



**CONSTRUCTION SPECIFICATION FOR  
STEEL BEAM GUIDE RAIL AND ADJUSTMENT OF CABLE GUIDE RAIL**

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**721.01 SCOPE**

This specification covers the requirements for the installation of steel beam guide rail and the adjustment of cable guide rail systems.

**721.01.01 Specification Significance and Use**

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

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

## **721.01.02 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.

## **721.02 REFERENCES**

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

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

### **Ontario Provincial Standard Specifications, Construction**

OPSS 501      Compacting

### **Ontario Provincial Standard Specifications, Material**

OPSS 1350      Concrete - Materials and Production  
OPSS 1503      Cable Guide Rail  
OPSS 1504      Steel Beam Guide Rail  
OPSS 1505      Channel Components for Steel Beam Guide Rail  
OPSS 1601      Wood, Preservative Treatment, and Shop Fabrication

### **Ontario Ministry of Transportation Publications**

Ontario Traffic Manual (OTM):  
Book 11 - Pavement, Hazard and Delineation Markings

### **CSA Standards**

G164-M92 (R2003)      Hot Dip Galvanizing of Irregularly Shaped Articles  
O56-10 (R2015)      Round Wood Piles

## **ASTM International**

A 36/A 36M-14	Carbon Structural Steel
A 780/A 780M-09 (2015)	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
D 4956-17	Retroreflective Sheeting for Traffic Control

### **721.05 MATERIALS**

#### **721.05.01 Cable Guide Rail**

Guide rail cable, fittings, cable clamps and nails, and steel sections for anchor blocks shall be according to OPSS 1503.

Guide rail posts shall be clean peeled according to CAN/CSA O56, and according to OPSS 1601.

Precast concrete anchor blocks shall be according to OPSS 1503.

Reflectorized strips on 0.5 mm thick aluminum sheet shall be according to OTM Book 11 and as specified in the Contract Documents.

#### **721.05.02 Steel Beam Guide Rail**

Steel beam guide rail shall be according to OPSS 1504.

Channel components shall be according to OPSS 1505.

Wooden posts and blocks shall be according to OPSS 1601.

Plastic blocks shall be as specified in the Contract Documents.

Steel sleeves and spacer tubes used in transition treatments to concrete structures shall be fabricated from Schedule 40 galvanized steel pipe.

Steel posts, sleeves, and spacer tubes shall be hot dip galvanized after fabrication according to CSA G164.

Steel posts shall be according to ASTM A 36.

Reflectors shall have a minimum reflective surface of 100 x 100 mm; high intensity retroreflective sheeting according to ASTM D 4956, Type VII; colour according to OTM Book 11; and flexibility to bend 90 degrees from vertical and self restore.

#### **721.05.03 Fabricated Steel Bases**

Fabricated steel bases shall be according to OPSS 1503.

#### **721.05.04 Concrete**

Concrete shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 30 MPa.

**721.07 CONSTRUCTION**

**721.07.01 General**

Guide rail systems shall be installed plumb and to the alignment and grade as specified in the Contract Documents, regardless of the material encountered.

Tops of wooden posts shall be cut as specified in the Contract Documents and treated with two coats of 2% copper naphthenate wood preservative. Field applied wood preservative that comes in contact with any galvanized components shall be removed immediately.

Acceptable material from posthole or anchor block excavation shall be used as backfill around posts and compacted according to OPSS 501.

When required, fabricated steel bases shall be installed level and square to the centreline of the roadway.

Cut ends, field drilled holes, and damaged areas of hot dip galvanized coatings on any galvanized component shall be repaired according to ASTM A 780.

Flame cutting shall not be permitted.

**721.07.02 Cable Guide Rail**

**721.07.02.01 Installation**

Wooden posts shall be installed to the specified depth with the larger end of the post in the ground.

Cable shall be attached to guide rail posts using cable clamps and nail fasteners.

Cable mounting height shall be measured from the top of final shoulder grade at the post face. Cable height shall be adjusted to provide a smooth installation.

Cables shall be tensioned so that the sag between posts shall be a maximum of 6 mm.

Cable splices occurring on the same cable shall be spaced a minimum length of 15 m apart.

There shall be only one cable splice per panel, regardless of the number of cables in the system.

**721.07.02.02 Anchor Blocks**

Precast or cast-in-place cubical or cylindrical anchor blocks shall be installed as specified in the Contract Documents, regardless of the material encountered.

In porous or crumbly soil, forms for cast-in-place anchors shall be used to prevent contamination of the concrete. Forms may be left in place or removed.

Earth backfill and granular materials shall be compacted according to OPSS 501.

### **721.07.02.03 ReflectORIZED Strips**

ReflectORIZED strips shall be installed:

- a) starting at the second post from the approach end.
- b) at a maximum interval of every fifth post on tangent.
- c) at a maximum interval of every third post on curves.
- d) ending on the second to last post.

The reflectORIZED strip shall be fastened on posts as specified in the Contract Documents using two 50 mm aluminum nails.

### **721.07.02.04 Adjust Cable Guide Rail**

Cable guide rail shall be adjusted at locations as specified in the Contract Documents.

Cable guide rail adjustment shall be as specified in the Contract Documents and include:

- a) the removal of the following:
  - i. staples and spacers or cable clamps and nails
  - ii. reflectORIZED strips
  - iii. cables as salvage
- b) the installation of the following:
  - i. salvaged cables
  - ii. new cable clamps and nails
  - iii. new reflectORIZED strips

To facilitate cable tensioning, one new turnbuckle assembly shall be installed on each cable between each set of adjacent anchor blocks. Cables shall be tensioned so that the sag between posts shall be a maximum of 6 mm.

### **721.07.02.05 Cable Guide Rail Post Replacement**

Existing cable guide rail posts shall be removed and replaced with new cable guide rail posts at locations as specified in the Contract Documents and installed as specified in the Cable Guide Rail Installation clause. Locations shall be confirmed with the Contractor Administrator prior to commencing the removal of existing posts.

### **721.07.03 Steel Beam Guide Rail**

#### **721.07.03.01 Installation**

Steel beam guide rail shall be installed as specified in the Contract Documents.

Each steel beam guide rail installation may incorporate either steel posts with either plastic or routed wooden blocks or wooden posts with wooden blocks, but not both. Wooden posts shall only be permitted within steel post installations when wooden posts are specified for treatments. Extension of an existing wooden post installation using steel posts shall only be permitted when the extension length is greater than 100 m.

Different types of plastic and wooden blocks shall not be used together within a steel beam guide rail installation.

When a transition to a rigid obstacle is required, the offset block for the channel may be either wood or a pipe sleeve over the connecting bolt. The pipe sleeve shall be 89 mm OD galvanized steel pipe cut to the required length.

Backup plates, steel spacer tubes, and pipe sleeves shall be installed as specified in the Contract Documents.

All joints shall be lapped in the direction of traffic.

Bolts shall be tightened to 100 N·m. Bolts for wooden post installations shall be field cut as required to maintain a maximum protrusion of 10 mm beyond the nut. The cut end of the bolt shall be ground smooth with all sharp edges and burrs removed.

Steel beam guide rail mounting heights shall be measured vertically from the top of the steel beam guide rail.

Steel beam guide rail without channel mounting heights shall be within the following ranges:

- a) 685 to 760 mm during construction and seasonal shutdown.
- b) 685 to 735 mm upon completion of the work.

Steel beam guide rail with channel mounting heights shall be within the following ranges:

- a) 685 to 785 mm during construction and seasonal shutdown.
- b) 735 to 785 mm 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.

Type M steel beam guide rail mounting heights shall be within the following ranges:

- a) 710 to 810 mm during construction and seasonal shutdown.
- b) 760 to 810 mm upon completion of the work.

Where curb with gutter is required with Type M steel beam guide rail, mounting heights shall be measured vertically at the inside edge of the concrete gutter.

Where sidewalk is required with Type M steel beam guide rail, mounting heights shall be measured vertically at the face of Type M steel beam guide rail.

### **721.07.03.02 Reflectors**

Reflectors shall be installed:

- a) starting at the fifth post from the approach end of a steel beam guide rail end treatment.
- b) at a maximum interval of every tenth post on tangent.
- c) as specified in OTM Book 11, Table 4, on curves.
- d) ending on the last post of the steel beam guide rail installation.
- e) on the posts at the four adjacent steel beam guide rail splices at the approach and leaving end of structures.

The reflector shall be fastened to the post using adhesives, bolts and nuts, or screws with reflective surfaces clear above the top of the posts. One-sided reflectors shall be installed on divided highways and two-sided reflectors shall be installed on undivided highways.

### **721.07.03.03 Steel Beam Guide Rail Structure Connections**

Steel beam guide rail shall be connected to new or existing structure walls as specified in the Contract Documents.

### **721.07.03.04 Adjust Steel Beam Guide Rail**

Steel beam guide rail shall be adjusted at locations as specified in the Contract Documents.

Steel beam rail elements, channel elements, and offset blocks shall be disassembled from the posts. Post bolts, washers, nuts and existing steel offset blocks shall be removed and disposed of as specified in the Contract Documents.

Steel beam rail elements, channel elements, wooden offset blocks, and plastic offset blocks, shall be salvaged for reinstallation. Washers from the front face of the existing steel beam guide rail shall not be reinstalled.

Salvaged steel beam rail elements, channel elements, and wooden or plastic offset blocks shall be reinstalled within the mounting height ranges as specified in the Steel Beam Guide Rail Installation clause using new post bolts, washers, and nuts.

For steel post adjustment, the post shall be raised a minimum of 50 mm above the specified height and then driven down to the required depth before the salvaged steel beam guide rail components are reinstalled. When existing steel offset blocks have been removed, new wooden or plastic offset blocks shall be installed. A new hole shall be field punched through the existing post as specified in the Contract Documents.

For wooden post adjustment, a new hole shall be field drilled through the existing post as specified in the Contract Documents. The top of the offset block shall not extend beyond the top of the existing post. When channel elements are being reinstalled, an additional hole shall be field drilled through the existing post as specified in the Contract Documents.

New reflectors shall be supplied and installed as specified in the Reflectors clause. When new reflectors are installed on a wooden post system, the reflector shall be installed on the approach transverse face of the wooden offset block with one edge 12 mm from edge of post.

**721.07.04 Management of Excess Material**

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

**721.09 MEASUREMENT FOR PAYMENT**

**721.09.01 Actual Measurement**

**721.09.01.01 Adjust Cable Guide Rail**

Measurement of adjust cable guide rail shall be by length in metres along the centreline of the system from centre of anchor block to centre of anchor block at each end of an installation. No additions shall be made for the overlapping length of cable at intermediate anchor blocks.

**721.09.01.02 Cable Guide Rail Post Replacement**

For measurement purposes, a count shall be made of the number of cable guide rail post replacement installed.

**721.09.01.03 Anchor Blocks**

For measurement purposes, a count shall be made of the number of anchor blocks installed.

**721.09.01.04 Single Rail Steel Beam Guide Rail  
Single Rail Steel Beam Guide Rail with Channel  
Double Rail Steel Beam Guide Rail  
Steel Beam Barricade**

Measurement of steel beam guide rail shall be by length in metres along the centreline of the system from end to end of each steel beam guide rail installation and does not include the terminal systems.

**721.09.01.05 Adjust Steel Beam Guide Rail, Wooden Posts  
Adjust Steel Beam Guide Rail, Steel Posts  
Adjust Steel Beam Guide Rail, Steel Posts with Steel Offset Blocks**

Measurement of adjust steel beam guide rail shall be by length in metres along the centreline of the adjusted system from end to end of each steel beam guide rail installation and includes the end treatments and terminal systems.

**721.09.01.06 Steel Beam Guide Rail Structure Connections**

For measurement purposes, a count shall be made of the number of steel beam guide rail structure connections installed.

**721.09.02 Plan Quantity Measurement**

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



721.10

**BASIS OF PAYMENT**

721.10.01

**Adjust Cable Guide Rail - Item**  
**Cable Guide Rail Post Replacement - Item**  
**Anchor Blocks - Item**  
**Single Rail Steel Beam Guide Rail - Item**  
**Single Rail Steel Beam Guide Rail with Channel - Item**  
**Double Rail Steel Beam Guide Rail - Item**  
**Adjust Steel Beam Guide Rail, Wooden Posts - Item**  
**Adjust Steel Beam Guide Rail, Steel Posts - Item**  
**Adjust Steel Beam Guide Rail, Steel Posts with Steel Offset Blocks - Item**  
**Steel Beam Guide Rail Structure Connections - Item**  
**Steel Beam Barricade - 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.

When there is not a separate tender item for steel beam guide rail structure connections, payment at the Contract price for single rail steel beam guide rail with channel shall include full compensation for all labour, Equipment, and Material to do the work of connecting steel beam guide rail to a structure.

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

**Appendix 721-A, November 2018  
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

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

**Designer Action/Considerations**

The designer should specify the following in the Contract Documents:

- Guide rail system type (include OPSD number) and locations. (721.07.01)
- Cable guide rail to be adjusted. (721.07.02.04)
- Cable guide rail post to be replaced. (721.07.02.05)
- Steel beam guide rail to be adjusted. (721.07.03.04)

For Type M steel beam guide rail, use only MASH Terminal Systems.

Leaving end treatments should only be used on divided highways and ramps, when the leaving end of the installation is located beyond the clear zone for opposing traffic.

Height adjustments for steel beam guide rail with wooden post shall be a minimum of 50 mm.

**Cable Guide Rail Adjustment:**

Mounting height tolerances for cable guide rail (CGR) are provided in the MTO Roadside Safety Manual. The purpose of the Adjust Cable Guide Rail item is to allow for the adjustment of the mounting height of an existing CGR installation. Generally, adjustment is necessary at locations where the pavement rehabilitation strategy will raise the existing ground elevation adjacent to an existing guide rail installation. An evaluation of existing guide rail will provide the designer with an inventory of the type of existing guide rail systems as well as the existing mounting height.

When adjusting CGR systems, the posts remain in their current location and the cables are reinstalled at the new mounting height. If the CGR was installed according to OPSD 913.130, there should be approximately 150 mm of space available for adjustment assuming that this is the first adjustment. Cables are not to be installed within 200 mm of the top of the posts. This ensures that the cables do not interfere with the reflectorized strip.

The Adjust Cable Guide Rail tender item also includes the removal and replacement of cable clamps and nails, the installation of one new turnbuckle per cable between anchor blocks, and the installation of new reflectorized strips.

When the evaluation of the existing CGR indicates that the posts are in unsound condition, out of plumb, or cannot meet the mounting height tolerance, it may be necessary to replace some or all of the posts. The Cable Guide Rail Post Replacement tender item can be used to replace existing cable guide rail posts when the remainder of the components (i.e., cables and anchor blocks) are in satisfactory condition.

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### Steel Beam Guide Rail Adjustment:

Mounting height tolerances for steel beam guide rail (SBGR) are specified in OPSS 721. There are three tender items available for adjustment of SBGR. The purpose of these items is to allow for the adjustment of the mounting height of an existing SBGR installation on wooden or steel posts. Generally, adjustment is necessary at locations where the pavement rehabilitation strategy will raise the existing ground elevation adjacent to an existing guide rail installation. An evaluation of the existing guide rail will provide the designer with an inventory of the type of existing guide rail systems as well as existing mounting height. Existing SBGR installations may consist of the following configurations:

a) Wooden posts with wooden offset blocks:

Although still installed today, these systems were used primarily in the years prior to implementation of SBGR on steel posts in 1995. When adjusting these systems, the posts remain in their current location, but the offset block and rail (and channel, where necessary) are reinstalled at the new mounting height. If the guide rail was installed according to OPSD 912.140, there should be approximately 150 mm of space available for adjustment assuming this is the first adjustment. The evaluation of existing guide rail should determine whether the existing installation can accommodate the proposed change in height.

b) Steel post with steel offset blocks:

Steel post systems have been the most common since they were first implemented in 1995 mainly due to their relative ease of handling and installation. Steel offset blocks were used exclusively with steel post systems from 1995 through 2002 when the standard was revised to specify routed wooden blocks. When they are adjusted, existing steel post systems with steel offset blocks will be retrofitted with routed wooden or plastic offset blocks. This requires the punching of a new hole to accommodate the wooden or plastic offset block.

c) Steel posts with wooden or plastic offset blocks:

From 2003 through the early 2008, steel post systems were installed exclusively with routed wooden offset blocks. In 2008, plastic offset blocks were implemented as an alternative to the routed wooden offset blocks. Since that time, steel post systems with plastic offset blocks have been the most common steel beam system.

Selection of the appropriate tender item for each installation will ensure that the Contractor will address the unique adjustment requirements of each system configuration.

Tender items for adjustment include the removal and replacement of existing hardware including bolts, washers, and nuts as well as the installation of new reflectors. For SBGR with steel offset blocks, replacement of steel offset blocks with plastic or wooden offset blocks is included.

Existing end terminals and treatments should be reviewed when SBGR is being considered for adjustment.

Existing end terminals may consist of eccentric loader terminal (ELT) systems, extruder terminal (ET) systems, or sequential kinking terminal (SKT) systems:

a) ELT Systems:

- Consider replacement of ELT installations that are greater than or equal to 5 years in age with a new steel beam energy attenuating terminal (SBEAT) system. If the ELT system is located on a horizontal curve with a radius of less than 190m, a new ELT should be installed.

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### b) SBEATs:

- Existing ET and SKT systems consist of several different variations on wooden and steel posts.
- Consider replacement of ET and SKT system installations on wooden posts with a new SBEAT System.
- ET and SKT systems on steel posts that are in good condition may be adjusted.

Existing leaving end treatments consisting of buried leaving end treatments (formerly OPSD 912.233) or upright fishtail ends:

- a) Buried leaving end treatments are a challenge to adjust and could be replaced with a standard leaving end treatment according to OPSD 912.235. This would require the removal of 16 m of existing SBGR and subsequent installation of 4 m of new SBGR according to OPSD 912.235.
- b) Existing upright fishtail type end treatments typically have been installed based on the extension requirements for unanchored guide rail in accordance with Table 3.4.2 in the MTO Roadside Safety Manual. When replacing an upright fishtail end treatment with a standard leaving end treatment, ensure that after removal of the unanchored end beyond the hazard that the 4 m of new SBGR in accordance with OPSD 912.235 extends beyond the hazard by 4 m.
- c) Where an existing buried end treatment or upright fishtail end treatment is on the leaving end of a SBGR installation located on an undivided highway or at a location on a divided highway where the end of the SBGR is located within the clear zone for opposing traffic, the treatment should be considered for replacement with an end terminal.

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

### Related Ontario Provincial Standard Drawings

OPSD 912.101 to 912.530	Steel Beam Guide Rail System
OPSD 913.101	Guide Rail System, Cable, Component - Cable Fittings
OPSD 913.135	Guide Rail System, Cable, Adjustment - Shoulder