911, CSA G164, and the applicable SSPC Standards.

When the sectional steel high mast lighting poles have been delivered to the Working Area and prior to installation, the manufacturer's inspector with the required credentials shall inspect them to ensure that all the components of the high mast lighting poles are according to the Contract Documents.

(b) Non-Destructive Testing

All full penetration groove welds, including shaft to base welds, circumferential splices in shaft and welds at slip joints, shall be 100% examined. Longitudinal welds at the bottom of the shaft shall be tested 100% for a length of 2.0 m from the base plate. All testing of groove welds shall be by radiographic or ultrasonic test method and shall be according to CSA W59 for cyclically loaded structures. Any repair welds shall be tested by appropriate methods as determined by the manufacturer's Engineer.

(c) Reporting

Prior to installation of the poles, the Contractor shall submit 2 copies of the manufacturer's inspection reports, containing the results of all the inspection and testing performed during welding, fabrication and coating work, to the Contract Administrator. The inspection report shall be completed and certified by the manufacturer's inspector and approved by the manufacturer's Engineer.

2471.07.06.02 Certification of the Welding Inspection Company

The company undertaking welding inspection shall be certified under the Bridges category according to CSA W178.1. The certification shall encompass at least the following methods: visual, radiograph, ultrasonic, dye penetrant, and magnetic particle.

2471.07.06.03 Certification of Welding inspectors for Visual Inspection and Non-Destructive Testing

Visual inspection of the sectional steel high mast lighting poles shall be performed by welding inspectors certified by CWB according to CSA W178.2. The certification shall be to Level II or III.

Non-destructive testing of the sectional steel high mast lighting poles shall be performed by an ultrasonic or radiographic technician or both, certified to Level II or Level III according to CGSB 48.9712.

2471.07.06.04 Certification of Coating Inspectors

Each Coating Inspector shall have:

- a) Successfully completed NACE CIP Level 1 and Level 2 with a minimum of 3 years of proven coating inspection experience;
- or,
- b) Successfully completed NACE CIP Level 1, or be a graduate of the MTO's Coating Course and be working under the direct technical supervision of a currently Certified NACE CIP Level 3 inspector.

2471.08**QUALITY ASSURANCE**

Sectional steel high mast lighting poles are subject to inspection by the Contract Administrator at any time during the course of fabrication and installation. The Contractor shall notify the Contract Administrator of the fabrication, testing, and delivery dates.

Welding is subject to inspection by the Contract Administrator using both visual and non-destructive testing procedures and techniques according to CSA W59 for cyclically loaded structures.

The surface preparation and coating of sectional high mast steel lighting poles are subject to inspection by the Contract Administrator during the coating work. Acceptance of the work shall be based on the applicable OPS specification and SSPC Standards.

**Appendix 2471-A, November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Coating requirements. (2471.07.05.03)
- Shaft wall attachment requirements. (2471.07.02)
- Paint coating system. (2471.07.04.02)
- Sectional steel high mast lighting pole requirements. (2471.07.06)

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

- Additional pole design requirements. (2471.04.01)

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

Related Ontario Provincial Standard Drawings

OPSD 2450.011	High Mast Lighting Pole 25, 30, and 35 m 8-Sided Pole
OPSD 2450.021	High Mast Lighting Pole 40 and 45 m 12-Sided Pole
OPSD 2453.010	High Mast Lighting Pole Cable Holder and Storage Hook Details
OPSD 2453.020	High Mast Lighting Pole, Handhole Cover Hinges, Latches, and Padlock
OPSD 2453.050	High Mast Lighting Pole Nameplate Details



**MATERIAL SPECIFICATION FOR
ANCHORAGE ASSEMBLY - HIGH MAST LIGHTING POLE**

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APPENDICES

2474-A	Commentary

2474.01 SCOPE

This specification covers the requirements of anchorage assemblies for the 25, 30, 35, 40, and 45 m base mounted sectional steel high mast lighting poles.

2474.01.01 Specification Significance and Use

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

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

2474.01.02 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.

2474.02 REFERENCES

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

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

CSA Standards

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
W59-13	Welded Steel Construction (Metal Arc Welding)
W178.2-14	Certification of Welding Inspectors

Canadian General Standards Board

48.9712-2014 Non-Destructive Testing - Qualification and Certification of NDT Personnel

ASTM International

A 153/A 153M-16	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 449-14	Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
A 563-15	Carbon and Alloy Steel Nuts

2474.04 DESIGN AND SUBMISSION REQUIREMENTS

2474.04.01 Submission Requirements

2474.04.01.01 Working Drawings

The Contractor shall submit 6 sets of Working Drawings to the Contract Administrator at least 14 Days prior to the commencement of fabrication. 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 anchorage assemblies shall include the following information:

- a) Dimensioned drawings, including plans, elevations, sections of the anchor rods, nuts, top and bottom plates, and their exact weights.
- b) Mill test certificates reports of all steel being used.

2474.05 MATERIALS

2474.05.01 Steel

Anchor rods shall be made of new billet steel round bar, quenched and tempered medium carbon steel, with a minimum yield strength of 517 MPa and a minimum tensile strength of 725 MPa, and shall satisfy Charpy V Notch test requirements of 20 joules at minus 30 °C.

The length, number, and size of the anchor rods shall be as specified in the Contract Documents.

Other general requirements shall be according to ASTM A 449 for anchor rods and ASTM A 563 for anchor rod nuts.

Anchor assembly top and bottom plates shall be made of PL10 x 100 mm according to CSA G40.20/G40.21, Grade 300W.

2474.05.02 Anchorage Setting Templates

The anchorage setting template shall be made of 20 mm thick plywood or hard wood or metal. Metal templates shall be a minimum of 12 gauge steel.

2474.07 PRODUCTION

2474.07.01 General

All fabrication shall be according to dimensions specified in the Working Drawings and as specified in the Contract Documents.

Anchorage assembly shall be supplied complete, as specified in the Contract Documents. Each assembly shall be supplied complete with anchor rods, hexagonal nuts, hardened steel washers, and steel top and bottom plates.

Each anchorage assembly shall be supplied with one anchorage setting template for positioning of the anchor rods to suit the required bolt circle diameter of the pole.

2474.07.02 Tolerance

Dimensions, threads, and hexagonal nuts tolerances shall be according to ASTM A 563, Grade DH. Exposed nuts are to be tapped oversized according to ASTM A 563 to allow for the thickness of the zinc coating on the rod threads.

2474.07.03 Welding

Hexagonal nuts shall be welded to the top and bottom plates according to CSA W59.

2474.07.04 Coating

The anchorage assembly shall be completely galvanized according to CAN/CSA G164M or ASTM A 153.

The exposed hexagonal nuts and washers shall be galvanized according to CAN/CSA G164M or ASTM A 153.

2474.07.05 Quality Control

The manufacturer shall certify that the anchorage assembly is according to the strength and material requirements as specified in the Contract Documents.

The manufacturer shall provide an inspector to inspect and test the anchorage assemblies. The manufacturer's inspector shall be certified for testing bridges according to CSA W178.2. The certification shall be either Level 2 or Level 3 for the methods used as specified in CAN/CGSB 48.9712.

The manufacturer's inspector shall inspect the place of manufacture of the anchorage assemblies while work on the units is being performed and shall inspect and examine the plant records and certificates, the materials used, and the fabrication process and shall conduct any tests as it may be considered necessary.

The manufacturer shall submit two copies of the completed inspection report to the Owner. Inspection reports shall be completed and certified by the manufacturer's inspector.

When the anchorage assemblies have been delivered to the Working Area and prior to installation, the manufacturer's inspector shall inspect the anchorage assemblies to ensure that they meet all the Contract requirements.

2474.07.06 Testing

Visual inspection of the anchorage assemblies shall be performed by welding inspectors certified by the Canadian Welding Bureau under CSA W178.2 at a Level 3 category or working under a Level 2 inspector.

2474.07.07 Packaging and Shipment

Each anchorage assembly shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity. A complete parts list shall be included in the shipment.

The supplier shall be responsible for loading, delivery, and off-loading of the anchorage assemblies to the designated areas. Anchorage assemblies shall be subject to inspection during and on completion of off-loading. If any damage is encountered during the off-loading inspection, the supplier shall be responsible for the necessary corrective measures subject to the approval of the Owner.

2474.08 QUALITY ASSURANCE

2474.08.01 Welding

All welding shall be subject to a visual inspection. Procedures and techniques for visual testing shall be according to CSA W59, Clause 7 and 8.

If faulty welding or material is encountered during the inspection procedures, the manufacturer shall submit corrective measures to the Contract Administrator for approval.

2474.08.02 Inspection

The Contract Administrator shall be notified a minimum of 3 Business Days prior to the start of fabrication, testing, and delivery dates.

The Contract Administrator shall have free access to the place of manufacture of the anchorage assemblies 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 anchorage assembly is being fabricated.

All anchorage assemblies may be subject to an inspection by the Contract Administrator prior to shipment.

2474.09 OWNER PURCHASE OF MATERIAL

2474.09.01 Measurement and Payment

For measurement purposes, a count shall be made of the number of anchorage assemblies supplied and accepted.

Payment at the price specified in the purchasing order shall be for the supply of the anchorage assemblies 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.

Appendix 2474-A, November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer shall specify the following in the Contract Documents:

- Length, number, and size of the anchor rods. (2474.05.01)
- Fabrication dimensions. (2474.07.01)
- Supply of anchorage assembly. (2474.07.01)

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

Related Ontario Provincial Standard Drawings

OPSD 2218.010	High Mast Lighting Pole Anchorage Assembly Placement
OPSD 2456.011	High Mast Lighting Pole Anchorage Assembly Details



**MATERIAL SPECIFICATION FOR UNINTERRUPTIBLE
POWER SUPPLY SYSTEMS FOR LED TRAFFIC SIGNALS**

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2475.09	OWNER PURCHASE OF MATERIAL - Not Used

APPENDICES

2475-A	Commentary

2475.01 SCOPE

This specification covers the requirements for uninterruptible power supply (UPS) systems for traffic signals utilizing light emitting diode (LED) modules.

2475.01.01 Specification Significance and Use

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

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

2475.01.02 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.

2475.02 REFERENCES

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

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

CSA Standards

C22.1-15	Canadian Electrical Code
C22.2 No. 94-M91 (R2001)	Special Purpose Enclosures

Electrical Safety Authority

Ontario Electrical Safety Code

National Electrical Manufacturer's Association

TS 2-2016 Traffic Controller Assemblies with NTCIP Requirements Version 03.07

2475.03 DEFINITIONS

AGM VRLA Battery means a sealed battery using absorbed glass mat and valve regulated lead acid technology.

CSA Enclosure Type 3 means an enclosure for either indoor or outdoor use, constructed so as to provide a degree of protection against rain, snow, and windblown dust, undamaged by the external formation of ice on the enclosure.

Gel Cell Battery means a sealed battery containing acid in a gel form.

2475.04 DESIGN AND SUBMISSION REQUIREMENTS

2475.04.01 Design Requirements

Each UPS system shall be designed for the traffic signal controller cabinet and equipment to which the UPS system will be connected. A comprehensive and detailed wiring diagram for each UPS system shall be designed and documented. The wiring diagram shall clearly indicate all UPS system wiring and connections, and shall clearly indicate all wiring and connections between the UPS system and the traffic signal controller cabinet and equipment.

2475.04.02 Submission Requirements

Prior to the installation of the UPS system, 3 copies of a comprehensive and detailed wiring diagram for each UPS system at each traffic control signal shall be submitted to the Contract Administrator.

2475.05 MATERIALS

2475.05.01 General

The UPS system shall provide uninterruptible power and conditioning of the utility power required for the operation of all electronic equipment used to operate the traffic control signals in the event of main utility power supply failure or voltage or frequency fluctuations.

The UPS system shall be supplied complete with UPS automatic switch.

The UPS control unit shall be a line interactive or double conversion type with automatic voltage regulation for 120V, 60Hz, single phase.

The UPS system shall include all wiring necessary to interconnect the UPS control unit to the power source and to the traffic signal control components.

The UPS control unit must latch from line to battery and from battery to line (transfer time) in less than 60 milliseconds.

When installed at a traffic signal using LED signal lamps, the UPS system shall be capable of maintaining full signal display operation for a minimum of 4 hours after which it shall be capable of maintaining a flashing signal display for a further 6 hours minimum.

Switching from full operation to a flashing operation may be determined by a timer circuit or based on battery capacity.

If the UPS control unit or the batteries fail, the system shall automatically switch back to utility line power.

If line power is restored during flashing operation, the traffic control signals shall commence the start-up sequence specified in the traffic control signals' timing sheet.

The UPS cabinet shall be supplied complete with pedestal or pole mounting hardware as specified in the Contract Documents.

The battery installation and wiring to the batteries shall be according to Ontario Electrical Safety Code.

The UPS system components shall operate properly for the time periods specified above under the following conditions:

- a) Ambient temperature: -37 to +74 °C.
- b) Humidity: 5 to 95 percent.
- c) The UPS system components shall withstand shock and vibration according to NEMA TS 2.

2475.05.02 UPS Cabinet

The cabinet shall be approved according to the Ontario Electrical Safety Code.

The UPS cabinet shall be a CSA Enclosure Type 3 cabinet constructed of aluminum and shall be painted grey. The cabinet shall be fabricated using sheet aluminum 3.17 mm thick and adequately reinforced by welded aluminum members.

Dimensions and details of the UPS cabinet shall be according to the Contract Documents.

The cabinet shall have one door hinged on one side with a continuous stainless steel piano hinge.

The door shall use a latch and lock mechanism. The door handle shall be zinc coated and painted the same colour as the cabinet.

The opening in the UPS cabinet shall allow full access to UPS components housed in the cabinet.

The cabinet shall be vented according to the Ontario Electrical Safety Code.

The circuit providing power to the battery heating mats shall be thermostat controlled and the thermostat shall be located in the UPS cabinet.

2475.05.03 Batteries

Batteries shall be AGM VRLA or gel cell technology.

Battery leads to UPS control unit shall be of suitable length and not less than 2.5 metres.

Each battery shall be placed on its own heater mat with all heater mats being supplied with AC power by the UPS control unit.

Battery mats shall become inoperable with loss of line voltage.

The batteries shall be protected by a circuit breaker or a fuse.

Each battery shall be labelled with the date of manufacture. The label shall be at a visible location on the top of the battery.

In addition to any other warranty, the Contractor shall provide a 3 year warranty on the batteries. The warranty period for each battery shall be 3 years, commencing from the date of "switch on" for operation of the UPS system in which the batteries are used. Any defective battery shall be replaced within 30 Days. The warranty shall include all labour, Equipment, and Materials required to replace the batteries, including traffic control and all removal and disposal work. The Contractor shall be responsible for the removal and disposal of any defective batteries replaced under warranty. The Owner shall be the sole judge in determining if a battery is defective.

2475.05.04**UPS Control Unit**

The UPS control unit shall be rack mountable with the following maximum dimensions: width of 483 mm (19 inches), depth of 254 mm (10 inches), and height of 153 mm (6 inches).

The front face of the control unit shall have indicators capable of displaying the following:

- a) Number of times the system was on battery supply.
- b) Total time on battery supply.
- c) Battery charge status to indicate the battery capacity.

Each of the battery supply indicators listed above shall have a manual reset switch.

The UPS control unit shall have a minimum of one standard 120V grounded socket located on either the back or the front panel.

The UPS control unit shall contain over-current protection located on the front panel to switch power on/off from the batteries and to switch AC input and output power on/off.

The UPS control unit shall have a self-test feature to test the UPS automatic switch and the control circuitry.

The UPS control unit shall have an open collector output or an AC or DC contact closure to indicate when the traffic signal is operating on battery supply.

The UPS control unit shall have an open collector output or an AC or DC contact closure to indicate low battery alarm.

The UPS control unit shall have a minimum of 1 switched AC output that will switch on when the traffic signal has been on battery supply continuously for 4 hours.

A 9 pin male serial port and/or Ethernet port shall be located on the front panel to allow for communication to a laptop computer for changing software settings. The Ethernet port shall support dynamic host configuration protocol (DHCP).

A set of battery voltage test points or a readout indicating battery voltage condition shall be located on the front panel.

2475.05.05**UPS Automatic Switch**

The UPS automatic switch shall allow the UPS control unit to be removed for replacement or maintenance without turning off the traffic signal system.

The utility line power shall be connected to the input of the automatic switch. Under normal operating conditions, the automatic switch shall connect the utility line power to the UPS control unit. In the event that the UPS control unit is not present or does not function, the automatic switch shall automatically connect the utility line power directly to the traffic signal system, bypassing the UPS control unit.

2475.05.06 Power Conditioning and the Use of Batteries by the UPS

Under normal operating conditions, the utility line power shall flow through the UPS control unit to the traffic signal system and any other connected loads.

When the utility line power is within the operating parameters specified by the UPS manufacturer and the Contract Documents, the UPS control unit shall condition and deliver the power to the loads without drawing power from the batteries.

When the utility line power is not within the operating parameters specified by the UPS manufacturer and the Contract Documents, the UPS control unit shall condition and deliver the power to the loads by drawing power from the batteries as required.

2475.05.07 Electrical

The UPS system shall accept an AC voltage input range of 85 to 135 VAC, single phase, 2 wire plus ground without drawing on battery power.

The UPS system shall provide voltage regulation at 120 VAC $\pm$ 3 percent under any line, load, or battery conditions other than "low battery", and a frequency regulation of 60 Hz $\pm$ 3 Hz synchronized to the utility line power.

Power rating shall be a minimum of 1000 VA (700W). The UPS system shall provide pure sine wave output, computer grade power compatible with all equipment loads, with power factor correction.

The UPS system shall include full time protection from sudden voltage increase with inrush protection and AC line filtering.

The UPS system shall provide complete isolation from the line operating as a separately derived power source according to CSA C22.1, Section 10, Grounding and Bonding.

The direct current (DC) system of the UPS system shall have a nominal DC system voltage of 60 VDC or less. The UPS DC system short circuit current shall not exceed 5000 A.

2475.07 PRODUCTION

All wires and leads shall be tied and secured within the UPS cabinet prior to delivery.

Appendix 2475-A, April 2018
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:

- Pedestal or pole mounting hardware to be supplied with the UPS cabinet. (2475.05.01)
- Dimensions and details of the UPS cabinet. (2475.05.02)
- Operating parameters of the utility line power to the UPS control unit. (2475.05.06)

The designer should perform an arc flash analysis.

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
RAISING AND LOWERING EQUIPMENT
FOR HIGH MAST LIGHTING POLES**

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APPENDICES

2476-A	Commentary

2476.01 SCOPE

The specification covers the requirements for raising and lowering equipment for high mast lighting poles.

2476.01.01 Specification Significance and Use

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

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

2476.01.02 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.

2476.02 REFERENCES

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 911 Coating Structural Steel Systems

Ontario Provincial Standard Specifications, Material

OPSS 1704 Paint Coating Systems for Structural Steel

CSA Standards

C22.2 No. 38-18	Thermoset-Insulated Wires and Cables
C22.2 No. 42-10 (R2015)	General Use Receptacles, Attachment Plugs, and Similar Wiring Devices
C22.2 No. 49-18	Flexible Cords and Cables
C22.2 No. 94-M91 (R2011)	Special Purpose Enclosures
G40.20-13/G40.21-13 (R2018)	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels
W47.1-09 (R2014)	Certification of Companies for Fusion Welding of Steel
W59-18	Welded Steel Construction
W178.1-18	Certification of Welding Inspection Organizations
W178.2-18	Certification of Welding Inspectors

Canadian General Standards Board (CGSB)

48.9712-2014 Non-Destructive Testing - Qualification and Certification of NDT Personnel

ASTM International

A 123/A 123M-17 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
F 593-17 Stainless Steel Bolts, Hex Cap Screws, and Studs
F 594-09 (2015) Stainless Steel Nuts

IEEE

C62.1-1989 Gapped Silicon-Carbide Surge Arresters for AC Power Circuits

National Electrical Manufacturers Association (NEMA)

250-2018 Enclosures for Electrical Equipment (1000 Volts Maximum)

2476.04 DESIGN AND SUBMISSION REQUIREMENTS

2476.04.01 Design Requirements

Raising and lowering equipment for high mast lighting poles shall be designed such that under all conditions the load on the winch cable shall never exceed 25% of the minimum breaking strength of the winch cable.

Raising and lowering equipment for high mast lighting poles shall be designed such that under all conditions the load on each support cable shall never exceed 25% of the minimum breaking strength of each support cable.

2476.04.02 Submission Requirements

2476.04.02.01 Working Drawings

Working Drawings shall be prepared for the fabrication of raising and lowering equipment for high mast lighting poles.

The Contractor shall submit 3 sets of Working Drawings to the Contract Administrator at least 14 Days prior to commencement of fabrication of the raising and lowering equipment for high mast lighting poles, for information purposes only. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

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

A copy of the Working Drawings shall be retained at the fabricator's plant during and after pole fabrication.

Working Drawings shall include the following:

- a) Detailed dimensioned layouts, including plans, elevations, and sections to clearly indicate the following:
 - i. Luminaire support rings and arms
 - ii. Luminaire mounting arrangements
 - iii. Counter-balancing arrangements
 - iv. Head assembly balancing arrangements
 - v. Motor mounting arrangements
 - vi. Winch mounting arrangements
 - vii. Electrical breaker box mounting arrangements
 - viii. Junction box details and mounting arrangements
 - ix. Electrical control enclosure mounting arrangements
- b) Detailed wiring diagrams for the internal drive luminaire raising and lowering equipment.
- c) Detailed wiring diagrams for the portable power units.
- d) Detailed bill of materials for the following:
 - i. Support cables and connectors
 - ii. Electrical cables and connectors
 - iii. Electrical circuit breakers
 - iv. Motors, reducers, and torque limiters
 - v. Electrical control enclosures
 - vi. Motor control circuitries
- e) Functional test data reports on the raising and lowering mechanism indicating that the gearbox mechanism meets manufacturer's specifications.
- f) Detailed parts list and sources of supply for each of the items listed.

2476.05 MATERIALS

2476.05.01 Attachment Hardware

All bolts, washers, spacers, springs, and locknuts shall be stainless steel type 304. Locknuts shall be vibration-proof and of the captive type. Self-tapping screws shall be stainless steel type 302HQ. Bolts shall be according to ASTM F 593 and nuts according to ASTM F 594.

2476.05.02 Latch Shaft and Locking Pin

The latch shaft and locking pin shall be formed from a continuous casting of type 316 stainless steel.

2476.05.03 Pulleys

Pulleys shall be fabricated from stainless steel or steel with a chromate finish.

2476.05.04 Luminaire Support Ring

The ring shall be fabricated from steel channel according to CAN/CSA G40.21, Grade 300W, and hot dip galvanized according to ASTM A 123. If required, counter balancing galvanized hardware shall be supplied as part of the ring assembly. The steel shall be certified to be impact tested per heat to Category 3 and shall satisfy the Charpy V-Notch test requirements of 20 joules for Grade 300 WT. Silicon content in the steel shall be equal to or less than 0.06%.

2476.05.05 Luminaire Tenon Arms

The luminaire tenon arms shall be HSS 60 mm diameter x 6.4 mm thick. The tenon arms shall be fabricated according to CSA G40.20/G40.21, Grade 260 WT, for high strength weldable notch tough steel, and hot dip galvanized according to ASTM A 123. The steel shall be certified to be impact tested per heat to Category 3 and shall satisfy the Charpy V-Notch test requirements of 20 joules for Grade 260 WT. Silicon content in the steel shall be equal to or less than 0.06%.

2476.05.06 Electrical Junction Box on the Ring

The electrical junction box on the ring shall be of stainless steel, CSA C22.2 No. 94, Type 4X, or NEMA 250, Type 4X, size 300 x 300 x 150 mm complete with connector and terminal blocks.

The connector shall be according to CSA C22.2 No. 42. The connector shall be protected with a cover and shall be housed in a CSA C22.2 No. 94, Type 3R, or NEMA 250, Type 3R, weatherproof, gasketed, polyester fibreglass reinforced housing.

2476.05.07 Lightning Arresters

Secondary thyrite-type lightning arrestors shall be rated to 650 V and according to IEEE C62.1.

2476.05.08 Electrical Cables

The electrical wiring on the ring shall be type SOW or SOOW according to CSA C22.2 No. 49 or Type TWH according to CSA C22.2 No. 38.

The power riser cable shall be type SO, SOW, or SOOW according to CSA C22.2 No. 49.

The circuit breaker cable shall be type SO, SOW, or SOOW according to CSA C22.2 No. 49.

The motor power cable and remote operating switch cable shall be type SOW or SOOW according to CSA C22.2 No. 49.

The motor cable shall be #12 AWG, number of conductors suitable for single or 3 phase motors.

The remote switch cable shall be #14 AWG, 4 conductor cable.

2476.05.09 Bumper Guard

The bumper guard shall be made from extruded santoprene thermoplastic rubber.

2476.05.10 Centring Arms

Centring arms shall be stainless steel spring-loaded complete with rubber non-marking rollers.

2476.05.11 Latch Indicator Flags

Indicator flags shall be flat stainless steel and shall be covered on the bottom side with high reflectance material.

2476.05.12 Twist Lock Plug Connectors

Twist lock plug connectors shall be according to CSA C22.2 No. 42.

2476.05.13 Winch Cable

As a minimum, the winch cable shall be 7.94 mm (5/16") diameter pre-stretched, stainless steel type 302/304, 7 x 19 strand aircraft cable.

2476.05.14 Internal Drive Motor

The internal drive motor shall be a 600 V, 3-phase, 1.5 hp reversible motor suitable for the 347/600 V system or a 240 V, single-phase, 1.5 hp reversible motor suitable for the 120/240 V system.

2476.05.15 Portable Power Unit

Portable power units shall be supplied when external drive mechanisms are used for driving the winch and shall be capable of operating the system at the capacity described and as specified in the Contract Documents.

The portable power unit shall be provided with a remote operating switch.

The portable power unit shall be provided with a torque limiting device between the power unit and the winch.

The portable power unit shall be equipped with a shear key that will give way before the breaking strength of the support cables is exceeded.

The portable power unit shall operate using a 120 V single-phase power source. When required to suit the power distribution system, a step down transformer shall be supplied with the unit. The portable power unit and the transformer shall be equipped with a female connector component of the combination twist lock plug connector type unit as described in the Electrical Connectors and Fittings clause in the Electrical Cables and Equipment subsection to match the plug for the luminaire riser wire and so ensure that the riser cable is disconnected prior to lowering the luminaire support ring. The transformer is to be housed in a weatherproof enclosure suitable for portable use.

2476.05.16 Reversing AC Magnetic Starter

The reversing AC magnetic starter shall comprise of an overload relay and a reversing contactor assembly rated 600 V, 7.5 hp for the 347/600 V system or 240 V, 3 hp for the 120/240 V system. Coil voltage for the contactors shall be 30 V or less.

The magnetic starter shall be electrically and mechanically interlocked to ensure against both contactors being energized simultaneously.

2476.05.17 Control Transformer and Power Supply

A control transformer, 347/30 V for the 347/600 V system or 120/30 V for the 120/240 V system shall be used to provide the 30 V or less coil voltage for the starter.

2476.05.18 Torque Limiter

The torque limiter shall be fabricated from corrosion resistant materials.

The torque limiter shall have automatic resetting features and provide flexibility between shafts.

2476.05.19 Remote Operating Switch Assembly

The complete remote operating switch shall have a CSA C22.2 No. 94, Type 4X, or NEMA 250, Type 4X, enclosure and operate at 30 V or less.

2476.05.20 Support Cables and Fittings

As a minimum, the support cables shall be flexible, 4.76 mm (3/16") diameter, pre-stretched, stainless steel type 302/304, 7 x 19 strand aircraft cables with a nominal breaking strength of 1,678 kg.

All cable fittings shall be stainless steel compression type and their load rating shall be at least 95% of the minimum breaking strength of the cable.

2476.05.21 Shroud Material and Coating

The shroud shall be 1.5 mm thick reinforced anodized aluminum. Coating shall be according to OPSS 911 and OPSS 1704.

2476.05.22 Electrical Connectors and Fittings

Electrical plugs and connectors for use with the riser wiring shall be a combination twist lock type that includes a disconnect switch according to CSA C22.2 No. 42.

2476.05.23 Housing for Connector

The housing for connector shall be CSA C22.2 No. 94, Type 3R, or NEMA 250, Type 3R, weatherproof, gasketed, polyester fibreglass reinforced housing.

2476.05.24 Electrical Breaker and Control Enclosure

The electrical breaker and control enclosure shall be CSA C22.2 No. 94, Type 4X, or NEMA 250, Type 4X, aluminum enclosure.

2476.07 PRODUCTION

2476.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

All fabrication shall be according to the dimensions on the Working Drawings and the Contract Documents.

2476.07.02 Head Frame Assembly

The head frame assembly shall consist of the following:

- a) Pulleys designed to support the power riser and support cables. The pulleys shall be fabricated from stainless steel or steel with a chromate finish and shall run on permanently lubricated bearings. Pulley diameters shall be large enough to prevent damage to the riser and support cables.
- b) A slip fitter to suit the pole tenon.
- c) Guides to ensure cables remain on their pulleys.
- d) Guides and stops to ensure the luminaire support ring is properly positioned.
- e) Spun aluminum dome cover to protect the pulleys from the elements. The cover shall be bolted to the head frame with stainless steel hardware.

- f) Three latching mechanisms to support the ring when it is in the locked position. The latching mechanisms shall consist of a stainless steel cam cover, a latch cam, and a latch shaft with a locking pin. The latch shaft and locking pin shall be formed from a continuous casting of type 316 stainless steel. The locking pin shall not be welded onto the latch shaft. The latch shall engage the latch plate. The latching mechanisms shall remove all the load from the winch and support cables when in the locked position.

2476.07.03 Luminaire Support Ring Assembly

The luminaire support ring shall support a maximum of 12 luminaires weighing a total maximum of 400 kg. The ring for the 25, 30, 35, 40, and 45 m poles shall support luminaires complete with shields and shroud having a combined maximum luminaire effective projected area of 4.0 m². Rings shall be capable of being drilled to accept up to 12 equally spaced HSS 60 mm diameter x 6.4 mm thick wall luminaire tenon arms. The arms shall be bolted to the ring.

The ring shall be fabricated from steel channel and hot dip galvanized. The ring shall be a balanced assembly and, if required, counter balancing galvanized hardware shall be supplied as part of the ring assembly.

Each tenon arm shall be capable of supporting a luminaire and shield having a maximum combined effective projected area of 0.2 m².

One weatherproof, stainless steel junction box, size 300 x 300 x 150 mm complete with connector and terminal blocks shall be mounted to the ring in-line with the pole handhole. The box shall be readily accessible for maintenance and shall not obstruct the raising or lowering of the ring. The male connector mounted on the ring-mounted junction box shall be used for testing the luminaires when the ring is in the lowered position. The connector shall be angled downward and shall be mounted on the surface of the junction box. This male connector shall be the inlet component of a combination twist lock plug connector unit and shall be compatible with the female connector unit supplied with the riser wiring. The connector shall be protected with a cover and shall be housed in a weatherproof, gasketed, polyester fibreglass reinforced housing. Liquid-tight, strain-relief, zinc-plated steel cable fittings complete with stainless steel locknuts and sealing washers shall be used for cable entries.

Secondary thyrite-type lightning arrestors shall be installed from the phase conductor to ground. The arresters shall be mounted on the ring junction box.

The ring shall be wired to the junction box and luminaire arms as required. All wiring on the ring shall be SOW or SOOW, with the number, size, and phase of conductors as specified in the Contract Documents.

The ring shall be equipped with a bumper guard. The bumper shall be continuous and securely fastened to the inside of the ring using plastic bolts and an appropriate bonding agent.

The ring shall be equipped with three equally spaced centring arms.

The ring shall be equipped with a top latching mechanism. The top latching mechanism shall lock and maintain the ring in the raised position, allowing the tension on the winch cable to be released.

The ring shall have three high visibility reflector indicator flags showing the latched and unlatched condition of the latches.

2476.07.04**Transition Assembly**

The transition assembly shall consist of a galvanized transition plate and attachment hardware for the winch and support cables. Each support cable shall be terminated with a galvanized or stainless steel thimble and compression sleeve and shall be attached to the transition plate either through a galvanized forged eyebolt or an anchor spring. The winch cable shall be terminated similarly and shall be attached to the plate through a galvanized or stainless steel shank ball or swivel of sufficient size to sustain the loading on the cable. The support cables shall travel through the pole shaft, over the head frame pulleys to the luminaire support ring where they are led through guides and are terminated with a collet type device or strand vise. Shock-absorbing compression springs shall be installed either at the transition assembly or at the cable attachment on the ring. The transition assembly design shall prevent twisting of the support cables and assure smooth winding of the winch cable.

The power riser cable originating from the ring junction box shall enter the head frame assembly such that no pressure is exerted on the cable while the ring is raised or lowered. The cable shall be supported by head frame pulleys and terminated with a male connector which is the inlet component of a combination twist lock plug connector unit and shall be compatible with the female unit provided with the riser wiring. It shall be protected with a cover and shall be housed in a weatherproof, gasketed, polyester fibreglass reinforced housing.

2476.07.05**Winch Assembly**

The winch to raise and lower the luminaire support ring shall be a sealed, maintenance free, oil bath worm gear that incorporates an internal friction drag brake to prevent free spooling. The winch drum shall have a cable guide assembly to guide the uncoiled cable neatly on the drum. The winch shall have a minimum lifting capacity of 750 kg and operate at 3 m/min $\pm$ 0.5 m/min. The winch drive shall be a horizontal drive and through a 16 mm (5/8") hex socket input shaft.

The drum shall be large enough to hold sufficient cable to meet individual pole height requirements. As a minimum, the winch cable shall be 7.94 mm (5/16") diameter pre-stretched, stainless steel type 302/304, 7 x 19 strand aircraft cable. The free end of the cable shall be finished with a galvanized or stainless steel thimble and compression sleeve. The winch cable shall be connected to the transition assembly through a galvanized or stainless steel shank ball or swivel.

The winch shall fit through the handhole opening and shall be mounted to the winch mounting plate with the hex socket input shaft to the right of the drum and pointing up. The winch mounting plate shall be attached to the pole mounting plate inside the handhole.

Operating instructions for raising and lowering the ring shall be provided and inscribed on a piece of anodized aluminum. The operating instructions shall be mounted on the inside of the pole handhole cover using silicone sealant. The lettering shall be large enough to be easily discernible.

2476.07.06**Internal Drive Motor**

The internal drive motor shall be totally enclosed, fan cooled, and require no maintenance.

The internal drive motor shall be assembled and mounted on the support plate by unistrut supports or similar products that facilitate quick easy removal of the complete unit when required. The removal of the internal drive motor shall be possible with a ring in either the latched or unlatched position without causing freewheeling of the winch drum.

The internal drive motor shall be operated by a remote operating switch.

2476.07.07 Reducer

A reducer used to reduce the speed of the motor shall be installed between the motor and torque limiter. The reducer shall be set such that the winch operates at 3 m/min $\pm$ 0.5 m/min.

2476.07.08 Torque Limiter

The torque limiter shall have automatic resetting features and provide flexibility between shafts. The torque limiter shall be bidirectional and factory pre-set at a torque value such that the raising and lowering equipment is according to the Design Requirements subsection and the manufacturer's recommendations.

2476.07.09 Remote Operating Switch Assembly

The remote operating switch shall be enclosed in a yellow, soft rubber moulded box. The box shall be provided with a tongue-and-groove cover and have a weatherproof, neoprene gasket seal and compression type nylon cord grip. The remote switch shall be clearly marked "Raise" and "Lower" and be attached to a 13 m cord. The raise and lower labels shall coincide with the supporting mechanism in the raised and lowered positions respectively. The raise and lower labels or nameplates shall be attached to the face of the remote operating switch assembly.

When an internal drive motor is used, the switch shall include a stainless steel bracket complete with S hook.

2476.07.10 Shroud

The shroud shall be attached to the luminaire support ring by means of mounting brackets.

The shroud support brackets, stiffeners, and mounting arms shall be fabricated from aluminum angle with an anodized finish. All fastening bolts and hardware shall be stainless steel.

The interior surface of the shroud assembly, shroud sections, supporting brackets, stiffeners, and mounting arms shall have a matte black finish. The exterior surface of the shroud shall be painted to suit the colour and finish of the high mast lighting pole.

The shroud and its supporting mounting brackets shall be constructed as specified in the Contract Documents.

The diameter of each shroud shall accommodate the luminaires and tenon arms that it encompasses.

2476.07.11 Electrical Cables and Equipment

2476.07.11.01 Electrical Cables

The power riser cable shall be terminated with a male connector of the inlet type that shall be a component of a combination plug connector unit. The connector shall be protected with a cover and shall be housed in a weatherproof, gasketed, polyester fibreglass reinforced housing. The cable shall have sufficient length to meet individual pole height requirements. In addition, there shall be a 2 m type SO, SOW, or SOOW jumper cable installed at the cover mounted electrical panel. The jumper cable shall be used for the following:

- a) Connection to the power riser cable with a ring in the raised position.
- b) Connection to the connector on a ring junction box for luminaire testing with the ring in the lowered position.

The motor power cable shall be able to be disconnected by means of a combination plug connector. The cable shall consist of a male and female cord-to-cord device that is sized to match the line voltage, phasing, and horsepower rating of the motor, and be of the ampacity rating specified in the Contract Documents. The unit shall include a spring-loaded connector lid, safety shutter, and spring-loaded pawl to prevent the plug from disengaging from the connector. The dead front connector shall be provided with spring-loaded silver nickel contacts that make or break the circuits. The unit as a whole shall be housed in a weatherproof, gasketed, polyester fibreglass reinforced housing.

The cable colour coding for each phase shall be according to CSA C22.2 No. 49 and shall be consistent both in the head and panel circuitry and as specified in the Contract Documents.

A braided copper strap shall be connected between the pole handhole cover and ground stud.

2476.07.11.02 Electrical Connectors and Fittings

Electrical plugs and connectors for use with the riser wiring shall be a combination twist lock type that includes a disconnect switch. The cord-to-cord unit shall be sized to match the line voltage, phasing, and horsepower rating of the motor, and be of the ampacity rating specified in the Contract Documents. It shall include a spring-loaded receptacle lid, safety shutter, and spring-loaded pawl to prevent the plug from disengaging from the connector and, that when operated, disconnects the circuits. The dead front connector shall be provided with spring-loaded silver nickel contacts that make or break the circuits. The unit as a whole shall be housed in a weatherproof, gasketed, polyester fibreglass reinforced housing.

2476.07.11.03 Electrical Breaker and Control Enclosure

One aluminum enclosure, sized as required, shall be used to house one main disconnect switch; branch circuit breakers; and motor controller complete with control transformer, terminal board, and 30 V or less power supply as required for the equipment located in the pole handhole and the system voltage. The enclosure shall be mounted on the inside of the pole using angle brackets or standoffs as specified in the Contract Documents.

2476.07.12 Welding

All welding shall be according to CSA W59. Welding shall only be undertaken by a fabricator fully approved under the requirements of CSA W47.1.

Prior to commencement of welding, the Canadian Welding Bureau Qualification Certificates for each person to be employed on the work shall be made available to the Contract Administrator. Certificates shall be currently valid and shall indicate the positions that the operator is qualified to weld.

2476.07.13 Testing

The company and inspector undertaking welding inspection shall be engaged by the Contractor. All welds shall be 100% examined by Magnetic Particle Inspection (MPI). The raising and lowering equipment shall be subjected to all visual and non-destructive testing.

The company undertaking welding inspection shall be certified for testing bridges in conformance with CSA W178.1. The certification shall encompass at least the following methods: radiograph, ultrasonic, and magnetic particle.

The inspector undertaking welding inspection shall be certified for testing bridges in conformance with CSA W178.2. Certification shall be to either Level II or III for the methods used, as required by CAN/CGSB 48.9712.

2476.07.14 Quality Control

The manufacturer shall certify that the raising and lowering devices are according to the strength and material requirements as specified in the Contract Documents.

The inspector shall perform the visual inspection and non-destructive testing of the raising and lowering devices. Both the inspector and the company employing the inspector shall be certified according to the Testing subsection.

The inspector shall inspect the place of manufacturer of the raising and lowering equipment while work on the units is being performed and shall inspect and examine the plant records and certificates, materials used, and fabrication process. The inspector shall conduct any tests as may be considered necessary.

Two copies of the completed inspection report shall be submitted to the Contract Administrator. The inspection report shall be completed and certified by the inspector.

2476.07.15 Packaging and Shipping

Raising and lowering equipment shall be shipped complete with hardware, suitably packaged to ensure that all parts are delivered as an entity. A complete parts list shall be included in the shipment. All cartons shall be marked with appropriate pole numbers.

Raising and lowering equipment shall be subject to inspection during and on completion of off-loading. If any damage is encountered during the inspection, the Contractor shall be responsible for the necessary corrective measures subject to the approval of the Owner.

The Contractor shall advise the Owner 3 Business Days prior to the shipping date of the intent to deliver and confirm that arrangements for off-loading have been made.

2476.08 QUALITY ASSURANCE

2476.08.01 Welding

All welding may be subject to inspection by both visual and non-destructive testing. The procedure and technique for visual and non-destructive testing shall be according to CSA W59, Clause 7 and 8.

If faulty welding is encountered during the inspection, corrective welding measures shall be submitted to the Contract Administrator by the Contractor.

2476.08.02 Inspection

The Contract Administrator shall be notified of the dates that fabrication and testing of the raising and lowering equipment will commence.

The Contract Administrator shall have free access to the place where the raising and lowering equipment is manufactured for the purpose of inspecting and examining the plant records, certificates, materials used, and fabrication process, while work is being performed. The Contract Administrator shall make or witness any tests as may be considered necessary.

All raising and lowering equipment may be inspected by the Contract Administrator prior to shipment.

2476.09 OWNER PURCHASE OF MATERIAL

2476.09.01 Measurement and Payment

For measurement purposes, a count shall be made of the number of raising and lowering equipment units delivered, offloaded, and accepted.

Payment at the price specified in the purchasing order shall be for the supply of the raising and lowering equipment 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 2476-A, April 2019 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:

- Operating capacity of portable power unit. (2476.05.15)
- Fabrication requirements. (2476.07.01)
- Number, size, and phase of conductors in the luminaire support ring. (2476.07.03)
- Ampacity rating for the male and female cord-to-cord device for the motor power cable. (2476.07.11.01)
- Cable colour coding in the head and panel circuitry. (2476.07.11.01)
- Ampacity rating for the cord-to-cord unit for electrical plugs and connectors. (2476.07.11.02)
- Angle brackets or standoffs to be used for mounted enclosures. (2476.07.11.03)

For Owner purchase of material, the following technical information should be given to the supplier in the purchasing order:

- a) Number and type of luminaires, including luminaire mounting arrangements.
- b) Length of the high mast lighting poles.

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 2453.060	High Mast Lighting Pole, Flood Light Luminaire Mounting Details
OPSD 2453.070	High Mast Lighting Pole, Luminaire Support Ring
OPSD 2453.080	High Mast Lighting Pole, Head Frame and Ring Assembly
OPSD 2453.090	High Mast Lighting Pole, Luminaire Shroud
OPSD 2453.091	High Mast Lighting Pole, Luminaire Shroud Details
OPSD 2453.140	High Mast Lighting Pole, Internal Drive Raising and Lowering Equipment - List of Components
OPSD 2453.150	High Mast Lighting Pole, Internal Drive Raising and Lowering Equipment - Layout
OPSD 2453.170	High Mast Lighting Pole, Internal Drive Wiring Diagram, 347/600V, 3-Phase
OPSD 2453.180	High Mast Lighting Pole, Internal Drive Wiring Diagram, 120/240V, 1-Phase
OPSD 2453.190	High Mast Lighting Pole, External Drive Raising and Lowering Equipment - List of Components
OPSD 2453.200	High Mast Lighting Pole, External Drive Raising and Lowering Equipment - Layout
OPSD 2453.210	High Mast Lighting Pole, External Drive Raising and Lowering Equipment, 347/600V, 3-Phase Wiring Diagram
OPSD 2453.220	High Mast Lighting Pole, External Drive Raising and Lowering Equipment, 120/240V, 1-Phase Wiring Diagram



Note: The MUNI implemented in November 2017 replaces OPSS 2479 COMMON, November 2015 with no technical content changes.

MATERIAL SPECIFICATION FOR FLOODLIGHT LUMINAIRES USED IN HIGH MAST LIGHTING

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2479-A	Commentary

2479.01 SCOPE

This specification covers the requirements for high mast floodlight luminaires with integral ballast for use in high mast lighting.

2479.01.01 Specification Significance and Use

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

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

2479.01.02

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.

2479.02

REFERENCES

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

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

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

CSA Standards

C22.2 No. 9.0-96 (R2011)	General Requirements for Luminaires
C863-11	Energy Efficiency of High-Intensity Discharge (HID) and Low-Pressure Sodium (LPS) Lamp Ballasts

2479.04 DESIGN AND SUBMISSION REQUIREMENTS

2479.04.01 Design Requirements

2479.04.01.01 Photometric Requirements

Photometric test results shall be provided for the floodlight type luminaire supplied and shall include the following data:

- a) Isolux curves and mounting height correction factors.
- b) Utilization charts or graphs indicating the total beam utilization.
- c) Candlepower distribution curves indicating peak intensity.
- d) Luminous intensity tables to Illuminating Engineering Society format (I-tables).
- e) Luminaire efficiency values.
- f) Lamp lumen outputs and wattages.

2479.04.01.02 Electrical Requirements

All electrical components and assembled luminaires shall be according to CSA C22.2 No. 9.0.

Ballasts, lamp sockets, ground connectors, internal wiring, and all other components shall be suitable for the supply voltage as specified in the Contract Documents and the maximum temperature encountered in totally enclosed, outdoor, weatherproof luminaires.

Ballasts shall be constant wattage auto-transformer or isolated secondary transformer type for grounded systems. Auto-transformer type ballasts shall have a maximum tolerance of 12% variation in lamp wattage for a 5% variation in line voltage. Isolated secondary transformer type ballasts shall have a maximum tolerance of 12% variation in lamp wattage for a 10% variation in line voltage.

Ballasts shall be of Class H, 180 °C insulation; 60 hertz; and low temperature, -35 °C with a power factor not less than 0.90.

The minimum nominal secondary open circuit voltage of the ballast for various lamps shall be sufficient to provide reliable starting at -35 °C.

Ballasts shall be suitable for the lamp's nominal operating voltage. Terminal blocks shall be held rigidly and shall provide a positive connection for terminating the field wiring.

Energy efficiency of lamp ballasts shall be according to CAN/CSA C863.

2479.04.01.03 Mechanical Requirements

The luminaire housing shall be cast aluminum or heavy-duty sheet aluminum. The ballast shall be integral. All external fasteners and associated hardware shall be stainless steel. The luminaire shall be provided with a built-in aiming device.

Mounting arrangements shall be trunnion type or slip fitter for a 50 mm diameter internal pipe size tenon with provisions for vertical and horizontal adjustment. The luminaire shall be complete with all external fasteners and associated hardware required for the aiming of the luminaire and attachment to the slip fitter or mounting pad.

The optical assembly shall consist of a specular high purity anodized aluminum reflector. The reflector shall be precision formed and assembled in a way that the formed contour is maintained when it is removed from the luminaire housing. The optical assembly shall be sealed with a high temperature neoprene or silicone rubber gasket located between the door frame and luminaire housing.

When required and as specified in the Contract Documents, a secondary reflector or louvre shall be provided inside the sealed optical assembly. The louvre shall effectively screen the lamp from direct view and provide a cut-off 10° above the peak intensity on the vertical plane.

The door assembly shall consist of a gasketed door frame and a clear tempered shock-resistant glass lens and shall be hinged to the luminaire housing. The luminaire shall be accessible with tool-less entry.

The lamp socket shall be a mogul type with a porcelain-enclosed, nickel-plated brass shell rated for 4,000 volts, and spring-loaded centre contact. The lamp holder shall have an electrically insulated lamp stabilizer and shall hold the lamp's outer envelope in precise alignment with suitable means for vibration damping.

The luminaire assembly when closed and in the operating position shall not be subject to damage by vibration.

2479.04.02 Submission Requirements

2479.04.02.01 Working Drawings

Three copies of Working Drawings shall be submitted to the Contract Administrator a minimum of 14 Days prior to the commencement of fabrication.

As a minimum, the Working Drawings shall include the following information:

- a) Detailed dimensioned layout, including plans, elevations, and weight.
- b) Photometric curve data.
- c) Details of optical system.

Each Working Drawing shall be sealed and stamped by an Engineer certifying that the Working Drawings comply with the Contract Documents.

One copy of the final accepted Working Drawings shall be returned to the supplier, along with written notification to commence fabrication. Within 14 Days of receipt of notification to commence fabrication, the supplier shall submit 3 copies of all final accepted Working Drawings to the Contract Administrator.

Fabrication of the equipment shall not commence until the Working Drawings have been accepted by the Contract Administrator.

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

2479.05 MATERIALS

2479.05.01 Marking

A permanent non-corrosive nameplate shall be attached to the exterior of the luminaire and located so that the marking is clearly visible during relamping. The nameplate shall indicate the manufacturer's name or trademark, catalogue number, electrical rating, input amperes, luminaire voltage, date of manufacture, and the vertical and horizontal beam distribution.

A permanent label shall be attached to the interior of the luminaire indicating the manufacturer's name or trademark, catalogue number, date of manufacture, and the American National Standards Institute (ANSI) or Illuminating Engineering Society (IES) photometric classification and distribution type; the suitable supply voltage and frequency; the lamp type; the lamp wattage; and the nominal operating voltage of the lamp so that it is clearly visible during maintenance operations.

A label including a wiring diagram shall be attached to each ballast showing the ballast schematic wiring diagram and shall be visible during maintenance operations.

For asymmetrical luminaires with adjustable optical systems, a permanent embossed identification mark shall be located on the luminaire that is clearly visible and identifiable as an orientation mark.

2479.07 PRODUCTION

2479.07.01 Ballast Assemblies

Ballast assemblies shall be factory pre-wired with all connections clearly marked and identified.

2479.07.02 Lamp Socket Positions

The lamp socket position shall be pre-set at the factory for the specified distribution.

2479.08 QUALITY ASSURANCE

2479.08.01 Inspection

The supplier shall notify the Owner of the date that the fabrication of the luminaires is to commence.

The Owner's representative shall have free access to the place of fabrication for the purpose of inspecting and examining plant records, certificates, materials used, fabrication process, and to make any tests as may be considered necessary, while the luminaires are being fabricated.

All luminaires are subject to an inspection by the Owner's representative prior to shipment.

2479.09 OWNER PURCHASE OF MATERIAL

2479.09.01 Packaging and Shipment

The supplier shall provide 3 copies of the luminaire ballast engineering data and shielding data such as material type, gauge thickness, and mounting arrangement to the Owner.

Each luminaire shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity. A complete parts list shall be included in the shipment. All cartons shall be marked with the ANSI or IES luminaire classification and distribution types.

The supplier is responsible for loading, delivery, and off-loading of luminaires to designated areas. Luminaires shall be subject to inspection during and on completion of off-loading. If any damage to the luminaires is encountered during the inspection, the supplier shall be responsible for the necessary corrective measures subject to the approval of the Owner.

The supplier shall advise the Owner 3 Working Days prior to the shipping date of the intent to deliver and confirm that arrangements for off-loading have been made.

2479.09.02 Measurement and Payment

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

Payment at the price specified in the purchasing order shall be full compensation for the supply and delivery of the floodlight luminaires to the destination at 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 2479-A, November 2017
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Supply voltage to the luminaires. (2479.04.01.02)

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

- Secondary reflector or louvre requirements. (2479.04.01.03)

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

For Owner purchase of material, the following technical information should be given to the supplier in the purchasing order:

- a) Nominal line voltages.
- b) Lamp wattages.
- c) Lamp types and ANSI designations.
- d) Ballast types.
- e) Mounting arrangements.
- f) Luminaire classifications and distribution types.
- g) Photometric curves or test report numbers.
- h) Luminaire vertical and horizontal beam distribution.
- i) Contract layout drawings.

Related Ontario Provincial Standard Drawings

OPSD 2453.060 High Mast Lighting Pole, Flood Light Luminaire Mounting Details



Note: The MUNI implemented in November 2017 replaces OPSS 2485 COMMON, November 2015 with no technical content changes.

MATERIAL SPECIFICATION FOR PHOTOELECTRIC CONTROLLERS

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2485.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
2485.05	MATERIALS - Not Used
2485.06	EQUIPMENT - Not Used
2485.07	PRODUCTION
2485.08	QUALITY ASSURANCE - Not Used
2485.09	OWNER PURCHASE OF MATERIAL

APPENDICES

2485-A	Commentary

2485.01	SCOPE

This specification covers the requirements for electronic photoelectric controllers rated for 1,800 VA for use with 105 to 305 volt power supply at 60 Hz.

2485.01.01 Specification Significance and Use

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

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

2485.01.02

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.

2485.02

REFERENCES

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

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

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

CSA Standards

C239-02 (R2011) Performance Standard for Dusk-to-Dawn Luminaires

American National Standards Institute (ANSI)

C136.10-2010 Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacle - Physical and Electrical Interchangeability and Testing

2485.07 PRODUCTION

2485.07.01 General

Photoelectric controllers shall be electronic and according to CAN/CSA C239.

Photoelectric controllers shall be of weatherproof construction and operational within a temperature range of -40 to 65 °C.

Photoelectric controllers shall be factory preset at 16 lux switch-on light level and 50 lux switch-off light level.

2485.07.02 Electrical Requirements

Photoelectric controllers shall be provided with three locking type blades according to ANSI C136.10.

Photoelectric controllers shall be supplied with contacts normally closed at nighttime or under failure conditions. Photoelectric controllers shall have an internal lightning arrester with a minimum spark over of 2.0 kV. The power consumption of the photoelectric controller itself shall be 5 watts or less.

2485.07.03 Marking

A permanent type of identification shall be provided on the outside of the photoelectric controller indicating the manufacturer's name or trademark, catalogue number, voltage, VA rating, and date coding.

2485.09 OWNER PURCHASE OF MATERIAL

2485.09.01 Packaging and Shipment

Each photoelectric controller shall be shipped complete with hardware and individually packaged and identified on the outside of the package.

The supplier shall advise the Owner 3 Working Days prior to the shipping date of the intent to deliver.

2485.09.02 Measurement and Payment

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

Payment at the price specified in the purchasing order shall be for the supply of the photoelectric controllers delivered to the destination on the date and time specified.

Appendix 2485-A, November 2017
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

Related Ontario Provincial Standard Drawings

No information provided here.



**MATERIAL SPECIFICATION FOR
CALCIUM CHLORIDE AND CALCIUM-MAGNESIUM CHLORIDE BLEND**

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2501.01	SCOPE
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2501.09	OWNER PURCHASE OF MATERIAL

APPENDICES

2501-A	Commentary

2501.01	SCOPE

This specification covers the requirements for calcium chloride or calcium-magnesium chloride blend for use as a dust suppressant or de-icer.

2501.01.01 Specification Significance and Use

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

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

2501.01.02 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.

2501.02 REFERENCES

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

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

Canadian General Standards Board (CGSB)

15.1-92 Standard for Calcium Chloride

ASTM International

D1293-18 Standard Test Methods for pH of Water
E449-18 Analysis of Calcium Chloride

Pacific Northwest Snowfighters (PNS)

Test Method B Corrosion Rate as Conducted from the NACE Standard TM0169-95 (1995 Revision) and as Modified by the Pacific Northwest States *

Test Method C Percent Total Settleable Solids and Percent Solids Passing on a No. 10 Sieve *

* [Part of 2008 Pacific Northwest Snowfighters Snow and Ice Control Chemical Products Specifications and Test Protocols]

2501.03 DEFINITIONS

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

Calcium chloride solid means a granular form of anhydrous calcium chloride (CaCl_2) that may be applied directly or dissolved in water to form calcium chloride solution.

Calcium chloride solution means an aqueous solution of calcium chloride solid.

Calcium-magnesium chloride blend means an aqueous solution containing predominantly calcium chloride with supplemental magnesium chloride (MgCl_2).

2501.05 MATERIALS

2501.05.01 Calcium Chloride Solid

Calcium chloride solid shall be loose, dry, and according to CAN/CGSB 15.1, Type S:

- a) Grade 1, Class A;
- b) Grade 2, Class B; or
- c) Grade 3, Class B.

2501.05.02 Calcium Chloride Solution

Calcium chloride solution shall be according to CAN/CGSB 15.1, Type L, Class 1, and shall be homogeneously mixed.

Calcium chloride solution used as a dust suppressant shall contain a minimum of 35% by mass of pure calcium chloride and shall meet the requirements shown in Table 1.

Calcium chloride solution used as a de-icer shall:

- a) Contain a minimum of 25% by mass of pure calcium chloride.
- b) Contain a corrosion inhibitor when specified in the Contract Documents or purchasing order.
- c) Meet the requirements shown in Table 1.

2501.05.03 Calcium-Magnesium Chloride Blend

Calcium-magnesium chloride blend used as a dust suppressant shall have a minimum of 27% by mass of calcium chloride, a minimum calcium chloride equivalence of 35% and shall meet the requirements shown in Table 2. Calcium-magnesium chloride blend shall exhibit no crystallization above 5 °C.

Calcium-magnesium chloride blend used as a de-icer shall:

- a) Contain a minimum of calcium chloride equivalence of 29% and shall meet the requirements shown in Table 2.
- b) Contain a corrosion inhibitor when specified in the Contract Documents or purchase order.
- c) Meet the requirements shown in Table 1.

2501.07 PRODUCTION

2501.07.01 Packaging and Delivery

Calcium chloride solid shall be delivered in moisture-proof 20, 40, or 1,000 kg bags by railway hopper car or by truck and in a dry and useable condition.

Calcium chloride solution and calcium-magnesium chloride blend shall be delivered by railway tank car or truck tank.

2501.07.02 Labelling

2501.07.02.01 Calcium Chloride Solid and Calcium Chloride Solution

Labelling shall be according to CAN/CGSB 15.1 with each container legibly marked with the following:

- a) Cautionary information specified in CAN/CGSB 15.1.
- b) Manufacturer's or supplier's name.
- c) Date packaged (i.e., yyyy-mm-dd).
- d) Type, grade, and class.
- e) Concentration of pure calcium chloride.
- f) Unit size (mass or volume).
- g) Standard number (i.e., CAN/CGSB 15.1-92).

When bulk shipping is provided, the shipping manifest shall include the same information.

2501.07.02.02 Calcium-Magnesium Chloride Blend

The shipping manifest shall include the following information:

- a) Manufacturer's or supplier's name.
- b) Date shipped (i.e., yyyy-mm-dd).
- c) Words "Calcium-Magnesium Chloride Blend".
- d) Concentration of pure calcium chloride and percent calcium chloride equivalency.
- e) Unit size (volume).

2501.08 QUALITY ASSURANCE

2501.08.01 Sampling and Testing

Calcium chloride solid, calcium chloride solution, and calcium-magnesium chloride blend may be subject to sampling and testing for conformity to the specified requirements. All materials that fail to meet the specified requirements shall be rejected.

2501.08.01.01 Sampling Calcium Chloride Solid

A minimum of three samples shall be selected by the Owner at random from the shipment. Samples shall be taken by the Owner by scraping aside the top layer of material to a depth of approximately 25 mm and taking a 0.5 kg representative sample by means of a sampling tube or other method. Precautions shall be taken during the sampling operation to avoid exposing the sample unduly to atmospheric moisture. Immediately after collecting the three samples, the individual samples shall be mixed thoroughly to form a composite sample of material, and then be stored and sealed in a suitable glass or plastic container.

2501.08.01.02 Sampling Calcium Chloride Solution and Calcium-Magnesium Chloride Blend

A minimum of three samples from each tank of the shipment shall be selected by the Owner. Each sample shall be representative of the contents of the tank. Precautions shall be taken during the sampling operation to avoid exposing the sample unduly to atmospheric moisture. Immediately after collecting the three samples, the individual samples shall be mixed thoroughly to form a composite sample of material, and then be stored and sealed in a suitable glass or plastic container.

2501.08.02 Certificate

Upon request, a manufacturer's certificate shall be provided stating that an independent laboratory has tested the product and found it to be in complete conformance with this specification.

2501.09 OWNER PURCHASE OF MATERIAL

2501.09.01 Measurement and Payment

2501.09.01.01 General

Payment at the price specified in the purchasing order shall be for the supply of the calcium chloride solid, calcium chloride solution, or calcium-magnesium chloride blend 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.

2501.09.01.02 Calcium Chloride Solid

Measurement of calcium chloride solid shall be by mass in kilograms. Weighing shall be as specified in the purchasing order.

2501.09.01.03 Calcium Chloride Solution

Measurement of calcium chloride solution, at the concentration specified, shall be by one of the following methods:

a) Mass of solution in tonnes.

When shipped by railway tank car or when weighed at the source of supply, the mass of solution shall be substantiated by bills of lading in as many copies as the Owner may require. Railway scales shall be as specified in the purchasing order.

When weighing by truck tank, the mass of solution shall be determined as specified in the purchasing order.

b) Volume of solution in litres.

The volume of solution in litres shall be measured by means of a metering device as specified in the purchasing order.

When volumetric measurement is used, the Owner shall be provided with an invoice for each tank load of solution delivered. The invoice shall contain a note signed by the delivery person, as the official representative of the supplier of solution, indicating the total volume in litres of the delivery tanker and certifying the actual volume of solution in litres delivered in each tank load.

When calcium chloride solution is used as a dust suppressant, the mass of solution in tonnes may be converted to a mass of equivalent solid in kg. In converting the mass of solution to an equivalent mass in solid, a conversion factor for a 35% calcium chloride solution of 1 tonne of solution to 455 kg of solid shall be used.

The volume in litres of solution may be converted to an equivalent mass of solution in tonnes. In converting the volume of solution to an equivalent mass of solution, the following conversion factors shall be used:

a) 1.353 kg/litre shall be used for a minimum 35% solution.

b) 1.236 kg/litre shall be used for a minimum 25% solution.

2501.09.01.03 Calcium-Magnesium Chloride Blend

Measurement of calcium-magnesium chloride blend, at the concentration specified, shall be by one of the following methods:

a) Mass of solution in tonnes.

When shipped by railway tank car or when weighed at the source of supply, the mass of solution shall be substantiated by bills of lading in as many copies as the Owner may require. Railway scales shall be as specified in the purchasing order.

When weighing by truck tank, the mass of solution shall be determined as specified in the purchasing order.

b) Volume of solution in litres.

The volume of solution in litres shall be measured by means of a metering device as specified in the purchasing order.

When volumetric measurement is used, the Owner shall be provided with an invoice for each tank load of solution delivered. The invoice shall contain a note signed by the delivery person, as the official representative of the supplier of solution, indicating the total volume in litres of the delivery tanker and certifying the actual volume of solution in litres delivered in each tank load.

TABLE 1
Calcium Chloride Properties

Material/Property	Calcium Chloride Solution		Test Procedure
	Dust Suppressant	De-Icing	
Total Settleable Solids	-	<1% (Note 1)	PNS Test Method C
Corrosion Inhibitor	-	Minimum 70% less corrosive than Sodium Chloride	PNS Test Method B
pH (Note 2)	6 to 9	6 to 9	ASTM D1293
Notes: 1. 99% of the solids passing through a 2.00 mm sieve after being stored for 168 hours at -29 ± 1 °C. 2. Dilute 1 part product to 4 parts distilled water before attempting a reading.			

TABLE 2
Calcium-Magnesium Chloride Blend Properties

Material/Property	Calcium-Magnesium Chloride Blend		Test Procedure
	Dust Suppressant	De-Icing	
Calcium Chloride (CaCl ₂), % minimum by mass	27.0	22.0	ASTM E449
Magnesium Chloride (MgCl ₂), % minimum by mass	As required for total CaCl ₂ equivalence (Note 1)		ASTM E449
Total CaCl ₂ equivalence, % minimum by mass	35.0	29.0	(Note 1)
Other Alkali Chlorides: NaCl, KCl, % maximum by mass	2.0	1.75	ASTM E449
pH (Note 2)	6 to 9	6 to 9	ASTM D1293
Corrosion Inhibitor	-	Minimum 70% less corrosive than Sodium Chloride	PNS Test Method B
Notes: 1. Total CaCl ₂ equivalence = % CaCl ₂ + (% MgCl ₂ x 1.166). 2. Dilute 1 part of product to 4 parts distilled water prior to attempting a reading.			

Appendix 2501-A, November 2021
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

- Corrosion inhibitor. (2501.05.02, 2501.05.03)

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

Related Ontario Provincial Standard Drawings

No information provided here.



**MATERIAL SPECIFICATION FOR
SODIUM CHLORIDE SOLID AND SODIUM CHLORIDE SOLUTION**

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2502.03	DEFINITIONS - Not Used
2502.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
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2502.06	EQUIPMENT - Not Used
2502.07	PRODUCTION
2502.08	QUALITY ASSURANCE
2502.09	OWNER PURCHASE OF MATERIAL

APPENDICES

2502-A	Commentary

2502.01 SCOPE

This specification covers the requirements for sodium chloride solid and sodium chloride solution for use in snow and ice control.

2502.01.01 Specification Significance and Use

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

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

2502.01.02 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.

2502.02 REFERENCES

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

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

ASTM International

D 632-01	Sodium Chloride
D 1293-12	Standard Test Methods for pH of Water
D 1429-13	Standard Test Methods for Specific Gravity of Water and Brine

Others:

2004 Pacific Northwest Snowfighters Snow and Ice Control Chemical Products Specifications and Test Protocols:
Test Method C - Percent Total Settleable Solids and Percent Solids Passing on a No. 10 Sieve

2502.05 MATERIALS

2502.05.01 Sodium Chloride Solid

Sodium chloride solid (rock salt) shall be in a free-flowing state until used and meet the requirements of ASTM D 632, Type I, Grade 1.

Sodium chloride solid from the mines in the Lake Huron basin can contain up to 3% combined magnesium chloride and calcium chloride.

2502.05.02 Sodium Chloride Solution

Sodium chloride solution shall:

- a) Contain 23.3% by mass of sodium chloride solid mixed homogeneously within a tolerance of -1.0% to +0.3%.
- b) Meet the requirements of Table 1.

2502.07 PRODUCTION

2502.07.01 Packaging and Delivery

When delivery in bags is specified in the Contract Documents or purchasing order, as appropriate, the sodium chloride solid shall be delivered in moisture-proof bags.

When delivery in bulk is specified in the Contract Documents or purchasing order, as appropriate, the sodium chloride solid shall be delivered by ship, rail, or truck; whichever method is specified. The loads shall be covered with weathertight coverings.

Sodium chloride solution shall be delivered by railway tank car or truck tank. The tanker shall be equipped with a meter that measures in litres and has been calibrated within the past 12 months.

2502.07.02 Marking

Bags shall be legibly marked with the following information:

- a) Name of manufacturer.
- b) Production date codes with key to decrypt the date codes.
- c) Net content mass.
- d) Salt grade (i.e., coarse crushed rock salt or fine crushed rock salt).

2502.08 QUALITY ASSURANCE

2502.08.01 Inspection, Sampling, and Testing

Sodium chloride solid and sodium chloride solution may be subjected to sampling and testing for conformity to the specified requirements. All materials that fail to meet the specified requirements may be rejected by the Owner. Rejected materials shall be replaced at no extra cost to the Owner. Materials currently in storage that have been contaminated by the rejected materials shall also be replaced at no extra cost to the Owner. All costs incurred by the Owner for service or repairs or both to Owner's equipment as a result of damages caused by the rejected material shall be paid by the supplier.

2502.08.01.01 Sampling Sodium Chloride Solid

Samples of the material may be taken on delivery and throughout the duration of the Contract by the Owner. The supplier shall be furnished at no cost with copies of the results of all testing undertaken by the Owner.

2502.08.01.02 Sampling Sodium Chloride Solution

Not less than three samples from each tank of each shipment shall be taken by the Owner. Each sample shall be representative of the contents of the tank. Sample size shall be a minimum of 2 litres. Precautions shall be taken during the sampling operation to avoid exposing the samples unduly to atmospheric moisture. Immediately after collecting the three samples, the individual samples shall be mixed thoroughly to form a composite sample of material and then be stored and sealed in a suitable glass or plastic container. The supplier shall be furnished at no cost with copies of the results of all testing undertaken by the Owner.

2502.08.01.02.01 Manufacturer's Certificate

Upon request, a manufacturer's certificate of analysis, signed by the manufacturer's representative, stating that the solution has been tested and found to be in complete conformance with this specification shall be provided.

2502.09 OWNER PURCHASE OF MATERIAL

2502.09.01 Inspection, Sampling, and Testing

Prior to the first delivery, the supplier shall provide the Owner with a 2 kg solid or 2 litre liquid sample, as appropriate, that is representative of the material to be supplied during the term of the purchasing order.

2502.09.02 Measurement and Payment

2502.09.02.01 Sodium Chloride Solid

Sodium chloride solid shall be measured by mass in tonnes as specified in the purchasing order.

When shipped in bulk, sodium chloride solid shall be weighed at the source of supply and the mass shall be substantiated by bills of lading in as many copies as the Owner may require.

Payment at the price specified in the purchasing order shall be for the supply of the sodium chloride solid 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.

2502.09.02.02 Sodium Chloride Solution

Sodium chloride solution shall be measured by volume in litres of solution.

Sodium chloride solution shall be weighed at the source of supply and the mass shall be substantiated by bills of lading in as many copies as the Owner may require.

When shipping is by railway tank car, railway scales shall be as specified in the purchasing order.

When shipping is by truck tank, the mass shall be determined as specified in the purchasing order.

As an alternative to weighing for measurement in tonnes, the sodium chloride solution may be measured by means of a metering device specified in the purchasing order by volume and reported in litres.

Specific gravity of 1.176 shall be used for a solution of 23.3%.

When volumetric measurement is used, the Owner shall be provided with a bill of lading produced by an electronic metering device located on the discharge piping from the tanker, for each tank load of solution delivered. The invoice shall contain a note, signed by the delivery person as the official representative of the supplier of sodium chloride solution, indicating the total volume in litres of the delivery tanker and certifying the actual volume in litres of sodium chloride solution delivered in each tank load.

Payment at the price specified in the purchasing order shall be for the supply of the sodium chloride solution 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.

TABLE 1
Material Properties
Sodium Chloride Solution

Material Property	Solution	Range	Test Procedure
Sodium Chloride %	23.3	-1.0 / +0.3	Atomic Absorption Spectrometric Method
Specific Gravity	1.176	-	ASTM D 1429 Test Method A 20 °C ± 1 °C
Combined Magnesium and Calcium Chloride % Maximum	< 1%	-	-
Total Settleable Solids	< 1%	-	PNS Test Method C
pH range (Note1)	-	6 - 9	ASTM D 1293
Note: 1. Dilute 1 part product to 4 parts distilled water before attempting a reading.			

Appendix 2502-A, November 2019
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 or purchasing order:

- Packaging and delivery requirements. (2502.07.01)

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

Related Ontario Provincial Standard Drawings

No information provided here.



Note: The MUNI implemented in November 2017 replaces OPSS 2503 COMMON, November 2011 with no technical content changes.

MATERIAL SPECIFICATION FOR MAGNESIUM CHLORIDE SOLID AND MAGNESIUM CHLORIDE SOLUTION

TABLE OF CONTENTS

2503.01	SCOPE
2503.02	REFERENCES
2503.03	DEFINITIONS - Not Used
2503.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
2503.05	MATERIALS
2503.06	EQUIPMENT - Not Used
2503.07	PRODUCTION
2503.08	QUALITY ASSURANCE
2503.09	OWNER PURCHASE OF MATERIAL

APPENDICES

2503-A	Commentary

2503.01	SCOPE

This specification covers the requirements for magnesium chloride solid and magnesium chloride solution for use as dust suppressant and de-icer.

2503.01.01 Specification Significance and Use

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

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

2503.01.02

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.

2503.02

REFERENCES

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

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

ASTM International

D 1293-99(2005) Standard Test Methods for pH of Water

American Public Health Association - American Water Works Association - Water Environment Federation

3500-Mg, Atomic Absorption Spectrometric Method Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998

Pacific Northwest Snowfighters (PNS)

Test Method B Corrosion Rate as Conducted from the NACE Standard TM0169-95 (1995 Revision) and as Modified by the Pacific Northwest States*

Test Method C Percent Total Settleable Solids and Percent Solids Passing on a No. 10 Sieve*
* [Part of 2008 Pacific Northwest Snowfighters Snow and Ice Control Chemical Products Specifications and Test Protocols]

U.S. Environmental Protection Agency - National Environmental Publications Information System

EPA-600/R-94/111 May 1994 Methods for the Determination of Metals in Environmental Samples, Supplement 1, Method No. 200.7 - Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma - Atomic Emission Spectrometry

2503.05 MATERIALS

2503.05.01 Magnesium Chloride Solid

Magnesium chloride solid shall be in the form of loose dry flakes or pellets, be magnesium dichloride hexahydrate ($\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$), and meet the requirements of Table 1.

2503.05.02 Magnesium Chloride Solution

Magnesium chloride solution used as dust suppressant shall contain a minimum 30% by mass of pure magnesium chloride and shall meet the requirements of Table 1.

Magnesium chloride solution used as de-icer shall:

- a) Contain a minimum of either 22 or 30% by mass of pure magnesium chloride as specified in the Contract Documents or purchasing order.
- b) Contain a corrosion control inhibitor when specified in the Contract Documents or purchasing order.
- c) Meet the requirements of Table 1.

2503.07 PRODUCTION

2503.07.01 Packaging and Delivery

Magnesium chloride solid shall be delivered in moisture-proof 22.6 or 1,000 kg bags. Magnesium chloride solution shall be delivered by railway tank car or truck tank.

2503.07.02 Marking

Each container shall be legibly marked with the following information:

- a) Manufacturer's or supplier's name.
- b) Date packaged (i.e., yyyy-mm-dd)
- c) Words "Magnesium Chloride Hexahydrate."
- d) Concentration of pure magnesium chloride.
- e) Unit size (mass or volume).

When bulk shipping is provided, the shipping manifest shall include the same information.

2503.08 QUALITY ASSURANCE

2503.08.01 Sampling and Testing

Magnesium chloride solid and magnesium chloride solution may be subject to sampling and testing for conformity to the specified requirements. All materials that fail to meet the specified requirements shall be rejected.

2503.08.01.01 Sampling Magnesium Chloride Solid

A minimum of 3 samples shall be selected by the Owner at random from the shipment. Samples shall be taken by the Owner by scraping aside the top layer of material to a depth of approximately 25 mm and taking a 0.5 kg representative sample by means of a sampling tube or other method. Precautions shall be taken during the sampling operation to avoid exposing the samples unduly to atmospheric moisture. The individual samples shall be mixed thoroughly and immediately to form a composite sample of material and then be stored and sealed in a suitable glass or plastic container.

2503.08.01.02 Sampling Magnesium Chloride Solution

A minimum of three samples from each tank of each shipment shall be taken by the Owner. Each sample shall be representative of the contents of the tank. Precautions shall be taken during the sampling operation to avoid exposing the samples unduly to atmospheric moisture. Immediately after collecting the three samples, the individual samples shall be mixed thoroughly to form a composite sample of material and then be stored and sealed in a suitable glass or plastic container.

2503.08.02 Certificate

Upon request, a manufacturer's certificate shall be provided stating that an independent laboratory has tested the product and found it to be in complete conformance with this specification.

2503.09 OWNER PURCHASE OF MATERIAL

2503.09.01 Measurement and Payment

Measurement of magnesium chloride solid shall be by mass in kilograms. Weighing shall be as specified in the purchasing order.

Measurement of magnesium chloride solution, at the concentration specified, shall be by one of the following methods:

a) Mass of solution in tonnes.

When shipped by railway tank car or when weighed at the source of supply, the mass of solution shall be substantiated by bills of lading in as many copies as the Owner may require. Railway scales shall be as specified in the purchasing order.

When weighing by truck tank, the mass of solution shall be determined as specified in the purchasing order.

b) Volume of solution in litres.

The volume of solution in litres shall be measured by means of a metering device as specified in the purchasing order.

When volumetric measurement is used, the Owner shall be provided with an invoice for each tank load of solution delivered. The invoice shall contain a note signed by the delivery person, as the official representative of the supplier of solution, indicating the total volume in litres of the delivery tanker and certifying the actual volume of solution in litres delivered in each tank load.

When magnesium chloride solution is used as dust suppressant, the mass of solution in tonnes may be converted to a mass of equivalent solid in kg. In converting the mass of solution to an equivalent mass in solid, a conversion factor for a 30% magnesium chloride solution of 1 tonne of solution to 639 kg of solid shall be used.

The volume in litres of solution may be converted to an equivalent mass of solution in tonnes. In converting the volume of solution to an equivalent mass of solution, the following conversion factors shall be used:

- a) 1.29 kg/litre shall be used for a minimum 30% solution.
- b) 1.21 kg/litre shall be used for a minimum 22% solution.

Payment at the price specified in the purchasing order shall be for the supply of the magnesium chloride solid or magnesium chloride solution 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.

TABLE 1
Material Properties

Material/Property	Magnesium Chloride Solution			Magnesium Chloride Solid	Test Procedure
	Dust Suppressant	De-icing			
Magnesium Chloride (MgCl ₂) % Minimum	30.0	30.0	22.0	46.0	3500-Mg, Magnesium Atomic Absorption Spectrometric Method
Potassium (K) % Maximum	0.5	0.5	0.4	--	EPA-600/R-94/111
Sodium (Na) % Maximum	0.7	0.7	0.6	--	
Calcium Chloride (CaCl ₂) %	--	--	--	2.0 - 3.0	
Potassium Chloride (KCl) %	--	--	--	0.5 - 1.0	
Sodium Chloride (NaCl) %	--	--	--	0.5 - 1.0	
Total Settleable Solids	--	<1% (Note 1)		--	PNS Test Method C
Corrosion Inhibitor	--	Minimum 70% less corrosive than Sodium Chloride		--	PNS Test Method B
pH (Note 2)	6 to 9			--	ASTM D 1293
Notes:					
1. 99% of the solids passing through a 2.00 mm sieve after being stored for 168 hours at -17.8 °C ± 1 °C.					
2. Dilute 1 part product to 4 parts distilled water before attempting a reading.					

Appendix 2503-A, November 2017
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents or purchasing order:

- Concentration of de-icer. (2503.05.02)

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

- Corrosion inhibitor. (2503.05.02)

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

Related Ontario Provincial Standard Drawings

No information provided here.



MATERIAL SPECIFICATION FOR TALL OIL PITCH EMULSION

TABLE OF CONTENTS

2510.01	SCOPE
2510.02	REFERENCES
2510.03	DEFINITIONS
2510.04	DESIGN AND SUBMISSION REQUIREMENTS
2510.05	MATERIALS
2510.06	EQUIPMENT - Not Used
2510.07	PRODUCTION
2510.08	QUALITY ASSURANCE
2510.09	OWNER PURCHASE OF MATERIAL – Not Used

APPENDICES

2510-A	Commentary

2510.01 SCOPE

This specification covers the requirements for tall oil pitch emulsion suitable for use as granular sealer.

2510.01.01 Specification Significance and Use

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

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

2510.01.02 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.

2510.02 REFERENCES

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

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

Ontario Provincial Standards Specifications, Material

OPSS 1004 Aggregates - Miscellaneous

ASTM International

D244-09 (2017) Standard Test Methods and Practices for Emulsified Asphalts

Ontario Ministry of the Environment, Conservation and Parks Publications

Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act

Protocol for Analytical Methods Used in the Assessment of Properties Under Part XV.1 of the Environmental Protection Act

Environmental Protection Act, Ontario Regulation 347, General - Waste Management - R.R.O. 1990 as amended by Ontario Regulation 558/00

Environment Canada Publications

- EPS1/RM/13 Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout, Second Edition: December 2000, Amendments: May 2007 and February 2016
- EPS1/RM/14 Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to *Daphnia magna*, Second Edition: December 2000, Amendments: February 2016

Organisation for Economic Co-operation and Development (OECD) Publications

- Method 301B Ready Biodegradability: CO₂ Evolution, OECD Guidelines for the Testing of Chemicals, 1992
- Method 302B Inherent Biodegradability: Zahn-Wellens/EMPA Test, OECD Guidelines for the Testing of Chemicals, 1992

United States Environmental Protection Agency Publications

- SW-846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 1996

Other

- ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories

2510.03 DEFINITIONS

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

Effluent means any liquid waste that may be discharged to the aquatic environment.

Tall Oil means a mixture of rosins and fatty acids produced from the processing of pulp and paper.

Tall Oil Pitch means the residue formed during the distillation of tall oil. Major components consist of fatty acids, resin acids, esters, and neutral materials.

Tall Oil Pitch Emulsion means a tall oil pitch homogeneously dispersed in a water-emulsifier solution.

2510.04 DESIGN AND SUBMISSION REQUIREMENTS

2510.04.01 Submission Requirements

Valid test results from an acceptable laboratory showing complete conformance of the tall oil pitch emulsion with the requirements of this specification shall be made available upon request.

2510.05 MATERIALS

2510.05.01 Tall Oil Pitch

Tall oil pitch shall be produced from distilled tall oil from the processing of pulp and paper not associated with the use of chlorine-based chemical to bleach pulp for the production of white paper.

2510.05.02 Water

Water shall be clean and free of contaminants that could adversely affect tall oil pitch emulsion and the environment.

2510.05.03 Emulsifier

Emulsifier shall be according to the manufacturer's requirements.

2510.05.04 Tall Oil Pitch Emulsion

Tall oil pitch emulsion shall meet the physical property requirements of Table 1 and the environmental testing requirements of Table 2.

Components used to produce the tall oil pitch emulsion shall not contain any petroleum based products, calcium chloride, magnesium chloride, lignosulphonate, or lignan derivatives.

Addition of any asphalt products, solvents, polymers, or other additives during or after the manufacture of tall oil pitch emulsion shall not be permitted.

Tall oil pitch emulsion shall show no signs of separation.

2510.07 PRODUCTION

2510.07.01 Storage

Tall oil pitch emulsion that is to be stored longer than seven Days shall be kept out of direct sunlight and maintained at a temperature of not less than 5 °C.

If stored more than 60 Days, the tall oil pitch emulsion shall be circulated prior to use using a low speed mechanical impeller or a pump rated at 5 hp or less. When a pump is used, the tall oil pitch emulsion shall be drawn from the bottom of the storage tank and fed to the top of the same tank with a submerged hose to avoid bubbling.

2510.07.02 Shipment

Tall oil pitch emulsion shall be shipped in sealed containers of a size that minimizes the air space between the surface of the liquid and the top of the container.

All shipping containers shall be clean and reusable. Reused containers shall be free of any form of contamination and, if required, cleaned prior to loading.

Tall oil pitch emulsion shall be protected from freezing.

A bill of lading or an invoice, as applicable, shall be supplied in as many copies as required by the Owner for each container of tall oil pitch emulsion delivered.

2510.07.03 Sampling and Testing

2510.07.03.01 General

Samples shall be collected, handled, prepared, and tested in accordance with the requirements of Table 1 and Table 2, except as noted below.

2510.07.03.01.01 Laboratory Requirements

Solids content testing of tall oil pitch emulsion shall be carried out in a laboratory that is acceptable to the Owner.

An acceptable laboratory for conducting environmental testing listed in Table 2, Section A, shall be one that has been certified by an organization accredited by the Standards Council of Canada in accordance with ISO/IEC 17025 and participates in mandatory proficiency testing programs for the applicable parameter in Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act.

An acceptable laboratory for conducting environmental testing listed in Table 2, Section B, shall be one that has been certified by an organization accredited by the Canadian Association for Environmental Analytical Laboratories (CAEAL) or by the Standards Council of Canada (SCC).

2510.07.03.01.02 Solids Content

Solids content shall be determined by measuring the mass of the residue remaining after drying a representative sample of tall oil pitch emulsion using the following procedure:

- a) Obtain a minimum 500 ml sample of tall oil pitch emulsion following thorough mixing or circulation of the contents of the shipping or storage container.
- b) Measure and record the mass of a suitable clean dry specimen container on a balance readable to 0.1 g and accurate to within 0.1% of the test load. A suitable container shall be one that is resistant to corrosion and change in mass upon heating, cooling, and exposure to materials of varying pH.
- c) Decant approximately 100 ml from the representative sample into the specimen container. Measure and record the mass of the container and tall oil pitch emulsion.
- d) Place the specimen and container in an oven maintained at $110\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and dry to a constant mass. Specimens may be dried at higher temperatures with a hot plate or burner provided that steam is allowed to escape freely.
- e) Allow the container and remaining residue to cool to room temperature. Measure and record the dried mass and container using the same balance as above.
- f) Calculate the percent solids as follows:

$$\text{Percent solids} = [(M_{\text{CR}} - M_{\text{C}}) / (M_{\text{CT}} - M_{\text{C}})] \times 100 = M_{\text{R}} / M_{\text{T}} \times 100$$

where: M_{C} = mass of container, *g*
 M_{CT} = mass of container and tall oil pitch emulsion, *g*
 M_{CR} = mass of container and residue, *g*
 M_{T} = mass of tall oil pitch emulsion specimen, *g*
 M_{R} = mass of residue, *g*

- g) Report the solids content as percent solids to the nearest 0.1%.

2510.07.03.01.03 Particle Charge

The particle charge of the tall oil pitch emulsion shall be determined according to ASTM D244 in the same manner as required for an asphalt emulsion.

2510.07.03.01.04 Environmental Testing

2510.07.03.01.04.01 Sample Preparation

Sample preparation for *Daphnia magna*, and Rainbow Trout testing shall be as follows:

- a) Obtain a sufficient amount of inert, non-absorptive material for the substrate meeting the gradation requirements of 9.5 mm clear stone according to OPSS 1004.
- b) Prepare the substrate by applying the tall oil pitch emulsion at a rate of 1,000 ml per 1,000 g of substrate distributed evenly in four coats (i.e., 250 ml per 1,000 g substrate per coat).
- c) Stir the mixture after each coat has dried to ensure that substrate particles do not adhere to each other.
- d) Allow each coat of the tall oil pitch emulsion to dry completely prior to the application of the next coat.
- e) To prepare the effluent for testing, expose a maximum of 1,000 ml of dechlorinated tap water for each 100 g of prepared substrate for a minimum of 24 hours.
- f) Decant sufficient effluent as required for each test.

2510.07.04 Marking

Bill of lading or invoice, as applicable, shall be legibly marked with the following information:

- a) Product name.
- b) Name of the manufacturer.
- c) Date shipped (i.e., yyyy-mm-dd).
- d) Product type.
- e) Net content mass in tonnes or volume in litres, as applicable.
- f) Solids content in percent.
- g) Particle charge (i.e., cationic).

2510.08 QUALITY ASSURANCE

2510.08.01 Inspections, Sampling, Testing, and Acceptance

The Owner reserves the right to make inspections, take samples, and perform tests at times and locations as the Owner may consider necessary to ensure that the materials supplied are in accordance with this specification.

TABLE 1
Physical Requirements

Solids content, % Minimum	Particle Size, µm Maximum (Note 1)	Particle Charge
8 (Note 2)	5.0	Cationic or non-ionic
Notes: - As determined by a particle size analyzer capable of resolution below 10 µm. - When the tall oil pitch emulsion is supplied at a higher concentration, it may be diluted with water to meet the solids content of this specification.		

TABLE 2
Environmental Testing

Section	Test	Requirement	Test Method
A	Full Metal Scan	Less than or equal to the concentrations for Agriculture or Other Property Use shown in Table 1 of Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act.	As described in Protocol for Analytical Methods Used in the Assessment of Properties Under Part XV.1 of the Environmental Protection Act.
	Inorganic Anions		
	Polychlorinated Biphenyls (PCBs)		
	Dioxins and Furans		
	Polyaromatic Hydrocarbons (PAHs)		
	Acid / Base / Neutral Extractable Organics		
B	Inherent Biodegradability	Minimum 20% biodegradation in 28 Days	OECD Method 302B
	Ready Biodegradability	Maximum 60% ThCO ₂	OECD Method 301B
C	<i>Daphnia magna</i> LC50	No greater than 50% impairment or mortality after continuous exposure for 48 hours.	EPS1/RM/14
	Leachate Testing: Metals Non-Metals, Metalloids	Less than the concentration shown in Schedule 4 of Ontario Regulation 347 as amended by Ontario Regulation 558/00, under the Environmental Protection Act	SW-846, Toxicity Characteristic Leaching Procedure, Method 1311
	Rainbow Trout LC50	No greater than 50% impairment or mortality after continuous exposure for 96 hours.	EPS1/RM/13

Appendix 2510-A, November 2021
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

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

Related Ontario Provincial Standard Drawings

No information provided here.



Ontario Provincial Standards Unit
301 St. Paul St., 2nd Floor North
St. Catharines, ON L2R 7R4

REVISION INFORMATION SHEET

ONTARIO PROVINCIAL STANDARDS FOR ROADS AND PUBLIC WORKS

VOLUME 8 MUNICIPAL-ORIENTED MATERIAL SPECIFICATIONS

MANUAL REVISION #18

NOVEMBER 2021

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

Individual OPS standards, revision packages, and complete manuals are available for download, free of charge, in PDF format, from the [MTO Technical Publications](#) website.

WAITING TO HEAR FROM YOU

Further news and information about the Ontario Provincial Standards organization can be obtained from the OPS website at www.ops.on.ca.

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

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 OPS Administration, for review and possible inclusion into the Ontario Provincial Standards.

THIS MANUAL IS REVISED AS FOLLOWS:

Index Pages Volume 8

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

Standard Specifications Volume 8

Superseded/Cancelled (Remove)		Revised/New (Insert)		Remarks
OPSS.MUNI	Dated	OPSS.MUNI	Dated	
1001	Nov 2018	1001	Nov 2021	Material Specification for Aggregates - General See Summary of Revisions.
1004	Nov 2013	1004	Nov 2021	Material Specification for Aggregates - Miscellaneous See Summary of Revisions.
1005	Apr 2017	1005	Nov 2021	Material Specification for Aggregates – Waterbody See Summary of Revisions.
1006	Nov 2013	1006	Nov 2021	Material Specification for Aggregates - Surface Treatment See Summary of Revisions.
		1204	Nov 2021	Material Specification for Polyvinyl Chloride Waterstops - Converted the specification from COMMON to MUNI. - Section 1204.02 References: ASTM D412, ASTM D624, and ASTM D2240 updated.
		1212	Nov 2021	Material Specification for Hot Poured Rubberized Asphalt Joint Sealing Compound The MUNI published in November 2021 replaces OPSS 1212 COMMON, November 2003 with no technical content changes.
		1213	Nov 2021	Material Specification for Hot Applied Rubberized Asphalt Waterproofing Membrane The MUNI published in November 2021 replaces OPSS 1213 COMMON, March 1998 with no technical content changes.
		1215	Nov 2021	Material Specification for Protection Board The MUNI published in November 2021 replaces OPSS 1215 COMMON, March 1998 with no technical content changes.

Superseded/Cancelled (Remove)		Revised/New (Insert)		Remarks
OPSS.MUNI	Dated	OPSS.MUNI	Dated	
		1304	Nov 2021	Material Specification for Packaged Silica Fume Dry Grout Mixture For Post Tensioning See Summary of Revisions.
		1312	Nov 2021	Material Specification for Latex Modifiers for Use in Concrete The MUNI published in November 2021 replaces OPSS 1312 COMMON, November 2008 with no technical content changes.
		1315	Nov 2021	Material Specification for White Pigmented Curing Compounds for Concrete The MUNI published in November 2021 replaces OPSS 1315 COMMON, November 2008 with no technical content changes.
		1352	Nov 2021	Material Specification for Precast Concrete Barriers The MUNI published in November 2021 replaces OPSS 1352 COMMON, November 1989 with no technical content changes.
		1503	Nov 2021	Material Specification for Cable Guide Rail - Converted the specification from COMMON to MUNI. - Section 1503.02 References: CSA Standards, ASTM International, and SAE International references updated.
1601	Nov 2014	1601	Nov 2021	Material Specification for Wood, Preservative Treatment, and Shop Fabrication See Summary of Revisions.
		1712	Nov 2021	Material Specification for Organic Solvent Based Traffic Paint The MUNI published in November 2021 replaces OPSS 1712 COMMON, February 1991 with no technical content changes.
		1713	Nov 2021	Material Specification for Thermoplastic Pavement Marking Materials The MUNI published in November 2021 replaces OPSS 1713 COMMON, February 1991 with no technical content changes.

Superseded/Cancelled (Remove)		Revised/New (Insert)		Remarks
OPSS.MUNI	Dated	OPSS.MUNI	Dated	
		1714	Nov 2021	Material Specification for Field Reacted Polymeric Pavement Marking Materials The MUNI published in November 2021 replaces OPSS 1714 COMMON, February 1991 with no technical content changes.
		1715	Nov 2021	Material Specification for Preformed Plastic Pavement Marking Tape The MUNI published in November 2021 replaces OPSS 1715 COMMON, February 1991 with no technical content changes.
		1716	Nov 2021	Material Specification for Water-Borne Traffic Paint The MUNI published in November 2021 replaces OPSS 1716 COMMON, February 1991 with no technical content changes.
		1750	Nov 2021	Material Specification for Traffic Paint ReflectORIZING Glass Beads The MUNI published in November 2021 replaces OPSS 1750 COMMON, December 1983 with no technical content changes.
1802	Apr 2018	1802	Nov 2021	Material Specification for Smooth Walled Steel Pipe See Summary of Revisions.
		1821	Nov 2021	Material Specification for Precast Reinforced Concrete Box Culverts The MUNI published in November 2021 replaces OPSS 1821 COMMON, November 2015 with no technical content changes.
2421	Nov 2017	2421	Nov 2021	Material Specification for Spun Concrete Poles See Summary of Revisions.
2452	Nov 2018	2452	Nov 2021	Material Specification for Aluminum Poles, Base Mounted See Summary of Revisions.
2501	Nov 2017	2501	Nov 2021	Material Specification for Calcium Chloride and Calcium-Magnesium Chloride Blend See Summary of Revisions.

Superseded/Cancelled (Remove)		Revised/New (Insert)		Remarks
OPSS.MUNI	Dated	OPSS.MUNI	Dated	
2510	Nov 2017	2510	Nov 2021	Material Specification for Tall Oil Pitch Emulsion See Summary of Revisions.

SUMMARY OF REVISIONS

OPSS.MUNI 1001

Material Specification for Aggregates - General

- Section 1001.02 References: LS-609 and LS-616, added. ASTM D5744 added. A new set called Others, added.
- Section 1001.03 Definitions: Crushed Material definition revised. Mine By-Product Rock definition added. Screened Sand and Quarried Rock definitions removed.
- New Clause 1001.04.01.01: General, added. Other subsections reordered. Brought content from Submission Requirements to it.
- New Clause 1001.04.01.02 Report for Aggregates Produced from Mine By-Product Rock: added.
- Clause 1001.05.01.02: updated.
- Clause 1001.05.01.03: updated.
- Clause 1001.07.02.03: revised.
- Subsection 1001.08.01 General: second paragraph revised.
- Subsection 1001.08.02 Sampling: titles for clauses removed.
- Subsection 1001.08.03 Testing: titles for clauses removed and new paragraph added.
- Appendix: updated.

OPSS.MUNI 1004

Material Specification for Aggregates - Miscellaneous

- Section 1004.02 References: ASTM references updated.
- Section 1004.03 Definitions: Gabion Stone definition revised and Quality Assurance (QA) definition removed.
- Subsection 1004.05.01 General: first paragraph revised.
- Subsection 1004.08.01 General: last two paragraphs revised.
- Appendix: updated.

OPSS.MUNI 1005

Material Specification for Aggregates - Waterbody

- All references to 'streambed' throughout this standard have been updated to 'waterbody'.
- Previous title, Aggregates – Streambed Material: updated to Aggregates – Waterbody.
- Section 1005.02 References: first paragraph amended to indicate a municipal-oriented specification. MTO LS-601, Fisheries Act, Ontario Water Resources Act removed. MTO LS-604, MTO Form PH-CC-112, MTO Form PH-D-10 added. ASTM D6473 updated.
- Section 1005.03 Definitions: amended to reference definitions in OPSS 182. Deleterious Substance, Streambed, and Streambed Material deleted. Waterbody and Watercourse updated.
- Subsection 1005.05.01 General: amended to include material and sourcing requirements for both WB-100 and smaller gradation bands and WB-100 and larger. Fifth paragraph amended to include additional table references.
- Subsection 1005.08.02 Sampling: amended to specify sample sizes up to the WB-350 gradation and amend table numbers. Amended to specify that all samples represent one lot of aggregate to include sampling processes for medium to large boulders and where duplicate sawed portions of individual boulders of WB-350 and larger waterbody materials shall be obtained. 'Contract Site' amended to 'Working Area' as defined in OPSS.MUNI 100.

- Table 1, Physical Property Requirements for Waterbody Materials: columns added to include WB-400, -500, -750, -1000, -1250 and -1500 classifications for testing. Row added to include testing for % Maximum Absorption for WB- 6.7, 13.2, 19 and 53. Note 1 amended replace 'pieces of rock' with 'cobbles or boulders' and note that the testing should be from randomly sampled cobbles or boulders. Note 3 added to note that testing may be carried out on another aggregate product if it is being simultaneously produced from the same formation and location (an example is given). Note 2 and 4 wording amended to reflect all testing categories.
- Table 3, Mass Gradation Requirements for Cobbles and Small Boulders Used as Waterbody Materials: title amended, Gradation Requirements amended to Percentage By Mass, Maximum 2nd Smallest Dimension of an Equivalent Rectangular Prism (mm) column added, Mass of Gravel/Cobble/Boulder (kg) added. Note 1 wording amended, Note 2 regarding determining the mass of a boulder larger than 25 kg added.
- Table 4, Medium to Large Boulders Used For Waterbody Materials: added.
- Table 5, Sample Size Requirements: previously Table 4, column title wording amended, Waterbody Material Designation column amended to remove SB-300, and replace with a WB-350 row, as well as a WB-400, WB-500, WB-750, WB-1000, WB-1250 and WB-1500 column. Note 1 wording amended, Notes 2-4 added.

OPSS.MUNI 1006

Material Specification for Aggregates - Surface Treatment

- Section 1006.03 Definitions: Bench and Quality Assurance (QA) definitions removed.
- Clause 1006.05.01.01: rewritten.
- Subsection 1006.08.04 Sampling: in paragraph-one added Contractor based on feedback from industry and committee members that this area causes confusion in field. Minimum quantity in paragraph-two updated.
- Table 2: notes section updated.

OPSS.MUNI 1304

Material Specification For Packaged Silica Fume Dry Grout Mixture For Post Tensioning

- Converted the specification from COMMON to MUNI.
- Section 1304.02 References: CSA A23.2-1B, CSA A283, CSA A3000, and ASTM D962 updated; and ASTM C1152 added.
- Section 1304.03 Definitions: Cementing Materials amended.
- Subsection 1304.05.01 Cementing Materials: amended to remove requirements made redundant by the change to the definition of Cementing Materials.
- Subsection 1304.05.02 Superplasticizer: amended to remove requirement that superplasticizer shall constitute 1.5% by mass of cementing materials in the dry grout mixture.
- Subsection 1304.05.03 Aluminum Powder: amended to remove requirement of coating with stearic acid.
- Subsection 1304.05.05 Grout: moved from 1304.07 Production. Amended to require cylinders to be poured within 5 minutes of batching. Note added to require constituent materials used shall be such that the acid-soluble chloride ion content of the mixed grout shall not exceed 0.08% by weight of the mixed grout as measured by ASTM C1152.
- Clause 1304.07.01.02 Compressive Strength Development Cure: amended to include requirement that testing is conducted according to the Sampling and Testing clause of the specification.
- Subsection 1304.07.02 Packaging, Handling, and Delivery: note b) removed.
- Subsection 1304.07.03 Certificate of Compliance: note d) removed.
- Clause 1304.07.03.01.01 Qualification of the Testing Laboratory: amended to require the testing laboratory to be a recognized certifying body to the requirement of CSA A283.
- Clause 1304.07.03.01.03.03 Compressive Strength Tests: testing for the certificate of compliance requirement removed. Amended to require grout cubes to be cast as specified in OPSS 910.

OPSS.MUNI 1601

Material Specification for Wood, Preservative Treatment, and Shop Fabrication

- Section 1601.02 References: CSA O56, CSA O80, CSA O122, CSA O141, CSA O177, AWWA P1/P13, and NLGA Standard Grading Rules updated; AWWA P5-6 deleted; and AWWA P23, AWWA P28, AWWA P29, AWWA P32, AWWA P35 added.
- Section 1601.03 Definitions: Dressed Wood, Preservative Treatment, and Wood definitions amended.
- Subsection 1601.05.02 Wood For Highway Fence, Cable Guide Rail, and Delineator Posts: allowable species of wood amended to be according to CSA O56.
- Subsection 1601.05.03 Wood For Steel Beam Guide Rail and Sign Posts: allowable species of wood amended to be according to CSA O80 Series.
- Subsection 1601.05.06 Preservatives: Alkaline Copper Quaternary Type D, Copper Azole Type B, and Micronized Copper Azole added to list of options for preservatives to be used. Note added that the use of fasteners and hardware shall be as specified in the Contract Documents.
- Subsection 1601.05.09 Marking of Wood for Identification of Preservative Treatment: amended to require wood to be marked with the CSA Use Category, preservative, and retention.
- Clause 1601.05.10.02: amended to require a certificate verifying the material was treated according to CSA O80 Series if the certification mark is obscured or nonexistence.
- Subsection 1601.05.11 Used Wood: amended for clarity.
- Subsection 1601.07.01 Preservative Treatment: amended to require that all products meet the minimum penetration and retention levels specified for each preservative and species according to CSA O80 Series. Product specific pre-treatment requirements such as conditioning and incising shall be according to CSA O80 Series.
- Appendix 1601-A: note added to Designer to include hardware and fasteners to be used with specific preservative treatments.

OPSS.MUNI 1802

Material Specification for Smooth Walled Steel Pipe

- Section 1802.02 References: CSA Z772, ASTM252, and AWWA C200 updated.
- Subsection 1802.07.01 Requirements: revised.
- Subsection 1802.07.02 Identification: new second paragraph added.
- Subsection 1802.08.02 Storage and Delivery: title updated and content revised.
- Subsection 1802.08.03 Inspection and Testing: new title added.

OPSS.MUNI 2421

Material Specification for Spun Concrete Poles

- Section 2421.02 References: OPSS 906 added and CSA A14 and CSA G30.18 reaffirmed.
- Clause 2421.04.02.01: 2nd paragraph, last sentence revised.
- Subsection 2421.05.04 Reinforcement: revised.

OPSS.MUNI 2452

Material Specification for Aluminum Poles, Base Mounted

- Section 2452.02 References: CSA S6, MTO Structural Manual, AASHTO LTS-5-M, and ASTM B108/B108B added; and CSA W47.2 and ASTM B221 updated.
- Subsection 2452.04.01 Design Requirements: added. Other section reordered.
- Clause 2452.04.02.01: 2nd paragraph revised.

- Subsection 2452.07.01 General: 4th paragraph revised.
- Subsection 2452.07.02 Mounting Plate for Grounding: revised.
- Subsection 2452.07.03 Marking: last paragraph revised.
- Tables 1 and 2: added.
- Appendix 2452-A, Related Ontario Provincial Drawings: OPSD 2428.010 added.

OPSS.MUNI 2501

Material Specification for Calcium Chloride and Calcium-Magnesium Chloride Blend

- Previously, OPSS.MUNI 2501 restricted the use of calcium chloride solution as a de-icer to 29% by weight, which provided a eutectic of -47 to -51 degrees Celsius. Calcium-magnesium chloride blend is allowed at 22%, which allows it to be used as a de-icer at a eutectic of -30 degrees Celsius. The changes to this standard amends the minimum percentage of calcium chloride solution to be used as a de-icer to be 25% in weight as opposed to the previous 29%. This change allows for calcium-magnesium chloride blend and calcium chloride to be used at the same temperature as de-icers.
 - The intent of this change is to allow municipalities to use calcium chloride at a strength and eutectic that they require, as opposed to needing to use a solution that is meant for lower temperatures than they require de-icer at.
- Title amended to add mention of calcium-magnesium chloride blend.
- Section 2501.01 Scope: amended to reference calcium-magnesium chloride blend.
- Section 2501.02 References: ASTM D1293-18 and ASTM E449-18 updated, and BNQ 2410-300 removed.
- Section 2501.03 Definitions: calcium-magnesium chloride blend amended.
- Subsection 201.05.02 Calcium Chloride Solution: a) amended to require calcium chloride solution used as a de-icer to contain a minimum of 25% by mass of pure calcium chloride.
- Clause 2501.07.02.02 Calcium-Magnesium Chloride Blend: b) amended to include an example of date shipped.
- Clause 2501.08.01.01 Sampling Calcium Chloride Solid: reworded.
- Clause 2501.08.01.02 Sampling Calcium Chloride Solution and Calcium-Magnesium Chloride Blend: reworded.
- Clause 2501.09.01.03 Calcium Chloride Solution: amended to reflect the correct kg/litre conversion factors.
- Table 1, Calcium Chloride Properties: ASTM D1293 reference updated.
- Table 2, Calcium-Magnesium Chloride Blend Properties: references updated.

OPSS. MUNI 2510

Material Specification for Tall Oil Pitch Emulsion

- Section 2510.02 References: ASTM D244, EPS1/RM/13, EPS1/RM/14, and ISO/IEC 17025 updated.
- Ministry of the Environment, Conservation and Parks (MECP) name and acronym updated throughout standard.
- Tall Oil Pitch (TOP) acronym removed throughout the standard. Reference to tall oil pitch or tall oil pitch emulsion is now explicitly stated.
- Section 2510.09 Owner Purchase of Material: removed.