



Ontario Provincial Standards Unit
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REVISION INFORMATION SHEET

ONTARIO PROVINCIAL STANDARDS FOR ROADS AND PUBLIC WORKS

VOLUME 8 MUNICIPAL-ORIENTED MATERIAL SPECIFICATIONS

MANUAL REVISION #10

APRIL 2017

UPDATING ONTARIO PROVINCIAL STANDARDS FOR YOUR USE

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for use of Ontario Provincial Standards; therefore, manual holders are cautioned about immediately discarding superseded and cancelled standards.

ACCESSING AND OBTAINING ONTARIO PROVINCIAL STANDARDS

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

- Available electronically on the OPS/MTO website. Online access to the current, updated, and archived standards; indexes; OPS User Notes; and publication Revision Information Sheets are available free of charge at the site.
(<http://www.rags.mto.gov.on.ca/techpubs/ops/nsf/OPSHomepage>)
- The eight OPS manuals of standards are also available for free as well in a single PDF format on the website.

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

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

WAITING TO HEAR FROM YOU

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

THIS MANUAL IS REVISED AS FOLLOWS:

Index Pages Volume 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Superseded/Cancelled (Remove)		Revised/New (Insert)		Remarks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	
		1005	Apr 2017	“MATERIAL SPECIFICATION FOR AGGREGATES – STREAMBED MATERIAL” The MUNI implemented in April 2017 replaces OPSS 1005 COMMON, November 2014 with no technical content changes.
1202	Nov 2016	1202	Apr 2017	“MATERIAL SPECIFICATION FOR BEARINGS – ELASTOMERIC PLAIN AND STEEL LAMINATED” Formatting update with no technical content changes.
1203	Nov 2016	1203	Apr 2017	“MATERIAL SPECIFICATION FOR BEARINGS – ROTATIONAL AND SLIDING SURFACE” Formatting update with no technical content changes.
		2423	Apr 2017	“MATERIAL SPECIFICATION FOR STEEL POLES, BASE MOUNTED” See Summary of Revisions.
		2461	Apr 2017	“MATERIAL SPECIFICATION FOR SIGNAL HEADS” The MUNI implemented in April 2017 replaces OPSS 2461 COMMON, November 2007 with no technical content changes.
		2502	Apr 2017	“MATERIAL SPECIFICATION FOR SODIUM CHLORIDE SOLID AND SODIUM CHLORIDE SOLUTION” See Summary of Revisions.

SUMMARY OF REVISIONS TO OPSS.MUNI 2423

MATERIAL SPECIFICATION FOR STEEL POLES, BASE MOUNTED

- Section 2423.02 References; MTO Structural Manual, CSA S6, and AASHTO LTS-5-M added; and CSA G40.20/G40.21, CSA W59, and ASTM A123/A123M updated.
- New subsection 2423.04.01 Design Requirements added. Other subsection renumbered.
- Subsection 2423.05.01 General, gussets deleted.
- Subsection 2423.07.02 Mounting Plate for Grounding, 2nd paragraph; number of wires revised from 1 to 2.
- New Tables 2 and 3 added.
- Appendix 2423, Related Ontario Provincial Standard Drawings; OPSD 2415.010 and OPSD 2416.010 deleted.

SUMMARY OF REVISIONS TO OPSS.MUNI 2502

MATERIAL SPECIFICATION FOR SODIUM CHLORIDE SOLID AND SODIUM CHLORIDE SOLUTION

- Section 2502.02 References, ASTM D 1293 and ASTM D 1429 updated.

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	27		
2	APR 2010	Included in new manuals	28		
3	NOV 2012	Included in new manuals	29		
4	APRIL 2013	Included in new manuals	30		
5	NOV 2013	Included in new manuals	31		
6	NOV 2014	Included in new manuals	32		
7	APR 2015	Included in new manuals	33		
8	NOV 2015	Included in new manuals	34		
9	NOV 2016	Included in new manuals	35		
10	APR 2017	Included in new manuals	36		
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NOV 2013	1003	Aggregates - Hot Mix Asphalt
NOV 2013	1004	Aggregates - Miscellaneous
APR 2017	1005	Aggregates – Streambed Material
NOV 2013	1006	Aggregates - Surface Treatment
NOV 2013	1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
DIVISION 11 – BITUMENS		
NOV 2016	1101	Performance Graded Asphalt Cement
NOV 2016	1102	Liquid Asphalt Used In Spraying, Sealing and Priming Applications
NOV 2016	1103	Emulsified Asphalt
NOV 2006	1151	Super pave and Stone Mastic Asphalt Mixtures
NOV 2016	1152	SC-800 Patching Material
NOV 2016	1153	Emulsified Asphalt Patching Material
DIVISION 12 - SEALS, BEARINGS, WATERSTOPS		
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APR 2017	1203	Bearings –Rotational and Sliding Surface
APR 2015	1205	Clay Seal
NOV 2014	1210	Deck Joint Assemblies
DIVISION 13 - CEMENT AND CONCRETE		
NOV 2014	1303	Admixtures for Concrete
NOV 2014	1350	Concrete - Materials and Production
NOV 2016	1359	Unshrinkable Backfill



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NOV 2016	1505	Channel Components For Steel Beam Guide Rail
NOV 2016	1540	Standard Highway Fence Components
DIVISION 16 - WOOD AND PLASTICS		
NOV 2014	1601	Wood, Preservative Treatment, and Shop Fabrication
DIVISION 17 - COATINGS		
NOV 2014	1704	Paint Coating Systems for Structural Steel
DIVISION 18 - PIPES AND ASSOCIATED DRAINAGE ITEMS		
NOV 2014	1820	Circular and Elliptical Concrete Pipe
NOV 2015	1841	Notice to Users of OPSS.MUNI 1841 (Non-Pressure Polyvinyl Chloride Pipe Products)
DIVISION 19 - ENVIRONMENTAL		
CURRENTLY NO SPECIFICATIONS		
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CURRENTLY NO SPECIFICATIONS		
DIVISION 21 - CLOTHING, CLOTH, AND THE LIKE		
CURRENTLY NO SPECIFICATIONS		
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NOV 2016	2422	Heavy Class Steel and Sectional Poles, Base Mounted
APR 2017	2423	Steel Poles, Base Mounted
NOV 2016	2434	High Pressure Sodium Luminaires For Underpass Lighting
NOV 2016	2453	Sectional Steel Poles
APR 2017	2461	Signal Heads
NOV 2016	2471	Sectional Steel High Mast Lighting Poles
NOV 2016	2474	Anchorage Assembly – High Mast Lighting Pole
DIVISION 25 - CHEMICALS		
APR 2017	2502	Sodium Chloride Solid and Sodium Chloride Solution



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**ONTARIO
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**METRIC
OPSS.MUNI 1005
APRIL 2017**

(Formerly OPSS 1005, November 2014)

Note: The MUNI implemented in April 2017 replaces OPSS 1005 COMMON, November 2014 with no technical content changes.

**MATERIAL SPECIFICATION FOR
AGGREGATES - STREAMBED MATERIAL**

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1005-A	Commentary
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1005.01 SCOPE

This specification covers the material requirements for aggregates used as streambed material.

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 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.

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-601	Materials Finer than 75 µm Sieve in Mineral Aggregates by Washing
LS-602	Sieve Analysis of Aggregates
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

Canadian and Provincial Statutes

Fisheries Act, R.S.C., 1985, c. F-14, as amended

Ontario Water Resources Act, R.S.O. 1990, c. 0.40, as amended

ASTM International

D 6473-10 Standard Test Method for Specific Gravity and Absorption of Rock for Erosion Control

1005.03

DEFINITIONS

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

Deleterious Material means as defined in OPSS 1001.

Deleterious Substance means as defined in the Fisheries Act.

Streambed means the bottom of the channel where a watercourse flows.

Streambed Material means the material that rests at the bottom of a waterbody and typically consists of natural sand, gravel, cobble, and boulders.

Waterbody means any permanent or intermittent, natural or constructed body of water including, lakes, ponds, wetlands, and watercourses, but does not include sewage works as defined in the Ontario Water Resources Act.

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

1005.05

MATERIALS

1005.05.01

General

The requirements of OPSS 1001 shall apply to this specification.

All streambed materials shall consist of clean, hard, durable, subrounded to rounded 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.

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 streambed materials shall meet the requirements shown in Table 1 for physical properties and Tables 2 and 3 for gradation.

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 streambed 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 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 shall be as shown in Table 4.

Unless otherwise indicated, 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 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.

The Contractor shall deliver all samples to the appropriate laboratory in a condition that is suitable for testing.

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 Streambed Materials

Description of Test	Test Number	SB-6.7	SB-13.2	SB-19	SB-37.5	SB-53	SB-100	SB-200	SB-300
Specific Gravity, Minimum	ASTM D 6473 (Note 1)	-	-	-	-	-	2.50	2.50	2.50
Absorption, % Maximum		-	-	-	-	-	2.0	2.0	2.0
Loss by Washing, Pass 75 µm Sieve, Guideline A, % Maximum	LS-601	5.0	2.0	2.0	-	2.0	-	-	-
Micro-Deval Abrasion Coarse Aggregate Loss, Grading A % Maximum	LS-618	-	30	30	30 (Note 2)	30	-	-	-
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 3)	(Note 3)	(Note 3)

Notes:

1. These requirements shall be based on the average test results for at least five pieces of rock where the source is macroscopically uniform or at least eight pieces of rock where the source is macroscopically non-uniform. 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. The coarse aggregate Micro-Deval abrasion loss shall be waived if the material has more than 80% passing the 4.75 mm sieve.
3. Stockpiles of SB-100, SB-200, and SB-300 shall not contain any visible contamination.

TABLE 2
Gradation Requirements For Streambed Sand and Gravel
Percent Passing

Sieve Size mm	Gradation (LS-602) of Streambed Materials % Less Than Sieve Size Specified				
	SB-6.7	SB-13.2	SB-19	SB-37.5	SB-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
Gradation Requirements For Streambed Cobbles and Boulders
Percent Passing

Mass kg	Gradation % Less Than Mass Specified (Note 1)		
	SB-100	SB-200	SB-300
55			100
30			40-60
16	-	100	0-10
7	-	40-60	-
2	100	0-10	-
0.5	40-60	-	-
0.3	0-10	-	-
Note: 1. The gradation shall be determined by individually weighing a minimum of 20 randomly chosen stone particles from the stockpile, then comparing the total mass of the stone particles within each fraction with the total mass of all of the stone particles that were measured.			

TABLE 4
Sample Size Requirements

Streambed Material	Minimum Sample Size kg (Note 1)
SB-6.7	10
SB-13.2	20
SB-19	20
SB-37.5	40
SB-53	80
SB-100	25 (consisting of cobbles from 0.4 to 1.5 kg each for ASTM D 6473 only)
SB-200	100 (consisting of cobbles from 5 to 12 kg each for ASTM D 6473 only)
SB-300	700 (consisting of cobbles/boulders from 25 to 45 kg each for ASTM D 6473 only) (Note 2)
Notes: 1. Individual sample bags shall not exceed 25 kg. 2. Large cobbles and small boulders may be broken to manageable sizes of no less than 12 kg and no more than 25 kg.	

Appendix 1005-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.



**ONTARIO
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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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1202-A	Commentary
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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.

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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.

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-A	Commentary
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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
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U.S. Military Specifications

MIL-S-8660 C	Silicone Compound
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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	$0.50 \text{ mm} \pm 0.25 \text{ mm}$
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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 STEEL POLES, BASE MOUNTED

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2423.02	REFERENCES
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2423-A	Commentary
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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)
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ASTM International

A123/A123M-15	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
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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.

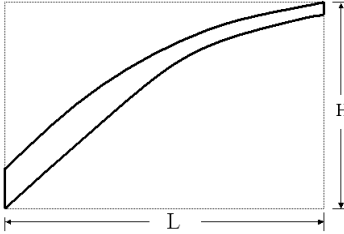
TABLE 1
Circumferential Welded Joints

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



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.MUNI 2461
APRIL 2017**

(formerly OPSS 2461 Common, November 2007)

Note: The MUNI implemented in April 2017 replaces OPSS 2461 COMMON, November 2007 with no technical content changes.

**MATERIAL SPECIFICATION FOR
SIGNAL HEADS**

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2461-A	Commentary
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2461.01	SCOPE
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This specification covers the requirements for traffic signal heads and associated components and accessories.

2461.01.01 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.

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

Canadian Standards Association

C22.2 No. 0.4-04	Bonding of Electrical Equipment
C22.2 No. 43-04	Lampholders
C22.2 No. 84-05	Incandescent Lamps
C22.2 No. 127-99 (R2004)	Equipment and Lead Wires
S157-05	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
Pedestrian Traffic Control Signal Indications - Part 2: Light Emitting Diode (LED) Pedestrian Traffic Signal Modules, March 19, 2004
Vehicle Traffic Control Signal Heads, Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Modules, April 3, 2006

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 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. The 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 lens shall be provided with a removable visor of the cowl (cap) type. When specified in the Contract Documents, lenses shall be provided with removable visors of the tunnel, full-circle, or louvre type.

2461.05.04 Lampholders

Lampholders shall be according to CAN/CSA C22.2 No. 43, complete with lamp grips and provisions for 360° rotation and lateral locking at the focal point of the reflectors.

2461.05.05 Wiring

Wiring shall be #18 AWG stranded copper type TEW and according to CSA C22.2 No. 127.

2461.05.06 Ground Terminals

Ground lugs shall be provided in signal heads to accommodate a #14 AWG bonding wire.

2461.05.07 Backboards

As a minimum, backboards shall be fabricated from 1.00 mm thick aluminum sheets or 3.00 mm thick high-density polyethylene sheets and shall project a minimum of 125 mm all around beyond the signal head housing. The signal head backboard shall be standard colour yellow according to Federal Specification Colour Yellow 595B-33538.

2461.05.08 Reflectors

Reflectors shall be Alzak aluminum and the reflective surface shall be according to ITE ST-017B.

2461.05.09 Lenses

Lenses shall be convex prismatic of the polycarbonate or glass type according to chromaticity characteristics specified in ITE ST-017B and with the size, type, colour, and orientation specified in the Contract Documents.

2461.05.10 Paint

Paint shall be synthetic resin enamel and according to Federal Standard Colour Yellow 595B-33538.

2461.05.11 Lamps

2461.05.11.01 Incandescent

Incandescent lamps shall be according to the requirements of CSA C22.2 No. 84, ITE ST-017B, and Table 1.

2461.05.11.02 LED

2461.05.11.02.01 LED Modules

LED circular modules at minimum shall be according to ITE ST-052 and the Contract Documents.

LED arrow signal modules at minimum shall be according to ITE Vehicle Traffic Control Signal Heads, Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Modules 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. The modules shall be designed and constructed to be installed in a programmable visibility head without modification to the housing.

2461.05.11.02.02 Electrical Requirements

Electrical requirements for LED circular modules shall be according to ITE ST-052; the LED arrow modules shall be according to ITE Vehicle Traffic Control Signal Heads, Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Modules; 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 2 and 3.

Power factor shall be a minimum of 0.95.

2461.05.11.02.03 Photometric Requirements

Photometric requirements of the LED circular modules shall be according to ITE ST-052. Photometric requirements of the LED arrow modules shall be according to ITE Vehicle Traffic Control Signal Heads, Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Modules.

All circular LED modules shall be the expanded view type.

2461.05.11.02.04 Physical and Mechanical Requirements

Physical and mechanical requirements for the LED circular modules shall be according to ITE ST-052; the LED arrow modules shall be according to ITE Vehicle Traffic Control Signal Heads, Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Modules; 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.

2461.05.11.02.05 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.

2461.05.11.02.06 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

The Contract Administrator shall be notified a minimum of 3 Business Days prior to the start of fabrication for the signal heads.

While work is being performed, the Contract Administrator shall have access to the place of manufacture of the signal heads for the purpose of inspecting and examining plant records and certificates, materials used, process of manufacturing, and to make any tests as may be considered necessary.

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 four copies of shop drawings, when required by the Owner. Shop 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 to 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 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 full compensation for the supply of the signal heads 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
Lamp Requirements

Lens Size and Application	Lamp Wattage Maximum		Lamp Voltage	Lamp Type	Lamp Life Hours	
	Argon	Krypton			Argon	Krypton
300 mm Diameter Traffic Signal Head	150	135	125	clear, traffic	6000	8000
200 mm Diameter Traffic Signal Head	100	90	125	clear, traffic	8000	8000
300 mm Square Pedestrian Signal Head	100	90	125	clear, traffic	8000	8000
300 mm Arrow Signal Head	150	90	125	clear, traffic	6000	8000
200 mm Diameter Flasher Beacon	116		125	clear, traffic	8000	
300 mm Diameter Flasher Beacon	150		125	clear, traffic	6000	
Sign Light Assembly	75		125	clear, PAR 38 (spot)	4000	
Down Light	150		125	clear	6000	

TABLE 2
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 3
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 2007
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Size, type, colour, and orientation of lenses. (2461.05.09)
- LED circular module requirements. (2461.05.11.02.01)
- LED arrow module requirements. (2461.05.11.02.01)
- 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)
- Type of visor to be provided for the lenses. (2461.05.03)
- 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
SODIUM CHLORIDE SOLID AND SODIUM CHLORIDE SOLUTION**

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2502.03	DEFINITIONS - Not Used
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2502.06	EQUIPMENT - Not Used
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APPENDICES

2502-A	Commentary
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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 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 Table 1. An anti-caking agent may be used to keep the salt in a free-flowing state.

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 2.

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 Solid

Gradation Requirements		
MTO Sieve Designation	Per Cent Passing by Weight	
	Coarse Crushed Rock Salt	Fine Crushed Rock Salt
9.5 mm	100	-
4.75 mm	30 - 100	100
2.36 mm	5 - 65	-
1.18 mm	0 - 30	35 min.
600 µm	0 – 10	-
Notes: A. Coarse and fine crush rock salt chemical composition, by mass: - Moisture content, not more than 1.5% - Sodium chloride content, dry mass basis, not less than 96.0% - Insoluble matter, dry mass basis, not more than 4.0% B. Sodium chloride solid from the mines in the Lake Huron basin can contain up to 3% combined magnesium chloride and calcium chloride.		

TABLE 2
Material Properties
Sodium Chloride Solution

Material Property	Solution	Range	Test Procedure
Sodium Chloride %	23.3	-1.0 / +0.3	Atomic Absorption Spectometric 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, April 2017
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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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.