



**CONSTRUCTION SPECIFICATION FOR
GUIDE RAIL END TREATMENT
CRASH-CUSHION ATTENUATING TERMINAL SYSTEM**

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731.01 SCOPE

This specification covers the requirements for the installation of the guide rail end treatment known as the Crash-Cushion Attenuating Terminal (CAT) system.

731.01.01 Specification Significance and Use

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

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

731.01.02 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.

731.02 REFERENCES

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

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

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

Ontario Provincial Standard Specifications, Construction

OPSS 510 Removal

Ontario Provincial Standard Specifications, Material

OPSS 1601 Wood, Preservative Treatment, and Shop Fabrication

Ontario Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 6 - Warning Signs

CSA Standards

G4-00 (R2006)	Steel Wire Rope for General Purpose and for Mine Hoisting and Mine Haulage
G40.20-04/G40.21-04	Rolled or Welded Structural Quality Steels
G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
W47.1-03	Certification of Companies for Fusion Welding of Steel Structures
W59-03	Welded Steel Construction (Metal Arc Welding)

ASTM International

A 307-07	Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
A 449-07	Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
A 576-90b (2006)	Steel Bars, Carbon, Hot-Wrought, Special Quality
A 741-98 (2003)	Zinc-Coated Steel Wire Rope and Fittings for Highway Guardrail
A 780-01 (2006)	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

731.04 DESIGN AND SUBMISSION REQUIREMENTS

731.04.01 Submission Requirements

One copy of the manufacturer's installation instructions shall be submitted to the Contract Administrator.

Installation of the CAT system shall not commence until the Contract Administrator has received the copy of the instructions.

731.05 MATERIALS

731.05.01 General

All supplied system components shall be according to the manufacturer's specifications.

731.05.02 Cable Anchor Assembly

Swaged fittings shall be machined from hot rolled carbon steel according to ASTM A 576, Grade 1035, and annealed suitable for cold swaging. Swaged fittings shall be galvanized according to CSA G164 prior to swaging.

Studs shall be according to ASTM A 449 and galvanized according to CSA G164. The threads shall have a Class 2A fit prior to galvanizing.

Cables shall be zinc coated steel wire rope according to ASTM A 741. The cable shall be 19.0 mm diameter, preformed, 6 x 19 wire strand core or independent wire rope core, Type II construction, Class A galvanized, right regular lay, and manufactured with improved plough steel. Steel shall be according to CSA G4, Grade 110/120, and have a minimum breaking strength of 190 kN.

Strength of the assembled swaged fitting, stud, and nuts shall match the breaking strength of the wire rope.

731.05.03 Wooden Posts and Blocks

Wooden posts and blocks shall be according to OPSS 1601.

731.05.04 Object Marker Posts

Object marker posts shall be 2.44 m long perforated steel U channel with 11 mm diameter holes at 50 mm c/c, minimum weight of 4.46 kg/m, and hot dip galvanized according to CSA G164.

731.05.05 Miscellaneous Steel Components

Miscellaneous steel components such as steel foundation tubes, restraint rods, channel struts, cable attachments, bearing plates, soil plates, plate washers, and spacer channels shall be medium structural steel according to CAN/CSA G40.21, Grade 260W, and shall be hot dip galvanized after fabrication according to CSA G164.

Bolt holes in miscellaneous components shall be flush to the surface and shall not deviate by more than 1.0 mm in any direction from the location specified in the Contract Documents. Cut edges shall not deviate from their specified location by more than 0.5 mm and length by more than 25 mm.

All welding shall be according to CSA W59 and CSA W47.1.

731.05.06 Bolts, Nuts, and Washers

Bolts, nuts, and washers shall be according to ASTM A 307 and hot dip galvanized according to CSA G164.

731.07 CONSTRUCTION

731.07.01 General

CAT systems shall be installed according to manufacturer's instructions at locations specified in the Contract Documents.

The CAT system shall be installed in a straight line.

731.07.02 Wooden Posts and Steel Foundation Tubes

Wooden posts and steel foundation tubes shall be set to the depth and alignment at the locations specified in the Contract Documents regardless of the material encountered. Permissible tolerance for plumb shall be 20 mm maximum over the post length above ground.

Wooden post tops shall be cut to the height and to the chamfer specified in the Contract Documents.

All holes shall be drilled in the wooden posts prior to installation.

Predrilled holes and cut tops of the wooden posts shall be treated with two coats of an approved wood preservative according to OPSS 1601.

All steel foundation tubes and soil plates shall be installed such that no more than 100 mm is exposed above finished grade at any location.

731.07.03 Steel Beam Guide Rails

CAT systems shall be connected to new or existing steel beam guide rail, structures, or concrete transition walls by installing the appropriate steel beam guide rail in these transition areas as specified in the Contract Documents.

CAT system mounting heights shall be measured vertically from the top of the steel beam guide rail. CAT system mounting heights shall be 685 to 735 mm during construction and upon completion of the work.

Where curb with gutter is required, steel beam guide rail mounting heights shall be measured:

- a) Vertically at face of steel beam guide rail, when face of steel beam guide rail is more than 300 mm beyond the gutter line.
- b) Vertically at the gutter line, when face of steel beam guide rail is 300 mm or less beyond the gutter line.

731.07.04 Damage to Galvanizing

Precautions shall be taken to protect galvanizing against damage. Minor abrasions (e.g., a single strip of damage area not wider than 30 mm throughout the length of the steel beam guide rail element) shall be repaired according to ASTM A 780.

The method of repair for any damage shall be approved by the Contract Administrator prior to the commencement of such work.

731.07.05 Object Markers

When specified in the Contract Documents, an object marker, according to OTM Book 6, and an oversize plow marker, as specified in the Contract Documents, shall be installed at each CAT system installation. The markers shall be installed and located as specified in the Contract Documents.

731.07.06 Temporary Crash-Cushion Attenuating Terminal System

The work shall include the installation and removal of steel foundation tubes, wooden posts, offset blocks, and all miscellaneous hardware for the temporary CAT. The pavement structure shall be restored to its existing condition, including replacement of granular, asphalt, and concrete.

Steel soil plates are required when the steel foundation tubes are installed in a granular or earth surface but are not required when steel foundation tubes are installed in asphalt, concrete, or composite pavement structure.

Removal of the temporary CAT and guide rail in the transition areas shall be according to OPSS 510.

731.07.07 Temporary Crash-Cushion Attenuating Terminal System, Relocation

The work shall include the dismantling, transportation, and re-installation of the temporary CAT system and the guide rail in the transition areas from its installed location to another site and removal of the temporary CAT and associated guide rail in transition areas from the Working Area upon completion of the work.

731.07.08 Management of Excess Material

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

731.09 MEASUREMENT FOR PAYMENT

731.09.01 Actual Measurement

731.09.01.01 Crash-Cushion Attenuating Terminal System

For measurement purposes, a count shall be made of the number of each complete Crash-Cushion Attenuating Terminal system installed.

731.09.01.02 Crash-Cushion Attenuating Terminal System, Temporary

For measurement purposes, a count shall be made of the number of each Crash-Cushion Attenuating Terminal system installed and removed, up to the maximum number of Crash-Cushion Attenuating Terminal systems required to be placed at any one time during the Contract.

731.09.01.03 Crash-Cushion Attenuating Terminal System, Relocation

For measurement purposes, a count shall be made of the number of each Crash-Cushion Attenuating Terminal system relocated. Crash-Cushion Attenuating Terminal systems that are temporarily surplus but are required for future stages shall be paid for as one relocation for the combined moves into and out of storage, including any off-site storage required due to on-site restrictions.

731.09.02 Plan Quantity Measurement

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

731.10 BASIS OF PAYMENT

**731.10.01 Crash-Cushion Attenuating Terminal System - Item
Crash-Cushion Attenuating Terminal System, Temporary - Item
Crash-Cushion Attenuating Terminal System, Relocation - Item**

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

Costs associated with any required repairs or removals and replacements of defective materials shall be the Contractor's responsibility at no extra cost to the Owner.

**Appendix 731-A, November 2010
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

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

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Crash-Cushion Attenuating Terminal system locations. (731.07.01)

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

- Object markers for Crash-Cushion Attenuating Terminal systems. (731.07.05)

Wherever possible, the designer should eliminate the use of curb with gutter, in advance of and along the length of end treatments and crash cushions. See MTO Roadside Safety Manual for additional information.

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

Related Ontario Provincial Standard Drawings

OPSD 912.141	Guide Rail System, Steel Beam, Wooden Post Assembly, Installation - Double Rail
OPSD 922.330	Energy Attenuator, End Treatment, Crash-Cushion Attenuating Terminal System, Assembly