

SAFETY BARRIERS AND PEDESTRIAN GUARDRAILS

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Safety Barriers and Pedestrian Guardrails

401 General

- 1 A safety barrier is a road vehicle restraint system (excluding bridge parapets) which has been designed to contain a vehicle on impact. Except for the Insitu Concrete Barrier as described in Clause 409, safety barriers shall:
 - (i) comply with this Series, Appendices 4/1 and 4/3 and the requirements of Standard NRA TD19; and
 - (ii) be certified in accordance with IS EN 1317-5 to conform to the parameters of containment level, impact severity level and working width identified in Appendix 4/1.
 - (iii) for transitions of terminals, in the absence of CE marking all of the equivalent information that would be required to apply for certification of a safety barrier under IS EN 1317-5 shall be submitted to the Employer's Representative at least 4 weeks prior to the installation of each terminal or transition type.
- 2 Pedestrian guardrails shall comply with the requirements of this Series and Appendix 4/2.
- 3 The Contractor shall take due account of the road alignment and position of obstructions etc. Any alteration to the design of the Works which results as a consequence of the safety barriers installed shall be undertaken by the Contractor and full details submitted to the Employer's Representative.
- 4 Wherever practicable, all prefabricated safety barriers installed in the Works shall be manufactured by the same manufacturer.
- 5 All proposed modifications to a safety barrier system that in all other regards meets the requirements of this clause 401 shall be evaluated in accordance with EN1317-5 Annex A.

402 Types

- 1 Proprietary safety barriers, of steel, concrete or other materials, shall comply with the requirements of this specification.
- 2 In-situ Concrete Safety Barriers shall comply with the requirements of Clause 409.

403 Durability

- 1 All components of a safety barriers and guardrails shall be designed to achieve a serviceable life of not less than 20 years and for concrete barriers 50 years, except for Temporary Safety Barriers where the nominal service life shall be not less than 10 years. Durability assessment shall specifically address the prevention of galvanic corrosion between dissimilar metals.
- 2 All safety barriers shall operate over an ambient temperature range of -20°C to +50°C without any reduction in performance.

404 Not Used

405 Not Used

406 Installation

Handling and Storage

- 1 All components shall be protected from damage and handled and stacked in such a way that permanent damage is not caused, particularly to threaded components. Transport and storage arrangements shall comply with the recommendations of the barrier manufacturer and IS EN ISO 1461, IS EN 10326 and IS EN 13369 as appropriate. In particular means shall be provided to avoid damage to galvanised coatings and any damage that does occur shall be made good in accordance with the recommendations of IS EN ISO 1461. Component ropes and tail ropes shall be supplied on reels with a barrel diameter that will avoid twisting and kinking of the ropes.

Layout

- 2 The overall layout and location of safety barriers, terminals, transitions and pedestrian guardrails shall be as indicated in the **Works Requirements** [Contractor's Documents] including Appendices 4/1, 4.2 and 4/3.
- 3 The Contractor shall ascertain the minimum overall length of safety barrier which is required in order that the barrier will perform as designed. Where this length is more than the overall length determined in accordance with Standard NRA TD19, the Contractor shall install the minimum length required.
- 4 All safety barriers shall be erected to present a flowing alignment and in accordance with the following:

- (i) The overall alignment on plan of safety barriers shall not depart from the prescribed overall layout by more than $\pm 30\text{mm}$, nor deviate in any 10m length from the straight or required radius by more than $\pm 15\text{mm}$.
- (ii) Barriers shall be at the height shown in the barrier manufacturer's details for the barrier installation. The height of the barrier shall be measured from the edge of the road pavement if the set-back is less than 1.5m. Elsewhere, the height shall be measured from the adjacent ground.
- (iii) The ground within the set-back and working width dimensions shall be generally level and free from obstructions.

Excavation for Concrete Foundations and Anchor Blocks

- 5 Where the sides of excavations cannot be maintained vertical until concrete is placed, suitable permanent or temporary casings shall be used. The casings shall be installed immediately after excavation and any lateral overbreak of the excavation shall be filled with concrete.
- 6 Impermeable plastic sheeting 125 microns thick shall be laid at the base of an in-situ concrete foundation located in a filter drain

Concrete in Foundations and Anchor Blocks

- 7 Concrete in foundations and anchor blocks shall be in accordance with the relevant Clauses of the 1700 and 2600 Series of this specification and the barrier manufacturer's requirements.
- 8 The Contractor shall ensure that any concrete which constitutes part of the barrier system has reached the specified strength stated by the barrier manufacturer prior to any tensioning taking place.

Posts

- 9 Where posts are mounted in cast in post sockets these shall be protected to prevent the collection of detritus in the socket voids.
- 10 When steel posts are driven into the ground this shall be carried out without damage to the post and any protective coating. Any minor damage to galvanising shall be treated in accordance with IS EN ISO 1461.

Cutting of components

- 11 No drilling, cutting (including flame cutting) or welding of beams and posts shall be permitted after application of any protective coating.

- 12 Special closure pieces shall be fabricated before application of any protective coating.

Assembly

- 13 Direct contact between dissimilar metals shall be avoided by interposing non-metallic sleeves, washers or coatings as detailed by the barrier manufacturer.

407 Site Testing

Anchorage in Drilled Holes

- 1 Where the impact characteristics of the safety barrier may be affected by the performance of anchorages in drilled holes, the Contractor shall carry out on-site tensile load tests as detailed in this Clause. For the purpose of this sub-Clause, the phrase types of fixings referred to in clause 1 of BS 5080 Part 1 shall include "anchorages". Where anchorages are tested they shall be loaded incrementally in tension in accordance with BS 5080 : Part 1 except that they shall be capable of resisting a test load equal to 10 per cent above the nominal tensile load applied to the anchor at failure of the safety barrier in lieu of testing to failure. The nominal tensile load shall be determined by the barrier manufacturer. Where the failure of the attachment system (e.g. the holding down bolt) is the prescribed failure mode of the barrier system, the test load shall be 90 per cent of the yield load of the attachment system. Incremental loads shall be held for not less than half a minute and the test load for not less than five minutes. Readings shall be taken immediately after applying load and at the end of the time intervals stated above.
- 2 The total movement of the anchorage shall not exceed 1.0mm during the test. Any evidence of slip during loading up to the test load, as demonstrated by a significant change in the slope of the load/extension curve, shall constitute failure.
- 3 The Contractor shall test the anchorages selected by the Employer's Representative and the testing frequency shall be in accordance with Appendix 1/5. In addition, testing shall comply with any special requirements given in Appendix 4/1.

Alternative anchorage systems

- 4 Where the barrier manufacturer proposes a form of anchorage system other than anchorages in drilled holes the Contractor shall implement a suitable site testing regime to demonstrate satisfactory performance in an equivalent manner to that described in sub clauses 1 to 3 above. The Contractor shall submit details of the proposed testing regime to the Employer's Representative at least four weeks prior to the installation of each anchorage type.

Barrier System

- 5 The Contractor shall undertake any testing that the barrier manufacturer may require on the installed safety barrier.

Ground Conditions

- 6 The Contractor shall ensure that the finished ground conditions are suitable for the correct performance of the safety barrier system selected, and shall:
- (i) demonstrate that the finished ground provides sufficient resistance to comply with the requirements identified in the barrier manufacturer's IS EN 1317-5 compliant installation manual, and
 - (ii) where posts are mounted in post sockets, demonstrate by on-site testing that the post sockets remain serviceable and in their correct original position following the collapse of the post.
- 7 Where the above requires in-situ testing these tests shall be undertaken at 50m centres with a minimum of two test locations per barrier length. On completion of loading tests the Contractor shall replace any damaged elements of the barrier system and reinstate the finished ground to meet the requirements of the Contract.

If the site tests fail to demonstrate that the ground conditions are suitable, the Contractor shall:

- (i) provide an alternative safety barrier; and/or
 - (ii) improve the ground conditions such that they are suitable.
- 8 A check shall be undertaken by an independent Chartered Engineer who shall certify that the site testing regime is appropriate for the safety barrier installation in the specific site conditions. Such certification shall be submitted to the Employer's Representative before the start of installation.

408 Anchorages and Attachment Systems for Surface Mounted Posts

- 1 At least 4 weeks before installation, the Contractor shall submit to the Employer's Representative well attested and documented evidence that proposed anchorages and attachment systems are capable of resisting the ultimate design loads of the barrier system. Anchorages of an expanding type, other than undercut anchorages, shall not be used.

- 2 Intermediate anchors shall be provided to all tensioned safety barrier systems that are over 1000m long. They shall be spaced approximately at equal distances between end anchors so that the maximum length of unanchored barrier does not exceed 1000m. The means of terminating tensioned elements shall ensure that there is at least 50 per cent of the normal containment capacity provided at any point within the termination sections. The minimum overlap distance between anchor blocks within the intermediate termination sections shall be 30m and the maximum distance 60m. These requirements shall be stated within the barrier manufacturer's details.
- 3 For anchorages in drilled holes, each hole location shall be checked to ensure that the hole will be clear of reinforcement before drilling is carried out. Where it is not possible to locate drilled holes without encountering reinforcement, the Contractor shall submit a report to the Employer's Representative on the consequences of drilling through or cutting the reinforcement from the Specialist responsible for the design or assessment of the affected reinforcement.
- 4 Before installation of anchorages in drilled holes, each hole shall be sound, clean and dry and the tolerance of the hole shall be within the values given by the anchorage manufacturer.
- 5 Where surface mounted posts are to be installed on bridge decks and other structures, the anchorages shall include an internally threaded component to receive the attachment system i.e. holding down nut and bolt or stud. All parts of anchorages on bridge decks and other structures (where the anchorage is within 80mm of the upper surface of the supporting concrete or where the anchorage parts are threaded to receive the holding down bolt) shall be of stainless steel grade designation 1.4401 or 1.4436 to IS EN 10088-1. Metal to metal contact between dissimilar materials within the attachment system and anchorage shall be prevented by the use of non-conductive sleeves, washers or coatings to prevent bimetallic corrosion.
- 6 The threads of steel anchorages shall be lined with grease having a high resistance to creep and being suitable for hot or cold smearing.
- 7 Attachment systems shall be tightened to the specified torque and have not less than the minimum thread engagement specified by manufacturer of the system.
- 8 Except where surface mounted posts are attached to a steel base they shall be bedded on mortar complying with Clause 2601 and Appendix 26/2. The bedding mortar shall have a minimum thickness of 10mm and a

maximum thickness of 30mm. An additional allowance may be made for longitudinal falls.

- 9 All voids in anchorages, attachment systems and base plates shall be filled with a non-setting passive filler.
- 10 Stainless steel bolts, studs, screws and nuts shall conform to IS EN ISO 3506-1 and IS EN ISO 3506-2, Grade A4-80. The dimensions and tolerances of the bolts, studs, screws and nuts shall conform to IS EN ISO 4016, IS EN ISO 4018 and IS EN ISO 4034.
- 11 Washers on bridge decks and other structures shall conform to BS 4320 and be made from stainless steel strip designation 1.4401 or 1.4436 to IS EN 10029, IS EN 10048, IS EN 10051 and IS EN ISO 9445.

409 In-Situ Concrete Barrier

- 1 The In-Situ Concrete Barrier shall comply with the details contained in the NRA Road Construction Details listed in Appendix 4/6. The materials shall be in accordance with the appropriate Series of this Specification.
- 2 The barrier has been approved by the National Roads Authority for use in situations which require an H2 Containment Level, an Impact Severity Level B In general this barrier requires a Working Width of W2. However where the barrier transforms to a provide a vertical face in line with a bridge or gantry support in a central reserve, as shown in the above NRA Road Construction Details, a working width of zero may be assumed.

410 Temporary Safety Barriers

- 1 Where required in order to comply with the requirements of Appendix 1/17 or as particularly required in Appendix 4/1 the Contractor shall provide, install and maintain temporary safety barriers, terminals and transitions, and on completion of the Works remove to the location stated therein. Any such temporary barriers shall comply with the requirements of this specification as for permanent barriers.

411 Terminals and Transitions

- 1 All full height terminals shall comply with the requirements of IS ENV 1317-4 for the performance criteria as described in Appendix 4/3.
- 2 All transitions shall comply with NRA TD19 and the requirements of the impact assessment test criteria and the critical impact requirements specified in IS EN 1317-2 for safety barriers.

- 3 In the case of a terminal for an in-situ concrete barrier:

- (i) the downstream terminal shall be ramped comply in accordance with the NRA Road Construction Details listed in Appendix 4/6.
- (ii) the upstream end shall either transition to a suitable full height terminal or be ramped in accordance with the above NRA Road Construction details and the ramped terminal protected by a suitable overlapping barrier.

- 4 In all other respects, terminals and transitions shall comply with the requirements of this specification for safety barriers.

412 Provision of Information, Training, Materials and Equipment

- 1 The Contractor shall provide to the Employer the types and quantities of information, training, materials and equipment stated in Appendix 4/4. He shall deliver them to the location(s) specified in Appendix 4/4.
- 2 The Contractor shall submit to the Employer's Representative a statement from the safety barrier supplier of the anticipated delivery period for all components of the safety barrier systems listed in Appendix 4/1. Period(s) shall be stated for the delivery of 50 to 100 metres of barrier, terminals, transitions and all other components.

413 Pedestrian Guardrails

- 1 Pedestrian Guardrails shall comply with BS 7818 and with any other requirements described in Appendix 4/2, and the durability requirements of Clause 403 of this Specification.
- 2 Protection against corrosion for pedestrian guardrails shall be as described in the manufacturer's specification and the following:-
 - (i) All steel components, except stainless steel items, shall be galvanised after shop fabrication as described in Clause 1911 of this Specification; and
 - (ii) The surface preparation and protection against corrosion of all steel components shall comply with Series 1900 of this Specification.

414 Anti-Glare Screens

- 1 Anti-glare screen systems shall conform to IS EN 12676-1 and IS EN 12676-2 and the requirements of Appendix 4/5.