

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. Unless otherwise approved by the Engineer or as described in Clause 409, safety barriers shall:
 - a) comply with this Series and the requirements of Standard NRA TD 19; and
 - b) have an initial type test report in accordance with Clause 405; and
 - c) be manufactured by a company that is accredited to ISO 9000 and who can demonstrate quality control measures at least equivalent to Clause 404; and
 - d) have been approved by the National Roads Authority.
- 2 Pedestrian guardrails shall comply with the requirements of this Specification.
- 3 The Contractor shall provide safety barriers which conform to the parameters of containment level, impact severity level and working width identified in Appendix 4/1.
- 4 The Contractor shall take due account of the highway 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 approved by the Engineer.
- 5 Wherever practicable, all prefabricated safety barriers installed in the Works shall be manufactured by the same manufacturer.

402 Types

- 1 Prefabricated 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 Materials

General

- 1 The following material specification information shall be provided to the Engineer at least 4 weeks prior to installation of each safety barrier type:
 - a) General system arrangement drawings with works descriptions and tolerances;
 - b) Component drawings with tolerances and all material specifications;
 - c) Specifications for all materials (including connectors, welding and bonding materials) and finishes including the standards with which they comply;
 - d) An assessment of the durability rating of the product;
 - e) Factory sub-assembly drawings;
 - f) Any other information relevant (e.g. recycling information, details of toxic or dangerous materials in the product).

Concrete

- 2 All concrete used in the manufacture and installation of the safety barriers shall conform to the requirements of Series 1700 and 2600 (if appropriate).

Metals

- 3 Direct contact between dissimilar metals shall be avoided by interposing non-metallic sleeves, washers or coatings as appropriate to prevent galvanic corrosion.

Other

- 4 Any other materials shall comply with appropriate CEN, IS or ISO standards and this Specification where appropriate.

Durability

- 5 All components of a safety barrier 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.
- 6 All safety barriers shall operate over an ambient temperature range of -20°C to +50°C without any reduction in performance.

- 7 All steel components of a safety barrier (excluding stainless steel items and reinforcement) shall be galvanised unless such treatment would be detrimental to the performance of the component or unless a coating or treatment of equivalent durability is provided. The galvanising shall be as described in Clause 1911 except that the coating weight shall comply with Table 4/1.
- 8 Black bolts, screws, nuts and washers shall be centrifuged. Nuts shall be tapped up to 0.4 mm oversize after galvanising and the threads shall be oiled. Small items may be centrifuged but the coating weight shall comply with the minimum values specified in Table 4/1.

Table 4/1: Coating Weights

Items	Minimum average coating weight for any individual test area
Items of which all parts are 5.5 mm thick or over	610 g/m ²
Items of which any part is less than 5.5 mm thick	460 g/m ²
Bolts, screws, nuts, washers, rigging screws, etc.	305 g/m ²

404 Quality Control for Manufacture

- 1 The Contractor shall provide details of the safety barrier manufacturer's quality control system. Unless otherwise agreed with the Engineer, such a system shall include at least the following:
- a) An independent initial inspection of the factory;
 - b) A Factory Production Control System;
 - c) Continuous surveillance, assessment revision and approval of Factory Production Control;
 - d) Procedures for tracing and rectifying defects;
 - e) Traceability of materials and components.

Initial Inspection

- 2 The Contractor shall demonstrate that the safety barrier manufacturer satisfies at least

the following requirements:

- a) A Quality Manual has been produced for the organisation's operations and processes;
- b) The manufacturing processes are documented in the form of specific procedures in the Quality Manual;
- c) A specific procedure for the receipt of incoming materials has been established by the manufacturer;
- d) Materials are traceable to test certification proving their conformance to specification, which shall be held on file for all safety barriers;
- e) Personnel are trained and qualified to operate the relevant manufacturing processes including ongoing testing as appropriate;
- f) Quality control measures are operated and records kept of all measurements on finished components including coatings, welds bonding etc;
- g) Continuous surveillance of the processes and procedures are undertaken and reports produced to identify non-compliance with the Quality Manual.

Factory Production Control

- 3 The manufacturer shall exercise continuous internal control of production. All elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures. This production control system" documentation shall ensure a common understanding of Factory Production Control and enable the achievement of the required product characteristics and the effective operation of the production control system to be inspected. Factory Production Control shall be a documented procedure in the Quality Manual.
- 4 The manufacturer's documentation shall be appropriate to the technical description of the products and processes.
- 5 Production control operations shall comprise at least the following:
- a) The inspection of raw materials and components;
 - b) The prescribed frequency of inspections and tests to be carried out during manufacture;

- c) The provision of reasonable handling and storage, so that the products and/or components remain in conformity with the technical specifications;
- d) The control of equipment, machines and tools required to manufacture the safety barrier components, including the necessary verification equipment (e.g. gauges);
- e) Assessment of the personnel qualified to carry out the relevant manufacturing processes.

Continuous Surveillance

- 6 The manufacturer shall provide evidence that he exercises continuous surveillance of his Quality Control system. This shall take the form of inspection reports highlighting the areas and procedures inspected and the outcome of these inspections.

405 Evaluation of Conformity

General

- 1 Unless otherwise approved by the Engineer, an initial type test report on a specimen of the safety barrier shall be submitted to the Engineer. This report shall contain the following:
- a) Impact test report to IS EN 1317 Parts 1 and 2;
 - b) Evaluation report of the tested safety barrier;
 - c) Technical description of the safety barrier, including drawings and installation instructions to match the system as tested.

Evaluation Report

- 2 The evaluation report shall include:
- a) Verification of the quality of material used in relevant structural components of the system;
 - b) Dimensional checks on structural components;
 - c) Coating thickness assessment;
 - d) Soil conditions and foundations report;
 - e) Evaluation of assembly drawings;
 - f) Other components and observations.

406 Installation

Installation Description

- 1 Installation requirements shall be provided to the Engineer for his approval at least 4 weeks prior to installation and shall include:
- a) An assessment of durability to weathering, including harsh location conditions;
 - b) Site sub-assembly drawings;
 - c) Recommendations on installation conditions to avoid poor design features;
 - d) Description of the installation works, including special equipment;
 - e) Procedures for installation (erection, assembly, foundations, etc.);
 - f) Description of the soil conditions and/or foundations suitable for the system;
 - g) Provisions for repair and maintenance;
 - h) Confirmation of the manufacturer's agreement to the Contractor's method statement for the barrier installation.

Handling and Storage

- 2 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. 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 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. Transport and storage of galvanised articles shall comply with the recommendations of EN ISO 1461.

Layout

- 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 TD 19, the Contractor shall install the minimum length required.
- 4 All safety barriers shall be erected to present a flowing alignment and, unless otherwise agreed by the Engineer, in accordance with the following.
- a) The overall alignment on plan of safety barriers shall not depart from the

- prescribed alignment by more than $\pm 30\text{mm}$, nor deviate in any 10m length from the straight or required radius by more than $\pm 15\text{mm}$.
- b) Barriers shall be at the height shown on the manufacturer's drawings for the barrier installation in the EN 1317 test report. 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.
 - c) The ground within the set-back and working width dimensions shall be generally level and free from obstructions.

407 Site Testing

Anchages 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 loading tests as detailed in this Clause. For the purpose of this sub-Clause, the phrase "Type of fixings" as defined in sub-Clause 1.2 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 the test load specified by the manufacturer in lieu of testing to failure. Incremental loads shall be held 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 Engineer 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.

System

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

Ground Conditions

- 5 The Contractor shall ascertain the ground conditions that existed when the system was successfully tested in accordance with IS EN 1317 Parts 1 and 2.
- 6 Site tests shall be earned out for all barrier systems that rely on resistance of the ground in order to function correctly. The tests shall either:
 - (a) have been approved for use by a national or regional road authority in a member state of the European Economic Area and have been used successfully in that state. Such approval shall be for use in conjunction with the proposed safety barrier and in an equivalent situation. Evidence of the approval and successful use shall be submitted to the National Roads Authority for approval; or
 - (b) demonstrate that the ground provides sufficient resistance to ensure the barrier conforms to the various parameters defined in the EN 1317 test report.

The tests shall be undertaken at 50m centres with a minimum of two test locations per barrier length.

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

- (a) provide an alternative safety barrier; and/or
 - (b) improve the ground conditions such that they are suitable.
- 7 [^] A check shall be undertaken by an independent Chartered Engineer who shall certify, before the start of installation, that the site testing regime is appropriate for the safety barrier installation.
 - 8 The Contractor shall demonstrate that the ground conditions are suitable for each safety barrier system to function as designed and tested. Details of the safety barrier manufacturer's requirements shall be submitted to the Engineer at least 28 days prior to commencement of the installation of each safety barrier system in the Works. The submission shall include the test regime that is required to demonstrate that the safety barrier system performs as intended.

- Two copies of the information containing the testing of the barrier support, and any other relevant test information, is to be provided to the National Roads Authority once the installation is completed. The Contractor shall also provide full installation details and testing equipment such that any future maintenance and repair can be undertaken correctly.

408 Anchorages and Attachment Systems for Surface Mounted Posts

- Unless otherwise described in Appendix 4/1, at least 4 weeks before installation, the Contractor shall submit to the Engineer well attested and documented evidence that proposed anchorages and attachment systems in drilled holes 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.
- Steel anchorages and attachment systems shall be used for securing surface mounted posts to a concrete or steel base. Attachment systems shall use bolts or studs as appropriate.
- For anchorages in drilled holes, the hole location shall be checked to ensure that the hole will be clear of reinforcement before drilling is carried out.
- Before installation of anchorages in drilled holes, the hole shall be sound, clean and dry and the tolerance of the hole shall be within the values given by the anchorage manufacturer.
- Where surface mounted posts are to be installed on bridge decks, the anchorages shall include an internally threaded component to receive the attachment system i.e. holding down and bolt or stud. All parts of anchorages on bridge decks (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 316 S 31 or 316 S 33 to BS 970: Part 1. Holding down bolts, studs and nuts on bridge decks shall be stainless steel grade A4-80 to BS 6105. Washers on bridge decks shall comply with BS 4320 and be made from stainless steel strip grade 316 S 31 or 316 S 33 to BS 970: Part 2.
- The threads of steel anchorages shall be lined with grease having a high resistance to creep and being suitable for hot or cold smearing.

The grease shall provide protection to the threads for a minimum of either 18 months under cover or 6 months exposed on site.

- Attachment systems shall be tightened to the appropriate torque and have the minimum thread engagement specified by manufacturer of the system.
- Except where surface mounted posts are attached to a steel base they shall be bedded on mortar complying with Clause 2601. The bedding mortar shall have a minimum thickness of 10mm and a maximum thickness of 30mm.
- All voids in anchorages, attachment systems and base plates shall be filled with a non-setting passive filler to prevent the collection of water.

409 In-Situ Concrete Barrier

- The In-situ Concrete Barrier shall comply with the details contained in the NRA Road Construction Details listed in Appendix 4/3.
- 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 and a Working Width of W2.

410 Temporary Safety Barriers

- Temporary safety barriers shall:
 - have an initial type test report in accordance with Clause 405; and
 - be manufactured by a company that is accredited to ISO 9000 and who can demonstrate quality control measures at least equivalent to Clause 404; and
 - have been approved by the National Roads Authority.
- Where required in Appendix 4/1 the Contractor shall provide, and on completion of the Works remove to the location stated therein, temporary safety barriers.
- Where a temporary safety barrier is to be provided by the Road Authority, the Contractor shall remove the barrier units from, and return on completion of the Works to, the location stated in Appendix 4/1.

411 Terminals and Transitions

1 All terminals shall either:

(a) have been approved for use by a national or regional road authority in a member state of the European Economic Area and have been installed successfully in that state. Such approval shall be for use in conjunction with the proposed safety barrier and in an equivalent situation. Evidence of the approval and installation shall be submitted to the National Roads Authority for approval; or

(b) comply with the requirements of IS ENV 1317-4 for the following performance criteria as described in that document:

Performance Class	P3
Impact Severity Class	A
Lateral D2.2	unless otherwise specified.
Displacement Class	

Evidence of compliance shall be submitted to the National Roads Authority in the form of a full report of a test carried out in accordance with IS ENV 1317-4; or

(c) In the case of a terminal for an In-situ Concrete Barrier comply with the details contained in the NRA Road Construction Details listed in Appendix 4/3.

Terminals and transitions shall be manufactured by a company that is accredited to ISO 9000 and who can demonstrate quality control measures at least equivalent to Clause 404.

3 All transitions shall either:

(a) have been approved for use by a national or regional road authority in a member state of the European Economic Area and have been installed successfully in that state. Such approval shall be for use in conjunction with the proposed safety barriers and in an equivalent situation. Evidence of the approval and installation shall be submitted to the National Roads Authority for approval; or

(b) comply with the requirements of the impact assessment test criteria and the critical impact requirements specified in IS EN 1317-2 for safety barriers. Evidence of compliance shall be submitted to the National Roads Authority in the form of a full test report; or

(c) in the case of a transition involving an In-situ Concrete Barrier comply with the details contained in the NRA Road Construction Details listed in Appendix 4/3.

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 4/1. He shall deliver them to the location(s) specified in Appendix 4/1.

2 The Contractor shall provide to the Engineer a statement from the safety barrier supplier of the anticipated delivery period for all components of the safety barrier system as specified 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.

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