OPSS.PROV - LEGACY COMMON APPENDIX A REMOVAL

Volume 6

Reference Type/Code	Existing Version	New Version	Implemented In CPS	New, Revised (Rev), Cancelled (Can), Reissued/Reinstated (Rei)	Initiator
Ontario Provincial Standard Specifications (OPSSs)					
1205	April 2015	April 2025	TBD	Rev: Material Specification for Clay Seal is implemented. The specification has been updated to new PROV format with no technical content changes. Legacy Appendix A removed.	Mike Pearsall
1303	November 2014	April 2025	TBD	Rev: Material Specification for Admixtures for Concrete is implemented. The specification has been updated to new PROV format with no technical content changes. Legacy Appendix A removed.	Mike Pearsall
1505	April 2017	April 2025	TBD	Rev: Material Specification for Channel Components for Steel Beam Guide Rail is implemented. The specification has been updated to new PROV format with no technical content changes.	Mike Pearsall
1704	November 2014	April 2025	TBD	Rev: Material Specification for Paint Coating Systems for Structural Steel is implemented. The specification has been updated to new PROV format with no technical content changes. Legacy Appendix A removed. OPSF 1704-1 table format updated.	Mike Pearsall
1820	November 2014	April 2025	TBD	Rev: Material Specification for Circular and Elliptical Concrete Pipe is implemented. The specification has been updated to new PROV format with no technical content changes. Legacy Appendix A removed.	Mike Pearsall
2422	November 2016	April 2025	TBD	Rev: Material Specification for Heavy Class Steel and Sectional Steel Poles, Base Mounted is implemented. The specification has been updated to new PROV format with no technical content changes. Legacy Appendix A removed. Gender neutral language updated.	Mike Pearsall
2423	April 2017	April 2025	TBD	Rev: Material Specification for Steel Poles, Base Mounted is implemented. The specification has been updated to new PROV format with no technical content changes.	Mike Pearsall

Reference Type/Code	Existing Version	New Version	Implemented In CPS	New, Revised (Rev), Cancelled (Can), Reissued/Reinstated (Rei)	Initiator
2434	November 2016	April 2025	TBD	Rev: Material Specification for High Pressure Sodium Luminaires for Underpass Lighting is implemented. The specification has been updated to new PROV format with no technical content changes. Legacy Appendix A removed.	Mike Pearsall
2474	November 2016	April 2025	TBD	Rev: Material Specification for Anchorage Assembly - High Mast Lighting Pole is implemented. The specification has been updated to new PROV format with no technical content changes. Legacy Appendix A removed. Gender neutral language updated.	Mike Pearsall
2475	April 2017	April 2025	TBD	Rev: Material Specification for Uninterruptible Power Supply Systems for LED Traffic Signals is implemented. The specification has been updated to new PROV format with no technical content changes.	Mike Pearsall

Ontario Provincial Standard Specifications (OPSSs)					
1205	April 2015	April 2025	TBD	Rev: Material Specification for Clay Seal is implemented. The specification has been updated to new PROV format with no technical content changes. Legacy Appendix A removed.	Mike Pearsall

Note: OPSS 1205 implemented in April 2025 replaces OPSS 1205, April 2015 with no technical content changes.

MATERIAL SPECIFICATION FOR CLAY SEAL

TABLE OF CONTENTS

1205.01 SCOPE

This specification covers the requirements of clay seal material for use at the upstream or inlet side of culverts.

~~1205.01.01 Specification Significance and Use~~

~~This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.~~

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

~~1205.01.02 Appendices Significance and Use~~

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

~~Appendices are developed for the Owner's use only.~~

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1205.02 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, Material

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

ASTM International

~~D 4318~~D4318-10 Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
~~D 5084~~D5084-10 Permeability of Saturated Soils Using a Flexible Wall Permeameter

1205.03 DEFINITIONS

For the purpose of this specification the following definitions apply:

Bentonite means a commercial term applied to clay deposits containing sodium montmorillonite as the essential mineral.

Clay means a fine textured (i.e., grain size smaller than 0.002 mm) sedimentary or residual deposit consisting of hydrated silicates of aluminum mixed with various impurities, but no organics. ~~-~~It is a cohesive soil and plastic within a wide range of water content.

Geosynthetic Clay Liner means sodium bentonite soils sandwiched between two protective geotextiles.

Liquid Limit means the water content between the semi-liquid and the plastic states of the soil.

Plastic Limit means the water content between the plastic and semi-solid states of the soil.

Plasticity Index means the water content range of a soil at which it is plastic, defined numerically as the liquid limit minus the plastic limit.

1205.04 DESIGN AND SUBMISSION REQUIREMENTS

1205.04.01 Submission Requirements

1205.04.01.01 Natural Clay

The results of the Atterberg Limit Tests (Liquid Limit and Plasticity Index) on the natural clay shall be submitted to the Contract Administrator at least one week prior to the commencement of work. The Atterberg Limits shall be determined using ASTM ~~D 4318~~D4318.

1205.04.01.02 Clay Mixture

The results of the Atterberg Limit Tests (Liquid Limit and Plasticity Index) and permeability tests on the clay mixture shall be submitted to the Contract Administrator at least one week prior to the commencement of work. The Atterberg Limits shall be determined using ASTM ~~D 4318.~~ D4318. The permeability shall be according to ASTM ~~D 5084~~ D5084.

1205.04.01.03 Geosynthetic Clay Liner

Material specifications containing the physical, mechanical, and hydraulic properties of the geosynthetic clay liner shall be obtained from the manufacturer and submitted to the Contract Administrator. The specification shall include the manufacturer's certification and warranty.

1205.05 MATERIAL

1205.05.01 General

Material used shall have plasticity index and liquid limit percentages that are within the hatched area shown in Figure 1. It shall be natural clay, clay mixture, or a geosynthetic clay liner and shall meet the physical requirements as specified below.

1205.05.02 Natural Clay

Not all clays are suitable for use as clay seal. Clay material shall be according to the following:

a) Liquid limit shall be > 50%.

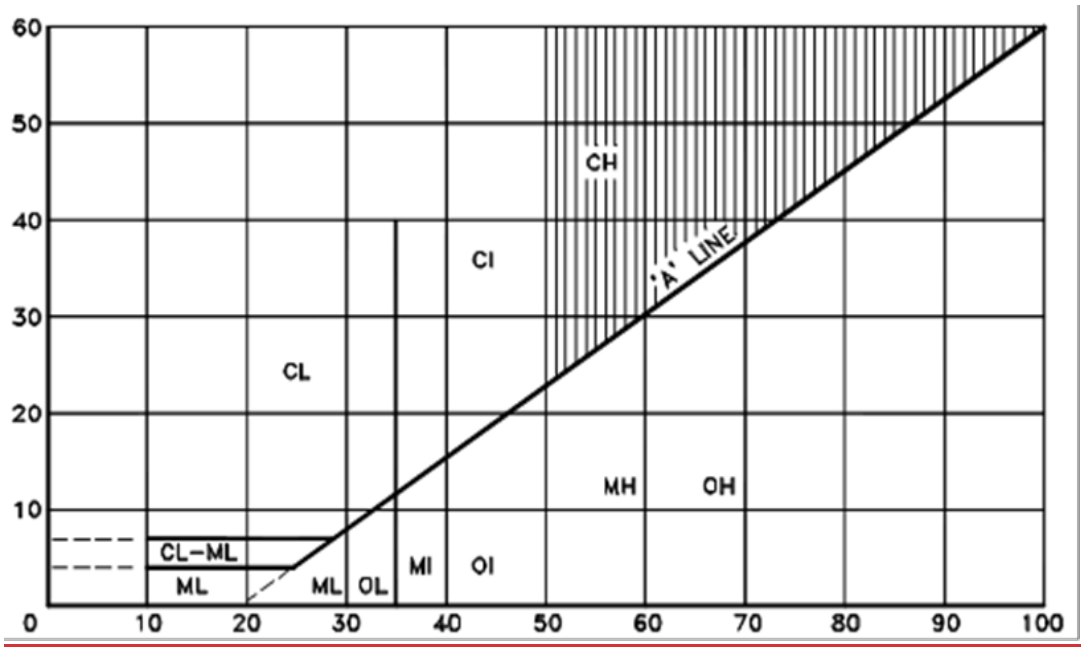
b) Plasticity index shall be > 0.75 x (Liquid Limit - 20%).

1205.05.03 Clay Mixture

A mixture of clay and other materials can be used, provided that they meet the physical properties for natural clay and the permeability as determined from the falling head permeameter test does not exceed 1 x 10^{-5} mm/s.

1205.05.04 Geosynthetic Clay Liner

The geosynthetic clay liner shall have a permeability not exceeding 1 x 10^{-5} mm/s.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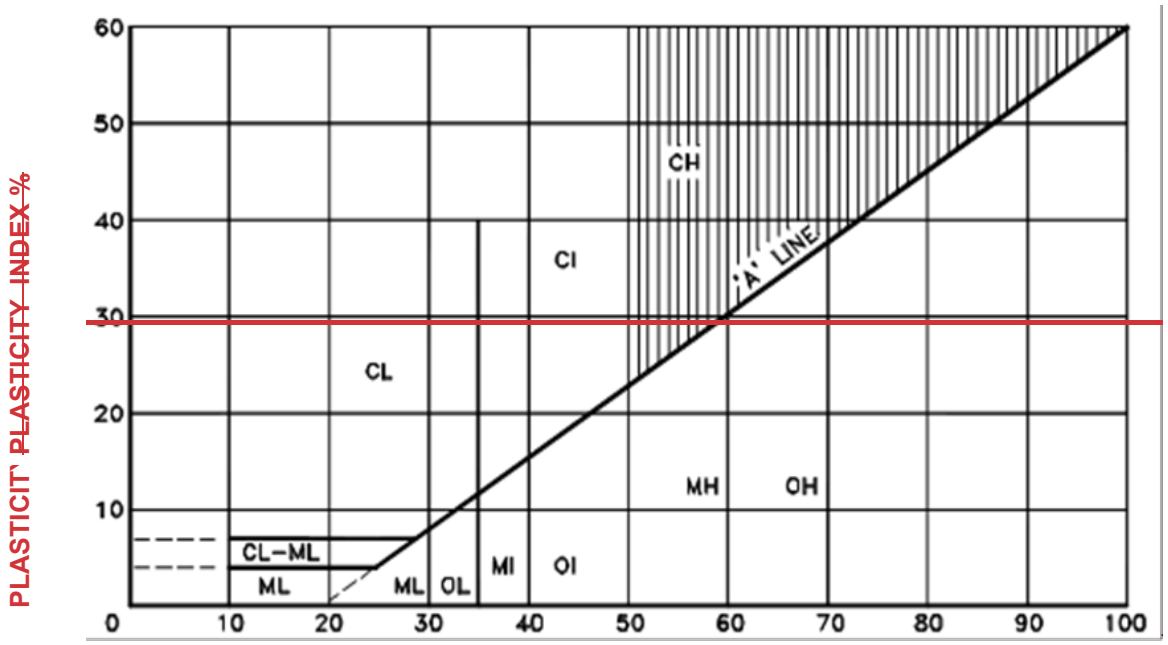

FIGURE 1
Plasticity Chart

LEGEND:

Soil Classifications

CH - Inorganic Clays of High Plasticity, Fat Clays
CI - Inorganic Silty Clays of Medium Plasticity
CL - Inorganic Silty Clays, Gravelly Clays, Sandy Clays, lean Clays
MH - Inorganic Silts, Highly Compressible Micaceous or Diatomaceous Fine Sandy Silts, Elastic Silts
MI - Inorganic Compressible Fine Sandy Silt With Clay of Medium Plasticity, Clayey Silts
ML - Inorganic Silts and Sandy Silts of Slight Plasticity, Rock Flour
OH - Organic Clays of High Plasticity
OI - Organic Silty Clays of Medium Plasticity
OL - Organic Silt of Low Plasticity, Organic Sandy Silts

Appendix 1205-A, April 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

Note: OPSS 1205 implemented in April 2025 replaces OPSS 1205, April 2015 with no technical content changes.

MATERIAL SPECIFICATION FOR CLAY SEAL

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Geosynthetic Clay Liner means sodium bentonite soils sandwiched between two protective geotextiles.

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1205.04 DESIGN AND SUBMISSION REQUIREMENTS

1205.04.01 Submission Requirements

1205.04.01.01 Natural Clay

The results of the Atterberg Limit Tests (Liquid Limit and Plasticity Index) on the natural clay shall be submitted to the Contract Administrator at least one week prior to the commencement of work. The Atterberg Limits shall be determined using ASTM D4318.

1205.04.01.02 Clay Mixture

The results of the Atterberg Limit Tests (Liquid Limit and Plasticity Index) and permeability tests on the clay mixture shall be submitted to the Contract Administrator at least one week prior to the commencement of work. The Atterberg Limits shall be determined using ASTM D4318. The permeability shall be according to ASTM D5084.

1205.04.01.03 Geosynthetic Clay Liner

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1205.05 MATERIAL

1205.05.01 General

Material used shall have plasticity index and liquid limit percentages that are within the hatched area shown in Figure 1. It shall be natural clay, clay mixture, or a geosynthetic clay liner and shall meet the physical requirements as specified below.

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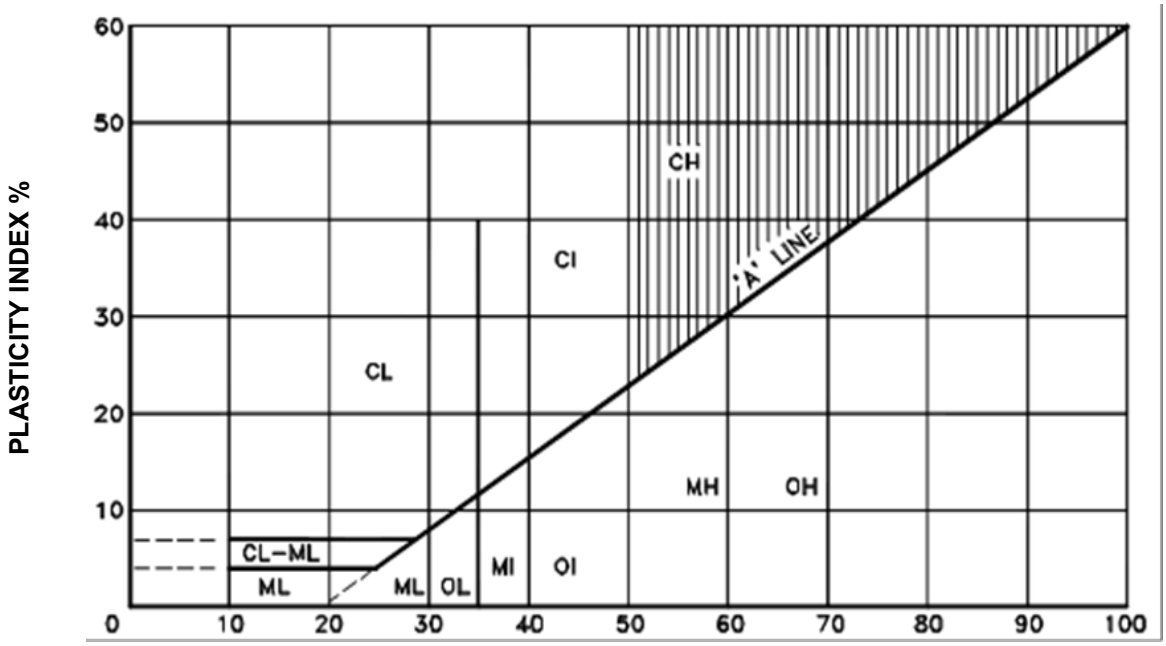

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Ontario Provincial Standard Specifications (OPSSs)					
1303	November 2014	April 2025	TBD	Rev: Material Specification for Admixtures for Concrete is implemented. The specification has been updated to new PROV format with no technical content changes. Legacy Appendix A removed.	Mike Pearsall

Note: The 1303 implemented in April 2025 replaces 1303, November 2014 with no technical content changes.

MATERIAL SPECIFICATION FOR ADMIXTURES FOR CONCRETE

TABLE OF CONTENTS

1303.01 SCOPE

This specification covers the materials for use as air entraining, chemical, and superplasticizing admixtures for concrete.

~~1303.01.01 Specification Significance and Use~~

~~This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.~~

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~~1303.01.02 Appendices Significance and Use~~

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

Ontario Ministry of Transportation Publications

Designated Sources for Materials (DSM)

Laboratory Testing Manual:

LS-413 Method of Test for Non-volatile Content of Chemical Admixtures, Latex Admixtures and Curing Compounds
LS-422 Method of Test for Evaluation of Air Entraining Admixtures for Concrete
LS-423 Method of Test for Evaluation of Chemical Admixtures for Concrete
LS-424 Method of Test for Evaluation of Superplasticizing Admixtures

ASTM International

~~C 494~~C494 Chemical Admixtures for Concrete
~~E 70~~E70-97 (2002) Test Method for pH of Aqueous Solutions with the Glass Electrode

1303.03 DEFINITIONS

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

Air Entraining Admixture means a ~~-~~type of admixture according to ASTM ~~C 260~~C260 that causes development of a system of microscopic air bubbles in concrete during mixing, to increase the workability of the concrete and its resistance to freezing and thawing.

Chemical Admixture means Types A, B, C, D, E, and S admixtures according to ASTM ~~C 494~~C494.

Non-Chloride Admixture means an admixture that contains not more than 0.01% chloride by mass of cement.

Superplasticizer means Types F and G admixtures according to ASTM ~~C 494~~C494.

Type A means a water reducing admixture that reduces the quantity of mixing water required to produce concrete of a given consistency.

Type B means a retarding admixture that retards the setting of concrete.

Type C means an accelerating admixture that accelerates the setting and early strength development of concrete.

Type D means a water reducing and retarding admixture that reduces the quantity of mixing water required to produce concrete of a given consistency and retards the setting of concrete.

Type E means a water reducing and accelerating admixture that reduces the quantity of mixing water required to produce concrete of a given consistency and accelerates the setting and early strength development of concrete.

Type F means a superplasticizing admixture that reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or greater.

Type G means a superplasticizing and retarding admixture that reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or greater and retards the setting of concrete.

Type S Admixture means a specific performance admixture that provides desired performance characteristics, other than reducing water content or changing the time of setting of concrete or both, without any adverse effects on fresh, hardened, and durability properties of concrete.

1303.04 DESIGN AND SUBMISSION REQUIREMENTS

1303.04.01 Submission Requirements

1303.04.01.01 Admixtures

The supplier shall submit documentation verifying that each admixture used on the Contract is included on the ministry's DSM.

1303.05 MATERIALS

All admixtures shall be in liquid form.

All admixtures shall be non-chloride, with the exception of admixtures used in fast-track full-depth repairs to concrete pavements or concrete base.

Admixtures shall be according to LS-422, LS-423, and LS-424.

In addition, required performance characteristics of each Type S chemical admixture shall be demonstrated on Owner approved field trials prior to use in the work.

1303.08 QUALITY ASSURANCE

Admixtures shall be sampled and tested as specified in the Contract Documents.

Relative density and pH of air entraining admixtures, and non-volatile content and relative density of chemical and superplasticizing admixtures shall be according to the product data shown on the DSM, within the following tolerances:

a) Relative density:

   i. Where relative density is 1.050 or less, the tolerance shall be ± 0.005.
   ii. Where relative density is greater than 1.050, the tolerance shall be calculated according to the following formula:

   Tolerance = (relative density of acceptance sample-1.000)/10

b) Non-volatile content ± 2.5%.

c) pH ~~-~~± 1.5.

Appendix 1303-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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Designer Action/Considerations

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

Note: The 1303 implemented in April 2025 replaces 1303, November 2014 with no technical content changes.

MATERIAL SPECIFICATION FOR ADMIXTURES FOR CONCRETE

TABLE OF CONTENTS

1303.01 SCOPE

This specification covers the materials for use as air entraining, chemical, and superplasticizing admixtures for concrete.

1303.02 REFERENCES

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

Ontario Ministry of Transportation Publications

Designated Sources for Materials (DSM)

Laboratory Testing Manual:
LS-413 Method of Test for Non-volatile Content of Chemical Admixtures, Latex Admixtures and Curing Compounds
LS-422 Method of Test for Evaluation of Air Entraining Admixtures for Concrete
LS-423 Method of Test for Evaluation of Chemical Admixtures for Concrete
LS-424 Method of Test for Evaluation of Superplasticizing Admixtures

ASTM International

C494 Chemical Admixtures for Concrete
E70-97 (2002) Test Method for pH of Aqueous Solutions with the Glass Electrode

1303.03 DEFINITIONS

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

Air Entraining Admixture means a type of admixture according to ASTM C260 that causes development of a system of microscopic air bubbles in concrete during mixing, to increase the workability of the concrete and its resistance to freezing and thawing.

Chemical Admixture means Types A, B, C, D, E, and S admixtures according to ASTM C494.

Non-Chloride Admixture means an admixture that contains not more than 0.01% chloride by mass of cement.

Superplasticizer means Types F and G admixtures according to ASTM C494.

Type A means a water reducing admixture that reduces the quantity of mixing water required to produce concrete of a given consistency.

Type B means a retarding admixture that retards the setting of concrete.

Type C means an accelerating admixture that accelerates the setting and early strength development of concrete.

Type D means a water reducing and retarding admixture that reduces the quantity of mixing water required to produce concrete of a given consistency and retards the setting of concrete.

Type E means a water reducing and accelerating admixture that reduces the quantity of mixing water required to produce concrete of a given consistency and accelerates the setting and early strength development of concrete.

Type F means a superplasticizing admixture that reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or greater.

Type G means a superplasticizing and retarding admixture that reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or greater and retards the setting of concrete.

Type S Admixture means a specific performance admixture that provides desired performance characteristics, other than reducing water content or changing the time of setting of concrete or both, without any adverse effects on fresh, hardened, and durability properties of concrete.

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All admixtures shall be in liquid form.

All admixtures shall be non-chloride, with the exception of admixtures used in fast-track full-depth repairs to concrete pavements or concrete base.

Admixtures shall be according to LS-422, LS-423, and LS-424.

In addition, required performance characteristics of each Type S chemical admixture shall be demonstrated on Owner approved field trials prior to use in the work.

1303.08 QUALITY ASSURANCE

Admixtures shall be sampled and tested as specified in the Contract Documents.

Relative density and pH of air entraining admixtures, and non-volatile content and relative density of chemical and superplasticizing admixtures shall be according to the product data shown on the DSM, within the following tolerances:

a) Relative density:

   i. Where relative density is 1.050 or less, the tolerance shall be ± 0.005.
   ii. Where relative density is greater than 1.050, the tolerance shall be calculated according to the following formula:

      Tolerance = (relative density of acceptance sample-1.000)/10

b) Non-volatile content ± 2.5%.

c) pH ± 1.5.

Ontario Provincial Standard Specifications (OPSSs)					
1505	April 2017	April 2025	TBD	Rev: Material Specification for Channel Components for Steel Beam Guide Rail is implemented. The specification has been updated to new PROV format with no technical content changes.	Mike Pearsall

Note: The ~~PROV~~1505 implemented in April ~~2017~~2025 replaces ~~OPSS~~ 1505 ~~COMMON, November 2010~~, April 2017 with no technical content changes.

MATERIAL SPECIFICATION FOR CHANNEL COMPONENTS FOR STEEL BEAM GUIDE RAIL

TABLE OF CONTENTS

1505.01 SCOPE

This specification covers the requirements for steel channel and installation hardware.

~~**1505.01.01 Specification Significance and Use**~~

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

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

~~**1505.01.02 Appendices Significance and Use**~~

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1505.02 REFERENCES

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

CSA Standards

G164-M92 (R2003) Hot Dip Galvanizing of Irregularly Shaped Articles
S136-07 Cold Formed Steel Structural Members

ASTM International

~~A 307~~A307-07 Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

1505.05 MATERIALS

1505.05.01 Cold Rolled Channel

Channels shall be cold rolled steel sections according to CSA S136 and have a minimum yield strength of 345 MPa. ~~-~~After fabrication, sections shall be hot dip galvanized according to CAN/CSA G164.

1505.05.02 Installation Hardware

All bolts, nuts, and washers shall be according to ASTM ~~A 307~~A307 and be hot dip galvanized according to CAN/CSA G164.

1505.07 PRODUCTION

1505.07.01 Fabrication Tolerances and Workmanship

Bolt holes in steel channels shall be perpendicular to the surface and shall not deviate more than 1.0 mm in any direction from the true location. Steel channel ends shall be cut square.

After fabrication, curved steel channels shall be hot dip galvanized according to CAN/CSA G164.

1505.07.02 Marking

As a minimum, each steel channel section shall be marked with the following information:

a) Name, trademark, or brand of the manufacturer.

b) Standard designation 1505.

c) Identification symbols or code for heat.

d) Week number and year of production.

Markings shall be clearly and permanently stamped in the valley of the steel channel, placed at a location clear of the splice overlap, and shall not be obscured after installation. The height of the letters and numerals shall be within the range of 19 to 32 mm.

1505.09 OWNER PURCHASE OF MATERIAL

1505.09.01 Measurement and Payment

For measurement purposes, a count shall be made of the number of steel channel sections delivered and accepted.

Installation hardware shall be measured in the units specified in the purchasing order, delivered and accepted.

Payment at the price specified in the purchasing order shall be for the supply of steel channels and installation hardware delivered to the destination or destinations at the dates and times specified.

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

Note: The 1505 implemented in April 2025 replaces 1505, April 2017 with no technical content changes.

MATERIAL SPECIFICATION FOR CHANNEL COMPONENTS FOR STEEL BEAM GUIDE RAIL

TABLE OF CONTENTS

1505.01 SCOPE

This specification covers the requirements for steel channel and installation hardware.

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1505.05 MATERIALS

1505.05.01 Cold Rolled Channel

Channels shall be cold rolled steel sections according to CSA S136 and have a minimum yield strength of 345 MPa. After fabrication, sections shall be hot dip galvanized according to CAN/CSA G164.

1505.05.02 Installation Hardware

All bolts, nuts, and washers shall be according to ASTM A307 and be hot dip galvanized according to CAN/CSA G164.

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1505.07.01 Fabrication Tolerances and Workmanship

Bolt holes in steel channels shall be perpendicular to the surface and shall not deviate more than 1.0 mm in any direction from the true location. Steel channel ends shall be cut square.

After fabrication, curved steel channels shall be hot dip galvanized according to CAN/CSA G164.

1505.07.02 Marking

As a minimum, each steel channel section shall be marked with the following information:

a) Name, trademark, or brand of the manufacturer.

b) Standard designation 1505.

c) Identification symbols or code for heat.

d) Week number and year of production.

Markings shall be clearly and permanently stamped in the valley of the steel channel, placed at a location clear of the splice overlap, and shall not be obscured after installation. The height of the letters and numerals shall be within the range of 19 to 32 mm.

1505.09 OWNER PURCHASE OF MATERIAL

1505.09.01 Measurement and Payment

For measurement purposes, a count shall be made of the number of steel channel sections delivered and accepted.

Installation hardware shall be measured in the units specified in the purchasing order, delivered and accepted.

Payment at the price specified in the purchasing order shall be for the supply of steel channels and installation hardware delivered to the destination or destinations at the dates and times specified.

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

Ontario Provincial Standard Specifications (OPSSs)					
1704	November 2014	April 2025	TBD	Rev: Material Specification for Paint Coating Systems for Structural Steel is implemented. The specification has been updated to new PROV format with no technical content changes. Legacy Appendix A removed. OPSF 1704-1 table format updated.	Mike Pearsall

Note: The 1704 implemented in April 2025 replaces 1704, November 2014 with no technical content changes.

MATERIAL SPECIFICATION FOR PAINT COATING SYSTEMS FOR STRUCTURAL STEEL

TABLE OF CONTENTS

1704.01 SCOPE

This specification covers the material requirements of paint coating systems for structural steel. ~~-~~It also covers the procedure to be followed for initial approval and subsequent acceptance testing of paint coatings and paint coating systems.

~~1704.01.01 Specification Significance and Use~~

~~This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.~~

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

~~1704.01.02 Appendices Significance and Use~~

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

~~Appendices are developed for the Owner's use only.~~

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

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

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

1704.02 REFERENCES

~~When the Contract Documents indicate that 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, Construction

OPSS 911 Coating Structural Steel Systems

ASTM International

~~A 123~~A123/A123M-12 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

~~B 117~~B117-11 Standard Practice for Operating Salt Spray (Fog) Apparatus
~~D 523~~D523-14 Standard Test Method for Specular Gloss
~~D 562~~D562-10 Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using the Stormer-Type Viscometer
~~D 609~~D609-00 (2012) Standard Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products
~~D 610~~D610-08 (2012) Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces
~~D 660~~D660-93 (2011) Standard Test Method for Evaluating Degree of Checking of Exterior Paints
~~D 661~~D661-93 (2011) Standard Test Method for Evaluating Degree of Cracking of Exterior Paints
~~D 714~~D714-02 (2009) Standard Test Method for Evaluating Degree of Blistering of Paints
~~D 772~~D772-86(2011) Standard Test Method for Evaluating Degree of Flaking (Scaling) of Exterior Paints
~~D 1210~~D1210-05 (2010 Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
~~D 1475~~D1475-13 Standard test Method for Density of Liquid Coatings, Inks, and Related Products
D1640 -03(2009) Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
~~D 1654~~D1654-08 Standard test method for Evaluation of Painted or Coated Specimens subjected to Corrosive environment
~~D 2369~~D2369-10e1 Standard Test Method for Volatile Content of Coatings
~~D 2371~~D2371-85(2010) Standard Test Method for Pigment Content of Solvent-Reducible Paints
~~D 2621~~D2621-87(2011) Standard Test Method for Infrared Identification of Vehicle Solids From Solvent-Reducible Paints
~~D 3271~~D3271-87(2012) Standard Practice for Direct Injection of Solvent-Reducible Paints Into a Gas Chromatograph for Solvent Analysis

~~D 3723~~D3723-05(2011) Standard Test Method for Pigment Content of Water-Emulsion Paints by Low-Temperature Ashing
~~D 3960~~D3960-05(2013) Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paint and Related Coatings
~~D 4214~~D4214-07 Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
~~D 4400~~D4400-99(2012)e1 Standard Test Method for Sag Resistance of Paints Using a Multinotch Applicator
~~D 4451~~D4451-02(2008) Standard Test Method for Pigment Content of Paints by Low-Temperature Ashing
~~D 4541~~D4541-09e1 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
~~D 4587~~D4587-11 Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
~~D 5894~~D5894-10 Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
~~D 6386~~D6386-10 Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
~~E 1347~~E1347-06 (2011) Standard Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry

ASTM International Manual Series: MNL 17

Paint and Coating Testing Manual, 15th Edition, 2012

The Society for Protective Coatings (SSPC)

Good Painting Practice, SSPC Painting Manual, Volume 1, 4th Edition, 2002
SP 3-82 (2004) Power Tool Cleaning
VIS 1-02 Visual Standard for Abrasive Blast Cleaned Steel
VIS 3-93(2004) Visual Standard for Power and Hand Tool Cleaned Steel

SSPC and National Association of Corrosion Engineers (NACE) Joint Publications

SP 5 / NACE No. 1, Jan 2007 White Metal Blast Cleaning
SP 10 / NACE No. 2, September 2000 Near-White Blast Cleaning

SSPC, American Welding Society (AWS) and NACE Joint Publications

SSPC-CS 23.00 / AWS C2.23M/NACE No.12-2003 Application of Thermal Spray Coatings (metalizing) of Aluminum, Zinc, and Their Alloys and Composites for Corrosion Protection of Steel

Others

U.S. General Services Administration:
Federal Standard 595C Colors, 2008

1704.03 DEFINITIONS

For the purpose of this specification, the definitions in the SSPC, Good Painting Practice Manual Volume 1, 4th Edition; and the following definitions apply:

Coating System means as defined in OPSS 911.

Low Volatile Organic Coating Material means coating material that contains not more than 340 g/L of volatile organic compounds (VOC) when tested according to ASTM ~~D 3960~~D3960.

Marginally Prepared Surface means a steel surface prepared by power tool cleaning according to SSPC – SP- 3.

Paint Coating means as defined in OPSS 911.

Paint Coating System means as defined in OPSS 911.

Pot Life means the length of time a multi-component material is usable after all the components are mixed in the recommended portions.

Seal Coat means as defined in OPSS 911.

Structural Steel means as defined in OPSS 911.

Target Value means the value of various properties listed in OPSF 1704-1 submitted by the supplier with the initial submission of material samples for coating system approval.

1704.04 DESIGN AND SUBMISSION REQUIREMENTS

1704.04.01 Submissions Requirements

1704.04.01.01 Paint Coatings and Paint Coating System Approval

The supplier shall provide samples and a completed OPSF 1704-1 for each component of the paint coating system for approval and material acceptance testing. -The sample shall be accompanied by the manufacturer's instructions for use; material safety data sheets; and material information, including documentation on laboratory and field tests carried out to establish the pot life; physical characteristics; and chemical composition as shown in OPSF 1704-1.

1704.05 MATERIALS

1704.05.01 Coating Material

1704.05.01.01 General

The requirements of the paint coating shall be according to the following:

a) The concentration of lead in the dry film of each coating shall not exceed 0.01% or 100 ppm.

b) The components shall be homogenous, well-dispersed to a uniform consistency and, when mixed according to manufacturer's instructions, shall be suitable for application by spray equipment.

c) Each paint coating shall be a low VOC material.

d)- Zinc–rich touch up paint shall contain not less than 87% of zinc by mass of non-volatile matter.

e) The paint coating system for marginally prepared surfaces shall be suitable for application over existing coatings of alkyd, vinyl, and currently approved low VOC paint coating systems.

1704.05.01.02 Colour

The prime coat shall be of such a colour as to assist the applicator in distinguishing between primed areas and the uncoated cleaned steel or other prepared surfaces.

Each coat shall be formulated to show a distinct colour difference. With the exception of coal tar epoxies, the colour of the finish coat shall be equivalent to 10045 brown for Atmospheric Corrosion Resistant steel, and a colour equivalent to 16307 grey for all other steels, both according to Federal Standard 595C Colors.

1704.05.01.03 Application Requirements

When applied according to the manufacturer's instructions and to the manufacturer's specified thickness, the paint coating shall show good levelling with no runs, sags, or mud cracks. Applied coatings shall have no pin-holes, holidays, bubbles, or craters.

Each coat shall be capable of application by spray, brush, or roller for a temperature range of 5 to 35 °C, without thinning.

After the components have been combined, multiple component paint coating shall have a minimum pot life of 3 hours at 25 °C.

1704.05.01.03.01 Two-Coat Zinc Rich Rapid Deployment Coating System

In order to qualify as a primer for a rapid deployment coating system, zinc rich coating material shall cure or dry sufficiently to be top coated within 3 hours at 15 ºC when applied at a wet film thickness required for a DFT of 100 µm.

The coatings to be used as the top coat material shall cure or dry to touch within 4 hours when applied at a wet film thickness required for a DFT of 125 µm.

1704.05.01.04 Performance Requirements

1704.05.01.04.01 General

The entire coating system shall be tested on test panels for adhesion, weathering resistance, and corrosion resistance performance. Testing shall be as shown in Table 1.

1704.05.01.04.02 Accelerated Weathering

After 5,000 hours of exposure, the coating system on the test panel for abrasive blast cleaned surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. Chalk rating shall be 7 or higher, and the colour difference shall not exceed 6 units.

After 2,500 hours of exposure, the coating system on the test panel for marginally prepared surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 5,000 hours of exposure, the coating system on the galvanized test panel shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 5,000 hours of exposure, the coating system on the metallized test panel shall exhibit none of the characteristics of the paint failure as described in the chapter "Causes and Prevention of Paint Failure" in SSPC Vol. 1. Chalking shall be 7 or higher, and the colour difference shall not exceed 6 units when measured as shown in Table 1.

1704.05.01.04.03 Cyclic Corrosion Resistance Testing

After 12 cycles of exposure, the coating system on the test panel for abrasive blast cleaned surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. There shall not be any corrosion, except along the score lines. The average value of the rust creepage of all the scored panels tested shall not be more than 4 mm. However, the rust creepage on any individual panel may exceed 4.0 mm, but shall be below 5.0 mm. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 6 cycles of exposure, the coating system on the test panel for marginally prepared surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. There shall not be any corrosion, except along the score lines. The average value of the rust creepage of all the scored panels tested shall not be more than 4 mm. However, the rust creepage on any individual panel may exceed 4.0 mm, but shall be below 5.0 mm. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 12 cycles of exposure, the coating system on the galvanized test panel shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. There shall not be any corrosion, except along the score lines. The average value of the rust creepage of all the scored panels tested shall not be more than 4 mm. However, the rust creepage on any individual panel may exceed 4.0 mm, but shall be below 5.0 mm. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 12 cycles of exposure, the seal coatings on the metallized test panel shall exhibit none of the characteristics of the paint failure as described in the chapter "Causes and Prevention of Paint Failure" in SSPC Vol. 1. There shall not be any corrosion, except along the score lines where the total width of rust creepage shall not be more than 1.0 mm. Chalking shall be 7 or higher and the colour difference shall not exceed 6 units when measured as shown in Table 1.

1704.05.01.04.04 Salt Spray Resistance Testing

Salt spray resistance testing of zinc-rich touch up paint coated test panels shall be conducted according to ASTM B117 for 720 hours. There shall not be any corrosion, except along the score lines where the total width of rust creepage shall not be more than 1.00mm.

1704.05.01.05 Recoat Time

At an ambient temperature of 23 °C and a relative humidity of 80%, a paint coating shall dry or cure sufficiently to receive the next coat satisfactorily within 16 hours of application. It shall remain recoatable for a minimum of 30 Days.

1704.07 PRODUCTION

1704.07.01 Quality Control

1704.07.01.01 Physical Tests and Paint Coating Composition

The results for physical tests and paint coating composition of production batches shall be within the tolerances as shown in Table 2, when the results of testing are compared to the respective test results of the sample submitted for the coating system approval.

1704.07.01.02 Chemical Analysis

When the product from production batches of paint coatings is analyzed for chemical composition, the test results shall not vary by more than:

a) ± 5% from the value of the original submission, if the amount of ingredient is greater than 50% by weight of the product.

b) ± 10% from the value of the original submission, if the amount of the ingredient is from 5 to 50% by weight of the product.

1704.07.01.03 Infrared Analysis

The infrared spectrum of the product or any product fraction of production batches of paint coatings shall match the corresponding spectrum from the sample submitted for coating system approval.

1704.07.01.04 Gas Chromatogram of Volatiles

The gas chromatogram of production batches of paint coatings shall show the identical volatile components present in the same proportions as in the sample submitted for coating system approval.

1704.07.01.05 Colour Difference

Colour difference of production batches of paint coatings shall be within the tolerances as shown in Table 2. The reference colour for the finish coat shall be the appropriate colour specified in the Material section. For all other coats, the reference colour shall be the colour of the sample submitted for paint coating system approval.

1704.07.02 Packaging and Delivery

The paint shall be delivered in the manufacturer's originally sealed containers.

Containers shall be leak-free and constructed so that the contents can be thoroughly and completely mixed. They shall be provided with triple-tight lids. Containers 4 litres or larger shall have wire bail handles.

Each container and shipping case shall be marked to show the following information:

a) Identification of the paint coating system.

b) The contents of container (i.e., prime coat, second coat, third coat, or fourth coat).

c) The colour and colour code.

d) The manufacturer's name and address.

e) The quantity of the contents in litres.

f) The date of filling the container (i.e., yyyy-mm-dd).

g) The manufacturer's code and coating batch numbers.

The markings shall be permanent and the coating batch number shall be prominently displayed.

1704.07.02.01 Certificate of Compliance

A certificate of compliance from the manufacturer indicating that the physical properties and chemical composition of the material supplied complies with the requirements of this specification shall be included with each shipment of paint.

1704.08 QUALITY ASSURANCE

1704.08.01 Test Panels

1704.08.01.01 Testing General

For the following tests, the number of panels specified below shall be made for the paint coating system being evaluated and the panels for the approved paint coating system to be used for reference purposes during paint coating operations.

1704.08.01.02 Weathering Resistance and Corrosion Resistance Testing

1704.08.01.02.01 Panel Preparation

1704.08.01.02.01.01 Abrasive Blast Cleaned Surfaces

Panels shall be cold-rolled carbon steel according to ASTM ~~D 609~~D609, measuring 75 x 150 x 2.6 mm with rounded edges. Panels shall be blast cleaned to the requirements of SP 10/NACE NO. 2. The pictorial standards as shown in SSPC-VIS 1 shall be used to check conformance of the panel preparation in conjunction with SP 10/NACE NO. 2. The height of the surface profile shall be a minimum of 25 µm and a maximum of 75 µm.

1704.08.01.02.01.02 Marginally Prepared Surfaces

The panels shall be prepared as specified in the Abrasive Blast Cleaned Surfaces clause and then be subjected to 72 hours of salt spray according to ASTM ~~B 117~~B117, after which, the rusted panels shall be power-tool cleaned to SSPC

SP 3 condition by power wire brush. The pictorial standards as shown in SSPC VIS 3 shall be used to check conformance of the panel preparation in conjunction with SSPC SP3.

1704.08.01.02.01.03 Paint Coating on Galvanized Surfaces

As the first step, cold-rolled carbon steel panels, measuring 75 x 150 x 5 mm with rounded edges shall be hot dip galvanized according to ASTM A123/A123M. Galvanized panel surfaces shall then be prepared according to ASTM ~~D 6386.~~ D6386. Thick edges due to excess zinc run-off, high spots, and rough edges shall be removed by power tools. Surface preparation shall be performed by sweep blasting to roughen the surface using an abrasive of a hardness that does not damage the galvanized coating.

1704.08.01.02.01.04 Seal Coating on Metallized Surfaces

As the first step, cold-rolled carbon steel panels measuring 75 mm x 150 mm x 2.6 mm, and shall be blast cleaned to the requirements of SP5/NACE NO. 1. The height of the surface profile shall be a minimum of 50 µm and a maximum of 75 µm. The blast cleaned panels shall then be coated on both surfaces and the edges with 85% zinc / 15% aluminum alloy by thermal metal spraying according to SSPC-CS 23.00 / AWS C2.23M/NACE No.12. The dry film thickness of the metallized coating shall be between 75 µm and 110 µm. The metallized panels shall be vacuum sealed or stored in a vacuum desiccator to prevent oxidation until the seal coat material is ready to be spray applied.

1704.08.01.02.02 Paint Coating and Seal Coating Application

The paint coating system shall be spray applied on both faces of the prepared test panels according to the manufacturer's recommendations and to the manufacturer's recommended thickness. When the painted faces are hard dry, the edges of the panels shall be covered with the same coating applied by brush. After the final coat, the panels shall be dried and cured for 7 Days prior to any further handling.

The coating on the panels intended for scoring shall be scored according to ASTM D1654.

1704.08.01.02.03 Test Method for Accelerated Weathering

Test panels shall be prepared and coated as specified in the Panel Preparation clause and the Paint Coating and Seal Coating Application clause.

Seven unscored panels shall be prepared for each cleaning requirement for each coating system. One panel from each set shall be set aside as reference for comparison purposes. The other panels from each set shall undergo exposure testing as shown in Table 1. Evaluation shall be done at 500 hour intervals of exposure to the maximum of 5,000 hours for coating systems on abrasive blast cleaned surfaces and galvanized surfaces, seal coating on metallized surfaces, and 2,500 hours for coatings on marginally prepared surfaces.

1704.08.01.02.04 Test Method for Cyclic Corrosion Resistance of Coatings

Test panels shall be prepared, coated, and scored as specified in the Panel Preparation clause and the Paint Coating and Seal Coating Application clause.

Eleven panels shall be prepared for each cleaning requirement for each coating system. One panel from each set shall be set aside as reference for comparison purposes. The other panels, 5 unscored and 5 scored from each set, shall undergo exposure testing as shown in Table 1. Evaluation shall be done after each cycle of exposure. At the completion of testing, the coating between the score lines on the bottom half of the scored panels shall be stripped and the mean rust creepage in millimetres for each panel shall be determined according to ASTM ~~D 1654.~~ D1654. The average rust creepage shall be calculated from the mean rust creepage values of the individual panels of the respective paint system.

1704.08.02 Coating System Approval

1704.08.02.01 General

Approval shall only be given for a complete paint coating system and for paint coating to be used as a seal coat for thermal spray metal coating.

Testing shall be performed by the Owner or by an independent laboratory chosen by the Owner.

When an independent laboratory is used, the paint manufacturer shall arrange for testing by the independent laboratory. The independent laboratory shall obtain samples of the approved paint coating and paint coating system to be used for comparison purposes from the Owner.

1704.08.02.02 Testing by Owner

When testing is carried out by the Owner for initial approval, the supplier shall be notified of the sample size, date, labelling, and other details regarding submission of samples, including cost.

1704.08.02.03 Testing for Coating System Approval and Approval of Subsequent Batches

The initial submission shall be evaluated for approval based on the requirements specified in the Materials section, using the testing methods as shown in Tables 1 and 2, and the data submitted on the completed OPSF 1704-1.

For comparison, an approved system from the Owner's list of approved coatings shall be subjected to the tests for accelerated weathering and cyclic corrosion resistance concurrently with the system under evaluation. Where possible, coatings of the same generic type shall be used for comparison.

When the testing is done by the approved independent laboratory, the Owner shall review the test results and may repeat any of the tests.

Subsequent batches of material shall be tested for acceptance as specified in the Quality Assurance section.

1704.08.02.05 Acceptance or Rejection

1704.08.02.05.01 Initial Approval

Approval shall only be given to paint coatings and paint coating systems satisfying the requirements of the Materials section.

1704.08.03 Sampling at Work Site

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

1704.08.03.01 Acceptance or Rejection on Site

Testing shall be done by the Owner according to the methods as shown in Table 2.

Acceptance shall be based on the testing requirements and allowable tolerances as shown in Table 2, when compared to the results of the testing conducted by the Owner on the initially approved material.

Failure to conform to the requirements of the Material section and the tolerances as shown in Table 2, changes made in the formulation after approval, inability to maintain production quality, and unsatisfactory field performance of paint coatings or paint coating systems shall be a cause for rejection.

TABLE 1
Performance Tests for Paint Coating Systems

Type of Test	ASTM Method	Requirements
Pull-Off Adhesion	~~D 4541~~D4541	2.75 MPa minimum
Accelerated Weathering using Fluorescent UV - Condensation Light- and Water-Exposure Apparatus for evaluation of: Paint coating system on abrasive blast cleaned test panels Paint coating systems on hot dip galvanized test panels Seal coating on metallized test panels Paint coating system on marginally prepared test panels	~~D 4587~~ D4587 Test Condition D	Exposed to: 5,000 hours maximum 5,000 hours maximum 5,000 hours maximum 2,500 hours maximum
Cyclic Corrosion Resistance Testing by Alternating Exposures in a UV/Condensation Cabinet and a Salt Fog/Dry Cabinet for evaluation of: Paint coating system on abrasive blast cleaned test panels Paint coating systems on hot dip galvanized test panels Seal coating on metallized test panels Paint coating system on marginally prepared test panels	~~D 5894~~D5894	Exposed to: 12 cycles maximum (Note 1) 12 cycles maximum (Note 1) 12 cycles maximum (Note 1) 6 cycles maximum (Note 1)
Evaluation of Test Panels After Accelerated Weathering Test / Cyclic Corrosion Resistance Test for: Gloss Colour Difference (ΔE) Chalking Checking Cracking Flaking Blistering Rusting Rust Creepage	~~D 523~~ ~~E 1347~~ ~~D 4214~~ ~~D 660~~ ~~D 661~~ ~~D 772~~ ~~D 714~~ ~~D 610~~ ~~D 1654~~D523 E1347 D4214 D660 D661 D772 D714 D610 D1654	Test Method for Accelerated Weathering and the Test Method for Cyclic Corrosion Resistance of Coatings clauses (Note 2)

Notes:

1. One cycle represents a total exposure of 336 hours which comprises 168 hours or 1 week of exposure of test panels in the fluorescent UV condensation cabinet, followed by 168 hours of exposure of the test panels in the cyclic salt fog or dry exposure cabinet.

2. Clauses in this specification.

TABLE 2
Test Methods for Physical Testing and Compositional Analysis of Paint Coatings

	ASTM	Acceptance Criteria (Note 1)	
		Tolerance (Note 2)	Others
Physical Tests on Mixed Coating:			
Density	~~D 1475~~	5%	-
Consistency, Kreb Units (KU)	~~D 562~~ D1475	± 10 or 25% (Note 3)	-
Dry Time:	D562		
To Touch		± 30%	-
Hard Dry		± 30%	-
Hiding Power Determination Using Pfund Black and White Cryptometer	D1640 D1640	± 1.5 (Note 4)	-
Skinning	Paint and Coating Testing Manual	-	-
Fineness of Grind, Hegman Units (HU)		± 2	-
Sag Resistance	- ~~D 1210~~ ~~D 4400~~D1210 D4400	± 20%	-
Coating Composition:			
Pigment Content by % mass	~~D 4451, D 2371, D 3723~~	± 5%	-
Vehicle Solids Content by % mass @ 24 hours	~~-~~	± 5%	-
Volatile Content by % mass @ 2 hours and 24 hours	~~D 2369~~D4451, D2371, D3723 ~~-~~ D2369	± 5%	-
Pigment Composition by Chemical and Instrumental Analysis	-	-	Chemical Analysis clause (Note 5)
VOC Content	~~D 3960~~D3960	± 10% but the total not exceeding 340 g/L (Note 6)	-
Vehicle Solids Identification by Infrared Analysis	~~D 2621~~D2621	-	Infrared Analysis clause (Note 5)
Determination of Paint Volatiles Composition by Gas Chromatography	~~D 3271~~D3271	-	Gas Chromatogram of Volatiles clause (Note 5)
Determination of Thinner Composition by Gas Chromatography	~~D 3271~~D3271	-	Gas Chromatogram of Volatiles clause (Note 5)
Tests on Cured Paint Coating:			
Gloss	~~D 523~~	± 30%	-
Colour Difference (ΔE)	~~E 1347~~ D523	± 4 units	-
IR Fingerprinting	E1347 Paint and Coating Testing Manual	-	Infrared Analysis clause (Note 5)

Notes:

1. Acceptance criteria for field samples and production batches.
2. Allowable tolerance for field samples or production batches based on the Owner's test results for the initially approved paint coating material.
3. Whichever is less.
4. Pfund black and white cryptometer, wedge #3.5.
5. Clause in this specification.
6. VOC content of Zinc -rich touch up paint shall not exceed ~~500g~~500 g/L.

PAINT COATING DATA FORM

~~A. MANUFACTURER INFORMATION~~

A. MANUFACTURER INFORMATION	
Name:	
Address:	
Telephone:	
Fax:	
Email:	
B. SAMPLE IDENTIFICATION	
Manufacturer's Code No.:	Coating Batch No.:
Colour of Coating:	Production Date:
C. TEST DATA OF MIXED COATING	

~~B. SAMPLE IDENTIFICATION~~

~~Manufacturer's Code No.:~~	~~Coating Batch No.:~~
~~Colour of Coating:~~	~~Production Date:~~

~~C. TEST DATA OF MIXED COATING~~

	Test Method	Manufacturer's Test Results
Density, kg/L	ASTM ~~D 1475~~D1475	
VOC, g/L	ASTM ~~D 3960~~D3960	
Viscosity, KU	ASTM ~~D 562~~D562	
Pot Life, hours @ 25 °C	Manufacturer's Procedure	
Sag Resistance, mm	ASTM ~~D 4400~~D4400	
Dry Time, hours @ 25 °C		
To touch	ASTM D1640	
Hard dry	ASTM D1640	
D. COMPOSITION OF MIXED COATING		

~~D. COMPOSITION OF MIXED COATING~~

	Test Method	% by Mass
Pigment and Fillers	ASTM ~~D 2371, D 4451, D 3723~~D2371, D4451, D3723	
Non Volatile	-	
Volatile	ASTM ~~D 2369~~D2369	
E. COMPOSITION OF PIGMENTS AND FILLERS IN EACH COMPONENT % BY MASS - List % lead to three decimal places		

~~E. COMPOSITION OF PIGMENTS AND FILLERS IN EACH COMPONENT % BY MASS - List % lead to three decimal places~~

	Component A	%	Component B	%	Component C	%
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

~~F. PAINT VOLATILE COMPOSITION BY GAS CHROMATOGRAPHY - Attach chromatogram with peaks identified~~

	Chemical Name	%
1		
2		
3		
4		
5		

~~G. COMPOSITION OF THINNER BY GAS CHROMATOGRAPHY - Attach chromatogram with peaks identified~~

	Chemical Name	%
1		
2		
3		
4		

5		

H. **VEHICLE SOLIDS IDENTIFICATION by Infrared Analysis - Attach spectrum with major peaks identified**

I. **MIXING RATIO OF COMPONENTS A, B, and C by weight _____**

J. **IR FINGERPRINT OF MIXED, CURED COATING - Attach Spectrum with major peaks identified**

OPSF 1704-1

~~**Appendix 1704-A, November 2014**~~
~~**FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**~~

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

~~**Designer Action/Considerations**~~

~~No information provided here.~~

~~**Related Ontario Provincial Standard Drawings**~~

~~No information provided here.~~

Note: The 1704 implemented in April 2025 replaces 1704, November 2014 with no technical content changes.

MATERIAL SPECIFICATION FOR PAINT COATING SYSTEMS FOR STRUCTURAL STEEL

TABLE OF CONTENTS

1704.01 SCOPE

This specification covers the material requirements of paint coating systems for structural steel. It also covers the procedure to be followed for initial approval and subsequent acceptance testing of paint coatings and paint coating systems.

1704.02 REFERENCES

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

Ontario Provincial Standard Specifications, Construction

OPSS 911 Coating Structural Steel Systems

ASTM International

A123/A123M-12 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
B117-11 Standard Practice for Operating Salt Spray (Fog) Apparatus
D523-14 Standard Test Method for Specular Gloss

D562-10	Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using the Stormer-Type Viscometer
D609-00 (2012)	Standard Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products
D610-08 (2012)	Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces
D660-93 (2011)	Standard Test Method for Evaluating Degree of Checking of Exterior Paints
D661-93 (2011)	Standard Test Method for Evaluating Degree of Cracking of Exterior Paints
D714-02 (2009)	Standard Test Method for Evaluating Degree of Blistering of Paints
D772-86(2011)	Standard Test Method for Evaluating Degree of Flaking (Scaling) of Exterior Paints
D1210-05 (2010	Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
D1475-13	Standard test Method for Density of Liquid Coatings, Inks, and Related Products
D1640 -03(2009)	Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
D1654-08	Standard test method for Evaluation of Painted or Coated Specimens subjected to Corrosive environment
D2369-10e1	Standard Test Method for Volatile Content of Coatings
D2371-85(2010)	Standard Test Method for Pigment Content of Solvent-Reducible Paints
D2621-87(2011)	Standard Test Method for Infrared Identification of Vehicle Solids From Solvent-Reducible Paints
D3271-87(2012)	Standard Practice for Direct Injection of Solvent-Reducible Paints Into a Gas Chromatograph for Solvent Analysis
D3723-05(2011)	Standard Test Method for Pigment Content of Water-Emulsion Paints by Low-Temperature Ashing
D3960-05(2013)	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paint and Related Coatings
D4214-07	Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
D4400-99(2012)e1	Standard Test Method for Sag Resistance of Paints Using a Multinotch Applicator
D4451-02(2008)	Standard Test Method for Pigment Content of Paints by Low-Temperature Ashing
D4541-09e1	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
D4587-11	Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
D5894-10	Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
D6386-10	Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
E1347-06 (2011)	Standard Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry

ASTM International Manual Series: MNL 17

Paint and Coating Testing Manual, 15th Edition, 2012

The Society for Protective Coatings (SSPC)

Good Painting Practice, SSPC Painting Manual, Volume 1, 4th Edition, 2002

SP 3-82 (2004)	Power Tool Cleaning
VIS 1-02	Visual Standard for Abrasive Blast Cleaned Steel
VIS 3-93(2004)	Visual Standard for Power and Hand Tool Cleaned Steel

SSPC and National Association of Corrosion Engineers (NACE) Joint Publications

SP 5 / NACE No. 1, Jan 2007 White Metal Blast Cleaning

SP 10 / NACE No. 2, September 2000 Near-White Blast Cleaning

SSPC, American Welding Society (AWS) and NACE Joint Publications

SSPC-CS 23.00 / AWS C2.23M/NACE No.12-2003 Application of Thermal Spray Coatings (metalizing) of Aluminum, Zinc, and Their Alloys and Composites for Corrosion Protection of Steel

Others

U.S. General Services Administration:
Federal Standard 595C Colors, 2008

1704.03 DEFINITIONS

For the purpose of this specification, the definitions in the SSPC, Good Painting Practice Manual Volume 1, 4th Edition; and the following definitions apply:

Coating System means as defined in OPSS 911.

Low Volatile Organic Coating Material means coating material that contains not more than 340 g/L of volatile organic compounds (VOC) when tested according to ASTM D3960.

Marginally Prepared Surface means a steel surface prepared by power tool cleaning according to SSPC-SP 3.

Paint Coating means as defined in OPSS 911.

Paint Coating System means as defined in OPSS 911.

Pot Life means the length of time a multi-component material is usable after all the components are mixed in the recommended portions.

Seal Coat means as defined in OPSS 911.

Structural Steel means as defined in OPSS 911.

Target Value means the value of various properties listed in OPSF 1704-1 submitted by the supplier with the initial submission of material samples for coating system approval.

1704.04 DESIGN AND SUBMISSION REQUIREMENTS

1704.04.01 Submissions Requirements

1704.04.01.01 Paint Coatings and Paint Coating System Approval

The supplier shall provide samples and a completed OPSF 1704-1 for each component of the paint coating system for approval and material acceptance testing. The sample shall be accompanied by the manufacturer's instructions for use; material safety data sheets; and material information, including documentation on laboratory and field tests carried out to establish the pot life; physical characteristics; and chemical composition as shown in OPSF 1704-1.

1704.05 MATERIALS

1704.05.01 Coating Material

1704.05.01.01 General

The requirements of the paint coating shall be according to the following:

a) The concentration of lead in the dry film of each coating shall not exceed 0.01% or 100 ppm.

b) The components shall be homogenous, well-dispersed to a uniform consistency and, when mixed according to manufacturer's instructions, shall be suitable for application by spray equipment.

c) Each paint coating shall be a low VOC material.

d) Zinc–rich touch up paint shall contain not less than 87% of zinc by mass of non-volatile matter.

e) The paint coating system for marginally prepared surfaces shall be suitable for application over existing coatings of alkyd, vinyl, and currently approved low VOC paint coating systems.

1704.05.01.02 Colour

The prime coat shall be of such a colour as to assist the applicator in distinguishing between primed areas and the uncoated cleaned steel or other prepared surfaces.

Each coat shall be formulated to show a distinct colour difference. With the exception of coal tar epoxies, the colour of the finish coat shall be equivalent to 10045 brown for Atmospheric Corrosion Resistant steel, and a colour equivalent to 16307 grey for all other steels, both according to Federal Standard 595C Colors.

1704.05.01.03 Application Requirements

When applied according to the manufacturer's instructions and to the manufacturer's specified thickness, the paint coating shall show good levelling with no runs, sags, or mud cracks. Applied coatings shall have no pin-holes, holidays, bubbles, or craters.

Each coat shall be capable of application by spray, brush, or roller for a temperature range of 5 to 35 °C, without thinning.

After the components have been combined, multiple component paint coating shall have a minimum pot life of 3 hours at 25 °C.

1704.05.01.03.01 Two-Coat Zinc Rich Rapid Deployment Coating System

In order to qualify as a primer for a rapid deployment coating system, zinc rich coating material shall cure or dry sufficiently to be top coated within 3 hours at 15 ºC when applied at a wet film thickness required for a DFT of 100 µm.

The coatings to be used as the top coat material shall cure or dry to touch within 4 hours when applied at a wet film thickness required for a DFT of 125 µm.

1704.05.01.04 Performance Requirements

1704.05.01.04.01 General

The entire coating system shall be tested on test panels for adhesion, weathering resistance, and corrosion resistance performance. Testing shall be as shown in Table 1.

1704.05.01.04.02 Accelerated Weathering

After 5,000 hours of exposure, the coating system on the test panel for abrasive blast cleaned surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. Chalk rating shall be 7 or higher, and the colour difference shall not exceed 6 units.

After 2,500 hours of exposure, the coating system on the test panel for marginally prepared surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 5,000 hours of exposure, the coating system on the galvanized test panel shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 5,000 hours of exposure, the coating system on the metallized test panel shall exhibit none of the characteristics of the paint failure as described in the chapter "Causes and Prevention of Paint Failure" in SSPC Vol. 1. Chalking shall be 7 or higher, and the colour difference shall not exceed 6 units when measured as shown in Table 1.

1704.05.01.04.03 Cyclic Corrosion Resistance Testing

After 12 cycles of exposure, the coating system on the test panel for abrasive blast cleaned surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. There shall not be any corrosion, except along the score lines. The average value of the rust creepage of all the scored panels tested shall not be more than 4 mm. However, the rust creepage on any individual panel may exceed 4.0 mm, but shall be below 5.0 mm. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 6 cycles of exposure, the coating system on the test panel for marginally prepared surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. There shall not be any corrosion, except along the score lines. The average value of the rust creepage of all the scored panels tested shall not be more than 4 mm. However, the rust creepage on any individual panel may exceed 4.0 mm, but shall be below 5.0 mm. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 12 cycles of exposure, the coating system on the galvanized test panel shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. There shall not be any corrosion, except along the score lines. The average value of the rust creepage of all the scored panels tested shall not be more than 4 mm. However, the rust creepage on any individual panel may exceed 4.0 mm, but shall be below 5.0 mm. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 12 cycles of exposure, the seal coatings on the metallized test panel shall exhibit none of the characteristics of the paint failure as described in the chapter "Causes and Prevention of Paint Failure" in SSPC Vol. 1. There shall not be any corrosion, except along the score lines where the total width of rust creepage shall not be more than 1.0 mm. Chalking shall be 7 or higher and the colour difference shall not exceed 6 units when measured as shown in Table 1.

1704.05.01.04.04 Salt Spray Resistance Testing

Salt spray resistance testing of zinc-rich touch up paint coated test panels shall be conducted according to ASTM B117 for 720 hours. There shall not be any corrosion, except along the score lines where the total width of rust creepage shall not be more than 1.00mm.

1704.05.01.05 Recoat Time

At an ambient temperature of 23 °C and a relative humidity of 80%, a paint coating shall dry or cure sufficiently to receive the next coat satisfactorily within 16 hours of application. It shall remain recoatable for a minimum of 30 Days.

1704.07 PRODUCTION

1704.07.01 Quality Control

1704.07.01.01 Physical Tests and Paint Coating Composition

The results for physical tests and paint coating composition of production batches shall be within the tolerances as shown in Table 2, when the results of testing are compared to the respective test results of the sample submitted for the coating system approval.

1704.07.01.02 Chemical Analysis

When the product from production batches of paint coatings is analyzed for chemical composition, the test results shall not vary by more than:

a) ± 5% from the value of the original submission, if the amount of ingredient is greater than 50% by weight of the product.

b) ± 10% from the value of the original submission, if the amount of the ingredient is from 5 to 50% by weight of the product.

1704.07.01.03 Infrared Analysis

The infrared spectrum of the product or any product fraction of production batches of paint coatings shall match the corresponding spectrum from the sample submitted for coating system approval.

1704.07.01.04 Gas Chromatogram of Volatiles

The gas chromatogram of production batches of paint coatings shall show the identical volatile components present in the same proportions as in the sample submitted for coating system approval.

1704.07.01.05 Colour Difference

Colour difference of production batches of paint coatings shall be within the tolerances as shown in Table 2. The reference colour for the finish coat shall be the appropriate colour specified in the Material section. For all other coats, the reference colour shall be the colour of the sample submitted for paint coating system approval.

1704.07.02 Packaging and Delivery

The paint shall be delivered in the manufacturer's originally sealed containers.

Containers shall be leak-free and constructed so that the contents can be thoroughly and completely mixed. They shall be provided with triple-tight lids. Containers 4 litres or larger shall have wire bail handles.

Each container and shipping case shall be marked to show the following information:

a) Identification of the paint coating system.

b) The contents of container (i.e., prime coat, second coat, third coat, or fourth coat).

c) The colour and colour code.

d) The manufacturer's name and address.

e) The quantity of the contents in litres.

f) The date of filling the container (i.e., yyyy-mm-dd).

g) The manufacturer's code and coating batch numbers.

The markings shall be permanent and the coating batch number shall be prominently displayed.

1704.07.02.01 Certificate of Compliance

A certificate of compliance from the manufacturer indicating that the physical properties and chemical composition of the material supplied complies with the requirements of this specification shall be included with each shipment of paint.

1704.08 QUALITY ASSURANCE

1704.08.01 Test Panels

1704.08.01.01 Testing General

For the following tests, the number of panels specified below shall be made for the paint coating system being evaluated and the panels for the approved paint coating system to be used for reference purposes during paint coating operations.

1704.08.01.02 Weathering Resistance and Corrosion Resistance Testing

1704.08.01.02.01 Panel Preparation

1704.08.01.02.01.01 Abrasive Blast Cleaned Surfaces

Panels shall be cold-rolled carbon steel according to ASTM D609, measuring 75 x 150 x 2.6 mm with rounded edges. Panels shall be blast cleaned to the requirements of SP 10/NACE NO. 2. The pictorial standards as shown in SSPC-VIS 1 shall be used to check conformance of the panel preparation in conjunction with SP 10/NACE NO. 2. The height of the surface profile shall be a minimum of 25 µm and a maximum of 75 µm.

1704.08.01.02.01.02 Marginally Prepared Surfaces

The panels shall be prepared as specified in the Abrasive Blast Cleaned Surfaces clause and then be subjected to 72 hours of salt spray according to ASTM B117, after which, the rusted panels shall be power-tool cleaned to SSPC SP 3 condition by power wire brush. The pictorial standards as shown in SSPC-VIS 3 shall be used to check conformance of the panel preparation in conjunction with SSPC SP3.

1704.08.01.02.01.03 Paint Coating on Galvanized Surfaces

As the first step, cold-rolled carbon steel panels, measuring 75 x 150 x 5 mm with rounded edges shall be hot dip galvanized according to ASTM A123/A123M. Galvanized panel surfaces shall then be prepared according to ASTM D6386. Thick edges due to excess zinc run-off, high spots, and rough edges shall be removed by power tools. Surface preparation shall be performed by sweep blasting to roughen the surface using an abrasive of a hardness that does not damage the galvanized coating.

1704.08.01.02.01.04 Seal Coating on Metallized Surfaces

As the first step, cold-rolled carbon steel panels measuring 75 mm x 150 mm x 2.6 mm, and shall be blast cleaned to the requirements of SP5/NACE NO. 1. The height of the surface profile shall be a minimum of 50 µm and a maximum of 75 µm. The blast cleaned panels shall then be coated on both surfaces and the edges with 85% zinc / 15% aluminum alloy by thermal metal spraying according to SSPC-CS 23.00 / AWS C2.23M/NACE No.12. The dry film thickness of the metallized coating shall be between 75 µm and 110 µm. The metallized panels shall be vacuum sealed or stored in a vacuum desiccator to prevent oxidation until the seal coat material is ready to be spray applied.

1704.08.01.02.02 Paint Coating and Seal Coating Application

The paint coating system shall be spray applied on both faces of the prepared test panels according to the manufacturer's recommendations and to the manufacturer’s recommended thickness. When the painted faces are hard dry, the edges of the panels shall be covered with the same coating applied by brush. After the final coat, the panels shall be dried and cured for 7 Days prior to any further handling.

The coating on the panels intended for scoring shall be scored according to ASTM D1654.

1704.08.01.02.03 Test Method for Accelerated Weathering

Test panels shall be prepared and coated as specified in the Panel Preparation clause and the Paint Coating and Seal Coating Application clause.

Seven unscored panels shall be prepared for each cleaning requirement for each coating system. One panel from each set shall be set aside as reference for comparison purposes. The other panels from each set shall undergo exposure testing as shown in Table 1. Evaluation shall be done at 500 hour intervals of exposure to the maximum of 5,000 hours for coating systems on abrasive blast cleaned surfaces and galvanized surfaces, seal coating on metallized surfaces, and 2,500 hours for coatings on marginally prepared surfaces.

1704.08.01.02.04 Test Method for Cyclic Corrosion Resistance of Coatings

Test panels shall be prepared, coated, and scored as specified in the Panel Preparation clause and the Paint Coating and Seal Coating Application clause.

Eleven panels shall be prepared for each cleaning requirement for each coating system. One panel from each set shall be set aside as reference for comparison purposes. The other panels, 5 unscored and 5 scored from each set, shall undergo exposure testing as shown in Table 1. Evaluation shall be done after each cycle of exposure. At the completion of testing, the coating between the score lines on the bottom half of the scored panels shall be stripped and the mean rust creepage in millimetres for each panel shall be determined according to ASTM D1654. The average rust creepage shall be calculated from the mean rust creepage values of the individual panels of the respective paint system.

1704.08.02 Coating System Approval

1704.08.02.01 General

Approval shall only be given for a complete paint coating system and for paint coating to be used as a seal coat for thermal spray metal coating.

Testing shall be performed by the Owner or by an independent laboratory chosen by the Owner.

When an independent laboratory is used, the paint manufacturer shall arrange for testing by the independent laboratory. The independent laboratory shall obtain samples of the approved paint coating and paint coating system to be used for comparison purposes from the Owner.

1704.08.02.02 Testing by Owner

When testing is carried out by the Owner for initial approval, the supplier shall be notified of the sample size, date, labelling, and other details regarding submission of samples, including cost.

1704.08.02.03 Testing for Coating System Approval and Approval of Subsequent Batches

The initial submission shall be evaluated for approval based on the requirements specified in the Materials section, using the testing methods as shown in Tables 1 and 2, and the data submitted on the completed OPSF 1704-1.

For comparison, an approved system from the Owner's list of approved coatings shall be subjected to the tests for accelerated weathering and cyclic corrosion resistance concurrently with the system under evaluation. Where possible, coatings of the same generic type shall be used for comparison.

When the testing is done by the approved independent laboratory, the Owner shall review the test results and may repeat any of the tests.

Subsequent batches of material shall be tested for acceptance as specified in the Quality Assurance section.

1704.08.02.05 Acceptance or Rejection

1704.08.02.05.01 Initial Approval

Approval shall only be given to paint coatings and paint coating systems satisfying the requirements of the Materials section.

1704.08.03 Sampling at Work Site

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

1704.08.03.01 Acceptance or Rejection on Site

Testing shall be done by the Owner according to the methods as shown in Table 2.

Acceptance shall be based on the testing requirements and allowable tolerances as shown in Table 2, when compared to the results of the testing conducted by the Owner on the initially approved material.

Failure to conform to the requirements of the Material section and the tolerances as shown in Table 2, changes made in the formulation after approval, inability to maintain production quality, and unsatisfactory field performance of paint coatings or paint coating systems shall be a cause for rejection.

TABLE 1
Performance Tests for Paint Coating Systems

Type of Test	ASTM Method	Requirements
Pull-Off Adhesion	D4541	2.75 MPa minimum
Accelerated Weathering using Fluorescent UV - Condensation Light- and Water-Exposure Apparatus for evaluation of:	D4587 Test Condition D	Exposed to:
Paint coating system on abrasive blast cleaned test panels		5,000 hours maximum
Paint coating systems on hot dip galvanized test panels		5,000 hours maximum
Seal coating on metallized test panels		5,000 hours maximum
Paint coating system on marginally prepared test panels		2,500 hours maximum
Cyclic Corrosion Resistance Testing by Alternating Exposures in a UV/Condensation Cabinet and a Salt Fog/Dry Cabinet for evaluation of:	D5894	Exposed to:
Paint coating system on abrasive blast cleaned test panels		12 cycles maximum (Note 1)
Paint coating systems on hot dip galvanized test panels		12 cycles maximum (Note 1)
Seal coating on metallized test panels		12 cycles maximum (Note 1)
Paint coating system on marginally prepared test panels		6 cycles maximum (Note 1)
Evaluation of Test Panels After Accelerated Weathering Test / Cyclic Corrosion Resistance Test for:		Test Method for Accelerated Weathering and the Test Method for Cyclic Corrosion Resistance of Coatings clauses (Note 2)
Gloss	D523	
Colour Difference (ΔE)	E1347	
Chalking	D4214	
Checking	D660	
Cracking	D661	
Flaking	D772	
Blistering	D714	
Rusting	D610	
Rust Creepage	D1654	

Notes:

1. One cycle represents a total exposure of 336 hours which comprises 168 hours or 1 week of exposure of test panels in the fluorescent UV condensation cabinet, followed by 168 hours of exposure of the test panels in the cyclic salt fog or dry exposure cabinet.

2. Clauses in this specification.

TABLE 2
Test Methods for Physical Testing and Compositional Analysis of Paint Coatings and Acceptance Criteria for Field Samples and Production Batches

	ASTM	Acceptance Criteria (Note 1)	
		Tolerance (Note 2)	Others
Physical Tests on Mixed Coating:			
Density	D1475	5%	-
Consistency, Kreb Units (KU)	D562	± 10 or 25% (Note 3)	-
Dry Time:			
To Touch	D1640	± 30%	-
Hard Dry	D1640	± 30%	-
Hiding Power Determination Using Pfund Black and White Cryptometer	Paint and Coating Testing Manual	± 1.5 (Note 4)	-
Skinning	-	-	-
Fineness of Grind, Hegman Units (HU)	D1210	± 2	-
Sag Resistance	D4400	± 20%	-
Coating Composition:			
Pigment Content by % mass	D4451, D2371, D3723	± 5%	-
Vehicle Solids Content by % mass @ 24 hours	-	± 5%	-
Volatile Content by % mass @ 2 hours and 24 hours	D2369	± 5%	-
Pigment Composition by Chemical and Instrumental Analysis	-	-	Chemical Analysis clause (Note 5)
VOC Content	D3960	± 10% but the total not exceeding 340 g/L (Note 6)	-
Vehicle Solids Identification by Infrared Analysis	D2621	-	Infrared Analysis clause (Note 5)
Determination of Paint Volatiles Composition by Gas Chromatography	D3271	-	Gas Chromatogram of Volatiles clause (Note 5)
Determination of Thinner Composition by Gas Chromatography	D3271	-	Gas Chromatogram of Volatiles clause (Note 5)
Tests on Cured Paint Coating:			
Gloss	D523	± 30%	-
Colour Difference (ΔE)	E1347	± 4 units	-
IR Fingerprinting	Paint and Coating Testing Manual	-	Infrared Analysis clause (Note 5)

Notes:

1. Acceptance criteria for field samples and production batches.
2. Allowable tolerance for field samples or production batches based on the Owner's test results for the initially approved paint coating material.
3. Whichever is less.
4. Pfund black and white cryptometer, wedge #3.5.
5. Clause in this specification.
6. VOC content of Zinc -rich touch up paint shall not exceed 500 g/L.

PAINT COATING DATA FORM

A. MANUFACTURER INFORMATION	
Name:	
Address:	
Telephone:	
Fax:	
Email:	
B. SAMPLE IDENTIFICATION	
Manufacturer's Code No.:	Coating Batch No.:
Colour of Coating:	Production Date:

C. TEST DATA OF MIXED COATING

	Test Method	**Manufacturer's Test Results**
Density, kg/L	ASTM D1475	
VOC, g/L	ASTM D3960	
Viscosity, KU	ASTM D562	
Pot Life, hours @ 25 °C	Manufacturer's Procedure	
Sag Resistance, mm	ASTM D4400	
Dry Time, hours @ 25 °C		
To touch	ASTM D1640	
Hard dry	ASTM D1640	

D. COMPOSITION OF MIXED COATING

	Test Method	**% by Mass**
Pigment and Fillers	ASTM D2371, D4451, D3723	
Non Volatile	-	
Volatile	ASTM D2369	

E. COMPOSITION OF PIGMENTS AND FILLERS IN EACH COMPONENT % BY MASS - List % lead to three decimal places

	Component A	%	Component B	%	Component C	%
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

	Chemical Name	%
1		
2		
3		
4		
5		

	Chemical Name	%
1		
2		
3		
4		
5		

H. VEHICLE SOLIDS IDENTIFICATION by Infrared Analysis - Attach spectrum with major peaks identified

I. MIXING RATIO OF COMPONENTS A, B, and C by weight _____

J. IR FINGERPRINT OF MIXED, CURED COATING - Attach Spectrum with major peaks identified

OPSF 1704-1

Ontario Provincial Standard Specifications (OPSSs)					
1820	November 2014	April 2025	TBD	Rev: Material Specification for Circular and Elliptical Concrete Pipe is implemented. The specification has been updated to new PROV format with no technical content changes. Legacy Appendix A removed.	Mike Pearsall

Note: The 1820 implemented in April 2025 replaces 1820, November 2014 with no technical content changes.

MATERIAL SPECIFICATION FOR CIRCULAR AND ELLIPTICAL CONCRETE PIPE

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1820.01 SCOPE

This specification covers the requirements for reinforced and non-reinforced non-pressure circular concrete pipe with rubber gasket joints, and for non-gasketed reinforced elliptical concrete pipe.

~~1820.01.01 Specification Significance and Use~~

~~This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.~~

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

~~1820.01.02 Appendices Significance and Use~~

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

~~Appendices are developed for the Owner's use only.~~

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

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

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

1820.02 REFERENCES

~~When the Contract Documents indicate that 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:

CSA Standards

A257.1-09	Non-Reinforced Circular Concrete Culvert, Storm Drain, Sewer Pipe, and Fittings [Part of A257 Series-09, Standards for Concrete Pipe and Manhole Sections]
A257.2-09	Reinforced Circular Concrete Culvert, Storm Drain, Sewer Pipe, and Fittings [Part of A257 Series-09, Standards for Concrete Pipe and Manhole Sections]
A257.3-09	Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections, and Fittings Using Rubber Gaskets [Part of A257 Series-09, Standards for Concrete Pipe and Manhole Sections]
A3000-08	Cementitious Materials Compendium

ASTM International

~~C 507M~~C507M-11 Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe (Metric)

Plant Prequalification Program Publication

Prequalification Requirements for Precast Concrete Drainage Products

1820.04 DESIGN AND SUBMISSION REQUIREMENTS

1820.04.01 Design Requirements

1820.04.01.01 Concrete Pipe

Non-reinforced circular concrete pipe shall be according to CAN/CSA A257.1.

Reinforced circular concrete pipe shall be according to CAN/CSA A257.2.

Reinforced elliptical concrete pipe shall be according to ASTM ~~C 507M~~C507M.

1820.04.01.02 Joints and Gaskets

Joints and gaskets for circular concrete pipe shall be according to CAN/CSA A257.3.

Joints for elliptical concrete pipe shall be according to ASTM ~~C 507M~~C507M, and according to the requirements outlined in the publication, Prequalification Requirements for Precast Concrete Drainage Products.

Elliptical concrete pipe produced with non-gasketed joints shall be used for storm pipe sewers only.

1820.04.01.03 Jacking Pipe

Jacking pipe shall be according to CAN/CSA A257.2 with a minimum class of 65-D and a minimum concrete strength of 40MPa.

1820.04.01.04 Elliptical Reinforcing

Elliptical reinforcing for circular concrete pipe is not permitted for pipes up to and including 900 mm nominal internal diameter.

1820.04.01.05 Lift Holes and Anchors

Lift holes are not permitted for pipes. Lift anchors are not permitted for pipes up to and including 900 mm nominal internal diameter.

1820.05 MATERIALS

1820.05.01 Cement

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

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

1820.07 PRODUCTION

1820.07.01 General

A manufacturer producing circular concrete pipe or elliptical concrete pipe or both shall possess a current Prequalification Certificate, issued under the Plant Prequalification Program as outlined in the publication, Prequalification Requirements for Precast Concrete Drainage Products.

1820.07.02 Markings

Markings for circular concrete pipe shall be according to CAN/CSA A257.2.

Markings for elliptical concrete pipe shall be according to ASTM ~~C 507M~~C507M.

In addition, all pipe shall be marked with the Prequalification Stamp shown in Figure 1 and as outlined in the publication, Prequalification Requirements for Precast Concrete Drainage Products.

Figure 1
Prequalification Stamp

Appendix 1820-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

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

Note: The 1820 implemented in April 2025 replaces 1820, November 2014 with no technical content changes.

MATERIAL SPECIFICATION FOR CIRCULAR AND ELLIPTICAL CONCRETE PIPE

TABLE OF CONTENTS

1820.01 SCOPE

This specification covers the requirements for reinforced and non-reinforced non-pressure circular concrete pipe with rubber gasket joints, and for non-gasketed reinforced elliptical concrete pipe.

1820.02 REFERENCES

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

CSA Standards

A257.1-09 Non-Reinforced Circular Concrete Culvert, Storm Drain, Sewer Pipe, and Fittings
[Part of A257 Series-09, Standards for Concrete Pipe and Manhole Sections]

A257.2-09 Reinforced Circular Concrete Culvert, Storm Drain, Sewer Pipe, and Fittings
[Part of A257 Series-09, Standards for Concrete Pipe and Manhole Sections]

A257.3-09 Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections, and Fittings Using Rubber Gaskets
[Part of A257 Series-09, Standards for Concrete Pipe and Manhole Sections]

A3000-08 Cementitious Materials Compendium

ASTM International

C507M-11 Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe (Metric)

Plant Prequalification Program Publication

Prequalification Requirements for Precast Concrete Drainage Products

1820.04 DESIGN AND SUBMISSION REQUIREMENTS

1820.04.01 Design Requirements

1820.04.01.01 Concrete Pipe

Non-reinforced circular concrete pipe shall be according to CAN/CSA A257.1.

Reinforced circular concrete pipe shall be according to CAN/CSA A257.2.

Reinforced elliptical concrete pipe shall be according to ASTM C507M.

1820.04.01.02 Joints and Gaskets

Joints and gaskets for circular concrete pipe shall be according to CAN/CSA A257.3.

Joints for elliptical concrete pipe shall be according to ASTM C507M, and according to the requirements outlined in the publication, Prequalification Requirements for Precast Concrete Drainage Products.

Elliptical concrete pipe produced with non-gasketed joints shall be used for storm pipe sewers only.

1820.04.01.03 Jacking Pipe

Jacking pipe shall be according to CAN/CSA A257.2 with a minimum class of 65-D and a minimum concrete strength of 40MPa.

1820.04.01.04 Elliptical Reinforcing

Elliptical reinforcing for circular concrete pipe is not permitted for pipes up to and including 900 mm nominal internal diameter.

1820.04.01.05 Lift Holes and Anchors

Lift holes are not permitted for pipes. Lift anchors are not permitted for pipes up to and including 900 mm nominal internal diameter.

1820.05 MATERIALS

1820.05.01 Cement

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

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

1820.07 PRODUCTION

1820.07.01 General

A manufacturer producing circular concrete pipe or elliptical concrete pipe or both shall possess a current Prequalification Certificate, issued under the Plant Prequalification Program as outlined in the publication, Prequalification Requirements for Precast Concrete Drainage Products.

1820.07.02 Markings

Markings for circular concrete pipe shall be according to CAN/CSA A257.2.

Markings for elliptical concrete pipe shall be according to ASTM C507M.

In addition, all pipe shall be marked with the Prequalification Stamp shown in Figure 1 and as outlined in the publication, Prequalification Requirements for Precast Concrete Drainage Products.

Figure 1
Prequalification Stamp

Ontario Provincial Standard Specifications (OPSSs)					
2422	November 2016	April 2025	TBD	Rev: Material Specification for Heavy Class Steel and Sectional Steel Poles, Base Mounted is implemented. The specification has been updated to new PROV format with no technical content changes. Legacy Appendix A removed. Gender neutral language updated.	Mike Pearsall

Note: The 2422 implemented in April 2025 replaces 2422, November 2016 with no technical content changes.

MATERIAL SPECIFICATION FOR HEAVY CLASS STEEL AND SECTIONAL STEEL POLES, BASE MOUNTED

TABLE OF CONTENTS

2422.01 SCOPE

This specification covers the requirements for base mounted galvanized heavy class steel and sectional steel poles 6.0, 7.5, 9.0, and 10.50 metres in height.

~~2422.01.01 Specification Significance and Use~~

~~This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.~~

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

~~**2422.01.02 Appendices Significance and Use**~~

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

~~Appendices are developed for the Owner's use only.~~

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

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

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

2422.02 REFERENCES

~~When the Contract Documents indicate that 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 Ministry of Transportation Publications

Structural Manual

CSA Standards

G40.20-13/G40.21-13	General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
S6-14	Canadian Highway Bridge Design Code
W59-13	Welded Steel Construction (Metal Arc Welding)

American Association of State Highway and Transportation Officials (AASHTO)

LTS-5-M	Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 5th Edition, Interim Revisions (2010)

2422.03 DEFINITIONS

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

Product Drawings means drawings prepared by the manufacturer that have been approved by the Owner for use with the product.

2422.04 DESIGN AND SUBMISSION REQUIREMENTS

2422.04.01 Design Requirements

All poles shall be designed to support the required traffic signal and lighting system components and shall be according to CSA S6 and MTO Structural Manual. All poles shall be according to CSA S6 and AASHTO LTS-5-M for fatigue requirements, AASHTO Fatigue Importance Category 2.

2422.04.01.01 Wind Loading

Wind loading shall be based on the maximum wind pressure for Ontario according to CSA S6.

2422.04.01.02 Ice Loading

Ice loading shall be based on the maximum ice loading for Ontario according to CSA S6.

2422.04.01.03 Geometric Parameters

Latitude of design and fabrication details is at the discretion of the supplier and is subject to approval of the design by the Owner.

2422.04.01.04 Supported Load Parameters

Design calculations shall employ force and dimensions for various items of equipment to be mounted on the poles as shown in Table 1.

2422.04.01.05 Heavy Class Steel and Sectional Steel Pole

Heavy class steel and sectional steel poles used for traffic signal or combination traffic signal and lighting system shall be capable of bearing the loads associated with configurations shown in Table 2.

2422.04.01.06 Location of Equipment

Mast arms shall be to be solidly attached to the pole at a height above the pole base plate as given by:

H_A = 5,650 mm - H

where: H_A = mast arm height above the pole base plate
H = mast arm height from Table 1

Where more than one mast arm is considered, the shorter arm shall be attached to the pole at a point 300 mm above that of the longer arm.

Pedestrian heads shall be mounted at a height of 2,750 mm above the pole base plate.

Luminaire brackets shall be mounted at a point 150 mm from the top of the pole.

2422.04.02 Submission Requirements

2422.04.02.01 Product Drawings

The heavy class steel and sectional steel pole manufacturer shall submit the product drawings and the design assumptions and calculations for the poles to the Contract Administrator.

As a minimum, the product drawings shall include the following information:

a) Material properties and standards.

b) Dimensions.

c) Hardware requirements.

d) Plans, elevations, sections, and details to show pole structural details.

e) Anchor bolt locations.

f) Welds.

g) Joining method for heavy class steel poles sections.

The product drawings and calculations shall bear the seals and signatures of the design and design-checking Engineers.

2422.04.02.02 Working Drawings

Working Drawings shall be prepared for the fabrication of heavy class steel and sectional steel poles.

Three sets of Working Drawings shall be submitted to the Contract Administrator at least 14 Days prior to the commencement of fabrication of the heavy class steel and sectional steel poles for information purposes only. An Engineer shall affix ~~his or her~~their seal and signature on the Working Drawings verifying that the Working Drawings are consistent with the Contract Documents and sound engineering practices.

Where multi-discipline engineering work is depicted on the same Working Drawing and a single Engineer is unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be signed and sealed by as many additional Engineers as necessary.

As a minimum, the Working Drawings shall include the following information:

a) Detailed dimensions.

b) Plans, elevations, sections, and details to show pole structural details.

c) Equipment layout.

d) Anchor bolt locations.

e) Exact pole weight.

f) Detailed bill of materials.

g) Details of equipment nameplates.

A copy of the Working Drawings shall be retained at the fabricator's plant during and after the heavy class steel and sectional steel pole fabrication.

2422.05 MATERIALS

2422.05.01 General

All steel used in the production of poles shall be according to CAN/CSA G40.21, Grade 300WT, for pole shafts, base plates, and gussets.

All galvanized steel shall be according to CSA G164.

All welding shall be according to CSA W59.

2422.07 PRODUCTION

2422.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

All welds, except for fillet welds, shall be ground smooth.

The pole base plate for any height of pole shall be made with mounting holes suitable for the anchor rod or anchorage assembly. The pole base plate shall be reinforced with four welded gussets equally spaced around the pole or with a welded collar or combination of both welded collar and gussets.

The underside of the anchor base shall be true, distortion free, and perpendicular to the centreline of the pole shaft after fabrication.

A waterproof, removable galvanized steel top cap shall be furnished with the pole. The cap shall blend with the general pole design to present a neat overall appearance. The cap shall be rigidly secured to the top of the pole by a hexagonal head stainless steel set screw.

Wiring apertures at the bracket mounting level and at the handhole shall be accurately positioned on the pole. The wiring apertures shall provide a smooth cable entrance.

For lighting applications, a wiring aperture, complete with rubber grommet, shall be provided.

Handholes, complete with covers, shall be reinforced with a steel handhole frame of such strength and cross-section that the strength of the pole is not reduced.

2422.07.02 Heavy Class Steel Poles

The poles, as specified in the Contract Documents, shall be round or octagonal in cross-section and shall taper uniformly inwards from the base for the height of the pole.

Poles shall have one or two longitudinal automatically electrically welded joints from top to bottom.

The maximum permitted number of circumferential (transverse) welded joints shall be as shown in Table 3.

The pole sections shall be joined by an electrical weld before galvanizing.

Sweep shall not exceed 3.2 mm per 4.57 m, and the overall sweep shall not be greater than:

(Pole height (m)/4.57 m) x 3.2 mm

In all cases, the base shall telescope the butt end of the pole and be secured with one continuous weld on the inside of the base at the end of the pole and another continuous weld on the outside at the top of the base. All

welding at base shall be made in such a manner as to ensure that the welded connection shall develop the same strength of the adjacent pole section to resist any bending action.

2422.07.03 Heavy Class Sectional Steel Poles

The pole sections shall be of round tapered construction so that a number of sections may be assembled by means of an overlapping press fit to form a tapered steel pole of the height specified in the Contract Documents.

Each section shall have one longitudinal automatically electrically welded joint from top to bottom.

Each section shall be stencilled with O-L (nominal overlap requirement) and graduations in one-inch increments.

2422.07.04 Ground Bar

A ground bar with a bronze ground connector suitable for No. 6 AWG wire shall be welded to the inside of each pole. The bronze ground connector shall be attached to the ground bar before shipment.

2422.07.05 Marking

Each pole shall have identification marking located approximately 300 mm above the top of the handhole showing the following:

a) Manufacturer's name or ~~trade mark~~trademark.

b) Height of pole.

c) Gauge of steel.

d) Bolt circle diameter.

e) Designation OPSS 2422.

f) Date of manufacture (i.e., yyyy-mm-dd).

This marking shall be on a corrosion-resistant metal plate securely attached to the surface of the pole.

2422.07.06 Packaging and Shipping

Each pole shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity.

The Contract Administrator shall be notified of the shipping date 3 Business Days prior to delivery.

2422.08 QUALITY ASSURANCE

2422.08.01 Inspection

All work is subject to an inspection by the Contract Administrator prior to shipment.

The supplier shall notify the Contract Administrator of the date that the fabrication of the poles is to commence.

The Contract Administrator shall have free access to the place of fabrication of the poles for the purpose of inspecting and examining plant records and certificates while work on the poles is being performed; materials used; process of fabrication, including welding and galvanizing; and to make any tests as may be considered necessary.

2422.09 OWNER PURCHASE OF MATERIAL

2422.09.01 Working Drawings

Within 30 Days of receipt of a purchasing order to supply heavy class steel and sectional steel poles, the supplier shall submit 4 copies of pole Working Drawings, as described in the Submission Requirements subsection, to the Owner, for approval.

Working Drawings shall be given final approval by the Owner, if found to be acceptable, or shall be marked with deficiencies, if unacceptable.

Unacceptable drawings shall be returned to the supplier for correction. The supplier shall resubmit 4 copies of corrected Working Drawings within 14 Days. When the resubmitted drawings are acceptable to the Owner, they shall be given final approval.

One copy of the final approved drawings shall be returned to the supplier along with written notification to commence fabrication. Within 14 Days of receipt of the notification to commence fabrication, the supplier shall submit 4 copies of all final approved Working Drawings to the Owner.

Fabrication of the equipment shall not commence until the supplier has received final approved Working Drawings and written notification to commence fabrication from the Owner. All fabrication shall conform to the dimensions indicated on the final approved Working Drawings.

The supplier shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2422.09.02 Measurement and Payment

For measurement purposes, a count shall be made of the number of heavy class steel and sectional steel poles supplied and accepted.

Payment at the price specified in the purchasing order shall be for the supply of the heavy class steel and sectional steel poles delivered to the destination on the date and time specified.

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

TABLE 1
Supported Load Parameters

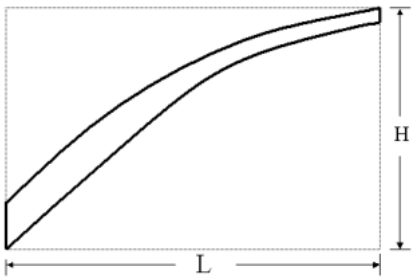
Item of Equipment	Dimensions mm	Projected Area m^2	Weight N
Roadway Lighting Luminaire (Ovuloid)	990 L x 380 H	0.22	107
Roadway Lighting Bracket (Aluminum)	2400 L x 1200 H (tapered)	0.15	112
Double Arm Brackets (Aluminum)	400 L x 42 Dia. (2 per set)	0.04	24
Mast Arm (Aluminum) 	610 L x 250 H (tapered)	0.04	78
	1200 L x 530 H (tapered)	0.10	91
	1800 L x 610 H (tapered)	0.15	114
	2400 L x 840 H (tapered)	0.19	65
	3000 L x 610 H (tapered)	0.23	94
	3600 L x 840 H (tapered)	0.38	113
	4600 L x 1070 H (tapered)	0.47	216
	5500 L x 910 H (tapered)	0.70	324
	6100 L x 1070 H (tapered)	0.79	307
	6700 L x 1150 H (tapered)	0.85	354
	7600 L x 1140 H (tapered)	1.10	504
Traffic Signal Heads (Aluminum: 4-Section)	1650 H x 610 W	1.01	123
Pedestrian Heads (Aluminum: 2-Section)	690 H x 345 W	0.23	78
Traffic Signs	Varies: see Table 2	1.50	23

TABLE 2
Heavy Class Steel and Sectional Steel Pole Configurations

Pole Height m	Luminaire and Bracket set	Longest Mast Arm with Head m	Maximum Mast Arm Total Length (Note 1) m	Number of Pedestrian Heads (Note 2)	Traffic Signs (Note 3) m^2
10.5	1	7.6	13.1	2	0.75
9.0	1	7.6	13.1	2	0.75
7.5	1	7.6	13.1	2	0.75
6.0	0	7.6	13.1	2	0.75

Notes:

1. Mast arm total length applies to the sum of the lengths of two mast arms at 90-degree orientation.

2. Two pedestrian heads at 90-degree orientation include a set of double arm brackets for each.

3. Traffic signs shall be split to give 0.25 m^2 mounted on the mast arm beside the signal head and 0.5 m^2 mounted at 2.75 m height above the pole base plate.

TABLE 3
Circumferential Welded Joints

Pole Height m	Maximum Number of Welds
6.0	1
7.5	1
9.0	1
10.5	2

Appendix 2422-A: November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

Note: The 2422 implemented in April 2025 replaces 2422, November 2016 with no technical content changes.

MATERIAL SPECIFICATION FOR HEAVY CLASS STEEL AND SECTIONAL STEEL POLES, BASE MOUNTED

TABLE OF CONTENTS

2422.01 SCOPE

This specification covers the requirements for base mounted galvanized heavy class steel and sectional steel poles 6.0, 7.5, 9.0, and 10.50 metres in height.

2422.02 REFERENCES

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

Ontario Ministry of Transportation Publications

Structural Manual

CSA Standards

G40.20-13/G40.21-13	General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
S6-14	Canadian Highway Bridge Design Code
W59-13	Welded Steel Construction (Metal Arc Welding)

American Association of State Highway and Transportation Officials (AASHTO)

LTS-5-M Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 5th Edition, Interim Revisions (2010)

2422.03 DEFINITIONS

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

Product Drawings means drawings prepared by the manufacturer that have been approved by the Owner for use with the product.

2422.04 DESIGN AND SUBMISSION REQUIREMENTS

2422.04.01 Design Requirements

All poles shall be designed to support the required traffic signal and lighting system components and shall be according to CSA S6 and MTO Structural Manual. All poles shall be according to CSA S6 and AASHTO LTS-5-M for fatigue requirements, AASHTO Fatigue Importance Category 2.

2422.04.01.01 Wind Loading

Wind loading shall be based on the maximum wind pressure for Ontario according to CSA S6.

2422.04.01.02 Ice Loading

Ice loading shall be based on the maximum ice loading for Ontario according to CSA S6.

2422.04.01.03 Geometric Parameters

Latitude of design and fabrication details is at the discretion of the supplier and is subject to approval of the design by the Owner.

2422.04.01.04 Supported Load Parameters

Design calculations shall employ force and dimensions for various items of equipment to be mounted on the poles as shown in Table 1.

2422.04.01.05 Heavy Class Steel and Sectional Steel Pole

Heavy class steel and sectional steel poles used for traffic signal or combination traffic signal and lighting system shall be capable of bearing the loads associated with configurations shown in Table 2.

2422.04.01.06 Location of Equipment

Mast arms shall be to be solidly attached to the pole at a height above the pole base plate as given by:

$$H_A = 5{,}650 \text{ mm} - H$$

where: H_A = mast arm height above the pole base plate
H = mast arm height from Table 1

Where more than one mast arm is considered, the shorter arm shall be attached to the pole at a point 300 mm above that of the longer arm.

Pedestrian heads shall be mounted at a height of 2,750 mm above the pole base plate.

Luminaire brackets shall be mounted at a point 150 mm from the top of the pole.

2422.04.02 Submission Requirements

2422.04.02.01 Product Drawings

The heavy class steel and sectional steel pole manufacturer shall submit the product drawings and the design assumptions and calculations for the poles to the Contract Administrator.

As a minimum, the product drawings shall include the following information:

a) Material properties and standards.

b) Dimensions.

c) Hardware requirements.

d) Plans, elevations, sections, and details to show pole structural details.

e) Anchor bolt locations.

f) Welds.

g) Joining method for heavy class steel poles sections.

The product drawings and calculations shall bear the seals and signatures of the design and design-checking Engineers.

2422.04.02.02 Working Drawings

Working Drawings shall be prepared for the fabrication of heavy class steel and sectional steel poles.

Three sets of Working Drawings shall be submitted to the Contract Administrator at least 14 Days prior to the commencement of fabrication of the heavy class steel and sectional steel poles for information purposes only. An Engineer shall affix their seal and signature on the Working Drawings verifying that the Working Drawings are consistent with the Contract Documents and sound engineering practices.

Where multi-discipline engineering work is depicted on the same Working Drawing and a single Engineer is unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be signed and sealed by as many additional Engineers as necessary.

As a minimum, the Working Drawings shall include the following information:

a) Detailed dimensions.

b) Plans, elevations, sections, and details to show pole structural details.

c) Equipment layout.

d) Anchor bolt locations.

e) Exact pole weight.

f) Detailed bill of materials.

g) Details of equipment nameplates.

A copy of the Working Drawings shall be retained at the fabricator's plant during and after the heavy class steel and sectional steel pole fabrication.

2422.05 MATERIALS

2422.05.01 General

All steel used in the production of poles shall be according to CAN/CSA G40.21, Grade 300WT, for pole shafts, base plates, and gussets.

All galvanized steel shall be according to CSA G164.

All welding shall be according to CSA W59.

2422.07 PRODUCTION

2422.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

All welds, except for fillet welds, shall be ground smooth.

The pole base plate for any height of pole shall be made with mounting holes suitable for the anchor rod or anchorage assembly. The pole base plate shall be reinforced with four welded gussets equally spaced around the pole or with a welded collar or combination of both welded collar and gussets.

The underside of the anchor base shall be true, distortion free, and perpendicular to the centreline of the pole shaft after fabrication.

A waterproof, removable galvanized steel top cap shall be furnished with the pole. The cap shall blend with the general pole design to present a neat overall appearance. The cap shall be rigidly secured to the top of the pole by a hexagonal head stainless steel set screw.

Wiring apertures at the bracket mounting level and at the handhole shall be accurately positioned on the pole. The wiring apertures shall provide a smooth cable entrance.

For lighting applications, a wiring aperture, complete with rubber grommet, shall be provided.

Handholes, complete with covers, shall be reinforced with a steel handhole frame of such strength and cross-section that the strength of the pole is not reduced.

2422.07.02 Heavy Class Steel Poles

The poles, as specified in the Contract Documents, shall be round or octagonal in cross-section and shall taper uniformly inwards from the base for the height of the pole.

Poles shall have one or two longitudinal automatically electrically welded joints from top to bottom.

The maximum permitted number of circumferential (transverse) welded joints shall be as shown in Table 3.

The pole sections shall be joined by an electrical weld before galvanizing.

Sweep shall not exceed 3.2 mm per 4.57 m, and the overall sweep shall not be greater than:

(Pole height (m)/4.57 m) x 3.2 mm

In all cases, the base shall telescope the butt end of the pole and be secured with one continuous weld on the inside of the base at the end of the pole and another continuous weld on the outside at the top of the base. All welding at base shall be made in such a manner as to ensure that the welded connection shall develop the same strength of the adjacent pole section to resist any bending action.

2422.07.03 Heavy Class Sectional Steel Poles

The pole sections shall be of round tapered construction so that a number of sections may be assembled by means of an overlapping press fit to form a tapered steel pole of the height specified in the Contract Documents.

Each section shall have one longitudinal automatically electrically welded joint from top to bottom.

Each section shall be stencilled with O-L (nominal overlap requirement) and graduations in one-inch increments.

2422.07.04 Ground Bar

A ground bar with a bronze ground connector suitable for No. 6 AWG wire shall be welded to the inside of each pole. The bronze ground connector shall be attached to the ground bar before shipment.

2422.07.05 Marking

Each pole shall have identification marking located approximately 300 mm above the top of the handhole showing the following:

a) Manufacturer's name or trademark.

b) Height of pole.

c) Gauge of steel.

d) Bolt circle diameter.

e) Designation OPSS 2422.

f) Date of manufacture (i.e., yyyy-mm-dd).

This marking shall be on a corrosion-resistant metal plate securely attached to the surface of the pole.

2422.07.06 Packaging and Shipping

Each pole shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity.

The Contract Administrator shall be notified of the shipping date 3 Business Days prior to delivery.

2422.08 QUALITY ASSURANCE

2422.08.01 Inspection

All work is subject to an inspection by the Contract Administrator prior to shipment.

The supplier shall notify the Contract Administrator of the date that the fabrication of the poles is to commence.

The Contract Administrator shall have free access to the place of fabrication of the poles for the purpose of inspecting and examining plant records and certificates while work on the poles is being performed; materials used; process of fabrication, including welding and galvanizing; and to make any tests as may be considered necessary.

2422.09 OWNER PURCHASE OF MATERIAL

2422.09.01 Working Drawings

Within 30 Days of receipt of a purchasing order to supply heavy class steel and sectional steel poles, the supplier shall submit 4 copies of pole Working Drawings, as described in the Submission Requirements subsection, to the Owner, for approval.

Working Drawings shall be given final approval by the Owner, if found to be acceptable, or shall be marked with deficiencies, if unacceptable.

Unacceptable drawings shall be returned to the supplier for correction. The supplier shall resubmit 4 copies of corrected Working Drawings within 14 Days. When the resubmitted drawings are acceptable to the Owner, they shall be given final approval.

One copy of the final approved drawings shall be returned to the supplier along with written notification to commence fabrication. Within 14 Days of receipt of the notification to commence fabrication, the supplier shall submit 4 copies of all final approved Working Drawings to the Owner.

Fabrication of the equipment shall not commence until the supplier has received final approved Working Drawings and written notification to commence fabrication from the Owner. All fabrication shall conform to the dimensions indicated on the final approved Working Drawings.

The supplier shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2422.09.02 Measurement and Payment

For measurement purposes, a count shall be made of the number of heavy class steel and sectional steel poles supplied and accepted.

Payment at the price specified in the purchasing order shall be for the supply of the heavy class steel and sectional steel poles delivered to the destination on the date and time specified.

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

TABLE 1
Supported Load Parameters

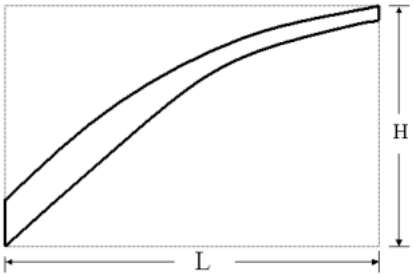
Item of Equipment	Dimensions mm	Projected Area m^2	Weight N
Roadway Lighting Luminaire (Ovuloid)	990 L x 380 H	0.22	107
Roadway Lighting Bracket (Aluminum)	2400 L x 1200 H (tapered)	0.15	112
Double Arm Brackets (Aluminum)	400 L x 42 Dia. (2 per set)	0.04	24
Mast Arm (Aluminum) 	610 L x 250 H (tapered)	0.04	78
	1200 L x 530 H (tapered)	0.10	91
	1800 L x 610 H (tapered)	0.15	114
	2400 L x 840 H (tapered)	0.19	65
	3000 L x 610 H (tapered)	0.23	94
	3600 L x 840 H (tapered)	0.38	113
	4600 L x 1070 H (tapered)	0.47	216
	5500 L x 910 H (tapered)	0.70	324
	6100 L x 1070 H (tapered)	0.79	307
	6700 L x 1150 H (tapered)	0.85	354
	7600 L x 1140 H (tapered)	1.10	504
Traffic Signal Heads (Aluminum: 4-Section)	1650 H x 610 W	1.01	123
Pedestrian Heads (Aluminum: 2-Section)	690 H x 345 W	0.23	78
Traffic Signs	Varies: see Table 2	1.50	23

TABLE 2
Heavy Class Steel and Sectional Steel Pole Configurations

Pole Height m	Luminaire and Bracket set	Longest Mast Arm with Head m	Maximum Mast Arm Total Length (Note 1) m	Number of Pedestrian Heads (Note 2)	Traffic Signs (Note 3) m^2
10.5	1	7.6	13.1	2	0.75
9.0	1	7.6	13.1	2	0.75
7.5	1	7.6	13.1	2	0.75
6.0	0	7.6	13.1	2	0.75

Notes:

1. Mast arm total length applies to the sum of the lengths of two mast arms at 90-degree orientation.

2. Two pedestrian heads at 90-degree orientation include a set of double arm brackets for each.

3. Traffic signs shall be split to give 0.25 m^2 mounted on the mast arm beside the signal head and 0.5 m^2 mounted at 2.75 m height above the pole base plate.

TABLE 3
Circumferential Welded Joints

Pole Height m	Maximum Number of Welds
6.0	1
7.5	1
9.0	1
10.5	2

Ontario Provincial Standard Specifications (OPSSs)					
2423	April 2017	April 2025	TBD	Rev: Material Specification for Steel Poles, Base Mounted is implemented. The specification has been updated to new PROV format with no technical content changes.	Mike Pearsall

Note: The 2423 implemented in April 2025 replaces 2423, April 2017 with no technical content changes.

MATERIAL SPECIFICATION FOR STEEL POLES, BASE MOUNTED

TABLE OF CONTENTS

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 provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.~~

~~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 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:

CSA Standards

G40.20-13/G40.21-13	General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
W59-13	Welded Steel Construction (Metal Arc Welding)

ASTM International

A123~~ / /~~A123M-15	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

2423.04 DESIGN AND SUBMISSION REQUIREMENTS

2423.04.01 Submission Requirements

2423.04.01.01 Working Drawings

Working Drawings shall be prepared for the fabrication of steel poles.

Three (3) sets of Working Drawings shall be submitted 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.

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 and gussets.

All steel shall be galvanized according to ASTM ~~A 123~~A123.

2423.07 PRODUCTION

2423.07.01 General

The length of the 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, the poles shall be galvanized.

Sweep shall not exceed 3.2 mm per 4.57 m, and the overall sweep shall not be greater than:

(Pole length (m) / 4.57 m) x 3.2 mm

The pole shall be supplied with a one-piece fabricated rolled steel base plate. The pole may be supplied as specified in the Contract Documents with a one-piece fabricated rolled steel plate without gussets.

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 No. 6 AWG wire 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~~trademark.

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 Owner shall be notified 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.

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

Note: The 2423 implemented in April 2025 replaces 2423, April 2017 with no technical content changes.

MATERIAL SPECIFICATION FOR STEEL POLES, BASE MOUNTED

TABLE OF CONTENTS

2423.01 SCOPE

This specification covers the requirements for base mounted galvanized steel poles maximum 15.1 m in length.

2423.02 REFERENCES

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

CSA Standards

G40.20-13/G40.21-13	General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
W59-13	Welded Steel Construction (Metal Arc Welding)

ASTM International

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

2423.04 DESIGN AND SUBMISSION REQUIREMENTS

2423.04.01 Submission Requirements

2423.04.01.01 Working Drawings

Working Drawings shall be prepared for the fabrication of steel poles.

Three (3) sets of Working Drawings shall be submitted 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.

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 and gussets.

All steel shall be galvanized according to ASTM A123.

2423.07 PRODUCTION

2423.07.01 General

The length of the 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, the poles shall be galvanized.

Sweep shall not exceed 3.2 mm per 4.57 m, and the overall sweep shall not be greater than:

(Pole length (m) / 4.57 m) x 3.2 mm

The pole shall be supplied with a one-piece fabricated rolled steel base plate. The pole may be supplied as specified in the Contract Documents with a one-piece fabricated rolled steel plate without gussets.

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 No. 6 AWG wire 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 trademark.

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 Owner shall be notified 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.

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

Ontario Provincial Standard Specifications (OPSSs)					
2434	November 2016	April 2025	TBD	Rev: Material Specification for High Pressure Sodium Luminaires for Underpass Lighting is implemented. The specification has been updated to new PROV format with no technical content changes. Legacy Appendix A removed.	Mike Pearsall

Note: The 2434 implemented in April 2025 replaces 2434, November 2016 with no technical content changes.

MATERIAL SPECIFICATION FOR HIGH PRESSURE SODIUM LUMINAIRES FOR UNDERPASS LIGHTING

TABLE OF CONTENTS

2434.01 SCOPE

This specification covers the requirements for underpass luminaires with integral ballast for use with 70 to 400 watt high pressure sodium lamps.

~~2434.01.01 Specification Significance and Use~~

~~This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.~~

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

~~**2434.01.02 Appendices Significance and Use**~~

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

~~Appendices are developed for the Owner's use only.~~

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

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

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

2434.02 REFERENCES

~~When the Contract Documents indicate that 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:

CSA Standards

C22.2 No. 89-15	Swimming-Pool Luminaires, Submersible Luminaires and Accessories
C863-16	Energy Efficiency of High-Intensity Discharge (HID) and Low-Pressure Sodium (LPS) Lamp Ballasts

ASTM International

~~B 117~~B117-11	Standard Practice for Operating Salt Spray (Fog) Apparatus
~~D 1654~~D1654-08	Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

American National Standards Institute (ANSI)

C136.31-2010	Roadway and Area Lighting Equipment - Luminaire Vibration

International Electrotechnical Commission (IEC)

60598 (2014-05)	Luminaires

62262 (2002-02) Degrees of Protection Provided by Enclosures for Electrical Equipment Against External Mechanical Impacts (IK code)

2434.04 DESIGN AND SUBMISSION REQUIREMENTS

2434.04.01 Submission Requirements

2434.04.01.01 Working Drawings

Three copies of Working Drawings shall be submitted to the Contract Administrator a minimum of 14 Days prior to the commencement of fabrication.

As a minimum, the Working Drawings shall include the following information:

a) All mechanical details, including dimensions, layouts, weights, shield details, and mounting arrangements for components.

b) All electrical details and certified test reports, including wiring diagrams and component ratings.

c) All photometric information and certified test reports regarding the luminaires, including, but not limited to lamp position, photometric data sheets, and photometric test reports.

d) Certified Test Reports for UL/CSA listing, IP rating, IK rating, and ANSI C136.31 vibration.

2434.04.01.02 Photometric Test Results

Photometric test results for the luminaires supplied shall be submitted to the Contract Administrator and include the following data:

a) Isolux curves and mounting height correction factors.

b) Utilization charts or graphs.

c) Candlepower distribution curves indicating peak intensity.

d) Luminous intensity tables to Illuminating Engineering Society format (I-tables).

e) Luminaire efficiency values.

f) Luminous outputs above and below horizontal.

g) Lamp lumen outputs and wattages.

2434.04.01.03 Luminaire Test Results

Certified test results for the luminaires supplied shall be submitted to the Contract Administrator and include the following data:

a) UL/CSA Listing Report according to CSA C22.2 No. 89.

b) Minimum IP65 Rating according to IEC 60598.

c) Minimum IK08 Rating according to IEC 62262.

d) 1.5G Vibration Test Report according to ANSI C136.31.

2434.05 MATERIALS

2434.05.01 Electrical Components

All electrical components and assembled luminaires shall be according to CSA C22.2 No. 89.

Ballasts, lamp sockets, ground connectors, internal wiring, and all other components shall be suitable for the supply voltage as specified in the Contract Documents and the maximum temperature encountered in totally enclosed, outdoor, weatherproof luminaires.

Ballasts shall be constant wattage auto-transformer or isolated secondary transformer type for grounded systems. ~~-~~Auto-transformer type ballasts shall have a maximum tolerance of 12% variation in lamp wattage for a 5% variation in line voltage.~~-~~ Isolated secondary transformer type ballasts shall have a maximum tolerance of 12% variation in lamp wattage for a 10% variation in line voltage.

Ballasts shall be Class H, 180 °C insulation; 60 hertz; and low temperature, -35 °C with a power factor not less than 0.90.

The minimum nominal secondary open circuit voltage of the ballast for various lamps shall be sufficient to provide reliable starting at -35 °C.

Ballasts shall be suitable for the lamp's nominal operating voltage. ~~-~~Terminal blocks shall be held rigidly and shall provide a positive connection for terminating the field wiring.

The current crest factor of the ballast shall not exceed 1.8 for high pressure sodium lamps.

Energy efficiency of lamp ballasts shall be according to CAN/CSA C863.

All wiring within fixture shall have a minimum temperature rating of 125 °C.

2434.05.02 Mechanical Components

The luminaire shall be comprised of a polycarbonate, aluminum, or stainless steel enclosure with a specular reflector and a glass prismatic refractor. ~~-~~Enclosure shall meet a scribe creepage rating of 7 according to ASTM ~~D 1654~~ D1654, when tested for 5,000 hours according to ASTM ~~B 117~~B117.

The luminaire shall be provided with a 20 mm threaded duct entry in each end of the enclosure and a cable entry hole in the rear of the enclosure together with a suitable waterproof gasket.

The luminaire shall have continuous captive gasket between the door and enclosure and between the refractor and the enclosure to provide a weatherproof seal.

All fixture hardware shall be Type 316 stainless steel and shall be captive.~~-~~ Proper dielectric insulation shall be provided between luminaire housing and fixture hardware of dissimilar metals, to prevent galvanic reaction.

The luminaire shall be provided with a ground terminal or lug for a single conductor #12 AWG stranded copper wire.

All unused cable and duct entry holes shall be plugged with approved filler caps.

The lamp socket shall be a porcelain-enclosed, nickel-plated brass shell rated for 4,000 volts, and spring-loaded centre contact. The lamp holder shall have an electrically insulated lamp stabilizer and shall hold the lamp's outer envelope to precise alignment with suitable means for vibration damping.

The refractor shall be heat-resistant and non-discolouring, with high resistance to breakage from thermal shock. It shall be securely attached to the housing by hinges and a safety device to hold it in the open position.

The reflector shall be fabricated of polished, chemically brightened, anodized aluminum not subject to distortion and shall be readily removable.

The luminaire shall be accessible with tool-less entry.

The luminaire shall not be subject to damage by vibration when closed and in the operating position.

2434.05.03 Marking

A permanent non-corrosive nameplate shall be attached to the exterior of the luminaire and located so that the marking is clearly visible after installation. The nameplate shall indicate the manufacturer's name or trademark, catalogue number, lamp wattage, and nominal voltage.

A permanent label shall be attached to the interior of the luminaire indicating the manufacturer's name or trademark, catalogue number, date of manufacture, and the American National Standards Institute (ANSI) or Illuminating Engineering Society (IES) photometric classification and distribution type; the suitable supply voltage and frequency; the lamp type; the lamp wattage; and the nominal operating voltage of the lamp so that it is clearly visible during maintenance operations.

A label including a wiring diagram shall be attached to each ballast showing the ballast schematic wiring diagram and shall be visible during maintenance operations.

For asymmetrical luminaires with adjustable optical systems, a permanent embossed identification mark shall be located on the luminaire that is clearly visible and identifiable as an orientation mark.

2434.07 PRODUCTION

2434.07.01 Ballast Assemblies

Ballast assemblies shall be factory pre-wired with all connections clearly marked and identified.

2434.07.02 Lamp Socket Positions

The lamp socket position shall be pre-set and legibly marked at the factory for the specified distribution.

2434.08 QUALITY ASSURANCE

2434.08.01 Inspection

The supplier shall notify the Contract Administrator of the date that the fabrication of the luminaires is to commence.

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

All luminaires are subject to an inspection by the Contract Administrator prior to shipment.

2434.09 OWNER PURCHASE OF MATERIAL

2434.09.01 Packaging and Shipment

The supplier shall provide 3 copies of the luminaire ballast engineering data and shielding data such as material type, gauge thickness, and mounting arrangement to the Owner.

Each luminaire shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity. A complete parts list shall be included in the shipment. All cartons shall be marked with the ANSI or IES luminaire classification and distribution types.

The supplier is responsible for loading, delivery, and off-loading of luminaires to designated areas. Luminaires shall be subject to inspection during and on completion of off-loading. If any damage to the luminaires is encountered during the inspection, the supplier shall be responsible for the necessary corrective measures subject to the approval of the Owner.

The supplier shall advise the Owner 3 Working Days prior to the shipping date of the intent to deliver and confirm that arrangements for off-loading have been made.

2434.09.02 Measurement and Payment

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

Payment at the price specified in the purchasing order shall be full compensation for the supply and delivery of the underpass lighting luminaires to the destination at the date and time specified.

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

Appendix D 2434-A, November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

Note: The 2434 implemented in April 2025 replaces 2434, November 2016 with no technical content changes.

MATERIAL SPECIFICATION FOR HIGH PRESSURE SODIUM LUMINAIRES FOR UNDERPASS LIGHTING

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2434.01 SCOPE

This specification covers the requirements for underpass luminaires with integral ballast for use with 70 to 400 watt high pressure sodium lamps.

2434.02 REFERENCES

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

CSA Standards

C22.2 No. 89-15	Swimming-Pool Luminaires, Submersible Luminaires and Accessories
C863-16	Energy Efficiency of High-Intensity Discharge (HID) and Low-Pressure Sodium (LPS) Lamp Ballasts

ASTM International

B117-11	Standard Practice for Operating Salt Spray (Fog) Apparatus

D1654-08 Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

American National Standards Institute (ANSI)

C136.31-2010 Roadway and Area Lighting Equipment - Luminaire Vibration

International Electrotechnical Commission (IEC)

60598 (2014-05) Luminaires
62262 (2002-02) Degrees of Protection Provided by Enclosures for Electrical Equipment Against External Mechanical Impacts (IK code)

2434.04 DESIGN AND SUBMISSION REQUIREMENTS

2434.04.01 Submission Requirements

2434.04.01.01 Working Drawings

Three copies of Working Drawings shall be submitted to the Contract Administrator a minimum of 14 Days prior to the commencement of fabrication.

As a minimum, the Working Drawings shall include the following information:

a) All mechanical details, including dimensions, layouts, weights, shield details, and mounting arrangements for components.

b) All electrical details and certified test reports, including wiring diagrams and component ratings.

c) All photometric information and certified test reports regarding the luminaires, including, but not limited to lamp position, photometric data sheets, and photometric test reports.

d) Certified Test Reports for UL/CSA listing, IP rating, IK rating, and ANSI C136.31 vibration.

2434.04.01.02 Photometric Test Results

Photometric test results for the luminaires supplied shall be submitted to the Contract Administrator and include the following data:

a) Isolux curves and mounting height correction factors.

b) Utilization charts or graphs.

c) Candlepower distribution curves indicating peak intensity.

d) Luminous intensity tables to Illuminating Engineering Society format (I-tables).

e) Luminaire efficiency values.

f) Luminous outputs above and below horizontal.

g) Lamp lumen outputs and wattages.

2434.04.01.03 Luminaire Test Results

Certified test results for the luminaires supplied shall be submitted to the Contract Administrator and include the following data:

a) UL/CSA Listing Report according to CSA C22.2 No. 89.

b) Minimum IP65 Rating according to IEC 60598.

c) Minimum IK08 Rating according to IEC 62262.

d) 1.5G Vibration Test Report according to ANSI C136.31.

2434.05 MATERIALS

2434.05.01 Electrical Components

All electrical components and assembled luminaires shall be according to CSA C22.2 No. 89.

Ballasts, lamp sockets, ground connectors, internal wiring, and all other components shall be suitable for the supply voltage as specified in the Contract Documents and the maximum temperature encountered in totally enclosed, outdoor, weatherproof luminaires.

Ballasts shall be constant wattage auto-transformer or isolated secondary transformer type for grounded systems. Auto-transformer type ballasts shall have a maximum tolerance of 12% variation in lamp wattage for a 5% variation in line voltage. Isolated secondary transformer type ballasts shall have a maximum tolerance of 12% variation in lamp wattage for a 10% variation in line voltage.

Ballasts shall be Class H, 180 °C insulation; 60 hertz; and low temperature, -35 °C with a power factor not less than 0.90.

The minimum nominal secondary open circuit voltage of the ballast for various lamps shall be sufficient to provide reliable starting at -35 °C.

Ballasts shall be suitable for the lamp's nominal operating voltage. Terminal blocks shall be held rigidly and shall provide a positive connection for terminating the field wiring.

The current crest factor of the ballast shall not exceed 1.8 for high pressure sodium lamps.

Energy efficiency of lamp ballasts shall be according to CAN/CSA C863.

All wiring within fixture shall have a minimum temperature rating of 125 °C.

2434.05.02 Mechanical Components

The luminaire shall be comprised of a polycarbonate, aluminum, or stainless steel enclosure with a specular reflector and a glass prismatic refractor. Enclosure shall meet a scribe creepage rating of 7 according to ASTM D1654, when tested for 5,000 hours according to ASTM B117.

The luminaire shall be provided with a 20 mm threaded duct entry in each end of the enclosure and a cable entry hole in the rear of the enclosure together with a suitable waterproof gasket.

The luminaire shall have continuous captive gasket between the door and enclosure and between the refractor and the enclosure to provide a weatherproof seal.

All fixture hardware shall be Type 316 stainless steel and shall be captive. Proper dielectric insulation shall be provided between luminaire housing and fixture hardware of dissimilar metals, to prevent galvanic reaction.

The luminaire shall be provided with a ground terminal or lug for a single conductor #12 AWG stranded copper wire.

All unused cable and duct entry holes shall be plugged with approved filler caps.

The lamp socket shall be a porcelain-enclosed, nickel-plated brass shell rated for 4,000 volts, and spring-loaded centre contact. The lamp holder shall have an electrically insulated lamp stabilizer and shall hold the lamp's outer envelope to precise alignment with suitable means for vibration damping.

The refractor shall be heat-resistant and non-discolouring, with high resistance to breakage from thermal shock. It shall be securely attached to the housing by hinges and a safety device to hold it in the open position.

The reflector shall be fabricated of polished, chemically brightened, anodized aluminum not subject to distortion and shall be readily removable.

The luminaire shall be accessible with tool-less entry.

The luminaire shall not be subject to damage by vibration when closed and in the operating position.

2434.05.03 Marking

A permanent non-corrosive nameplate shall be attached to the exterior of the luminaire and located so that the marking is clearly visible after installation. The nameplate shall indicate the manufacturer’s name or trademark, catalogue number, lamp wattage, and nominal voltage.

A permanent label shall be attached to the interior of the luminaire indicating the manufacturer's name or trademark, catalogue number, date of manufacture, and the American National Standards Institute (ANSI) or Illuminating Engineering Society (IES) photometric classification and distribution type; the suitable supply voltage and frequency; the lamp type; the lamp wattage; and the nominal operating voltage of the lamp so that it is clearly visible during maintenance operations.

A label including a wiring diagram shall be attached to each ballast showing the ballast schematic wiring diagram and shall be visible during maintenance operations.

For asymmetrical luminaires with adjustable optical systems, a permanent embossed identification mark shall be located on the luminaire that is clearly visible and identifiable as an orientation mark.

2434.07 PRODUCTION

2434.07.01 Ballast Assemblies

Ballast assemblies shall be factory pre-wired with all connections clearly marked and identified.

2434.07.02 Lamp Socket Positions

The lamp socket position shall be pre-set and legibly marked at the factory for the specified distribution.

2434.08 QUALITY ASSURANCE

2434.08.01 Inspection

The supplier shall notify the Contract Administrator of the date that the fabrication of the luminaires is to commence.

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

All luminaires are subject to an inspection by the Contract Administrator prior to shipment.

2434.09 OWNER PURCHASE OF MATERIAL

2434.09.01 Packaging and Shipment

The supplier shall provide 3 copies of the luminaire ballast engineering data and shielding data such as material type, gauge thickness, and mounting arrangement to the Owner.

Each luminaire shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity. A complete parts list shall be included in the shipment. All cartons shall be marked with the ANSI or IES luminaire classification and distribution types.

The supplier is responsible for loading, delivery, and off-loading of luminaires to designated areas. Luminaires shall be subject to inspection during and on completion of off-loading. If any damage to the luminaires is encountered during the inspection, the supplier shall be responsible for the necessary corrective measures subject to the approval of the Owner.

The supplier shall advise the Owner 3 Working Days prior to the shipping date of the intent to deliver and confirm that arrangements for off-loading have been made.

2434.09.02 Measurement and Payment

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

Payment at the price specified in the purchasing order shall be full compensation for the supply and delivery of the underpass lighting luminaires to the destination at the date and time specified.

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

Ontario Provincial Standard Specifications (OPSSs)					
2474	November 2016	April 2025	TBD	Rev: Material Specification for Anchorage Assembly - High Mast Lighting Pole is implemented. The specification has been updated to new PROV format with no technical content changes. Legacy Appendix A removed. Gender neutral language updated.	Mike Pearsall

Note: The 2474 implemented in April 2025 replaces 2474, November 2016 with no technical content changes.

MATERIAL SPECIFICATION FOR
ANCHORAGE ASSEMBLY - HIGH MAST LIGHTING POLE

TABLE OF CONTENTS

2474.01 SCOPE

This specification covers the requirements of anchorage assemblies for the 25, 30, 35, 40, and 45 m base mounted sectional steel high mast lighting poles.

~~2474.01.01 Specification Significance and Use~~

~~This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.~~

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

~~**2474.01.02 Appendices Significance and Use**~~

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

~~Appendices are developed for the Owner's use only.~~

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

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

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

2474.02 REFERENCES

~~When the Contract Documents indicate that 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:

CSA Standards

G40.20-13/G40.21-13	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
W59-13	Welded Steel Construction (Metal Arc Welding)
W178.2-14	Certification of Welding Inspectors

ASTM International

~~A 153/A 153M~~A153/A153M-16	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
~~A 449~~A449-14	Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
~~A 563~~A563-15	Carbon and Alloy Steel Nuts

Canadian General Standards Board

48.9712-2014	Non-Destructive Testing - Qualification and Certification of NDT Personnel

2474.04 DESIGN AND SUBMISSION REQUIREMENTS

2474.04.01 Submission Requirements

2474.04.01.01 Working Drawings

Six sets of Working Drawings shall be submitted to the Contract Administrator a minimum 14 Days prior to the commencement of fabrication. ~~–~~An Engineer shall affix ~~his or her~~their seal and signature on the Working Drawings verifying that the drawings are consistent with the Contract Documents and sound engineering practices.

When multi-discipline engineering work is depicted on the same Working Drawing and a single Engineer is unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be signed and sealed by as many additional Engineers, as necessary.

As a minimum, the Working Drawings for anchorage assemblies shall include the following information:

a) Dimensioned drawings, including plans, elevations, sections of the anchor rods, nuts, top and bottom plates, and their exact weights.

b) Mill test certificates reports of all steel being used.

2474.05 MATERIALS

2474.05.01 Steel

Anchor rods shall be made of new billet steel round bar, quenched and tempered medium carbon steel, with a minimum yield strength of 517 MPa and a minimum tensile strength of 725 MPa, and shall satisfy Charpy V Notch test requirements of 20 joules at minus 30 °C.

The length, number, and size of the anchor rods shall be as specified in the Contract Documents.

Other general requirements shall be according to ASTM ~~A 449~~A449 for anchor rods and ASTM ~~A 563~~A563 for anchor rod nuts.

Anchor assembly top and bottom plates shall be made of PL10 x 100 mm according to CSA G40.20/G40.21, Grade 300W.

2474.05.02 Anchorage Setting Templates

The anchorage setting template shall be made of 20 mm thick plywood or hard wood or metal. ~~-~~Metal templates shall be a minimum of 12 gauge steel.

2474.07 PRODUCTION

2474.07.01 General

All fabrication shall be according to dimensions specified in the Working Drawings and as specified in the Contract Documents.

Anchorage assembly shall be supplied complete, as specified in the Contract Documents. ~~-~~Each assembly shall be supplied complete with anchor rods, hexagonal nuts, hardened steel washers, and steel top and bottom plates.

Each anchorage assembly shall be supplied with one anchorage setting template for positioning of the anchor rods to suit the required bolt circle diameter of the pole.

2474.07.02 Tolerance

Dimensions, threads, and hexagonal nuts tolerances shall be according to ASTM ~~A 563~~A563, Grade DH. Exposed nuts are to be tapped oversized according to ASTM ~~A 563~~A563 to allow for the thickness of the zinc coating on the rod threads.

2474.07.03 Welding

Hexagonal nuts shall be welded to the top and bottom plates according to CSA W59.

2474.07.04 Coating

The anchorage assembly shall be completely galvanized according to CAN/CSA G164M or ASTM ~~A 153~~A153.

The exposed hexagonal nuts and washers shall be galvanized according to CAN/CSA G164M or ASTM ~~A 153~~A153.

2474.07.05 Quality Control

Certification from the manufacturer shall be submitted to the Contract Administrator certifying that the anchorage assembly is according to the strength and material requirements as specified in the Contract Documents.

An inspector retained by the manufacturer shall inspect and test the anchorage assemblies. ~~-~~The inspector shall be certified for testing bridges according to CSA W178.2.~~-~~ The certification shall be either Level 2 or Level 3 for the methods used as specified in CAN/CGSB 48.9712.

The~~-~~ inspector shall inspect the place of manufacture of the anchorage assemblies while work on the units is being performed and shall inspect and examine the plant records and certificates, the materials used, and the fabrication process and shall conduct any tests as it may be considered necessary.

Two copies of the completed inspection report shall be submitted to the Contract Administrator. ~~-~~Inspection reports shall be completed and certified by the inspector.

When the anchorage assemblies have been delivered to the Working Area and prior to installation, the inspector shall inspect the anchorage assemblies to ensure that they meet all the Contract requirements.

2474.07.06 Testing

Visual inspection of the anchorage assemblies shall be performed by welding inspectors certified by the Canadian Welding Bureau under CSA W178.2 at a Level 3 category or working under a Level 2 inspector.

2474.07.07 Packaging and Shipment

Each anchorage assembly shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity. ~~-~~A complete parts list shall be included in the shipment.

The supplier shall be responsible for loading, delivery, and off-loading of the anchorage assemblies to the designated areas. Anchorage assemblies shall be subject to inspection during and on completion of off-loading. If any damage is encountered during the off-loading inspection, the supplier shall be responsible for the necessary corrective measures subject to the approval of the Owner.

2474.08 QUALITY ASSURANCE

2474.08.01 Welding

All welding shall be subject to a visual inspection. Procedures and techniques for visual testing shall be according to CSA W59, Clause 7 and 8.

If faulty welding or material is encountered during the inspection procedures, the manufacturer shall submit corrective measures to the Contract Administrator for approval.

2474.08.02 Inspection

The Contract Administrator shall be notified a minimum of 3 Business Days prior to the start of fabrication, testing, and delivery.

The Contract Administrator shall have free access to the place of manufacture of the anchorage assemblies for the purpose of inspecting and examining plant records and certificates; materials used; process of manufacturing, including welding and galvanizing; and to make any tests as may be considered necessary, while the anchorage assembly is being fabricated.

All anchorage assemblies may be subject to an inspection by the Contract Administrator prior to shipment.

2474.09 OWNER PURCHASE OF MATERIAL

2474.09.01 Measurement and Payment

For measurement purposes, a count shall be made of the number of anchorage assemblies supplied and accepted.

Payment at the price specified in the purchasing order shall be for the supply of the anchorage assemblies delivered to the destination on the date and time specified.

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

Appendix 2474-A, November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

Note: The 2474 implemented in April 2025 replaces 2474, November 2016 with no technical content changes.

MATERIAL SPECIFICATION FOR ANCHORAGE ASSEMBLY - HIGH MAST LIGHTING POLE

TABLE OF CONTENTS

2474.01 SCOPE

This specification covers the requirements of anchorage assemblies for the 25, 30, 35, 40, and 45 m base mounted sectional steel high mast lighting poles.

2474.02 REFERENCES

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

CSA Standards

G40.20-13/G40.21-13	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
W59-13	Welded Steel Construction (Metal Arc Welding)
W178.2-14	Certification of Welding Inspectors

ASTM International

A153/A153M-16	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A449-14	Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
A563-15	Carbon and Alloy Steel Nuts

Canadian General Standards Board

48.9712-2014	Non-Destructive Testing - Qualification and Certification of NDT Personnel

2474.04 DESIGN AND SUBMISSION REQUIREMENTS

2474.04.01 Submission Requirements

2474.04.01.01 Working Drawings

Six sets of Working Drawings shall be submitted to the Contract Administrator a minimum 14 Days prior to the commencement of fabrication. An Engineer shall affix their seal and signature on the Working Drawings verifying that the drawings are consistent with the Contract Documents and sound engineering practices.

When multi-discipline engineering work is depicted on the same Working Drawing and a single Engineer is unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be signed and sealed by as many additional Engineers, as necessary.

As a minimum, the Working Drawings for anchorage assemblies shall include the following information:

a) Dimensioned drawings, including plans, elevations, sections of the anchor rods, nuts, top and bottom plates, and their exact weights.

b) Mill test certificates reports of all steel being used.

2474.05 MATERIALS

2474.05.01 Steel

Anchor rods shall be made of new billet steel round bar, quenched and tempered medium carbon steel, with a minimum yield strength of 517 MPa and a minimum tensile strength of 725 MPa, and shall satisfy Charpy V Notch test requirements of 20 joules at minus 30 °C.

The length, number, and size of the anchor rods shall be as specified in the Contract Documents.

Other general requirements shall be according to ASTM A449 for anchor rods and ASTM A563 for anchor rod nuts.

Anchor assembly top and bottom plates shall be made of PL10 x 100 mm according to CSA G40.20/G40.21, Grade 300W.

2474.05.02 Anchorage Setting Templates

The anchorage setting template shall be made of 20 mm thick plywood or hard wood or metal. Metal templates shall be a minimum of 12 gauge steel.

2474.07 PRODUCTION

2474.07.01 General

All fabrication shall be according to dimensions specified in the Working Drawings and as specified in the Contract Documents.

Anchorage assembly shall be supplied complete, as specified in the Contract Documents. Each assembly shall be supplied complete with anchor rods, hexagonal nuts, hardened steel washers, and steel top and bottom plates.

Each anchorage assembly shall be supplied with one anchorage setting template for positioning of the anchor rods to suit the required bolt circle diameter of the pole.

2474.07.02 Tolerance

Dimensions, threads, and hexagonal nuts tolerances shall be according to ASTM A563, Grade DH. Exposed nuts are to be tapped oversized according to ASTM A563 to allow for the thickness of the zinc coating on the rod threads.

2474.07.03 Welding

Hexagonal nuts shall be welded to the top and bottom plates according to CSA W59.

2474.07.04 Coating

The anchorage assembly shall be completely galvanized according to CAN/CSA G164M or ASTM A153.

The exposed hexagonal nuts and washers shall be galvanized according to CAN/CSA G164M or ASTM A153.

2474.07.05 Quality Control

Certification from the manufacturer shall be submitted to the Contract Administrator certifying that the anchorage assembly is according to the strength and material requirements as specified in the Contract Documents.

An inspector retained by the manufacturer shall inspect and test the anchorage assemblies. The inspector shall be certified for testing bridges according to CSA W178.2. The certification shall be either Level 2 or Level 3 for the methods used as specified in CAN/CGSB 48.9712.

The inspector shall inspect the place of manufacture of the anchorage assemblies while work on the units is being performed and shall inspect and examine the plant records and certificates, the materials used, and the fabrication process and shall conduct any tests as it may be considered necessary.

Two copies of the completed inspection report shall be submitted to the Contract Administrator. Inspection reports shall be completed and certified by the inspector.

When the anchorage assemblies have been delivered to the Working Area and prior to installation, the inspector shall inspect the anchorage assemblies to ensure that they meet all the Contract requirements.

2474.07.06 Testing

Visual inspection of the anchorage assemblies shall be performed by welding inspectors certified by the Canadian Welding Bureau under CSA W178.2 at a Level 3 category or working under a Level 2 inspector.

2474.07.07 Packaging and Shipment

Each anchorage assembly shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity. A complete parts list shall be included in the shipment.

The supplier shall be responsible for loading, delivery, and off-loading of the anchorage assemblies to the designated areas. Anchorage assemblies shall be subject to inspection during and on completion of off-loading. If any damage is encountered during the off-loading inspection, the supplier shall be responsible for the necessary corrective measures subject to the approval of the Owner.

2474.08 QUALITY ASSURANCE

2474.08.01 Welding

All welding shall be subject to a visual inspection. Procedures and techniques for visual testing shall be according to CSA W59, Clause 7 and 8.

If faulty welding or material is encountered during the inspection procedures, the manufacturer shall submit corrective measures to the Contract Administrator for approval.

2474.08.02 Inspection

The Contract Administrator shall be notified a minimum of 3 Business Days prior to the start of fabrication, testing, and delivery.

The Contract Administrator shall have free access to the place of manufacture of the anchorage assemblies for the purpose of inspecting and examining plant records and certificates; materials used; process of manufacturing, including welding and galvanizing; and to make any tests as may be considered necessary, while the anchorage assembly is being fabricated.

All anchorage assemblies may be subject to an inspection by the Contract Administrator prior to shipment.

2474.09 OWNER PURCHASE OF MATERIAL

2474.09.01 Measurement and Payment

For measurement purposes, a count shall be made of the number of anchorage assemblies supplied and accepted.

Payment at the price specified in the purchasing order shall be for the supply of the anchorage assemblies delivered to the destination on the date and time specified.

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

Ontario Provincial Standard Specifications (OPSSs)					
2475	April 2017	April 2025	TBD	Rev: Material Specification for Uninterruptible Power Supply Systems for LED Traffic Signals is implemented. The specification has been updated to new PROV format with no technical content changes.	Mike Pearsall

Note: The 2475 implemented in April 2025 replaces 2475, April 2017 with no technical content changes.

MATERIAL SPECIFICATION FOR UNINTERRUPTIBLE POWER SUPPLY SYSTEMS FOR LED TRAFFIC SIGNALS

TABLE OF CONTENTS

2475.01 SCOPE

This specification covers the requirements for uninterruptible power supply (UPS) systems for traffic signals utilizing light emitting diode (LED) modules.

~~2475.01.01 Specification Significance and Use~~

~~This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.~~

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

~~2475.01.02 Appendices Significance and Use~~

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

~~Appendices are developed for the Owner's use only.~~

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

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

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

2475.02 REFERENCES

~~When the Contract Documents indicate that 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:

CSA Standards

C22.1-15	Canadian Electrical Code
C22.2 No. 94-M91 (R2001)	Special Purpose Enclosures

Electrical Safety Authority

Ontario Electrical Safety Code

National Electrical Manufacturer's Association

TS 2-2016 Traffic Controller Assemblies with NTCIP Requirements Version 03.07

2475.03 DEFINITIONS

AGM VRLA Battery means a sealed battery using absorbed glass mat and valve regulated lead acid technology.

CSA Enclosure Type 3 means an enclosure for either indoor or outdoor use, constructed so as to provide a degree of protection against rain, snow, and windblown dust, undamaged by the external formation of ice on the enclosure.

Gel Cell Battery means a sealed battery containing acid in a gel form.

2475.04 DESIGN AND SUBMISSION REQUIREMENTS

2475.04.01 Design Requirements

Each UPS system shall be designed for the traffic signal controller cabinet and equipment to which the UPS system will be connected. A comprehensive and detailed wiring diagram for each UPS system shall be designed and documented. The wiring diagram shall clearly indicate all UPS system wiring and connections, and shall clearly indicate all wiring and connections between the UPS system and the traffic signal controller cabinet and equipment.

2475.04.02 Submission Requirements

Prior to the installation of the UPS system, three copies of a comprehensive and detailed wiring diagram for each UPS system at each traffic control signal shall be submitted to the Contract Administrator.

2475.05 MATERIALS

2475.05.01 General

The UPS system shall provide uninterruptible power and conditioning of the utility power required for the operation of all electronic equipment used to operate the traffic control signals in the event of main utility power supply failure or voltage or frequency fluctuations.

The UPS system shall be supplied complete with UPS automatic switch.

The UPS control unit shall be a line interactive or double conversion type with automatic voltage regulation for 120V, 60Hz, single phase.

The UPS system shall include all wiring necessary to interconnect the UPS control unit to the power source and to the traffic signal control components.

The UPS control unit must latch from line to battery and from battery to line (transfer time) in less than 60 milliseconds.

When installed at a traffic signal using LED signal lamps, the UPS system shall be capable of maintaining full signal display operation for a minimum of 4 hours after which it shall be capable of maintaining a flashing signal display for a further 6 hours minimum.

Switching from full operation to a flashing operation may be determined by a timer circuit or based on battery capacity.

If the UPS control unit or the batteries fail, the system shall automatically switch back to utility line power.

If line power is restored during flashing operation, the traffic control signals shall commence the start-up sequence specified in the traffic control signals' timing sheet.

The UPS cabinet shall be supplied complete with pedestal or pole mounting hardware as indicated in the Contract Documents.

The battery installation and wiring to the batteries shall be according to Ontario Electrical Safety Code.

The UPS system components shall operate properly for the time periods specified above under the following conditions:

a) Ambient temperature -37 °C to +74 °C

b) Humidity: 5 percent to 95 percent

c) The UPS system components shall withstand shock and vibration according to NEMA TS 2.

2475.05.02 UPS Cabinet

The cabinet shall be approved according to the Ontario Electrical Safety Code.

The UPS cabinet shall be a CSA Enclosure Type 3 cabinet constructed of aluminum and shall be painted grey. The cabinet shall be fabricated using sheet aluminum 3.17 mm thick and adequately reinforced by welded aluminum members.

The dimensions and details of the UPS cabinet shall be according to the Contract Documents.

The cabinet shall have one door hinged on one side with a continuous stainless steel piano hinge.

The door shall use a latch and lock mechanism. The door handle shall be zinc coated and painted the same colour as the cabinet.

The opening in the UPS cabinet shall allow full access to UPS components housed in the cabinet.

The cabinet shall be vented according to the Ontario Electrical Safety Code.

The circuit providing power to the battery heating mats shall be thermostat controlled and the thermostat shall be located in the UPS cabinet.

2475.05.03 Batteries

Batteries shall be AGM VRLA or gel cell technology.

Battery leads to UPS control unit shall be of suitable length and not less than 2.5 metres.

Each battery shall be placed on its own heater mat with all heater mats being supplied with AC power by the UPS control unit.

Battery mats shall become inoperable with loss of line voltage.

The batteries shall be protected by a circuit breaker or a fuse.

Each battery shall be labelled with the date of manufacture. The label shall be at a visible location on the top of the battery.

In addition to any other warranty, the Contractor shall provide a 3 year warranty on the batteries. The warranty period for each battery shall be 3 years, commencing from the date of "switch on" for operation of the UPS system in which the batteries are used. Any defective battery shall be replaced within 30 days. The warranty shall include all labour, Equipment, and Materials required to replace the batteries, including traffic control and all removal and disposal work. The Contractor shall be responsible for the removal and disposal of any defective batteries replaced under warranty. The Owner shall be the sole judge in determining if a battery is defective.

2475.05.04 UPS Control Unit

The UPS control unit shall be rack mountable with the following maximum dimensions: width of 483 mm (19 inch), depth of 254 mm (10 inches), and height of 153 mm (6 inches).

The front face of the control unit shall have indicators capable of displaying the following:

a) Number of times the system was on battery supply

b) Total time on battery supply

c) Battery charge status to indicate the battery capacity

Each of the battery supply indicators listed above shall have a manual reset switch.

The UPS control unit shall have a minimum of one standard 120V grounded socket located on either the back or the front panel.

The UPS control unit shall contain over-current protection located on the front panel to switch power on/off from the batteries and to switch AC input and output power on/off.

The UPS control unit shall have a self-test feature to test the UPS automatic switch and the control circuitry.

The UPS control unit shall have an open collector output or an AC or DC contact closure to indicate when the traffic signal is operating on battery supply.

The UPS control unit shall have an open collector output or an AC or DC contact closure to indicate low battery alarm.

The UPS control unit shall have a minimum of 1 switched AC output that will switch on when the traffic signal has been on battery supply continuously for 4 hours.

A 9 pin male serial port and/or Ethernet port shall be located on the front panel to allow for communication to a laptop computer for changing software settings. The Ethernet port shall support dynamic host configuration protocol (DHCP).

A set of battery voltage test points, or a readout indicating battery voltage condition shall be located on the front panel.

2475.05.05 UPS Automatic Switch

The UPS automatic switch shall allow the UPS control unit to be removed for replacement or maintenance without turning off the traffic signal system.

The utility line power shall be connected to the input of the automatic switch. Under normal operating conditions the automatic switch shall connect the utility line power to the UPS control unit. In the event that the UPS control unit is not present or does not function, the automatic switch shall automatically connect the utility line power directly to the traffic signal system, bypassing the UPS control unit.

2475.05.06 Power Conditioning and the Use of Batteries by the UPS

Under normal operating conditions the utility line power shall flow through the UPS control unit to the traffic signal system and any other connected loads.

When the utility line power is within the operating parameters specified by the UPS manufacturer and the Contract Documents the UPS control unit shall condition and deliver the power to the loads without drawing power from the batteries.

When the utility line power is not within the operating parameters specified by the UPS manufacturer and the Contract Documents the UPS control unit shall condition and deliver the power to the loads by drawing power from the batteries as required.

2475.05.07 Electrical

The UPS system shall accept an AC voltage input range of 85 to 135 VAC, single phase, 2 wire plus ground without drawing on battery power.

The UPS system shall provide voltage regulation at 120 VAC ± 3 percent under any line, load or battery conditions other than “low battery”, and a frequency regulation of 60 Hz ± 3 Hz synchronized to the utility line power.

Power rating shall be a minimum of 1000 VA (700W). The UPS system shall provide pure sine wave output, computer grade power compatible with all equipment loads, with power factor correction.

The UPS system shall include full time protection from sudden voltage increase with inrush protection and AC line filtering.

The UPS system shall provide complete isolation from the line operating as a separately derived power source according to Section 10, Grounding and Bonding, CSA C22.1.

The direct current (DC) system of the UPS system shall have a nominal DC system voltage of 60 VDC or less. The UPS DC system short circuit current shall not exceed 5000 A.

2475.07 PRODUCTION

All wires and leads shall be tied and secured within the UPS cabinet prior to delivery.

Note: The 2475 implemented in April 2025 replaces 2475, April 2017 with no technical content changes.

MATERIAL SPECIFICATION FOR UNINTERRUPTIBLE POWER SUPPLY SYSTEMS FOR LED TRAFFIC SIGNALS

TABLE OF CONTENTS

2475.01 SCOPE

This specification covers the requirements for uninterruptible power supply (UPS) systems for traffic signals utilizing light emitting diode (LED) modules.

2475.02 REFERENCES

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

CSA Standards

C22.1-15 Canadian Electrical Code
C22.2 No. 94-M91 (R2001) Special Purpose Enclosures

Electrical Safety Authority

Ontario Electrical Safety Code

National Electrical Manufacturer's Association

TS 2-2016 Traffic Controller Assemblies with NTCIP Requirements Version 03.07

2475.03 DEFINITIONS

AGM VRLA Battery means a sealed battery using absorbed glass mat and valve regulated lead acid technology.

CSA Enclosure Type 3 means an enclosure for either indoor or outdoor use, constructed so as to provide a degree of protection against rain, snow, and windblown dust, undamaged by the external formation of ice on the enclosure.

Gel Cell Battery means a sealed battery containing acid in a gel form.

2475.04 DESIGN AND SUBMISSION REQUIREMENTS

2475.04.01 Design Requirements

Each UPS system shall be designed for the traffic signal controller cabinet and equipment to which the UPS system will be connected. A comprehensive and detailed wiring diagram for each UPS system shall be designed and documented. The wiring diagram shall clearly indicate all UPS system wiring and connections, and shall clearly indicate all wiring and connections between the UPS system and the traffic signal controller cabinet and equipment.

2475.04.02 Submission Requirements

Prior to the installation of the UPS system, three copies of a comprehensive and detailed wiring diagram for each UPS system at each traffic control signal shall be submitted to the Contract Administrator.

2475.05 MATERIALS

2475.05.01 General

The UPS system shall provide uninterruptible power and conditioning of the utility power required for the operation of all electronic equipment used to operate the traffic control signals in the event of main utility power supply failure or voltage or frequency fluctuations.

The UPS system shall be supplied complete with UPS automatic switch.

The UPS control unit shall be a line interactive or double conversion type with automatic voltage regulation for 120V, 60Hz, single phase.

The UPS system shall include all wiring necessary to interconnect the UPS control unit to the power source and to the traffic signal control components.

The UPS control unit must latch from line to battery and from battery to line (transfer time) in less than 60 milliseconds.

When installed at a traffic signal using LED signal lamps, the UPS system shall be capable of maintaining full signal display operation for a minimum of 4 hours after which it shall be capable of maintaining a flashing signal display for a further 6 hours minimum.

Switching from full operation to a flashing operation may be determined by a timer circuit or based on battery capacity.

If the UPS control unit or the batteries fail, the system shall automatically switch back to utility line power.

If line power is restored during flashing operation, the traffic control signals shall commence the start-up sequence specified in the traffic control signals' timing sheet.

The UPS cabinet shall be supplied complete with pedestal or pole mounting hardware as indicated in the Contract Documents.

The battery installation and wiring to the batteries shall be according to Ontario Electrical Safety Code.

The UPS system components shall operate properly for the time periods specified above under the following conditions:

a) Ambient temperature -37 °C to +74 °C

b) Humidity: 5 percent to 95 percent

c) The UPS system components shall withstand shock and vibration according to NEMA TS 2.

2475.05.02 UPS Cabinet

The cabinet shall be approved according to the Ontario Electrical Safety Code.

The UPS cabinet shall be a CSA Enclosure Type 3 cabinet constructed of aluminum and shall be painted grey. The cabinet shall be fabricated using sheet aluminum 3.17 mm thick and adequately reinforced by welded aluminum members.

The dimensions and details of the UPS cabinet shall be according to the Contract Documents.

The cabinet shall have one door hinged on one side with a continuous stainless steel piano hinge.

The door shall use a latch and lock mechanism. The door handle shall be zinc coated and painted the same colour as the cabinet.

The opening in the UPS cabinet shall allow full access to UPS components housed in the cabinet.

The cabinet shall be vented according to the Ontario Electrical Safety Code.

The circuit providing power to the battery heating mats shall be thermostat controlled and the thermostat shall be located in the UPS cabinet.

2475.05.03 Batteries

Batteries shall be AGM VRLA or gel cell technology.

Battery leads to UPS control unit shall be of suitable length and not less than 2.5 metres.

Each battery shall be placed on its own heater mat with all heater mats being supplied with AC power by the UPS control unit.

Battery mats shall become inoperable with loss of line voltage.

The batteries shall be protected by a circuit breaker or a fuse.

Each battery shall be labelled with the date of manufacture. The label shall be at a visible location on the top of the battery.

In addition to any other warranty, the Contractor shall provide a 3 year warranty on the batteries. The warranty period for each battery shall be 3 years, commencing from the date of “switch on” for operation of the UPS system in which the batteries are used. Any defective battery shall be replaced within 30 days. The warranty shall include all labour, Equipment, and Materials required to replace the batteries, including traffic control and all removal and disposal work. The Contractor shall be responsible for the removal and disposal of any defective batteries replaced under warranty. The Owner shall be the sole judge in determining if a battery is defective.

2475.05.04 UPS Control Unit

The UPS control unit shall be rack mountable with the following maximum dimensions: width of 483 mm (19 inch), depth of 254 mm (10 inches), and height of 153 mm (6 inches).

The front face of the control unit shall have indicators capable of displaying the following:

a) Number of times the system was on battery supply

b) Total time on battery supply

c) Battery charge status to indicate the battery capacity

Each of the battery supply indicators listed above shall have a manual reset switch.

The UPS control unit shall have a minimum of one standard 120V grounded socket located on either the back or the front panel.

The UPS control unit shall contain over-current protection located on the front panel to switch power on/off from the batteries and to switch AC input and output power on/off.

The UPS control unit shall have a self-test feature to test the UPS automatic switch and the control circuitry.

The UPS control unit shall have an open collector output or an AC or DC contact closure to indicate when the traffic signal is operating on battery supply.

The UPS control unit shall have an open collector output or an AC or DC contact closure to indicate low battery alarm.

The UPS control unit shall have a minimum of 1 switched AC output that will switch on when the traffic signal has been on battery supply continuously for 4 hours.

A 9 pin male serial port and/or Ethernet port shall be located on the front panel to allow for communication to a laptop computer for changing software settings. The Ethernet port shall support dynamic host configuration protocol (DHCP).

A set of battery voltage test points, or a readout indicating battery voltage condition shall be located on the front panel.

2475.05.05 UPS Automatic Switch

The UPS automatic switch shall allow the UPS control unit to be removed for replacement or maintenance without turning off the traffic signal system.

The utility line power shall be connected to the input of the automatic switch. Under normal operating conditions the automatic switch shall connect the utility line power to the UPS control unit. In the event that the UPS control unit is not present or does not function, the automatic switch shall automatically connect the utility line power directly to the traffic signal system, bypassing the UPS control unit.

2475.05.06 Power Conditioning and the Use of Batteries by the UPS

Under normal operating conditions the utility line power shall flow through the UPS control unit to the traffic signal system and any other connected loads.

When the utility line power is within the operating parameters specified by the UPS manufacturer and the Contract Documents the UPS control unit shall condition and deliver the power to the loads without drawing power from the batteries.

When the utility line power is not within the operating parameters specified by the UPS manufacturer and the Contract Documents the UPS control unit shall condition and deliver the power to the loads by drawing power from the batteries as required.

2475.05.07 Electrical

The UPS system shall accept an AC voltage input range of 85 to 135 VAC, single phase, 2 wire plus ground without drawing on battery power.

The UPS system shall provide voltage regulation at 120 VAC ± 3 percent under any line, load or battery conditions other than “low battery”, and a frequency regulation of 60 Hz ± 3 Hz synchronized to the utility line power.

Power rating shall be a minimum of 1000 VA (700W). The UPS system shall provide pure sine wave output, computer grade power compatible with all equipment loads, with power factor correction.

The UPS system shall include full time protection from sudden voltage increase with inrush protection and AC line filtering.

The UPS system shall provide complete isolation from the line operating as a separately derived power source according to Section 10, Grounding and Bonding, CSA C22.1.

The direct current (DC) system of the UPS system shall have a nominal DC system voltage of 60 VDC or less. The UPS DC system short circuit current shall not exceed 5000 A.

2475.07 PRODUCTION

All wires and leads shall be tied and secured within the UPS cabinet prior to delivery.

Appendix A – Original CPS Documents

1. OPSS.PROV 1205 - Apr 2015
2. OPSS.PROV 1303 - Nov 2014
3. OPSS.PROV 1505 - Apr 2017
4. OPSS.PROV 1704 - Nov 2014
5. OPSS.PROV 1801 - Apr 2018
6. OPSS.PROV 1820 - Nov 2014
7. OPSS.PROV 2422 - Nov 2016
8. OPSS.PROV 2423 - Apr 2017
9. OPSS.PROV 2434 - Nov 2016
10. OPSS.PROV 2474 - Nov 2016
11. OPSS.PROV 2475 - Apr 2017

MATERIAL SPECIFICATION FOR CLAY SEAL

TABLE OF CONTENTS

1205.01 SCOPE

This specification covers the requirements of clay seal material for use at the upstream or inlet side of culverts.

1205.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

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

1205.01.02 Appendices Significance and Use

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

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.

1205.02 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, Material

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

ASTM International

D 4318-10 Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
D 5084-10 Permeability of Saturated Soils Using a Flexible Wall Permeameter

1205.03 DEFINITIONS

For the purpose of this specification the following definitions apply:

Bentonite means a commercial term applied to clay deposits containing sodium montmorillonite as the essential mineral.

Clay means a fine textured (i.e., grain size smaller than 0.002 mm) sedimentary or residual deposit consisting of hydrated silicates of aluminum mixed with various impurities, but no organics. It is a cohesive soil and plastic within a wide range of water content.

Geosynthetic Clay Liner means sodium bentonite soils sandwiched between two protective geotextiles.

Liquid Limit means the water content between the semi-liquid and the plastic states of the soil.

Plastic Limit means the water content between the plastic and semi-solid states of the soil.

Plasticity Index means the water content range of a soil at which it is plastic, defined numerically as the liquid limit minus the plastic limit.

1205.04 DESIGN AND SUBMISSION REQUIREMENTS

1205.04.01 Submission Requirements

1205.04.01.01 Natural Clay

The results of the Atterberg Limit Tests (Liquid Limit and Plasticity Index) on the natural clay shall be submitted to the Contract Administrator at least one week prior to the commencement of work. The Atterberg Limits shall be determined using ASTM D 4318.

1205.04.01.02 Clay Mixture

The results of the Atterberg Limit Tests (Liquid Limit and Plasticity Index) and permeability tests on the clay mixture shall be submitted to the Contract Administrator at least one week prior to the commencement of work. The Atterberg Limits shall be determined using ASTM D 4318. The permeability shall be according to ASTM D 5084.

1205.04.01.03 Geosynthetic Clay Liner

Material specifications containing the physical, mechanical, and hydraulic properties of the geosynthetic clay liner shall be obtained from the manufacturer and submitted to the Contract Administrator. The specification shall include the manufacturer's certification and warranty.

1205.05 MATERIAL

1205.05.01 General

Material used shall have plasticity index and liquid limit percentages that are within the hatched area shown in Figure 1. It shall be natural clay, clay mixture, or a geosynthetic clay liner and shall meet the physical requirements as specified below.

1205.05.02 Natural Clay

Not all clays are suitable for use as clay seal. Clay material shall be according to the following:

a) Liquid limit shall be > 50%.

b) Plasticity index shall be > 0.75 x (Liquid Limit - 20%).

1205.05.03 Clay Mixture

A mixture of clay and other materials can be used, provided that they meet the physical properties for natural clay and the permeability as determined from the falling head permeameter test does not exceed 1 x 10^{-5} mm/s.

1205.05.04 Geosynthetic Clay Liner

The geosynthetic clay liner shall have a permeability not exceeding 1 x 10^{-5} mm/s.

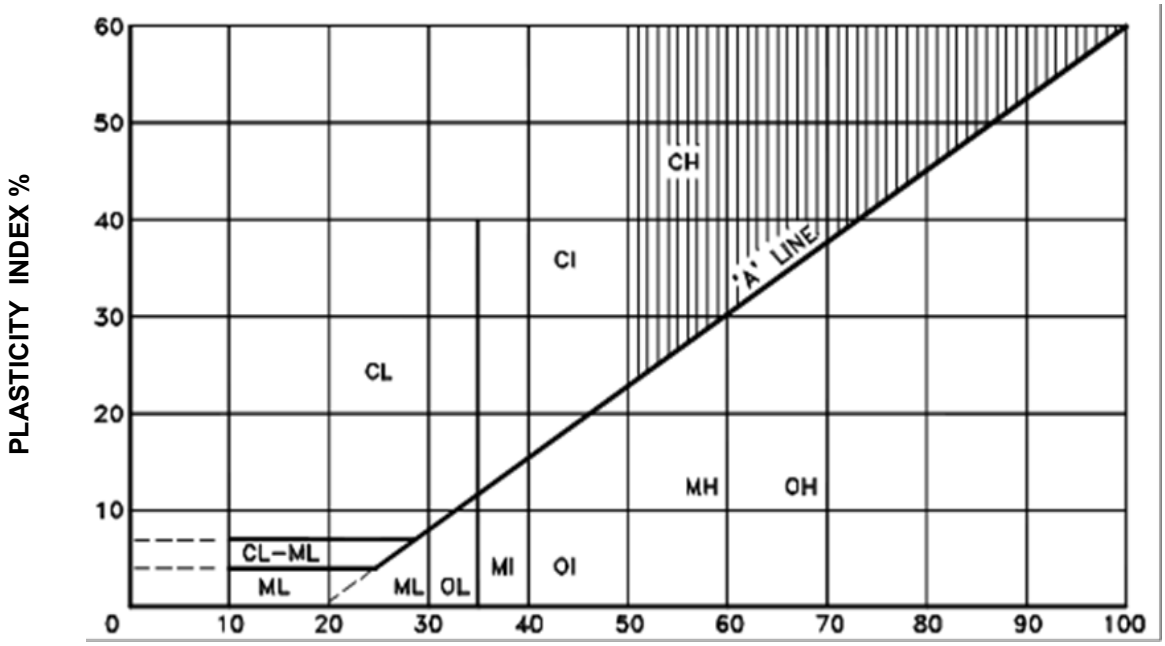

FIGURE 1
Plasticity Chart

LEGEND:

Soil Classifications

CH - Inorganic Clays of High Plasticity, Fat Clays
CI - Inorganic Silty Clays of Medium Plasticity
CL - Inorganic Silty Clays, Gravelly Clays, Sandy Clays, lean Clays
MH - Inorganic Silts, Highly Compressible Micaceous or Diatomaceous Fine Sandy Silts, Elastic Silts
MI - Inorganic Compressible Fine Sandy Silt With Clay of Medium Plasticity, Clayey Silts
ML - Inorganic Silts and Sandy Silts of Slight Plasticity, Rock Flour
OH - Organic Clays of High Plasticity
OI - Organic Silty Clays of Medium Plasticity
OL - Organic Silt of Low Plasticity, Organic Sandy Silts

Appendix 1205-A, April 2015
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

MATERIAL SPECIFICATION FOR ADMIXTURES FOR CONCRETE

TABLE OF CONTENTS

1303.01 SCOPE

This specification covers the materials for use as air entraining, chemical, and superplasticizing admixtures for concrete.

1303.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

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

1303.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

1303.02 REFERENCES

When the Contract Documents indicate that 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 Ministry of Transportation Publications

Designated Sources for Materials (DSM)

Laboratory Testing Manual:

LS-413	Method of Test for Non-volatile Content of Chemical Admixtures, Latex Admixtures and Curing Compounds
LS-422	Method of Test for Evaluation of Air Entraining Admixtures for Concrete
LS-423	Method of Test for Evaluation of Chemical Admixtures for Concrete
LS-424	Method of Test for Evaluation of Superplasticizing Admixtures

ASTM International

C 494	Chemical Admixtures for Concrete
E 70-97 (2002)	Test Method for pH of Aqueous Solutions with the Glass Electrode

1303.03 DEFINITIONS

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

Air Entraining Admixture means a type of admixture according to ASTM C 260 that causes development of a system of microscopic air bubbles in concrete during mixing, to increase the workability of the concrete and its resistance to freezing and thawing.

Chemical Admixture means Types A, B, C, D, E, and S admixtures according to ASTM C 494.

Non-Chloride Admixture means an admixture that contains not more than 0.01% chloride by mass of cement.

Superplasticizer means Types F and G admixtures according to ASTM C 494.

Type A means a water reducing admixture that reduces the quantity of mixing water required to produce concrete of a given consistency.

Type B means a retarding admixture that retards the setting of concrete.

Type C means an accelerating admixture that accelerates the setting and early strength development of concrete.

Type D means a water reducing and retarding admixture that reduces the quantity of mixing water required to produce concrete of a given consistency and retards the setting of concrete.

Type E means a water reducing and accelerating admixture that reduces the quantity of mixing water required to produce concrete of a given consistency and accelerates the setting and early strength development of concrete.

Type F means a superplasticizing admixture that reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or greater.

Type G means a superplasticizing and retarding admixture that reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or greater and retards the setting of concrete.

Type S Admixture means a specific performance admixture that provides desired performance characteristics, other than reducing water content or changing the time of setting of concrete or both, without any adverse effects on fresh, hardened, and durability properties of concrete.

1303.04 DESIGN AND SUBMISSION REQUIREMENTS

1303.04.01 Submission Requirements

1303.04.01.01 Admixtures

The supplier shall submit documentation verifying that each admixture used on the Contract is included on the ministry's DSM.

1303.05 MATERIALS

All admixtures shall be in liquid form.

All admixtures shall be non-chloride, with the exception of admixtures used in fast-track full-depth repairs to concrete pavements or concrete base.

Admixtures shall be according to LS-422, LS-423, and LS-424.

In addition, required performance characteristics of each Type S chemical admixture shall be demonstrated on Owner approved field trials prior to use in the work.

1303.08 QUALITY ASSURANCE

Admixtures shall be sampled and tested as specified in the Contract Documents.

Relative density and pH of air entraining admixtures, and non-volatile content and relative density of chemical and superplasticizing admixtures shall be according to the product data shown on the DSM, within the following tolerances:

a) Relative density:

   i. Where relative density is 1.050 or less, the tolerance shall be ± 0.005.
   ii. Where relative density is greater than 1.050, the tolerance shall be calculated according to the following formula:

      Tolerance = (relative density of acceptance sample-1.000)/10

b) Non-volatile content ± 2.5%.

c) pH ± 1.5.

Appendix 1303-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

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

ONTARIO PROVINCIAL STANDARD SPECIFICATION

METRIC
OPSS.PROV 1505
APRIL 2017
(Formerly OPSS 1505, November 2010)

Note: The PROV implemented in April 2017 replaces OPSS 1505 COMMON, November 2010 with no technical content changes.

MATERIAL SPECIFICATION FOR CHANNEL COMPONENTS FOR STEEL BEAM GUIDE RAIL

TABLE OF CONTENTS

1505.01 SCOPE

This specification covers the requirements for steel channel and installation hardware.

1505.01.01 Specification Significance and Use

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

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

1505.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

1505.02 REFERENCES

When the Contract Documents indicate that 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:

CSA Standards

G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
S136-07	Cold Formed Steel Structural Members

ASTM International

A 307-07	Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

1505.05 MATERIALS

1505.05.01 Cold Rolled Channel

Channels shall be cold rolled steel sections according to CSA S136 and have a minimum yield strength of 345 MPa. After fabrication, sections shall be hot dip galvanized according to CAN/CSA G164.

1505.05.02 Installation Hardware

All bolts, nuts, and washers shall be according to ASTM A 307 and be hot dip galvanized according to CAN/CSA G164.

1505.07 PRODUCTION

1505.07.01 Fabrication Tolerances and Workmanship

Bolt holes in steel channels shall be perpendicular to the surface and shall not deviate more than 1.0 mm in any direction from the true location. Steel channel ends shall be cut square.

After fabrication, curved steel channels shall be hot dip galvanized according to CAN/CSA G164.

1505.07.02 Marking

As a minimum, each steel channel section shall be marked with the following information:

a) Name, trademark, or brand of the manufacturer.

b) Standard designation 1505.

c) Identification symbols or code for heat.

d) Week number and year of production.

Markings shall be clearly and permanently stamped in the valley of the steel channel, placed at a location clear of the splice overlap, and shall not be obscured after installation. The height of the letters and numerals shall be within the range of 19 to 32 mm.

1505.09 OWNER PURCHASE OF MATERIAL

1505.09.01 Measurement and Payment

For measurement purposes, a count shall be made of the number of steel channel sections delivered and accepted.

Installation hardware shall be measured in the units specified in the purchasing order, delivered and accepted.

Payment at the price specified in the purchasing order shall be for the supply of steel channels and installation hardware delivered to the destination or destinations at the dates and times specified.

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

MATERIAL SPECIFICATION FOR PAINT COATING SYSTEMS FOR STRUCTURAL STEEL

TABLE OF CONTENTS

1704.01 SCOPE

This specification covers the material requirements of paint coating systems for structural steel. It also covers the procedure to be followed for initial approval and subsequent acceptance testing of paint coatings and paint coating systems.

1704.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

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

1704.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

1704.02 REFERENCES

When the Contract Documents indicate that 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, Construction

OPSS 911 Coating Structural Steel Systems

ASTM International

A 123/A123M-12	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
B 117-11	Standard Practice for Operating Salt Spray (Fog) Apparatus
D 523-14	Standard Test Method for Specular Gloss
D 562-10	Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using the Stormer-Type Viscometer
D 609-00 (2012)	Standard Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products
D 610-08 (2012)	Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces
D 660-93 (2011)	Standard Test Method for Evaluating Degree of Checking of Exterior Paints
D 661-93 (2011)	Standard Test Method for Evaluating Degree of Cracking of Exterior Paints
D 714-02 (2009)	Standard Test Method for Evaluating Degree of Blistering of Paints
D 772-86(2011)	Standard Test Method for Evaluating Degree of Flaking (Scaling) of Exterior Paints
D 1210-05 (2010	Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
D 1475-13	Standard test Method for Density of Liquid Coatings, Inks, and Related Products
D1640 -03(2009)	Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature

D 1654-08	Standard test method for Evaluation of Painted or Coated Specimens subjected to Corrosive environment
D 2369-10e1	Standard Test Method for Volatile Content of Coatings
D 2371-85(2010)	Standard Test Method for Pigment Content of Solvent-Reducible Paints
D 2621-87(2011)	Standard Test Method for Infrared Identification of Vehicle Solids From Solvent-Reducible Paints
D 3271-87(2012)	Standard Practice for Direct Injection of Solvent-Reducible Paints Into a Gas Chromatograph for Solvent Analysis
D 3723-05(2011)	Standard Test Method for Pigment Content of Water-Emulsion Paints by Low-Temperature Ashing
D 3960-05(2013)	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paint and Related Coatings
D 4214-07	Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
D 4400-99(2012)e1	Standard Test Method for Sag Resistance of Paints Using a Multinotch Applicator
D 4451-02(2008)	Standard Test Method for Pigment Content of Paints by Low-Temperature Ashing
D 4541-09e1	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
D 4587-11	Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
D 5894-10	Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
D 6386-10	Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
E 1347-06 (2011)	Standard Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry

ASTM International Manual Series: MNL 17

Paint and Coating Testing Manual, 15th Edition, 2012

The Society for Protective Coatings (SSPC)

Good Painting Practice, SSPC Painting Manual, Volume 1, 4th Edition, 2002

SP 3-82 (2004)	Power Tool Cleaning
VIS 1-02	Visual Standard for Abrasive Blast Cleaned Steel
VIS 3-93(2004)	Visual Standard for Power and Hand Tool Cleaned Steel

SSPC and National Association of Corrosion Engineers (NACE) Joint Publications

SP 5 / NACE No. 1, Jan 2007	White Metal Blast Cleaning
SP 10 / NACE No. 2, September 2000	Near-White Blast Cleaning

SSPC, American Welding Society (AWS) and NACE Joint Publications

SSPC-CS 23.00 / AWS C2.23M/NACE No.12-2003	Application of Thermal Spray Coatings (metalizing) of Aluminum, Zinc, and Their Alloys and Composites for Corrosion Protection of Steel

Others

U.S. General Services Administration:
Federal Standard 595C Colors, 2008

1704.03 DEFINITIONS

For the purpose of this specification, the definitions in the SSPC, Good Painting Practice Manual Volume 1, 4th Edition; and the following definitions apply:

Coating System means as defined in OPSS 911.

Low Volatile Organic Coating Material means coating material that contains not more than 340 g/L of volatile organic compounds (VOC) when tested according to ASTM D 3960.

Marginally Prepared Surface means a steel surface prepared by power tool cleaning according to SSPC-SP 3.

Paint Coating means as defined in OPSS 911.

Paint Coating System means as defined in OPSS 911.

Pot Life means the length of time a multi-component material is usable after all the components are mixed in the recommended portions.

Seal Coat means as defined in OPSS 911.

Structural Steel means as defined in OPSS 911.

Target Value means the value of various properties listed in OPSF 1704-1 submitted by the supplier with the initial submission of material samples for coating system approval.

1704.04 DESIGN AND SUBMISSION REQUIREMENTS

1704.04.01 Submissions Requirements

1704.04.01.01 Paint Coatings and Paint Coating System Approval

The supplier shall provide samples and a completed OPSF 1704-1 for each component of the paint coating system for approval and material acceptance testing. The sample shall be accompanied by the manufacturer's instructions for use; material safety data sheets; and material information, including documentation on laboratory and field tests carried out to establish the pot life; physical characteristics; and chemical composition as shown in OPSF 1704-1.

1704.05 MATERIALS

1704.05.01 Coating Material

1704.05.01.01 General

The requirements of the paint coating shall be according to the following:

a) The concentration of lead in the dry film of each coating shall not exceed 0.01% or 100 ppm.

b) The components shall be homogenous, well-dispersed to a uniform consistency and, when mixed according to manufacturer's instructions, shall be suitable for application by spray equipment.

c) Each paint coating shall be a low VOC material.

d) Zinc–rich touch up paint shall contain not less than 87% of zinc by mass of non-volatile matter.

e) The paint coating system for marginally prepared surfaces shall be suitable for application over existing coatings of alkyd, vinyl, and currently approved low VOC paint coating systems.

1704.05.01.02 Colour

The prime coat shall be of such a colour as to assist the applicator in distinguishing between primed areas and the uncoated cleaned steel or other prepared surfaces.

Each coat shall be formulated to show a distinct colour difference. With the exception of coal tar epoxies, the colour of the finish coat shall be equivalent to 10045 brown for Atmospheric Corrosion Resistant steel, and a colour equivalent to 16307 grey for all other steels, both according to Federal Standard 595C Colors.

1704.05.01.03 Application Requirements

When applied according to the manufacturer's instructions and to the manufacturer's specified thickness, the paint coating shall show good levelling with no runs, sags, or mud cracks. Applied coatings shall have no pin-holes, holidays, bubbles, or craters.

Each coat shall be capable of application by spray, brush, or roller for a temperature range of 5 to 35 °C, without thinning.

After the components have been combined, multiple component paint coating shall have a minimum pot life of 3 hours at 25 °C.

1704.05.01.03.01 Two-Coat Zinc Rich Rapid Deployment Coating System

In order to qualify as a primer for a rapid deployment coating system, zinc rich coating material shall cure or dry sufficiently to be top coated within 3 hours at 15 ºC when applied at a wet film thickness required for a DFT of 100 µm.

The coatings to be used as the top coat material shall cure or dry to touch within 4 hours when applied at a wet film thickness required for a DFT of 125 µm.

1704.05.01.04 Performance Requirements

1704.05.01.04.01 General

The entire coating system shall be tested on test panels for adhesion, weathering resistance, and corrosion resistance performance. Testing shall be as shown in Table 1.

1704.05.01.04.02 Accelerated Weathering

After 5,000 hours of exposure, the coating system on the test panel for abrasive blast cleaned surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. Chalk rating shall be 7 or higher, and the colour difference shall not exceed 6 units.

After 2,500 hours of exposure, the coating system on the test panel for marginally prepared surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 5,000 hours of exposure, the coating system on the galvanized test panel shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 5,000 hours of exposure, the coating system on the metallized test panel shall exhibit none of the characteristics of the paint failure as described in the chapter "Causes and Prevention of Paint Failure" in SSPC Vol. 1. Chalking shall be 7 or higher, and the colour difference shall not exceed 6 units when measured as shown in Table 1.

1704.05.01.04.03 Cyclic Corrosion Resistance Testing

After 12 cycles of exposure, the coating system on the test panel for abrasive blast cleaned surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. There shall not be any corrosion, except along the score lines. The average value of the rust creepage of all the scored panels tested shall not be more than 4 mm. However, the rust creepage on any individual panel may exceed 4.0 mm, but shall be below 5.0 mm. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 6 cycles of exposure, the coating system on the test panel for marginally prepared surfaces shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. There shall not be any corrosion, except along the score lines. The average value of the rust creepage of all the scored panels tested shall not be more than 4 mm. However, the rust creepage on any individual panel may exceed 4.0 mm, but shall be below 5.0 mm. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 12 cycles of exposure, the coating system on the galvanized test panel shall exhibit none of the characteristics of the paint failure as described in the Coating Failures chapter of the SSPC Good Painting Practice Manual, except for characteristics noted below. There shall not be any corrosion, except along the score lines. The average value of the rust creepage of all the scored panels tested shall not be more than 4 mm. However, the rust creepage on any individual panel may exceed 4.0 mm, but shall be below 5.0 mm. Chalk rating shall be 7 or higher and the colour difference shall not exceed 6 units.

After 12 cycles of exposure, the seal coatings on the metallized test panel shall exhibit none of the characteristics of the paint failure as described in the chapter "Causes and Prevention of Paint Failure" in SSPC Vol. 1. There shall not be any corrosion, except along the score lines where the total width of rust creepage shall not be more than 1.0 mm. Chalking shall be 7 or higher and the colour difference shall not exceed 6 units when measured as shown in Table 1.

1704.05.01.04.04 Salt Spray Resistance Testing

Salt spray resistance testing of zinc-rich touch up paint coated test panels shall be conducted according to ASTM B117 for 720 hours. There shall not be any corrosion, except along the score lines where the total width of rust creepage shall not be more than 1.00mm.

1704.05.01.05 Recoat Time

At an ambient temperature of 23 °C and a relative humidity of 80%, a paint coating shall dry or cure sufficiently to receive the next coat satisfactorily within 16 hours of application. It shall remain recoatable for a minimum of 30 Days.

1704.07 PRODUCTION

1704.07.01 Quality Control

1704.07.01.01 Physical Tests and Paint Coating Composition

The results for physical tests and paint coating composition of production batches shall be within the tolerances as shown in Table 2, when the results of testing are compared to the respective test results of the sample submitted for the coating system approval.

1704.07.01.02 Chemical Analysis

When the product from production batches of paint coatings is analyzed for chemical composition, the test results shall not vary by more than:

a) ± 5% from the value of the original submission, if the amount of ingredient is greater than 50% by weight of the product.

b) ± 10% from the value of the original submission, if the amount of the ingredient is from 5 to 50% by weight of the product.

1704.07.01.03 Infrared Analysis

The infrared spectrum of the product or any product fraction of production batches of paint coatings shall match the corresponding spectrum from the sample submitted for coating system approval.

1704.07.01.04 Gas Chromatogram of Volatiles

The gas chromatogram of production batches of paint coatings shall show the identical volatile components present in the same proportions as in the sample submitted for coating system approval.

1704.07.01.05 Colour Difference

Colour difference of production batches of paint coatings shall be within the tolerances as shown in Table 2. The reference colour for the finish coat shall be the appropriate colour specified in the Material section. For all other coats, the reference colour shall be the colour of the sample submitted for paint coating system approval.

1704.07.02 Packaging and Delivery

The paint shall be delivered in the manufacturer's originally sealed containers.

Containers shall be leak-free and constructed so that the contents can be thoroughly and completely mixed. They shall be provided with triple-tight lids. Containers 4 litres or larger shall have wire bail handles.

Each container and shipping case shall be marked to show the following information:

a) Identification of the paint coating system.

b) The contents of container (i.e., prime coat, second coat, third coat, or fourth coat).

c) The colour and colour code.

d) The manufacturer's name and address.

e) The quantity of the contents in litres.

f) The date of filling the container (i.e., yyyy-mm-dd).

g) The manufacturer's code and coating batch numbers.

The markings shall be permanent and the coating batch number shall be prominently displayed.

1704.07.02.01 Certificate of Compliance

A certificate of compliance from the manufacturer indicating that the physical properties and chemical composition of the material supplied complies with the requirements of this specification shall be included with each shipment of paint.

1704.08 QUALITY ASSURANCE

1704.08.01 Test Panels

1704.08.01.01 Testing General

For the following tests, the number of panels specified below shall be made for the paint coating system being evaluated and the panels for the approved paint coating system to be used for reference purposes during paint coating operations.

1704.08.01.02 Weathering Resistance and Corrosion Resistance Testing

1704.08.01.02.01 Panel Preparation

1704.08.01.02.01.01 Abrasive Blast Cleaned Surfaces

Panels shall be cold-rolled carbon steel according to ASTM D 609, measuring 75 x 150 x 2.6 mm with rounded edges. Panels shall be blast cleaned to the requirements of SP 10/NACE NO. 2. The pictorial standards as shown in SSPC-VIS 1 shall be used to check conformance of the panel preparation in conjunction with SP 10/NACE NO. 2. The height of the surface profile shall be a minimum of 25 µm and a maximum of 75 µm.

1704.08.01.02.01.02 Marginally Prepared Surfaces

The panels shall be prepared as specified in the Abrasive Blast Cleaned Surfaces clause and then be subjected to 72 hours of salt spray according to ASTM B 117, after which, the rusted panels shall be power-tool cleaned to SSPC SP 3 condition by power wire brush. The pictorial standards as shown in SSPC-VIS 3 shall be used to check conformance of the panel preparation in conjunction with SSPC SP3.

1704.08.01.02.01.03 Paint Coating on Galvanized Surfaces

As the first step, cold-rolled carbon steel panels, measuring 75 x 150 x 5 mm with rounded edges shall be hot dip galvanized according to ASTM A123/A123M. Galvanized panel surfaces shall then be prepared according to ASTM D 6386. Thick edges due to excess zinc run-off, high spots, and rough edges shall be removed by power tools. Surface preparation shall be performed by sweep blasting to roughen the surface using an abrasive of a hardness that does not damage the galvanized coating.

1704.08.01.02.01.04 Seal Coating on Metallized Surfaces

As the first step, cold-rolled carbon steel panels measuring 75 mm x 150 mm x 2.6 mm, and shall be blast cleaned to the requirements of SP5/NACE NO. 1. The height of the surface profile shall be a minimum of 50 µm and a maximum of 75 µm. The blast cleaned panels shall then be coated on both surfaces and the edges with 85% zinc / 15% aluminum alloy by thermal metal spraying according to SSPC-CS 23.00 / AWS C2.23M/NACE No.12. The dry film thickness of the metallized coating shall be between 75 µm and 110 µm. The metallized panels shall be vacuum sealed or stored in a vacuum desiccator to prevent oxidation until the seal coat material is ready to be spray applied.

1704.08.01.02.02 Paint Coating and Seal Coating Application

The paint coating system shall be spray applied on both faces of the prepared test panels according to the manufacturer's recommendations and to the manufacturer's recommended thickness. When the painted faces are hard dry, the edges of the panels shall be covered with the same coating applied by brush. After the final coat, the panels shall be dried and cured for 7 Days prior to any further handling.

The coating on the panels intended for scoring shall be scored according to ASTM D1654.

1704.08.01.02.03 Test Method for Accelerated Weathering

Test panels shall be prepared and coated as specified in the Panel Preparation clause and the Paint Coating and Seal Coating Application clause.

Seven unscored panels shall be prepared for each cleaning requirement for each coating system. One panel from each set shall be set aside as reference for comparison purposes. The other panels from each set shall undergo exposure testing as shown in Table 1. Evaluation shall be done at 500 hour intervals of exposure to the maximum of 5,000 hours for coating systems on abrasive blast cleaned surfaces and galvanized surfaces, seal coating on metallized surfaces, and 2,500 hours for coatings on marginally prepared surfaces.

1704.08.01.02.04 Test Method for Cyclic Corrosion Resistance of Coatings

Test panels shall be prepared, coated, and scored as specified in the Panel Preparation clause and the Paint Coating and Seal Coating Application clause.

Eleven panels shall be prepared for each cleaning requirement for each coating system. One panel from each set shall be set aside as reference for comparison purposes. The other panels, 5 unscored and 5 scored from each set, shall undergo exposure testing as shown in Table 1. Evaluation shall be done after each cycle of exposure. At the completion of testing, the coating between the score lines on the bottom half of the scored panels shall be stripped and the mean rust creepage in millimetres for each panel shall be determined according to ASTM D 1654. The average rust creepage shall be calculated from the mean rust creepage values of the individual panels of the respective paint system.

1704.08.02 Coating System Approval

1704.08.02.01 General

Approval shall only be given for a complete paint coating system and for paint coating to be used as a seal coat for thermal spray metal coating.

Testing shall be performed by the Owner or by an independent laboratory chosen by the Owner.

When an independent laboratory is used, the paint manufacturer shall arrange for testing by the independent laboratory. The independent laboratory shall obtain samples of the approved paint coating and paint coating system to be used for comparison purposes from the Owner.

1704.08.02.02 Testing by Owner

When testing is carried out by the Owner for initial approval, the supplier shall be notified of the sample size, date, labelling, and other details regarding submission of samples, including cost.

1704.08.02.03 Testing for Coating System Approval and Approval of Subsequent Batches

The initial submission shall be evaluated for approval based on the requirements specified in the Materials section, using the testing methods as shown in Tables 1 and 2, and the data submitted on the completed OPSF 1704-1.

For comparison, an approved system from the Owner's list of approved coatings shall be subjected to the tests for accelerated weathering and cyclic corrosion resistance concurrently with the system under evaluation. Where possible, coatings of the same generic type shall be used for comparison.

When the testing is done by the approved independent laboratory, the Owner shall review the test results and may repeat any of the tests.

Subsequent batches of material shall be tested for acceptance as specified in the Quality Assurance section.

1704.08.02.05 Acceptance or Rejection

1704.08.02.05.01 Initial Approval

Approval shall only be given to paint coatings and paint coating systems satisfying the requirements of the Materials section.

1704.08.03 Sampling at Work Site

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

1704.08.03.01 Acceptance or Rejection on Site

Testing shall be done by the Owner according to the methods as shown in Table 2.

Acceptance shall be based on the testing requirements and allowable tolerances as shown in Table 2, when compared to the results of the testing conducted by the Owner on the initially approved material.

Failure to conform to the requirements of the Material section and the tolerances as shown in Table 2, changes made in the formulation after approval, inability to maintain production quality, and unsatisfactory field performance of paint coatings or paint coating systems shall be a cause for rejection.

TABLE 1
Performance Tests for Paint Coating Systems

Type of Test	ASTM Method	Requirements
Pull-Off Adhesion	D 4541	2.75 MPa minimum
Accelerated Weathering using Fluorescent UV - Condensation Light- and Water-Exposure Apparatus for evaluation of:	D 4587 Test Condition D	Exposed to:
Paint coating system on abrasive blast cleaned test panels		5,000 hours maximum
Paint coating systems on hot dip galvanized test panels		5,000 hours maximum
Seal coating on metallized test panels		5,000 hours maximum
Paint coating system on marginally prepared test panels		2,500 hours maximum
Cyclic Corrosion Resistance Testing by Alternating Exposures in a UV/Condensation Cabinet and a Salt Fog/Dry Cabinet for evaluation of:	D 5894	Exposed to:
Paint coating system on abrasive blast cleaned test panels		12 cycles maximum (Note 1)
Paint coating systems on hot dip galvanized test panels		12 cycles maximum (Note 1)
Seal coating on metallized test panels		12 cycles maximum (Note 1)
Paint coating system on marginally prepared test panels		6 cycles maximum (Note 1)
Evaluation of Test Panels After Accelerated Weathering Test / Cyclic Corrosion Resistance Test for:		Test Method for Accelerated Weathering and the Test Method for Cyclic Corrosion Resistance of Coatings clauses (Note 2)
Gloss	D 523	
Colour Difference (ΔE)	E 1347	
Chalking	D 4214	
Checking	D 660	
Cracking	D 661	
Flaking	D 772	
Blistering	D 714	
Rusting	D 610	
Rust Creepage	D 1654	

Notes:

1. One cycle represents a total exposure of 336 hours which comprises 168 hours or 1 week of exposure of test panels in the fluorescent UV condensation cabinet, followed by 168 hours of exposure of the test panels in the cyclic salt fog or dry exposure cabinet.

2. Clauses in this specification.

TABLE 2
Test Methods for Physical Testing and Compositional Analysis of Paint Coatings and Acceptance Criteria for Field Samples and Production Batches

	ASTM	Acceptance Criteria (Note 1)	
		Tolerance (Note 2)	Others
Physical Tests on Mixed Coating:			
Density	D 1475	5%	-
Consistency, Kreb Units (KU)	D 562	± 10 or 25% (Note 3)	-
Dry Time:			
To Touch	D1640	± 30%	-
Hard Dry	D1640	± 30%	-
Hiding Power Determination Using Pfund Black and White Cryptometer	Paint and Coating Testing Manual	± 1.5 (Note 4)	-
Skinning	-	-	-
Fineness of Grind, Hegman Units (HU)	D 1210	± 2	-
Sag Resistance	D 4400	± 20%	-
Coating Composition:			
Pigment Content by % mass	D 4451, D 2371, D 3723	± 5%	-
Vehicle Solids Content by % mass @ 24 hours	-	± 5%	-
Volatile Content by % mass @ 2 hours and 24 hours	D 2369	± 5%	-
Pigment Composition by Chemical and Instrumental Analysis	-	-	Chemical Analysis clause (Note 5)
VOC Content	D 3960	± 10% but the total not exceeding 340 g/L (Note 6)	-
Vehicle Solids Identification by Infrared Analysis	D 2621	-	Infrared Analysis clause (Note 5)
Determination of Paint Volatiles Composition by Gas Chromatography	D 3271	-	Gas Chromatogram of Volatiles clause (Note 5)
Determination of Thinner Composition by Gas Chromatography	D 3271	-	Gas Chromatogram of Volatiles clause (Note 5)
Tests on Cured Paint Coating:			
Gloss	D 523	± 30%	-
Colour Difference (ΔE)	E 1347	± 4 units	-
IR Fingerprinting	Paint and Coating Testing Manual	-	Infrared Analysis clause (Note 5)

Notes:

1. Acceptance criteria for field samples and production batches.
2. Allowable tolerance for field samples or production batches based on the Owner's test results for the initially approved paint coating material.
3. Whichever is less.
4. Pfund black and white cryptometer, wedge #3.5.
5. Clause in this specification.
6. VOC content of Zinc -rich touch up paint shall not exceed 500g/L.

PAINT COATING DATA FORM

A. MANUFACTURER INFORMATION

Name:
Address:
Telephone:
Fax:
Email:

B. SAMPLE IDENTIFICATION

Manufacturer's Code No.:	Coating Batch No.:
Colour of Coating:	Production Date:

C. TEST DATA OF MIXED COATING

	Test Method	Manufacturer's Test Results
Density, kg/L	ASTM D 1475	
VOC, g/L	ASTM D 3960	
Viscosity, KU	ASTM D 562	
Pot Life, hours @ 25 °C	Manufacturer's Procedure	
Sag Resistance, mm	ASTM D 4400	
Dry Time, hours @ 25 °C		
To touch	ASTM D1640	
Hard dry	ASTM D1640	

D. COMPOSITION OF MIXED COATING

	Test Method	% by Mass
Pigment and Fillers	ASTM D 2371, D 4451, D 3723	
Non Volatile	-	
Volatile	ASTM D 2369	

E. COMPOSITION OF PIGMENTS AND FILLERS IN EACH COMPONENT % BY MASS - List % lead to three decimal places

	Component A	%	Component B	%	Component C	%
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

F. PAINT VOLATILE COMPOSITION BY GAS CHROMATOGRAPHY - Attach chromatogram with peaks identified

	Chemical Name	%
1		
2		
3		
4		
5		

G. COMPOSITION OF THINNER BY GAS CHROMATOGRAPHY - Attach chromatogram with peaks identified

	Chemical Name	%
1		
2		
3		
4		
5		

H. VEHICLE SOLIDS IDENTIFICATION by Infrared Analysis - Attach spectrum with major peaks identified

I. MIXING RATIO OF COMPONENTS A, B, and C by weight _____

J. IR FINGERPRINT OF MIXED, CURED COATING - Attach Spectrum with major peaks identified

OPSF 1704-1

Appendix 1704-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

MATERIAL SPECIFICATION FOR CIRCULAR AND ELLIPTICAL CONCRETE PIPE

TABLE OF CONTENTS

1820.01 SCOPE

This specification covers the requirements for reinforced and non-reinforced non-pressure circular concrete pipe with rubber gasket joints, and for non-gasketed reinforced elliptical concrete pipe.

1820.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

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

1820.01.02 Appendices Significance and Use

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

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1820.02 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:

CSA Standards

A257.1-09	Non-Reinforced Circular Concrete Culvert, Storm Drain, Sewer Pipe, and Fittings [Part of A257 Series-09, Standards for Concrete Pipe and Manhole Sections]
A257.2-09	Reinforced Circular Concrete Culvert, Storm Drain, Sewer Pipe, and Fittings [Part of A257 Series-09, Standards for Concrete Pipe and Manhole Sections]
A257.3-09	Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections, and Fittings Using Rubber Gaskets [Part of A257 Series-09, Standards for Concrete Pipe and Manhole Sections]
A3000-08	Cementitious Materials Compendium

ASTM International

C 507M-11	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe (Metric)

Plant Prequalification Program Publication

Prequalification Requirements for Precast Concrete Drainage Products

1820.04 DESIGN AND SUBMISSION REQUIREMENTS

1820.04.01 Design Requirements

1820.04.01.01 Concrete Pipe

Non-reinforced circular concrete pipe shall be according to CAN/CSA A257.1.

Reinforced circular concrete pipe shall be according to CAN/CSA A257.2.

Reinforced elliptical concrete pipe shall be according to ASTM C 507M.

1820.04.01.02 Joints and Gaskets

Joints and gaskets for circular concrete pipe shall be according to CAN/CSA A257.3.

Joints for elliptical concrete pipe shall be according to ASTM C 507M, and according to the requirements outlined in the publication, Prequalification Requirements for Precast Concrete Drainage Products.

Elliptical concrete pipe produced with non-gasketed joints shall be used for storm pipe sewers only.

1820.04.01.03 Jacking Pipe

Jacking pipe shall be according to CAN/CSA A257.2 with a minimum class of 65-D and a minimum concrete strength of 40MPa.

1820.04.01.04 Elliptical Reinforcing

Elliptical reinforcing for circular concrete pipe is not permitted for pipes up to and including 900 mm nominal internal diameter.

1820.04.01.05 Lift Holes and Anchors

Lift holes are not permitted for pipes. Lift anchors are not permitted for pipes up to and including 900 mm nominal internal diameter.

1820.05 MATERIALS

1820.05.01 Cement

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

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

1820.07 PRODUCTION

1820.07.01 General

A manufacturer producing circular concrete pipe or elliptical concrete pipe or both shall possess a current Prequalification Certificate, issued under the Plant Prequalification Program as outlined in the publication, Prequalification Requirements for Precast Concrete Drainage Products.

1820.07.02 Markings

Markings for circular concrete pipe shall be according to CAN/CSA A257.2.

Markings for elliptical concrete pipe shall be according to ASTM C 507M.

In addition, all pipe shall be marked with the Prequalification Stamp shown in Figure 1 and as outlined in the publication, Prequalification Requirements for Precast Concrete Drainage Products.

Figure 1
Prequalification Stamp

Appendix 1820-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

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

MATERIAL SPECIFICATION FOR HEAVY CLASS STEEL AND SECTIONAL STEEL POLES, BASE MOUNTED

TABLE OF CONTENTS

2422.01 SCOPE

This specification covers the requirements for base mounted galvanized heavy class steel and sectional steel poles 6.0, 7.5, 9.0, and 10.50 metres in height.

2422.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

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

2422.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

2422.02 REFERENCES

When the Contract Documents indicate that 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 Ministry of Transportation Publications

Structural Manual

CSA Standards

G40.20-13/G40.21-13	General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
S6-14	Canadian Highway Bridge Design Code
W59-13	Welded Steel Construction (Metal Arc Welding)

American Association of State Highway and Transportation Officials (AASHTO)

LTS-5-M	Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 5th Edition, Interim Revisions (2010)

2422.03 DEFINITIONS

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

Product Drawings means drawings prepared by the manufacturer that have been approved by the Owner for use with the product.

2422.04 DESIGN AND SUBMISSION REQUIREMENTS

2422.04.01 Design Requirements

All poles shall be designed to support the required traffic signal and lighting system components and shall be according to CSA S6 and MTO Structural Manual. All poles shall be according to CSA S6 and AASHTO LTS-5-M for fatigue requirements, AASHTO Fatigue Importance Category 2.

2422.04.01.01 Wind Loading

Wind loading shall be based on the maximum wind pressure for Ontario according to CSA S6.

2422.04.01.02 Ice Loading

Ice loading shall be based on the maximum ice loading for Ontario according to CSA S6.

2422.04.01.03 Geometric Parameters

Latitude of design and fabrication details is at the discretion of the supplier and is subject to approval of the design by the Owner.

2422.04.01.04 Supported Load Parameters

Design calculations shall employ force and dimensions for various items of equipment to be mounted on the poles as shown in Table 1.

2422.04.01.05 Heavy Class Steel and Sectional Steel Pole

Heavy class steel and sectional steel poles used for traffic signal or combination traffic signal and lighting system shall be capable of bearing the loads associated with configurations shown in Table 2.

2422.04.01.06 Location of Equipment

Mast arms shall be to be solidly attached to the pole at a height above the pole base plate as given by:

$$H_A = 5{,}650 \text{ mm} - H$$

where: H_A = mast arm height above the pole base plate
H = mast arm height from Table 1

Where more than one mast arm is considered, the shorter arm shall be attached to the pole at a point 300 mm above that of the longer arm.

Pedestrian heads shall be mounted at a height of 2,750 mm above the pole base plate.

Luminaire brackets shall be mounted at a point 150 mm from the top of the pole.

2422.04.02 Submission Requirements

2422.04.02.01 Product Drawings

The heavy class steel and sectional steel pole manufacturer shall submit the product drawings and the design assumptions and calculations for the poles to the Contract Administrator.

As a minimum, the product drawings shall include the following information:

a) Material properties and standards.

b) Dimensions.

c) Hardware requirements.

d) Plans, elevations, sections, and details to show pole structural details.

e) Anchor bolt locations.

f) Welds.

g) Joining method for heavy class steel poles sections.

The product drawings and calculations shall bear the seals and signatures of the design and design-checking Engineers.

2422.04.02.02 Working Drawings

Working Drawings shall be prepared for the fabrication of heavy class steel and sectional steel poles.

Three sets of Working Drawings shall be submitted to the Contract Administrator at least 14 Days prior to the commencement of fabrication of the heavy class steel and sectional steel poles for information purposes only. An Engineer shall affix his or her seal and signature on the Working Drawings verifying that the Working Drawings are consistent with the Contract Documents and sound engineering practices.

Where multi-discipline engineering work is depicted on the same Working Drawing and a single Engineer is unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be signed and sealed by as many additional Engineers as necessary.

As a minimum, the Working Drawings shall include the following information:

a) Detailed dimensions.

b) Plans, elevations, sections, and details to show pole structural details.

c) Equipment layout.

d) Anchor bolt locations.

e) Exact pole weight.

f) Detailed bill of materials.

g) Details of equipment nameplates.

A copy of the Working Drawings shall be retained at the fabricator's plant during and after the heavy class steel and sectional steel pole fabrication.

2422.05 MATERIALS

2422.05.01 General

All steel used in the production of poles shall be according to CAN/CSA G40.21, Grade 300WT, for pole shafts, base plates, and gussets.

MATERIAL SPECIFICATION FOR STEEL POLES, BASE MOUNTED

TABLE OF CONTENTS

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 provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

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 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:

CSA Standards

G40.20-13/G40.21-13	General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
W59-13	Welded Steel Construction (Metal Arc Welding)

ASTM International

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

2423.04 DESIGN AND SUBMISSION REQUIREMENTS

2423.04.01 Submission Requirements

2423.04.01.01 Working Drawings

Working Drawings shall be prepared for the fabrication of steel poles.

Three (3) sets of Working Drawings shall be submitted 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.

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 and gussets.

All steel shall be galvanized according to ASTM A 123.

2423.07 PRODUCTION

2423.07.01 General

The length of the 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, the poles shall be galvanized.

Sweep shall not exceed 3.2 mm per 4.57 m, and the overall sweep shall not be greater than:

(Pole length (m) / 4.57 m) x 3.2 mm

The pole shall be supplied with a one-piece fabricated rolled steel base plate. The pole may be supplied as specified in the Contract Documents with a one-piece fabricated rolled steel plate without gussets.

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 No. 6 AWG wire 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 Owner shall be notified 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.

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

All galvanized steel shall be according to CSA G164.

All welding shall be according to CSA W59.

2422.07 PRODUCTION

2422.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

All welds, except for fillet welds, shall be ground smooth.

The pole base plate for any height of pole shall be made with mounting holes suitable for the anchor rod or anchorage assembly. The pole base plate shall be reinforced with four welded gussets equally spaced around the pole or with a welded collar or combination of both welded collar and gussets.

The underside of the anchor base shall be true, distortion free, and perpendicular to the centreline of the pole shaft after fabrication.

A waterproof, removable galvanized steel top cap shall be furnished with the pole. The cap shall blend with the general pole design to present a neat overall appearance. The cap shall be rigidly secured to the top of the pole by a hexagonal head stainless steel set screw.

Wiring apertures at the bracket mounting level and at the handhole shall be accurately positioned on the pole. The wiring apertures shall provide a smooth cable entrance.

For lighting applications, a wiring aperture, complete with rubber grommet, shall be provided.

Handholes, complete with covers, shall be reinforced with a steel handhole frame of such strength and cross-section that the strength of the pole is not reduced.

2422.07.02 Heavy Class Steel Poles

The poles, as specified in the Contract Documents, shall be round or octagonal in cross-section and shall taper uniformly inwards from the base for the height of the pole.

Poles shall have one or two longitudinal automatically electrically welded joints from top to bottom.

The maximum permitted number of circumferential (transverse) welded joints shall be as shown in Table 3.

The pole sections shall be joined by an electrical weld before galvanizing.

Sweep shall not exceed 3.2 mm per 4.57 m, and the overall sweep shall not be greater than:

(Pole height (m)/4.57 m) x 3.2 mm

In all cases, the base shall telescope the butt end of the pole and be secured with one continuous weld on the inside of the base at the end of the pole and another continuous weld on the outside at the top of the base. All welding at base shall be made in such a manner as to ensure that the welded connection shall develop the same strength of the adjacent pole section to resist any bending action.

2422.07.03 Heavy Class Sectional Steel Poles

The pole sections shall be of round tapered construction so that a number of sections may be assembled by means of an overlapping press fit to form a tapered steel pole of the height specified in the Contract Documents.

Each section shall have one longitudinal automatically electrically welded joint from top to bottom.

Each section shall be stencilled with O-L (nominal overlap requirement) and graduations in one-inch increments.

2422.07.04 Ground Bar

A ground bar with a bronze ground connector suitable for No. 6 AWG wire shall be welded to the inside of each pole. The bronze ground connector shall be attached to the ground bar before shipment.

2422.07.05 Marking

Each pole shall have identification marking located approximately 300 mm above the top of the handhole showing the following:

a) Manufacturer's name or trade mark.

b) Height of pole.

c) Gauge of steel.

d) Bolt circle diameter.

e) Designation OPSS 2422.

f) Date of manufacture (i.e., yyyy-mm-dd).

This marking shall be on a corrosion-resistant metal plate securely attached to the surface of the pole.

2422.07.06 Packaging and Shipping

Each pole shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity.

The Contract Administrator shall be notified of the shipping date 3 Business Days prior to delivery.

2422.08 QUALITY ASSURANCE

2422.08.01 Inspection

All work is subject to an inspection by the Contract Administrator prior to shipment.

The supplier shall notify the Contract Administrator of the date that the fabrication of the poles is to commence.

The Contract Administrator shall have free access to the place of fabrication of the poles for the purpose of inspecting and examining plant records and certificates while work on the poles is being performed; materials used; process of fabrication, including welding and galvanizing; and to make any tests as may be considered necessary.

2422.09 OWNER PURCHASE OF MATERIAL

2422.09.01 Working Drawings

Within 30 Days of receipt of a purchasing order to supply heavy class steel and sectional steel poles, the supplier shall submit 4 copies of pole Working Drawings, as described in the Submission Requirements subsection, to the Owner, for approval.

Working Drawings shall be given final approval by the Owner, if found to be acceptable, or shall be marked with deficiencies, if unacceptable.

Unacceptable drawings shall be returned to the supplier for correction. The supplier shall resubmit 4 copies of corrected Working Drawings within 14 Days. When the resubmitted drawings are acceptable to the Owner, they shall be given final approval.

One copy of the final approved drawings shall be returned to the supplier along with written notification to commence fabrication. Within 14 Days of receipt of the notification to commence fabrication, the supplier shall submit 4 copies of all final approved Working Drawings to the Owner.

Fabrication of the equipment shall not commence until the supplier has received final approved Working Drawings and written notification to commence fabrication from the Owner. All fabrication shall conform to the dimensions indicated on the final approved Working Drawings.

The supplier shall advise the Owner of the shipping date 3 Business Days prior to delivery.

2422.09.02 Measurement and Payment

For measurement purposes, a count shall be made of the number of heavy class steel and sectional steel poles supplied and accepted.

Payment at the price specified in the purchasing order shall be for the supply of the heavy class steel and sectional steel poles delivered to the destination on the date and time specified.

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

TABLE 1
Supported Load Parameters

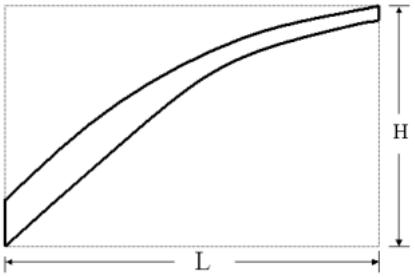
Item of Equipment	Dimensions mm	Projected Area m^2	Weight N
Roadway Lighting Luminaire (Ovuloid)	990 L x 380 H	0.22	107
Roadway Lighting Bracket (Aluminum)	2400 L x 1200 H (tapered)	0.15	112
Double Arm Brackets (Aluminum)	400 L x 42 Dia. (2 per set)	0.04	24
Mast Arm (Aluminum) 	610 L x 250 H (tapered)	0.04	78
	1200 L x 530 H (tapered)	0.10	91
	1800 L x 610 H (tapered)	0.15	114
	2400 L x 840 H (tapered)	0.19	65
	3000 L x 610 H (tapered)	0.23	94
	3600 L x 840 H (tapered)	0.38	113
	4600 L x 1070 H (tapered)	0.47	216
	5500 L x 910 H (tapered)	0.70	324
	6100 L x 1070 H (tapered)	0.79	307
	6700 L x 1150 H (tapered)	0.85	354
	7600 L x 1140 H (tapered)	1.10	504
Traffic Signal Heads (Aluminum: 4-Section)	1650 H x 610 W	1.01	123
Pedestrian Heads (Aluminum: 2-Section)	690 H x 345 W	0.23	78
Traffic Signs	Varies: see Table 2	1.50	23

TABLE 2
Heavy Class Steel and Sectional Steel Pole Configurations

Pole Height m	Luminaire and Bracket set	Longest Mast Arm with Head m	Maximum Mast Arm Total Length (Note 1) m	Number of Pedestrian Heads (Note 2)	Traffic Signs (Note 3) m^2
10.5	1	7.6	13.1	2	0.75
9.0	1	7.6	13.1	2	0.75
7.5	1	7.6	13.1	2	0.75
6.0	0	7.6	13.1	2	0.75

Notes:

1. Mast arm total length applies to the sum of the lengths of two mast arms at 90-degree orientation.

2. Two pedestrian heads at 90-degree orientation include a set of double arm brackets for each.

3. Traffic signs shall be split to give 0.25 m^2 mounted on the mast arm beside the signal head and 0.5 m^2 mounted at 2.75 m height above the pole base plate.

TABLE 3
Circumferential Welded Joints

Pole Height m	Maximum Number of Welds
6.0	1
7.5	1
9.0	1
10.5	2

Appendix 2422-A: November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

MATERIAL SPECIFICATION FOR HIGH PRESSURE SODIUM LUMINAIRES FOR UNDERPASS LIGHTING

TABLE OF CONTENTS

2434.01 SCOPE

This specification covers the requirements for underpass luminaires with integral ballast for use with 70 to 400 watt high pressure sodium lamps.

2434.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

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

2434.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

2434.02 REFERENCES

When the Contract Documents indicate that 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:

CSA Standards

C22.2 No. 89-15	Swimming-Pool Luminaires, Submersible Luminaires and Accessories
C863-16	Energy Efficiency of High-Intensity Discharge (HID) and Low-Pressure Sodium (LPS) Lamp Ballasts

ASTM International

B 117-11	Standard Practice for Operating Salt Spray (Fog) Apparatus
D 1654-08	Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

American National Standards Institute (ANSI)

C136.31-2010	Roadway and Area Lighting Equipment - Luminaire Vibration

International Electrotechnical Commission (IEC)

60598 (2014-05)	Luminaires
62262 (2002-02)	Degrees of Protection Provided by Enclosures for Electrical Equipment Against External Mechanical Impacts (IK code)

2434.04 DESIGN AND SUBMISSION REQUIREMENTS

2434.04.01 Submission Requirements

2434.04.01.01 Working Drawings

Three copies of Working Drawings shall be submitted to the Contract Administrator a minimum of 14 Days prior to the commencement of fabrication.

As a minimum, the Working Drawings shall include the following information:

a) All mechanical details, including dimensions, layouts, weights, shield details, and mounting arrangements for components.

b) All electrical details and certified test reports, including wiring diagrams and component ratings.

c) All photometric information and certified test reports regarding the luminaires, including, but not limited to lamp position, photometric data sheets, and photometric test reports.

d) Certified Test Reports for UL/CSA listing, IP rating, IK rating, and ANSI C136.31 vibration.

2434.04.01.02 Photometric Test Results

Photometric test results for the luminaires supplied shall be submitted to the Contract Administrator and include the following data:

a) Isolux curves and mounting height correction factors.

b) Utilization charts or graphs.

c) Candlepower distribution curves indicating peak intensity.

d) Luminous intensity tables to Illuminating Engineering Society format (I-tables).

e) Luminaire efficiency values.

f) Luminous outputs above and below horizontal.

g) Lamp lumen outputs and wattages.

2434.04.01.03 Luminaire Test Results

Certified test results for the luminaires supplied shall be submitted to the Contract Administrator and include the following data:

a) UL/CSA Listing Report according to CSA C22.2 No. 89.

b) Minimum IP65 Rating according to IEC 60598.

c) Minimum IK08 Rating according to IEC 62262.

d) 1.5G Vibration Test Report according to ANSI C136.31.

2434.05 MATERIALS

2434.05.01 Electrical Components

All electrical components and assembled luminaires shall be according to CSA C22.2 No. 89.

Ballasts, lamp sockets, ground connectors, internal wiring, and all other components shall be suitable for the supply voltage as specified in the Contract Documents and the maximum temperature encountered in totally enclosed, outdoor, weatherproof luminaires.

Ballasts shall be constant wattage auto-transformer or isolated secondary transformer type for grounded systems. Auto-transformer type ballasts shall have a maximum tolerance of 12% variation in lamp wattage for a 5% variation in line voltage. Isolated secondary transformer type ballasts shall have a maximum tolerance of 12% variation in lamp wattage for a 10% variation in line voltage.

Ballasts shall be Class H, 180 °C insulation; 60 hertz; and low temperature, -35 °C with a power factor not less than 0.90.

The minimum nominal secondary open circuit voltage of the ballast for various lamps shall be sufficient to provide reliable starting at -35 °C.

Ballasts shall be suitable for the lamp's nominal operating voltage. Terminal blocks shall be held rigidly and shall provide a positive connection for terminating the field wiring.

The current crest factor of the ballast shall not exceed 1.8 for high pressure sodium lamps.

Energy efficiency of lamp ballasts shall be according to CAN/CSA C863.

All wiring within fixture shall have a minimum temperature rating of 125 °C.

2434.05.02 Mechanical Components

The luminaire shall be comprised of a polycarbonate, aluminum, or stainless steel enclosure with a specular reflector and a glass prismatic refractor. Enclosure shall meet a scribe creepage rating of 7 according to ASTM D 1654, when tested for 5,000 hours according to ASTM B 117.

The luminaire shall be provided with a 20 mm threaded duct entry in each end of the enclosure and a cable entry hole in the rear of the enclosure together with a suitable waterproof gasket.

The luminaire shall have continuous captive gasket between the door and enclosure and between the refractor and the enclosure to provide a weatherproof seal.

All fixture hardware shall be Type 316 stainless steel and shall be captive. Proper dielectric insulation shall be provided between luminaire housing and fixture hardware of dissimilar metals, to prevent galvanic reaction.

The luminaire shall be provided with a ground terminal or lug for a single conductor #12 AWG stranded copper wire.

All unused cable and duct entry holes shall be plugged with approved filler caps.

The lamp socket shall be a porcelain-enclosed, nickel-plated brass shell rated for 4,000 volts, and spring-loaded centre contact. The lamp holder shall have an electrically insulated lamp stabilizer and shall hold the lamp's outer envelope to precise alignment with suitable means for vibration damping.

The refractor shall be heat-resistant and non-discolouring, with high resistance to breakage from thermal shock. It shall be securely attached to the housing by hinges and a safety device to hold it in the open position.

The reflector shall be fabricated of polished, chemically brightened, anodized aluminum not subject to distortion and shall be readily removable.

The luminaire shall be accessible with tool-less entry.

The luminaire shall not be subject to damage by vibration when closed and in the operating position.

2434.05.03 Marking

A permanent non-corrosive nameplate shall be attached to the exterior of the luminaire and located so that the marking is clearly visible after installation. The nameplate shall indicate the manufacturer's name or trademark, catalogue number, lamp wattage, and nominal voltage.

A permanent label shall be attached to the interior of the luminaire indicating the manufacturer's name or trademark, catalogue number, date of manufacture, and the American National Standards Institute (ANSI) or Illuminating Engineering Society (IES) photometric classification and distribution type; the suitable supply voltage and frequency; the lamp type; the lamp wattage; and the nominal operating voltage of the lamp so that it is clearly visible during maintenance operations.

A label including a wiring diagram shall be attached to each ballast showing the ballast schematic wiring diagram and shall be visible during maintenance operations.

For asymmetrical luminaires with adjustable optical systems, a permanent embossed identification mark shall be located on the luminaire that is clearly visible and identifiable as an orientation mark.

2434.07 PRODUCTION

2434.07.01 Ballast Assemblies

Ballast assemblies shall be factory pre-wired with all connections clearly marked and identified.

2434.07.02 Lamp Socket Positions

The lamp socket position shall be pre-set and legibly marked at the factory for the specified distribution.

2434.08 QUALITY ASSURANCE

2434.08.01 Inspection

The supplier shall notify the Contract Administrator of the date that the fabrication of the luminaires is to commence.

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

All luminaires are subject to an inspection by the Contract Administrator prior to shipment.

2434.09 OWNER PURCHASE OF MATERIAL

2434.09.01 Packaging and Shipment

The supplier shall provide 3 copies of the luminaire ballast engineering data and shielding data such as material type, gauge thickness, and mounting arrangement to the Owner.

Each luminaire shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity. A complete parts list shall be included in the shipment. All cartons shall be marked with the ANSI or IES luminaire classification and distribution types.

The supplier is responsible for loading, delivery, and off-loading of luminaires to designated areas. Luminaires shall be subject to inspection during and on completion of off-loading. If any damage to the luminaires is encountered during the inspection, the supplier shall be responsible for the necessary corrective measures subject to the approval of the Owner.

The supplier shall advise the Owner 3 Working Days prior to the shipping date of the intent to deliver and confirm that arrangements for off-loading have been made.

2434.09.02 Measurement and Payment

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

Payment at the price specified in the purchasing order shall be full compensation for the supply and delivery of the underpass lighting luminaires to the destination at the date and time specified.

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

Appendix D 2434-A, November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

MATERIAL SPECIFICATION FOR ANCHORAGE ASSEMBLY - HIGH MAST LIGHTING POLE

TABLE OF CONTENTS

2474.01 SCOPE

This specification covers the requirements of anchorage assemblies for the 25, 30, 35, 40, and 45 m base mounted sectional steel high mast lighting poles.

2474.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

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

2474.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

2474.02 REFERENCES

When the Contract Documents indicate that 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:

CSA Standards

G40.20-13/G40.21-13	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
W59-13	Welded Steel Construction (Metal Arc Welding)
W178.2-14	Certification of Welding Inspectors

ASTM International

A 153/A 153M-16	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 449-14	Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
A 563-15	Carbon and Alloy Steel Nuts

Canadian General Standards Board

48.9712-2014	Non-Destructive Testing - Qualification and Certification of NDT Personnel

2474.04 DESIGN AND SUBMISSION REQUIREMENTS

2474.04.01 Submission Requirements

2474.04.01.01 Working Drawings

Six sets of Working Drawings shall be submitted to the Contract Administrator a minimum 14 Days prior to the commencement of fabrication. An Engineer shall affix his or her seal and signature on the Working Drawings verifying that the drawings are consistent with the Contract Documents and sound engineering practices.

When multi-discipline engineering work is depicted on the same Working Drawing and a single Engineer is unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be signed and sealed by as many additional Engineers, as necessary.

As a minimum, the Working Drawings for anchorage assemblies shall include the following information:

a) Dimensioned drawings, including plans, elevations, sections of the anchor rods, nuts, top and bottom plates, and their exact weights.

b) Mill test certificates reports of all steel being used.

2474.05 MATERIALS

2474.05.01 Steel

Anchor rods shall be made of new billet steel round bar, quenched and tempered medium carbon steel, with a minimum yield strength of 517 MPa and a minimum tensile strength of 725 MPa, and shall satisfy Charpy V Notch test requirements of 20 joules at minus 30 °C.

The length, number, and size of the anchor rods shall be as specified in the Contract Documents.

Other general requirements shall be according to ASTM A 449 for anchor rods and ASTM A 563 for anchor rod nuts.

Anchor assembly top and bottom plates shall be made of PL10 x 100 mm according to CSA G40.20/G40.21, Grade 300W.

2474.05.02 Anchorage Setting Templates

The anchorage setting template shall be made of 20 mm thick plywood or hard wood or metal. Metal templates shall be a minimum of 12 gauge steel.

2474.07 PRODUCTION

2474.07.01 General

All fabrication shall be according to dimensions specified in the Working Drawings and as specified in the Contract Documents.

Anchorage assembly shall be supplied complete, as specified in the Contract Documents. Each assembly shall be supplied complete with anchor rods, hexagonal nuts, hardened steel washers, and steel top and bottom plates.

Each anchorage assembly shall be supplied with one anchorage setting template for positioning of the anchor rods to suit the required bolt circle diameter of the pole.

2474.07.02 Tolerance

Dimensions, threads, and hexagonal nuts tolerances shall be according to ASTM A 563, Grade DH. Exposed nuts are to be tapped oversized according to ASTM A 563 to allow for the thickness of the zinc coating on the rod threads.

2474.07.03 Welding

Hexagonal nuts shall be welded to the top and bottom plates according to CSA W59.

2474.07.04 Coating

The anchorage assembly shall be completely galvanized according to CAN/CSA G164M or ASTM A 153.

The exposed hexagonal nuts and washers shall be galvanized according to CAN/CSA G164M or ASTM A 153.

2474.07.05 Quality Control

Certification from the manufacturer shall be submitted to the Contract Administrator certifying that the anchorage assembly is according to the strength and material requirements as specified in the Contract Documents.

An inspector retained by the manufacturer shall inspect and test the anchorage assemblies. The inspector shall be certified for testing bridges according to CSA W178.2. The certification shall be either Level 2 or Level 3 for the methods used as specified in CAN/CGSB 48.9712.

The inspector shall inspect the place of manufacture of the anchorage assemblies while work on the units is being performed and shall inspect and examine the plant records and certificates, the materials used, and the fabrication process and shall conduct any tests as it may be considered necessary.

Two copies of the completed inspection report shall be submitted to the Contract Administrator. Inspection reports shall be completed and certified by the inspector.

When the anchorage assemblies have been delivered to the Working Area and prior to installation, the inspector shall inspect the anchorage assemblies to ensure that they meet all the Contract requirements.

2474.07.06 Testing

Visual inspection of the anchorage assemblies shall be performed by welding inspectors certified by the Canadian Welding Bureau under CSA W178.2 at a Level 3 category or working under a Level 2 inspector.

2474.07.07 Packaging and Shipment

Each anchorage assembly shall be shipped complete with hardware suitably packaged to ensure that all parts are delivered as an entity. A complete parts list shall be included in the shipment.

The supplier shall be responsible for loading, delivery, and off-loading of the anchorage assemblies to the designated areas. Anchorage assemblies shall be subject to inspection during and on completion of off-loading. If any damage is encountered during the off-loading inspection, the supplier shall be responsible for the necessary corrective measures subject to the approval of the Owner.

2474.08 QUALITY ASSURANCE

2474.08.01 Welding

All welding shall be subject to a visual inspection. Procedures and techniques for visual testing shall be according to CSA W59, Clause 7 and 8.

If faulty welding or material is encountered during the inspection procedures, the manufacturer shall submit corrective measures to the Contract Administrator for approval.

2474.08.02 Inspection

The Contract Administrator shall be notified a minimum of 3 Business Days prior to the start of fabrication, testing, and delivery.

The Contract Administrator shall have free access to the place of manufacture of the anchorage assemblies for the purpose of inspecting and examining plant records and certificates; materials used; process of manufacturing, including welding and galvanizing; and to make any tests as may be considered necessary, while the anchorage assembly is being fabricated.

All anchorage assemblies may be subject to an inspection by the Contract Administrator prior to shipment.

2474.09 OWNER PURCHASE OF MATERIAL

2474.09.01 Measurement and Payment

For measurement purposes, a count shall be made of the number of anchorage assemblies supplied and accepted.

Payment at the price specified in the purchasing order shall be for the supply of the anchorage assemblies delivered to the destination on the date and time specified.

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

Appendix 2474-A, November 2016
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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

Designer Action/Considerations

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

MATERIAL SPECIFICATION FOR UNINTERRUPTIBLE POWER SUPPLY SYSTEMS FOR LED TRAFFIC SIGNALS

TABLE OF CONTENTS

2475.01 SCOPE

This specification covers the requirements for uninterruptible power supply (UPS) systems for traffic signals utilizing light emitting diode (LED) modules.

2475.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

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

2475.01.02 Appendices Significance and Use

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

Appendices are developed for the Owner's use only.

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

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

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

2475.02 REFERENCES

When the Contract Documents indicate that 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:

CSA Standards

C22.1-15	Canadian Electrical Code
C22.2 No. 94-M91 (R2001)	Special Purpose Enclosures

Electrical Safety Authority

Ontario Electrical Safety Code

National Electrical Manufacturer's Association

TS 2-2016 Traffic Controller Assemblies with NTCIP Requirements Version 03.07

2475.03 DEFINITIONS

AGM VRLA Battery means a sealed battery using absorbed glass mat and valve regulated lead acid technology.

CSA Enclosure Type 3 means an enclosure for either indoor or outdoor use, constructed so as to provide a degree of protection against rain, snow, and windblown dust, undamaged by the external formation of ice on the enclosure.

Gel Cell Battery means a sealed battery containing acid in a gel form.

2475.04 DESIGN AND SUBMISSION REQUIREMENTS

2475.04.01 Design Requirements

Each UPS system shall be designed for the traffic signal controller cabinet and equipment to which the UPS system will be connected. A comprehensive and detailed wiring diagram for each UPS system shall be designed and documented. The wiring diagram shall clearly indicate all UPS system wiring and connections, and shall clearly indicate all wiring and connections between the UPS system and the traffic signal controller cabinet and equipment.

2475.04.02 Submission Requirements

Prior to the installation of the UPS system, three copies of a comprehensive and detailed wiring diagram for each UPS system at each traffic control signal shall be submitted to the Contract Administrator.

2475.05 MATERIALS

2475.05.01 General

The UPS system shall provide uninterruptible power and conditioning of the utility power required for the operation of all electronic equipment used to operate the traffic control signals in the event of main utility power supply failure or voltage or frequency fluctuations.

The UPS system shall be supplied complete with UPS automatic switch.

The UPS control unit shall be a line interactive or double conversion type with automatic voltage regulation for 120V, 60Hz, single phase.

The UPS system shall include all wiring necessary to interconnect the UPS control unit to the power source and to the traffic signal control components.

The UPS control unit must latch from line to battery and from battery to line (transfer time) in less than 60 milliseconds.

When installed at a traffic signal using LED signal lamps, the UPS system shall be capable of maintaining full signal display operation for a minimum of 4 hours after which it shall be capable of maintaining a flashing signal display for a further 6 hours minimum.

Switching from full operation to a flashing operation may be determined by a timer circuit or based on battery capacity.

If the UPS control unit or the batteries fail, the system shall automatically switch back to utility line power.

If line power is restored during flashing operation, the traffic control signals shall commence the start-up sequence specified in the traffic control signals' timing sheet.

The UPS cabinet shall be supplied complete with pedestal or pole mounting hardware as indicated in the Contract Documents.

The battery installation and wiring to the batteries shall be according to Ontario Electrical Safety Code.

The UPS system components shall operate properly for the time periods specified above under the following conditions:

a) Ambient temperature -37 °C to +74 °C

b) Humidity: 5 percent to 95 percent

c) The UPS system components shall withstand shock and vibration according to NEMA TS 2.

2475.05.02 UPS Cabinet

The cabinet shall be approved according to the Ontario Electrical Safety Code.

The UPS cabinet shall be a CSA Enclosure Type 3 cabinet constructed of aluminum and shall be painted grey. The cabinet shall be fabricated using sheet aluminum 3.17 mm thick and adequately reinforced by welded aluminum members.

The dimensions and details of the UPS cabinet shall be according to the Contract Documents.

The cabinet shall have one door hinged on one side with a continuous stainless steel piano hinge.

The door shall use a latch and lock mechanism. The door handle shall be zinc coated and painted the same colour as the cabinet.

The opening in the UPS cabinet shall allow full access to UPS components housed in the cabinet.

The cabinet shall be vented according to the Ontario Electrical Safety Code.

The circuit providing power to the battery heating mats shall be thermostat controlled and the thermostat shall be located in the UPS cabinet.

2475.05.03 Batteries

Batteries shall be AGM VRLA or gel cell technology.

Battery leads to UPS control unit shall be of suitable length and not less than 2.5 metres.

Each battery shall be placed on its own heater mat with all heater mats being supplied with AC power by the UPS control unit.

Battery mats shall become inoperable with loss of line voltage.

The batteries shall be protected by a circuit breaker or a fuse.

Each battery shall be labelled with the date of manufacture. The label shall be at a visible location on the top of the battery.

In addition to any other warranty, the Contractor shall provide a 3 year warranty on the batteries. The warranty period for each battery shall be 3 years, commencing from the date of “switch on” for operation of the UPS system in which the batteries are used. Any defective battery shall be replaced within 30 days. The warranty shall include all labour, Equipment, and Materials required to replace the batteries, including traffic control and all removal and disposal work. The Contractor shall be responsible for the removal and disposal of any defective batteries replaced under warranty. The Owner shall be the sole judge in determining if a battery is defective.

2475.05.04 UPS Control Unit

The UPS control unit shall be rack mountable with the following maximum dimensions: width of 483 mm (19-inch), depth of 254 mm (10 inches), and height of 153 mm (6 inches).

The front face of the control unit shall have indicators capable of displaying the following:

a) Number of times the system was on battery supply

b) Total time on battery supply

c) Battery charge status to indicate the battery capacity

Each of the battery supply indicators listed above shall have a manual reset switch.

The UPS control unit shall have a minimum of one standard 120V grounded socket located on either the back or the front panel.

The UPS control unit shall contain over-current protection located on the front panel to switch power on/off from the batteries and to switch AC input and output power on/off.

The UPS control unit shall have a self-test feature to test the UPS automatic switch and the control circuitry.

The UPS control unit shall have an open collector output or an AC or DC contact closure to indicate when the traffic signal is operating on battery supply.

The UPS control unit shall have an open collector output or an AC or DC contact closure to indicate low battery alarm.

The UPS control unit shall have a minimum of 1 switched AC output that will switch on when the traffic signal has been on battery supply continuously for 4 hours.

A 9 pin male serial port and/or Ethernet port shall be located on the front panel to allow for communication to a laptop computer for changing software settings. The Ethernet port shall support dynamic host configuration protocol (DHCP).

A set of battery voltage test points, or a readout indicating battery voltage condition shall be located on the front panel.

2475.05.05 UPS Automatic Switch

The UPS automatic switch shall allow the UPS control unit to be removed for replacement or maintenance without turning off the traffic signal system.

The utility line power shall be connected to the input of the automatic switch. Under normal operating conditions the automatic switch shall connect the utility line power to the UPS control unit. In the event that the UPS control unit is not present or does not function, the automatic switch shall automatically connect the utility line power directly to the traffic signal system, bypassing the UPS control unit.

2475.05.06 Power Conditioning and the Use of Batteries by the UPS

Under normal operating conditions the utility line power shall flow through the UPS control unit to the traffic signal system and any other connected loads.

When the utility line power is within the operating parameters specified by the UPS manufacturer and the Contract Documents the UPS control unit shall condition and deliver the power to the loads without drawing power from the batteries.

When the utility line power is not within the operating parameters specified by the UPS manufacturer and the Contract Documents the UPS control unit shall condition and deliver the power to the loads by drawing power from the batteries as required.

2475.05.07 Electrical

The UPS system shall accept an AC voltage input range of 85 to 135 VAC, single phase, 2 wire plus ground without drawing on battery power.

The UPS system shall provide voltage regulation at 120 VAC ± 3 percent under any line, load or battery conditions other than “low battery”, and a frequency regulation of 60 Hz ± 3 Hz synchronized to the utility line power.

Power rating shall be a minimum of 1000 VA (700W). The UPS system shall provide pure sine wave output, computer grade power compatible with all equipment loads, with power factor correction.

The UPS system shall include full time protection from sudden voltage increase with inrush protection and AC line filtering.

The UPS system shall provide complete isolation from the line operating as a separately derived power source according to Section 10, Grounding and Bonding, CSA C22.1.

The direct current (DC) system of the UPS system shall have a nominal DC system voltage of 60 VDC or less. The UPS DC system short circuit current shall not exceed 5000 A.

2475.07 PRODUCTION

All wires and leads shall be tied and secured within the UPS cabinet prior to delivery.