

## **SECTION R14**

### **Guard rails and safety fencing**

#### **R14 01 Scope**

Under this Section of the Specification, the Contractor shall construct highway guard rails and safety fencing at such locations as the Drawings indicates or the Engineer designates.

The term "guard rail" refers to the complete structure composed of posts, rail members and pieces, brackets, fittings, fastenings, etc., as shown on the Drawings and specified in Clauses R14 03 to R14 07 below.

#### **R14 02 Guard rails, designs and types**

Guard rails shall be constructed in accordance with the designs shown on the Drawings. The type of guard rail to be used at any given location shall be as indicated on the Drawings or as set forth in the Special Specification of Particular Application.

#### **R14 03 Metal posts**

Metal posts shall be either (a) 15cm x 15cm wide-flange beam structural steel members weighing approximately 23kg/m, or (b) not less than 35kg/m standard railway flat bottom rails; as the Contractor may elect. New materials will not be required, provided that the posts are straight, structurally sound and free from rust and scale. Each post shall be given one coat of a standard rust inhibitive primer prior to delivery at the site of the work.

Each metal post, either the 15cm x 15cm wide-flange beam type or the railway rail type, shall be provided with a steel bearing plate centered on and welded or bolted to the head of the railway rail posts and to the back flange of beam-type posts as installed.

Each metal end post shall be provided with an additional steel bearing plate welded or bolted transversely to the alignment of the guard rail as erected.

The steel bearing plates shall have a thickness of not less than 6mm and a surface area of not less than 750cm<sup>2</sup>. The least dimension of their width or length shall be 25cm and they shall be placed on the post with the greater dimension transverse to the longitudinal axis of the post. The tops of the bearing plates shall be 70cm from the tops of the posts.

Each post shall be drilled to provide holes of proper size and at proper location to permit the attaching of the rail member or bracket intended for use therewith. The holes shall be in one flange of the beam-type post and in the base of the rail-type post and as near the centre of the posts as is practicable. Unless the posts can be and are set accurately to grade and line after drilling, the drilling of holes shall be performed after the posts are installed.

Metal posts are to be painted in the field as provided below.

Metal posts shall be tested in accordance with AASHTO T 65.

#### **R14 04 Metal rail members and fittings**

Metal rail members shall be of open hearth or electric furnaces steel of 2.5mm fabricated and shaped into beams having a width (vertical projection when in place) of

not less than 30cm nor more than 35cm and having a depth (horizontal projection when in place) of not less than 8cm nor more than 10cm.

Rail members which are designed to make contact with the post at their centre and also within 40mm of their top and bottom edges (as installed) may be attached directly to the posts.

Rail members which are so designed that they do not make contact with the post within 4cm of their top and bottom edges as well as at their centers shall be attached to the posts either (a) by suitable rigid metal brackets which shall provide such edge support and centre contact, or (b) by suitable resilient spring steel offset brackets which will support the rail 13 to 18cm from the post.

Rail members shall be provided with slotted holes to permit expansion and contraction, and they shall have rolled or rounded edges free from sharpness and burrs. The projecting heads of bolts shall be rounded and shallow 50 as not to obstruct or impede the sliding of vehicles when in contact therewith.

Unless otherwise called for on the Drawings or in the Special Specification of Particular Application, metal rail members and brackets shall be clean and shall be given one coat of a standard rust inhibitive primer prior to delivery at the site of the work.

If galvanized rail members and brackets are called for, they shall be galvanized (610g/m<sup>2</sup> coating) in conformance to the AASHTO M 111-74 Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip.

Bolts, nuts, washers, and other fittings shall be galvanized (381g/m<sup>2</sup> coating) by the hot dip process, AASHTO M232-74 Zinc Coating (Hot Dip) on Iron and Steel Hardware.

Non-galvanized rail members, brackets and fittings shall be painted in the field as specified below.

Brackets, bolts and other fittings required in conjunction with the installing of the rail member shall be of steel and of proper design for use with the type of rail member to be used on the project.

Where rail members with resilient spring steel offset brackets are used, the brackets shall have full bearing over an area of not less than 130cm<sup>2</sup> where attached to the posts.

#### **R14 05 Bolts, washers and hardware**

Bolts, washers, nails, spikes and other hardware required for guard rail construction shall be of the sizes and kinds called for on the Drawings or if not there shown shall be of such sizes and kinds as are consistent with first class workmanship and of recognized adequacy. All shall be galvanized by the hot dip process, AASHTO M232-74.

#### **R14 06 Construction of guard rail**

The construction of the guard rail shall be in accordance with recognized standard practice for the type furnished and as recommended by the manufacturer, except as otherwise set forth in this Specification. The posts shall be placed at intervals of not more than 4m centre to centre unless otherwise specified.

Post holes shall be excavated to the lines on grades and depths shown, on the Drawings. No posts shall be set until the lines and grades of the holes have been checked by the Engineer's Representative. After the posts are properly set, the holes shall be backfilled

to within about 10cm of final ground surface, to permit the backfilling material being solidly compacted as it is placed below ground level.

Metal posts may be set by driving, when practicable, provided they are thus installed to vertical position, true to line and grade. The flange of the metal beam-type post and the base of the railway rail-type post shall face the roadway and shall be the respective faces to which the rail member or its support bracket is to be attached. Intermediate metal posts shall be set with the bearing plate on the "off-roadway" side.

The rail members shall be erected with a smooth roadway face free from protrusions which would constitute a hazard to vehicles in moving contact therewith. Provision for expansion and contraction in metal rail members shall be made. In no case shall the top of posts extend above the top of the rail members.

Each end of each continuous installation of metal rail member shall be finished with a standard rail member and piece, or in lieu thereof the metal rail member shall be turned back on a smooth curve so that its end will project a minimum of 18cm back from the front face of the rail and ending not less than 45cm beyond the centre of the end post.

After the rails, brackets, braces and other parts of the structure are in place, the guard rail shall be accurately aligned, bolts and other fastenings securely tightened, and the entire structure brought to smooth, taut and well-finished condition, after which the painting shall be carried out.

## **R14 07 Safety-fences-overall requirements**

### **General**

1. Safety fences shall comprise beams, posts or mounting brackets and means for fixing, post footings, anchorages and ancillary fittings as shown on the Drawings and detailed in the Contract. They shall be so constructed as to provide a flowing visual alignment, failing which the Contractor shall make good by adjusting the alignment of any beam as directed by the Engineer's Representative.

### **Beams**

2. Except where shown on the Drawings beams shall be straight and of approved cross-section within manufacturing tolerances.

3. Beam sections shall be connected by lap (or butt) joints and to posts or mounting brackets using bolts, nuts, screws, washers and fish plates or other approved means as shown on the Drawings.

4. All beams shall be shaped and all bolts and screws so located that the whole assembly presents no sharp edges or projection to traffic. Lap joints shall be made in the direction of adjacent traffic.

### **Posts**

5. Metal posts shall be driven or set in concrete footings as shown on the Drawings. Driven posts shall be provided with a mild steel distribution plate welded to one flange, the bottom of the plate being above the bottom of the post.

Post sockets in concrete footings shall be so constructed that the posts can be easily withdrawn from them for replacement purposes. Over digging of post holes shall be made up to the level of the post butt with Class E concrete.

### **Treatment of Ends**

6. The ends of safety fences shall terminate in:

- (i) A terminal section, which may be flared away from the line of the fence, ramped down to an anchorage; or
- (ii) A connection with another type safety fence by means of a transition piece; or
- (iii) A full height anchorage; or
- (iv) A direct connection with a bridge parapet by means of an approved connection, or
- (v) An expansion joint assembly, as shown on the Drawings.

### **Concrete in Footings and Anchorages**

7. Concrete in footings and anchorages shall be Class 230.

### **Assembly**

8. The overall length of beam sections and posts and spacing of posts or mounting brackets shall be as shown on the Drawings.

9. Other than at a flare or ramp or as shown on the Drawings:

- (i) The horizontal alignment of fences shall not depart from the road alignment by more than 3cm nor deviate from the straight or required radius by more than 1cm in any two successive section lengths.
- (ii) The beam shall be at the specified height above the edge of the nearest adjacent carriageway, hard shoulder or hard strip, or if the fence is located more than 1.5m from the carriageway, hard shoulder or hard strip above the level of the surface vertically beneath the fence face within a tolerance of  $\pm 3$ cm. In addition the deviation from the straight grade shall not exceed  $\pm 5$ mm in any two successive section lengths.

10. No site drilling or cutting of beams and posts will be permitted without the prior approval of the Engineer's Representative and unless otherwise approved special closure pieces shall be fabricated prior to galvanizing. Under no circumstances will flame cutting be permitted to form holes or cut beams.

### **Galvanizing**

11. All steel parts shall after fabrication be galvanized by the hot-dip process in accordance with BS729 (1971).

## **R14 08 Tensioned corrugated beam safety fence**

### **Beams**

1. Corrugated beams shall be of mild steel and not less than 30cm in depth and so formed that the traffic face has a central trough at least 7.5cm deep, Each section shall be 3.5m long. When the section is freely supported over a span of 3m with the road face uppermost and centrally loaded with a point load of 1,000kgf the deflection measured at the centre of the span shall not exceed 4cm.

2. Beam sections shall be connected by lap joints using bolts, nuts and washers manufactured in accordance with BS970: 080M40 (normalized). The strength in tension of the beams and the joints between beams shall be not less than 33,000kgf.

### **Posts**

3. Posts shall be manufactured from 5mm mild steel plate in accordance with BS4360 Grade 43A formed into Z section 100mm x 32mm x 6kg/m. The overall length and spacing of posts and the length breadth and thickness of distribution plates on driven posts shall be as shown on the Drawings. Posts shall be mounted in concrete footings where shown on the Drawings or directed by the Engineer; otherwise they may be either driven or mounted in concrete footings.

### **R14 09 Tensioned rectangular hollow section beam safety fence**

#### **Beams**

1. Rectangular hollow section beams shall be rolled to BS4 Part 2 (1969) shall be either 100mm x 100mm x 5mm thick and made of high yield steel in accordance with BS4360 (1972) Grade 50c or 200mm x 100mm x 5mm thick and made of mild steel in accordance with BS4360 (1972) Grade 43c. Each section shall be not more than 4.8m long unless otherwise approved by the Engineer.

2. Beam Sections shall be joined by means of internal mild steel plates as shown on the Drawings.

#### **Posts**

3. Posts and the method of ground fixing shall be the same as specified in Clause R14 08 for tensioned corrugated beam safety fences.

### **R14 10 Open box beam safety fence**

#### **Beams**

1. Open Box beams shall be made of mild steel and of trapezoidal cross-section as shown on the Drawings. Each section shall be 4.8m long except on radii less than 107m when they shall be 2.4m long. When a 4.8m long section is freely supported over a span of 3m with the road face uppermost and centrally loaded with a point load of 2,000kgf the deflection at the centre of the span shall not exceed 12mm.

2. Beam sections shall be joined by fish plates using bolts, nuts and washers manufactured in accordance with B5970: 080 M40 (normalized).

#### **Posts**

3. Posts and the method of fixing shall be as specified in Clause R14 08 for tensioned corrugated beam safety fences except that the Z-section shall be 110mm x 50mm x 8kg/m. Adjuster platforms shall be provided where shown and detailed on the Drawing to maintain the alignment of the fence at curved piers.

#### **Assembly**

4. Beams shall be bolted directly to the posts or where shown on the Drawings shall be off-set from the posts by means of spacers. Where spacers are used at the posts to separate the beams of a double sided fence, stiffeners shall be inserted at and midway between the fish plate joints.

### **R14 11 Painting**

Where galvanized guard rails or safety fences are to act as a chevron marked warning sign, the beams shall be painted as specified below.

For ungalvanized guard rails the surfaces of metal posts, metal rail members and metal brackets from which the primer coat has been removed by handling or by erection shall be re-painted with one coat of a standard rust inhibitive primer.

All exposed surfaces of erected metal posts, metal members, metal brackets and fastenings shall be given two coats of a special white, alkyd type, paint for metal surfaces. The paint to be furnished and used shall be in accordance with Section B 12.

The exposed surface of each erected concrete post shall be painted one coat with one of the following: (a) a mixture of 85 percent Portland cement and 15 percent hydrated lime with sufficient water to give a creamy consistency.

All paint shall be applied by brush or spray. No paint shall be applied on damp, dusty or un-clean surfaces, and no painting shall be done during rainy weather. No coat of paint shall be applied over a preceding coat until the preceding coat is entirely dry and not within 3 days of the preceding application unless otherwise authorized by the Engineer.

### **R14 12 Finishing of construction**

After the painting is completed and the paint has dried, the guard rail members and fittings shall be finally adjusted, and the backfilling of post holes shall be complete to the ground surface. The site of the work shall then be cleaned up, all excess excavated materials and all construction debris being disposed of in a manner satisfactory to the Engineer's Representative.

### **R14 13 Workmanship**

Only high-grade workmanship will be accepted. All joints shall be accurately fitted, and the completed guard rail shall be true to the lines and grades to which it was ordered by the Engineer to be constructed.

### **R14 14 Measurement and payment**

For the construction of given type of guard rail and safety fences in accordance with the foregoing Specification, payment will be made at the price tendered per linear meter for the appropriate type of guard rail or safety fence.

The key lengths will be determined by measurement along the guard rail as constructed and from end to end of the rail member of each section (run) of completed guard rail.

The price tendered per linear meter for the applicable item tendered as set forth above shall be understood to include payment for all excavating and backfilling work, the furnishing and placing of end pieces and the painting work, as well as the furnishing and placing of all materials and the performance of all other work required.