CONSTRUCTION SPECIFICATION FOR METAL TRAFFIC BARRIERS AND METAL RAILINGS FOR STRUCTURES

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908.01 SCOPE

This specification covers the requirements for metal traffic barriers and metal railings for structures including posts and anchors.

908.01.01 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.

908.01.02 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.

908.02 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 906	Structural Steel
OPSS 911	Coating for Structural Steel Systems

Ontario Ministry of Transportation Publications

Designated Source for Materials (DSM)

CSA Standards

G40.20/G40.21-04 (R2009)	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels
O80-Series 08	Wood Preservation
W47.1-03 (R2008)	Certification of Companies for Fusion Welding of Steel
W47.2-M1987 (R2008)	Certification of Companies for Fusion Welding of Aluminum
W59.2-M1991 (R2008)	Welded Aluminum Construction
S6-06	Canadian Highway Bridge Design Code

ASTM International

A 27/A27M-13	Specification for Steel Castings, Carbon, for General Application
A 108-13	Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
A 123/A123M-12	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A 143/A143M-12	Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
A 153/A153M-12	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 307-12	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
A 314-13a	Specification for Stainless Steel Billets and Bars for Forging
A 325M-13	Standard Specification for Structural Steel Bolts, Steel, Heat Treated 830MPa Minimum Tensile Strength [Metric\
A 563 - 07a (2014)	Standard Specification for Carbon and Alloy Steel Nuts
A 780/A780M-09	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
B 108/B108M-12e1	Specification for Aluminum-Alloy Pavement Mold Castings
B 117-11	Standard Practice for Operating Salt Spray (Fog) Apparatus
B 209-10	Specification for Aluminum and Aluminum-Alloy Sheet and Plate
B 221-12	Aluminum and Aluminum-Alloy Extruded bars, Red, Wire, Shapes and Tubes
B 695-09	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
D 4541-09	Test Methods for Pull-Off Strength of Coatings Using Portable Adhesion Testers
F 844 - 07a (2013)	Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use

The Society for Protective Coatings (SSPC)

SP 8-2004 Pickling

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.

908.03 DEFINITIONS

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

Barrier Wall Railing means a metal railing that is fastened to the top of a concrete barrier wall and is part of a barrier system that has undergone the barrier appraisal requirements of CAN/CSA-S6.

Bicycle Railing means an all-metal barrier system mounted on a structure that has been designed to meet the bicycle barrier requirements of CAN/CSA-S6.

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Metal Traffic Barrier means an all-metal traffic barrier system mounted on a structure that has undergone the barrier appraisal requirements of CAN/CSA-S6.

Parapet Wall Railing means a metal railing that is fastened to the top of a concrete parapet wall and is part of a barrier system that has undergone the barrier appraisal requirements of CAN/CSA-S6.

Pedestrian Railing means an all-metal barrier system mounted on a structure that has been designed to meet the pedestrian barrier requirements of CAN/CSA-S6.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Railing means a general or generic term for railing and includes barrier wall railing, pedestrian railing, bicycle railing, parapet wall railing, or metal traffic barrier.

908.04 DESIGN AND SUBMISSION REQUIREMENTS

908.04.01 Submission Requirements

908.04.01.01 General

The Contractor shall submit 3 sets of Working Drawings to the Contract Administrator, prior to commencement of fabrication of the railings, for information purposes only. Prior to a submission, an Engineer's seal and signature shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

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 sealed and signed by as many additional Engineers as necessary.

The manufacturer shall not commence fabrication of the railing or the metal traffic barrier until receiving a sealed and signed copy of the Working Drawings. A copy of these drawings shall be retained at the manufacturing plant during the railing fabrication.

The Contractor shall have a sealed and signed copy of the railing Working Drawings at the site prior to and during installation of the railing.

908.04.01.02 Interim Inspection After Fabrication of Railing and Metal Traffic Barrier

Upon completion of fabrication, the Quality Verification Engineer shall conduct an interim inspection of the work to verify that the fabrication of the railing or the metal traffic barrier or both has been carried out according to the Working Drawings and as specified in the Contract Documents, and issue written permission to proceed with the delivery.

908.04.01.03 Test Reports for Fasteners and Anchorages

Proof that the bolts, anchorages, nuts, and washers meet the chemical composition, mechanical properties, dimensions, workmanship, and head burst as specified in the Contract Documents shall be submitted to the Contract Administrator. Verification of the acceptability of assemblage of zinc-coated bolts, anchors, nuts, and washers delivered to the job site shall be submitted to the Contract Administrator.

For bolts, anchors, nuts, and washers supplied from a manufacturer outside of Canada or the United States of America, the above information shall be verified by testing at a Canadian laboratory as specified in the Mill Test Certificates clause of OPSS 906.

908.05 MATERIALS

908.05.01 Metal Traffic Barrier

Materials shall be according to the barrier as specified in the Contract Documents.

908.05.02 Barrier Wall Railing, Parapet Wall Railing, Pedestrian Railing, and Bicycle Railing

908.05.02.01 Steel Railing and Steel Posts

Steel shall be according to CSA G40.20/G40.21.

Rails and posts shall be Grade 350W or 350WT as specified in the Contract Documents.

Steel plate shall be Grade 300W or 350W as specified in the Contract Documents.

Galvanized bolts and nuts shall be according to ASTM A 307 or ASTM A 325M as specified in the Contract Documents.

Studs shall be according to ASTM A 108. Lock nuts shall be according to ASTM A 563. Washers shall be according to ASTM F 844.

Cast steel posts shall be according to ASTM A 27, Grade 65-35.

Paint shall be as specified in the Contract Documents.

908.05.02.02 Aluminum Railing and Aluminum Posts

Extruded aluminum tubing shall be 6061-T6 or 6351-T6 alloy according to ASTM B 221M.

Aluminum sheet and plate shall be 6061-T6 alloy according to ASTM B 209M.

Cast Posts shall be A444.0-T4 heat-treated according to ASTM B 108. Extruded posts shall be 6061-T6 or 6531-T6.

908.05.02.03 Stainless Steel Fasteners

Bolts, set screws, nuts, and washers shall be Type 304 stainless steel according to ASTM A 314.

908.05.02.04 Hardware - Galvanized

L-bolt assemblies shall be according to ASTM A 307 and include hex nuts, flat washers, and lock washers. The assemblies shall be galvanized according to ASTM A153/A153M.

908.05.03 Anchorage Assembly

Anchorage assemblies shall be as specified in the Contract Documents.

The anchorage assembly shall be supplied with the bolts installed in a template.

908.05.04 Grout

Grout shall be non-staining, non-shrink cement based grout or non-staining, non-shrink epoxy based grout, and as specified in the Contract Documents.

908.05.05 Hot Dip Galvanizing

Purity of the zinc and the galvanizing bath composition for hot dip galvanizing of railing and metal traffic barrier components shall be according to ASTM A 123/A 123M.

908.05.06 Zinc-Rich Touch-Up Paint

Zinc-rich touch-up paint shall be according to the ministry's DSM.

908.05.07 Thermal Sprayed Metal Coatings

The metallizing wire for thermal metal spray coatings shall be an alloy consisting of 85% zinc and 15% aluminum.

908.05.08 Zinc-Tin-Copper Solder

The zinc-tin-copper solder shall be 50% zinc, 49% tin, and 1% copper used with the manufacturer's recommended flux.

908.07 CONSTRUCTION

908.07.01 General

Railing and metal traffic barrier components shall be protected from damage and distortion during hot dip galvanizing, handling, transportation, storage, and installation.

Bedding grout shall not be used. Epoxy grout may be placed under post bases, as necessary, to fill the voids. The epoxy grout shall not have a thickness exceeding 3 mm. The surface preparation, mixing, installation, and curing time for the epoxy grout shall be according to the manufacturer's recommendations.

The work shall include installation of the anchorage assemblies installed after concrete placement or installed in wood.

908.07.02 Alignment

The railing and metal traffic barriers shall be installed to the elevations and alignments as specified in the Contract Documents within a tolerance of $\pm$ 6 mm and with no kinks or other visible breaks in alignment throughout the length of the installation.

908.07.03 Anchorages

908.07.03.01 General

Anchorage assemblies shall be installed as specified in the Contract Documents.

908.07.03.02 Anchorages Installed Before Concrete Placement

When specified in the Contract Documents, anchorage components shall be installed prior to placing concrete and shall be securely tied to reinforcing steel. Anchorage assemblies shall be positioned with templates and installed securely in the formwork to maintain the position of the anchors during placement of concrete.

908.07.03.03 Anchorages Installed After Concrete Placement

When specified in the Contract Documents, anchorages shall be installed after concrete placement. Holes shall be core drilled, anchoring grout placed, and anchors properly positioned at locations as specified in the Contract Documents. The placement of the anchoring agent and the anchors shall be according to the manufacturer's recommendations, except as modified herein. The holes shall be free of dust and debris immediately prior to placement of the anchoring agent. When the anchoring agent fails to fill the hole after insertion of the anchor, additional anchoring agent shall be immediately added to fill the hole.

When a cement based grout is used as the anchoring agent, the holes shall be pre-dampened for a period of 1 hour and any free water shall be removed prior to the application of the cement based grout.

When an epoxy grout is specified as the anchoring agent, the inside surface of the holes shall be roughened and dry prior to the application of the epoxy grout.

Where anchors are inserted into horizontal or inclined holes in a vertical face, the anchors shall be maintained in position during the setting of the anchoring agent. Loss of anchoring agent from the holes shall be prevented.

908.07.03.04 Anchorages Installed in Timber

Holes for bolts shall be drilled with a bit 1.5 mm larger in diameter than the bolt. The diameter of the recessed holes for the bolt heads shall be no greater than 10 mm larger than the width of the bolt head.

Where oil treatment has been used on the wooden curbing, the cut surfaces of the wood shall be given three coats of creosote oil. Each coat shall be allowed to dry before the next coat is applied.

Repairs to cuts in material treated with water-borne preservatives shall be according to CSA O80 Series.

908.07.04 Fabrication of Railings and Metal Traffic Barriers

908.07.04.01 General

The railing system and metal traffic barrier components shall be fabricated according to the details specified in the Working Drawings. Field modification shall only be done when approved by the Contract Administrator.

When welding is required, the fabricator shall be certified according to Division 2.1 of CSA W47.1 for steel railings or CSA W47.2 for aluminum railings.

908.07.04.02 Steel Components

908.07.04.02.01 Fabrication

908.07.04.02.01.01 General

Fabrication and welding shall be according to OPSS 906.

All flame cut edges shall be as smooth and regular as those produced by edge planing and shall be free of slag.

908.07.04.02.02 Surface Preparation for Hot Dip Galvanizing

The railing and metal traffic barrier components shall be cleaned to the requirements of SSPC-SP 8 prior to galvanizing. The length of time that the components are immersed in the pickling solution shall be kept to an absolute minimum to achieve the specified surface preparation condition, prior to hot dip galvanizing. The galvanizer shall employ proper pickling and galvanizing procedures as precautionary measures to safeguard against embrittlement as specified in ASTM A 143/A 143M.

908.07.04.02.03 Hot Dip Galvanizing

Hot dipped galvanizing of railings and metal traffic components shall be according to ASTM A 123/A 123M. Hot dip galvanizing of structural bolts and steel hardware that are to be centrifuged or otherwise handled to remove excess zinc shall be according to ASTM A 153/A 153M.

908.07.04.02.04 Zinc and Zinc-Nickel Plating

Setscrews shall have zinc-nickel plating applied to a thickness of 10 µm. The plating shall show no red rust after 1,000-hour exposure to salt spray according to ASTM B 117.

Lock nuts shall be zinc plated according to ASTM B 695.

908.07.04.02.05 Paint Coating of Galvanized Surfaces

Where specified, paint coating of galvanized surfaces shall be according to OPSS 911.

908.07.04.02.06 Repair of Damage to Galvanized Coating

When the galvanized surface of a railing or metal traffic barrier component is damaged or uncoated, the exposed steel shall be repaired if the cumulative total of the damaged and uncoated areas does not exceed 2% of the total area of each component or 0.02 m^2, whichever is less. Where the cumulative area exceeds these amounts, the damaged coating shall be stripped and the component re-galvanized according to ASTM A 123/A 123M.

Damaged and uncoated areas shall be cleaned of all rust and other contaminants and repaired using one of the following methods:

a) Soldering method using zinc-tin-copper solder

   The surface preparation and application of thermal spray metal coating or metallizing shall be done according to SSPC-CS 23.00 / AWS C2.23M/NACE No.12 to provide a minimum thickness of 200 µm, applied in two separate coats.

   The finished thickness of the metal coating in the repaired area shall be a minimum of 90 µm. The repaired surface shall be ground flush with the surrounding galvanized coating.

b) Metallizing

   The surface preparation and application of thermal spray metal coating or metallizing shall be done according to CSA G189 to provide a minimum thickness of 100 µm, applied in two separate coats.

   The metal coating on the repaired areas shall have a minimum adhesion of 2.8 MPa, when tested according to ASTM D 4541.

c) Zinc-Rich Touch-Up Paint

This method of repair of galvanized coating is permitted when:

i. The individual damaged and uncoated area is less than 625 mm^2, and

ii. The number of repair spots does not exceed 6 per each 12 m section of galvanized rail bar or metal traffic barrier. The number of repair spots in each galvanized rail post shall be limited to a maximum of 2.

Two coats of one of the approved zinc-rich touch-up paint shall be brush applied after the surface preparation according to ASTM A 780/A 780M.

908.07.04.03 Aluminum Components

Aluminum railings and posts shall be thoroughly cleaned of all discolourations by approved methods and all marks and scratches shall be removed. The railings, when erected, shall have a clean degreased aluminum surface of uniform appearance and texture.

Railing components shall be joined by riveting, bolting, expanding, or welding as specified in the Working Drawings. Special aluminum alloy fasteners shall only be used with written approval from the Contract Administrator.

When tubular balusters are fastened to the horizontal rails by expanding the tubes, the holes drilled into the rail shall not be more than 1 mm greater than the nominal diameter of the baluster tube. A standard self-feeding tapered roll expander shall be used to expand the balusters to allow for a tight fit in all rails.

Sheet or plate material may be sheared, sawn, or cut with a router; however, sheet or plate materials more than 10 mm thick shall only be sawn or routed. Cut edges shall be true and smooth, free from excessive burrs and ragged edges.

Re-entrant cuts shall only be used when unavoidable and, when they are used, a fillet shall be provided by drilling prior to cutting.

Aluminum alloys shall not be flame cut.

Boltholes in 10 mm or thinner material may be drilled or punched to finished size. In material thicker than 10 mm, the holes shall be drilled to finished size or sub-punched smaller than the nominal diameter of the fastener and reamed to size.

During fit-up, holes shall not be drifted in such a manner as to distort the metal, but holes misaligned less than 2 mm may be reamed to render a reasonable fit.

The shank of bolts shall be long enough to provide full bearing in the connection and, where the shank extends beyond the surface being clamped, washers shall be used under the nuts to ensure proper clamping.

Welding of aluminum shall be permitted only where specified in the Working Drawings.

Inert Gas Shielded Arc (GSA) processes and the quality of the welding shall be according to CSA W59.2-M.

908.07.05 Contact Surfaces

Where aluminum would otherwise come in contact with other metal surfaces, the contacting surfaces shall be separated from each other by use of a synthetic rubber or neoprene gasket. The single rail and double rail galvanized steel railings mounted on aluminum casting posts on top of a barrier wall or parapet wall are exempt from these requirements.

Where aluminum would otherwise come in contact with concrete, wood, or masonry, the contact surfaces shall be separated by means of a synthetic rubber or neoprene gasket or the aluminum surface shall be given a heavy coat of alkali-resistant bituminous paint prior to installation. The paint shall be applied as it is received from the manufacturer without the addition of thinner.

908.07.06 Quality Control

908.07.06.01 Certificate of Conformance

A completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Qualification Verification Engineer's seal and signature shall be affixed on the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:

a) Materials

b) Fabrication

c) Installation and adjustments

908.07.07 Management of Excess Material

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

908.09 MEASUREMENT FOR PAYMENT

908.09.01 Actual Measurement

908.09.01.01 Metal Traffic Barrier
Barrier Wall Railing
Parapet Wall Railing
Pedestrian Railing
Bicycle Railing

Measurement of railing shall be by length in metres from end to end of railing.

908.09.02 Plan Quantity Measurement

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

908.10 BASIS OF PAYMENT

908.10.01 Metal Traffic Barrier - Item
Barrier Wall Railing - Item
Parapet Wall Railing - Item
Pedestrian Railing - Item
Bicycle Railing - Item

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

Appendix 908-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.