
SERIES 400
ROAD RESTRAINT SYSTEMS (VEHICLE
AND PEDESTRIAN)

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ROAD RESTRAINT SYSTEMS (VEHICLE AND PEDESTRIAN)

VEHICLE RESTRAINT SYSTEMS

General Requirements

401 General

- 1** (11/06) Road Vehicle Restraint Systems as defined in BS EN 1317-1 shall conform with the specific requirements of TD 19 (DMRB 2.2.8), this Series, Appendix 4/1, Appendix 4/2, and any other requirements described hereafter and elsewhere in the Contract.
- 2** (11/06) Unless otherwise described in Appendix 4/1 and as amended in the relevant Clauses of this Series, Performance Criteria for:
- (i) Safety barriers shall conform to the requirements of BS EN 1317-1 and BS EN 1317-2;
 - (ii) (11/06) Vehicle parapets shall conform to the requirements of BS EN 1317-1, BS EN 1317-2 and BS 6779-1: 1998 (Amd. No. 14290, 21 March 2003) and BS 6779-2 as amended by TD 19 (DMRB 2.2.8), Clause 402 and Clauses 406 to 410;
 - (iii) (11/06) Terminals and transitions to safety barriers and vehicle parapets shall conform to the requirements of DD ENV 1317-4: 2002; and
 - (iv) (11/06) Crash cushions shall conform to the requirements of BS EN 1317-3.
- 3** (11/06) The Performance Class Requirements (Containment Level, Impact Severity Level [ISL], Working Width Class, Performance Level, Redirection Zone Class [Z], Permanent Lateral Displacement Zone Class [D], Performance Class [P], Permanent Lateral Displacement Zone [PLDZ] characteristic, Exit Box Class) and other requirements such as the Length of Need (see definition in TD 19 (DMRB 2.2.8)) and the maximum height that allows the required visibility shall be as described in Appendix 4/1.

Acceptance of Proposals

- 4** (11/06) The Contractor shall submit to the Overseeing Organisation for acceptance Road Vehicle Restraint Systems to conform with the Performance

Class Requirements and any other requirements specified in Appendix 4/1.

- 5** (11/06) Vehicle Restraint Systems proposed by the Contractor shall be submitted to the Overseeing Organisation for acceptance with the following supporting information demonstrating compliance with the applicable part of BS EN 1317 and DD ENV 1317-4:2002:

5.1 (11/06) **For those Vehicle Restraint Systems contained in SA1- List of Compliant/ Approved/Registered Products (MCHW 0.3.1)**

- (i) Documentation showing compliance with and operation of the Quality Assurance requirements of Clause 104 and the associated quality management schemes detailed in Appendix A.

5.2 (11/06) **For those Vehicle Restraint Systems NOT contained in SA1 - List of Compliant/Approved/ Registered Products**

- (i) Certification of compliance with BS EN 1317-1, BS EN 1317-2, BS EN 1317-3 and DD ENV 1317-4: 2002 as appropriate and other submission documents and information detailed in Appendix 4/2; and
- (ii) Documentation showing compliance with and operation of the Quality Assurance requirements of Clause 104 and the associated quality management schemes detailed in Appendix A.

Durability

- 6** (11/07) Safety barriers, vehicle parapets, terminals, transitions and crash cushions shall conform to the following:

- (i) All components shall be designed to achieve a serviceable life of not less than:
 - (a) 20 years for metal safety barriers, terminals, transitions and crash cushions;

- (b) 50 years for concrete safety barrier systems, except for temporary safety barriers where the serviceable life shall be not less than 10 years;
 - (c) 30 years for metal vehicle parapets and concrete components of combined metal and concrete vehicle parapets; and
 - (d) 120 years for concrete vehicle parapets and concrete components of combined metal and concrete vehicle parapets; and
- (ii) For metal vehicle parapets and metal components of combined metal and concrete parapets the serviceable life shall, except where stated in Appendix 4/1, be obtained without the requirement for any maintenance other than that resulting from accidental damage.

402 Components for Vehicle Restraint Systems

1 For the purpose of vehicle parapet requirements, this Clause shall also be read in conjunction with Clause 406.

Materials

2 (11/06) Materials and fabrication of components and fittings shall be as described and detailed on the Drawings submitted by the Contractor, in compliance with Clause 104, sub-Clause 401.5 and other requirements of this Series.

3 Structural concrete, reinforcement, workmanship and other requirements shall conform to the relevant requirements of Series 1700 and Appendices 17/1 to 17/5. Standardised prescribed concrete shall conform to Clause 2602 and Appendix 26/1.

Protection Against Corrosion

4 (11/07) Protection against corrosion shall be as described in the Manufacturer's Specification and the following:

- (i) All steel components except stainless steel items, reinforcing rings and reinforcing bars shall be galvanized after shop fabrication as described in Clause 1909; and
- (ii) Where required in Appendix 4/1, the surface preparation and protection against corrosion of all steel vehicle parapets and steel components of combined metal and concrete vehicle parapets shall comply with Series 1900.

Tolerances

5 (11/06) Fabrication tolerances, including tolerance on hole diameters, shall be as shown and described on the Drawings submitted by the Contractor in accordance with sub-Clause 401.5. Components, which are to be galvanized or metal coated, shall be measured before galvanizing or metal coating.

Welding

6 (i) (11/06) **General:** Arc welding of ferritic steels shall conform to BS EN 1011-1 and BS EN 1011-2. Weld symbols shown on the Drawings, submitted by the Contractor in accordance with sub-Clause 401.5, shall be as described in BS EN 22553. Welding shall not be used except as where detailed on the Drawings submitted by the Contractor in accordance with sub-Clause 401.5. Arc welding of stainless steels shall conform to BS EN 1011-3. Arc welding of aluminium alloys shall conform to BS EN 1011-1 and BS EN 1011-4.

(ii) (11/05) **Procedures:** Written welding procedures shall be used with testing to BS EN ISO 15607, BS EN ISO 15609-1 and BS EN ISO 15614-1 for steel and BS EN ISO 15607, BS EN ISO 15609-1 and BS EN ISO 15609-2 for aluminium alloys and shall apply to all production and repair procedures. These shall be subject to re-approval after a period of seven years. When applying BS EN ISO 15607, BS EN ISO 15609-1 and BS EN ISO 15614-1, the welding consumables and procedures used shall be such that the mechanical properties of deposited weld metal shall not be less than the respective minimum specified values of the parent metal being welded. Weld testing shall be undertaken by an appropriate organisation accredited in accordance with sub-Clauses 105.3 and 105.4. Approval shall be by an Independent Inspecting Authority using Registered Welding Engineers or Registered Welding Quality Engineers or equivalent. Welding procedures shall be approved in accordance with BS EN ISO 15613. Pre-production test pieces shall represent the main assembly types.

(iii) (11/05) **Welder Qualification:** All welders shall hold certificates of approval to BS EN 287-1 and BS EN 1418 for steel and BS EN ISO 9606-2 for aluminium alloys.

The tests shall include in addition an application test on transverse butt welds in beams. Welders carrying out fillet welds only may be approved to BS 4872-1. Certificates of approval shall be by an Independent Inspecting Authority using Registered Welding Engineers, Registered Welding Quality Engineers or Welding Inspectors certified by the Certification Scheme for Weldment Inspection Personnel (CSWIP) or equivalent. Weld testing shall be undertaken by an appropriate organisation accredited in accordance with sub-Clauses 105.3 and 105.4.

- (iv) **Production Inspection and Testing:** The manufacturer shall provide suitable personnel to carry out inspection of production welds in (a) to (c) below. Personnel conducting visual inspection shall be certified by the Certification Scheme for Weldment Inspection Personnel (CSWIP) or equivalent at a competency level appropriate to the type of weld inspected. Personnel conducting non-destructive testing (NDT) shall be certified by the Certification Scheme for Weldment Inspection Personnel (CSWIP) or equivalent appropriate to the equipment used and the weld groups inspected all in accordance with BS EN 473. Evidence of training and qualification shall be retained and made available for examination when required. The results of all weld inspections shall be recorded.

- (a) **Visual Inspection:** All welded joints shall be subject to visual inspection in accordance with BS EN 970 prior to any NDT and galvanizing. Weld surfaces shall be free of slag residues and sharp edges. All surfaces shall be free of traces of weld splatter, arc strikes and contaminants. The apparent throat dimensions of butt welds and the apparent leg length and apparent throat dimensions of fillet welds, as measured by a welding gauge, taking into account any known lack of fit, shall not be less than those specified, except that local shortfalls up to 1 mm may be accepted, provided the average over any 50 mm length is not less than the specified dimension. The toe angle shall not be less than 90°. The surface of all welds shall be free from cracks, lack of fusion including overlap, and slag. Isolated discontinuous porosity may be accepted

provided it is not detrimental to the galvanising process. Undercut shall not result in a section loss of more than 5% over any 50 mm length of joint, nor shall its depth exceed 0.5 mm or 10% of the thickness, whichever is the less.

- (b) **Magnetic Particle Inspection (MPI) and Liquid Penetrant Inspection (LPI):** MPI shall be applied in accordance with BS EN ISO 9934-1 to joints selected in accordance with (d) below, where any of the material thickness exceeds 20 mm. Notwithstanding the requirements of (d) below, MPI or LPI in accordance with BS EN 571-1, shall be applied as appropriate where on visual inspection the presence of cracking or lack of fusion may be suspected. To aid inspection, the profile of the weld may be dressed by burr grinding provided that the specified throat size and leg length is still maintained. The surface of the weld shall be free of cracks, lack of fusion and slag.
- (c) **Ultrasonic Testing:** All butt joints in material 8 mm thick or greater selected in accordance with (d) below shall be ultrasonically tested in accordance with BS EN 1714. The weld shall be free of cracks. The height of buried slag, lack of fusion or lack of penetration shall not exceed 3 mm and within 6 mm of the outer surface their individual lengths shall not exceed 10 mm. The resulting net throat area loss over any 50 mm length of weld shall not exceed 5% of the specified throat area.
- (d) **Frequency of NDT:** Joints shall be selected as follows:
All joints of each type up to a batch size of 10 components and 10% of additional components thereafter. If non-conformances are found the scope of NDT shall be doubled. If further non-conformances are found, the whole batch shall be tested.
- (e) **Reporting:** Inspection records for production welds shall be retained by the manufacturer for three years and those covering the production periods relating to the components supplied shall be made available for examination.

- (v) **Destructive Testing:** Copies of certified reports of destructive tests on components supplied under earlier contracts with the Overseeing Organisation shall be provided.
- (vi) **Frequency of Destructive Testing:** The Contractor shall supply components, or sample joints cut from components, for destructive testing as selected on behalf of the Overseeing Organisation. The basis of selection shall be as follows:
- (a) For batches of less than 100 beam assemblies with transverse butt welds, 1 sample joint shall be supplied unless an identical sample joint from the same works has been destructively tested within the previous four weeks. For batches exceeding 100 or more, 1 sample joint shall be supplied for each subsequent sampling lot not exceeding 100.
- (b) Welded adjuster brackets shall be supplied at a rate of 1 for each sampling lot not exceeding 300.
- (c) Each type of post shall be supplied at a rate of 1 post for each sampling lot not exceeding 1000.
- (d) Each type of surface mounted post shall be supplied at the rate of 1 post for each sampling lot not exceeding 100.
- (e) **For batches of up to 150 vehicle parapet posts:** No test required, provided that records certified by a representative of the Overseeing Organisation are produced of successful testing carried out on posts of the same weld group within the previous 3 months. If no satisfactory record is available, one post to be tested.
- For batches of 150 to 300 vehicle parapet posts:** One post to be tested.
- For batches exceeding 300 vehicle parapet posts:** Two posts to be tested.
- (f) Each type of anchor frame, vehicle parapet connection and connection piece shall be supplied at an interval not exceeding 6 months for each manufacturer's works.
- (g) For batches of up to 150 shop welded vehicle parapet splices and/or less than 50 site welded vehicle parapet splices, one splice shall be supplied for testing unless successful testing has been carried out within the previous 3 months on a similar splice(s), where the splice to be tested was selected by the Overseeing Organisation's representative and the welding is to be carried out by the same personnel. For batches greater than 150 shop welded and/or site welded vehicle parapet splices, two splices shall be tested.
- (h) Other welded components shall be supplied at an interval not exceeding 12 months for each manufacturer's works.
- (vii) **Acceptance Criteria:** The acceptance criteria shall be as specified in sub-Clause 402.6(iv), except that in sub-Clause 402.6(iv)(a), the throat and leg dimension of the weld shall apply to the true rather than apparent dimension.
- (viii) **Non-conformance:** In the event that there is a non-conformance arising from a deviation in materials, preparation, assembly or welding procedure, the batch concerned shall be rejected and further production of the components affected stopped until such time as the fault has been corrected. A minor non-compliance shall only be accepted on the basis that further sampling and testing shows that the fault is not repetitive and will not in that instance impair structural integrity. If the problem can be traced to a particular manufacturing period, operator, piece of equipment or batch of material and if proper traceability to individual batches of components can be assured, only those batches affected may be subjected to rejection.
- (ix) **Test Report:** The destruction test reports shall be retained by the Contractor and recorded in a register for a period of three years. The destructive test samples shall be retained for a period of 18 months. These shall be made available for examination on future contracts with the Overseeing Organisation.
- (x) **Remedial Work:** Welds which do not conform to the Specification may be repaired to an approved procedure as described in sub-Clause 402.6(ii). Welds in aluminium alloys shall not be repaired more than once.

Marking

7 All components, excluding fasteners, reinforcing rings and bars, shall be clearly and durably marked with the manufacturer's identification mark and digits indicating month and year of manufacture. In addition to the marking requirements of BS EN ISO 898-1, fasteners shall be clearly marked with the following:

- (i) (11/06) Safety barrier, terminal, transition, crash cushion manufacturer's identification mark; and
- (ii) Fastener number as referenced on the manufacturer's construction drawings.

Workmanship and Testing

8 (05/05) All components shall be manufactured so as to permit the construction of the accepted systems within the tolerances described in sub-Clauses 403.2 and 403.4 and in accordance with the accepted Drawings submitted by the Contractor.

9 Unless otherwise indicated on the accepted Drawings submitted by the Contractor to the Overseeing Organisation, all fabrication of components shall be completed before galvanizing or metal coating.

10 The Contractor shall provide the Overseeing Organisation with evidence that the manufacturer has arranged for tensile tests to destruction to be carried out by a testing laboratory, accredited in accordance with sub-Clauses 105.3 and 105.4, annually and whenever the production technique is changed.

Handling and Storage

11 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 galvanized coatings and any damage that does occur shall be made good in accordance with BS EN ISO 1461.

Safety Barriers, Terminals, Transitions and Crash Cushions

403 Installation of Safety Barriers, Terminals, Transitions and Crash Cushions - Overall Requirements

Layout

1 The overall layout and location of safety barriers, terminals, transitions and crash cushions shall be as

indicated on the Contract Drawings and described in Appendix 4/1.

2 All safety barriers, terminals and transitions shall be erected to present a flowing alignment in accordance with the following:

- (i) The overall alignment on plan shall not depart from the prescribed alignment by more than ± 30 mm, nor deviate in any 10 m length from the straight or required radius by more than ± 15 mm.

Excavation for Concrete Foundations and Anchor Blocks

3 Excavations for concrete foundations and anchor blocks shall be in accordance with the accepted Drawings submitted by the Contractor to the Overseeing Organisation.

4 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 conforming to BS 8500-2 as appropriate.

5 Impermeable plastic sheeting 125 microns thick shall be laid at the base of an in-situ concrete foundation located in filter drains.

Concrete in Foundations and Anchor Blocks

6 Concrete in foundations and anchor blocks shall be in accordance with the relevant Clauses of this Series and the accepted Drawings submitted by the Contractor to the Overseeing Organisation.

7 The Contractor shall ensure that any concrete which constitutes part of the system has reached the specified strength stated on the accepted Drawings prior to any tensioning taking place.

Beams

8 (11/06) Notwithstanding the manufacturing tolerances permitted for individual beams, the cumulative length tolerance shall be such that beams and posts can be positioned in their prescribed location and the requirements of sub-Clauses 403.1 and 403.2 can be met. With the exception of any special closure pieces necessary to complete lengths of safety barriers, terminals or transitions, beam lengths shall not differ from those described on the accepted Drawings submitted by the Contractor in accordance with sub-Clause 401.5.

Posts

9 (11/06) Where applicable, posts, foundations and post sockets shall be as shown on the accepted Drawings submitted by the Contractor in accordance with sub-Clause 401.5.

10 Where posts are mounted in cast in post sockets these shall be protected to prevent the collection of detritus in the socket voids.

11 When steel posts are driven into the ground this shall be carried out without damage to the post and the protective coating. Any minor damage to the galvanising shall be treated in accordance with BS EN ISO 1461.

Cutting of components

12 No drilling, cutting (including flame cutting) or welding of beams and posts shall be permitted after galvanizing.

13 Special closure pieces shall be fabricated before galvanizing.

Assembly

14 Direct contact between dissimilar metals shall be avoided by interposing non-metallic sleeves, washers or coatings as detailed on the accepted Drawings submitted by the Contractor.

Anchorage and Attachment Systems for Surface Mounted Posts

15 (11/06) Unless otherwise described in Appendix 4/1, at least 4 weeks before installation, the Contractor shall submit to the Overseeing Organisation well attested and documented evidence that proposed anchorages and attachment systems in drilled holes, are capable of resisting the ultimate tensile loads resulting from failure of the proposed safety barrier, terminal, transition or crash cushion system. Where the ultimate capacity of a safety barrier, terminal, transition or crash cushion system, is governed by the failure of the attachment system the evidence shall demonstrate that the anchorages in drilled holes, are capable of resisting the ultimate tensile loads resulting from failure of the attached system. Anchorages of an expanding type, other than undercut anchorages, shall not be permitted.

16 Steel anchorages and attachment systems shall be used for securing surface mounted posts to a concrete or steel base.

17 (11/08) 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. 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 designation 1.4401, 1.4436, 1.4362 or 1.4462 to BS EN 10088-1. Holding down bolts, studs and nuts on bridge decks and other structures shall be stainless steel grade A4-80 to BS EN ISO 3506-1 and BS EN ISO 3506-2. 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 BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10258 and BS EN 10259. 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.

18 (11/06) Except where surface mounted posts are attached to a steel base they shall be bedded on mortar conforming with Clause 2601 and Appendix 26/2. The bedding mortar shall have a minimum thickness of 10 mm and a maximum thickness of 30 mm. An additional allowance may be made for longitudinal falls.

19 (11/06) 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 provide a Specialist's report to the Overseeing Organisation on the consequences of drilling through or cutting the reinforcement. No drilling or cutting shall take place without the prior written acceptance of the Overseeing Organisation.

20 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.

21 (11/06) Attachment systems shall be tightened to the specified torque and have not less than the minimum thread engagement specified by the manufacturer of the system.

22 Stainless steel bolts, screws and nuts shall conform to BS EN ISO 3506-1 and BS EN ISO 3506-2, Grade A4-80. The dimensions and tolerances of the bolts, screws and nuts shall conform to BS EN ISO 4016, BS EN ISO 4018 and BS EN ISO 4034.

23 Stainless steel washers shall conform to BS 4320 and be made from stainless steel strip designation 1.4401 or 1.4436 to BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10258 and BS EN 10259.

24 The threads of steel anchorages shall be lined with grease having a high resistance to creep and being suitable for hot or cold smearing.

25 All voids in anchorages, attachment systems and base plates shall be filled with a non-setting passive filler.

26 Intermediate anchors shall be provided to all wire rope safety barrier systems that are over 1000 m long. They shall be spaced approximately at equal distances between end anchors so that the maximum length of unanchored wire rope safety barrier does not exceed 1000 m. The means of terminating wire ropes shall ensure that there is at least 50% of the normal containment capacity provided at any point within the termination sections. The minimum distance between anchor blocks within the intermediate terminating sections shall be 30 m and the maximum distance 60 m. These requirements shall be stated on the manufacturer's drawings.

27 (11/06) All permanent crash cushion installations shall be monitored over a three-year period from the date upon which completion for the Works or any section thereof, which incorporates crash cushion installations, is certified. All temporary crash cushion installations shall be monitored over the period of deployment. The monitoring of the installations shall comprise recording and reporting to the Overseeing Organisation, in an agreed format, the number of accidents involving the crash cushion and the maintenance/repair costs.

404 Site Testing

(11/06) Anchorages in Drilled Holes for Safety Barriers, Terminals, Transitions and Crash Cushions

1 (11/06) The Contractor shall carry out on-site tensile load tests on anchorages in drilled holes. For the purpose of this sub-Clause the types of fixing referred to in clause 1 of BS 5080-1 shall include "anchorages". Where anchorages are tested they shall be loaded incrementally in tension in accordance with BS 5080-1 except that they shall be capable of resisting a test load equal to 10 per cent above the nominal tensile load applied to the anchorage at failure of the safety barrier, terminal, transition or crash cushion system in lieu of testing to failure. The nominal tensile load shall be determined by the manufacturer of the safety barrier, terminal, transition or crash cushion system. Where the failure of the attachment system (e.g., the holding down bolt) is the prescribed failure mode of the safety barrier, terminal, transition or crash cushion 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 interval stated above.

2 The total movement of the anchorage shall not exceed 1.0 mm during the test. Any evidence of slip during loading as demonstrated by a significant change in the slope of the load/extension curve, shall constitute failure.

3 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.

Post Foundations

4 (11/06) The Contractor shall provide the test equipment and carry out loading tests on post foundations to ascertain compliance with the manufacturer's specification for the proposed safety barrier, terminal, transition and crash cushion system. The tests shall be carried out and the results submitted to the Overseeing Organisation at least one week prior to installation of the relevant lengths of safety barrier, terminal, transition and crash cushion system. The testing frequency shall be in accordance with Appendix 1/5.

5 Where stated in Appendix 4/1, the Overseeing Organisation shall provide the test equipment and carry out loading tests on post foundations installed by the Contractor for that purpose. The Contractor shall make available a vehicle of not less than 5 tonnes for the Overseeing Organisation's use while carrying out the tests.

6 The Contractor shall install test posts and foundations after completion of the finished ground.

7 On completion of loading tests the Contractor shall remove the test posts and foundations and reinstate the finished ground to meet the requirements of the Contract.

8 Where appropriate, the Contractor shall establish and maintain traffic safety and management measures complying with Clause 117 and Appendix 1/17 during installation, loading and removal of the test posts and foundations.

405 Temporary Safety Barriers

1 (11/06) Where 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 them to the locations stated in Appendix 4/1.

2 (11/06) Where temporary safety barriers, terminals and transitions are to be provided by the Overseeing

Organisation, the Contractor shall remove them from the location stated in Appendix 4/1 and install and maintain them. On completion of the Works, the Contractor shall remove the temporary safety barriers, terminals and transitions to the locations stated in Appendix 4/1.

Vehicle Parapets

406 General

1 (11/06) Unless otherwise described in Appendix 4/1, vehicle parapets shall be designed, fabricated, installed and tested in accordance with the following requirements except where these conflict with BS EN 1317-1 and BS EN 1317-2 in which event BS EN 1317-1 and BS EN 1317-2 shall take precedence:

- (i) (11/06) TD 19 (DMRB 2.2.8);
- (ii) (11/06) Clauses 401, 402, Appendix 1/5 and Appendix 4/1;
- (iii) (11/06) BS 6779-1: 1998 (Amd. No. 14290, 21 March 2003) and BS 6779-2 as amended by TD 19 (DMRB 2.2.8); and
- (iv) Clauses 407 to 411.

Aesthetic Requirements

2 The design of vehicle parapets shall comply with the aesthetic requirements given in Appendix 4/1.

407 Anchorages and Attachment Systems for Vehicle Parapets

1 (11/06) Unless otherwise described in Appendix 4/1, the design, fabrication, and installation of the anchorage and attachment system shall conform to the manufacturer's Drawings and specifications, the requirements of BS EN 1317-1, BS EN 1317-2 and TD 19.

2 (11/06) Unless otherwise described in Appendix 4/1, at least 4 weeks before installation, the Contractor shall submit to the Overseeing Organisation well attested and documented evidence that the proposed attachment systems and anchorages in drilled holes are capable of resisting the ultimate tensile loads resulting from failure of the proposed vehicle parapet system. Where the ultimate capacity of a vehicle parapet system is governed by the failure of the attachment system, the evidence shall demonstrate that the anchorages in drilled holes are capable of resisting the ultimate tensile loads resulting from the failure of the attachment

system. Anchorages of an expanding type shall not be permitted.

3 (11/08) Anchorages shall include an internally threaded component to receive the attachment system. All parts of anchorages (where the anchorage is within 80mm of the upper surface of the supporting concrete or where the anchorage part is threaded to receive the holding down bolt) shall be of stainless steel designation 1.4401, 1.4436, 1.4362 or 1.4462 to BS EN 10088-1. Holding down bolts, studs and nuts shall be in stainless steel grade A4-80 to BS EN ISO 3506-1 and BS EN ISO 3506-2. Washers shall conform to BS 4320 and be made from stainless steel strip designation 1.4401 or 1.4436 to BS EN 100029, BS EN 10048, BS EN 10051, BS EN 10258 and BS EN 10259. Metal to metal contact between dissimilar materials within the attachment system and anchorage shall be prevented by the use of non conducting sleeves, washers or coatings to prevent bimetallic corrosion.

4 (11/06) Except where vehicle parapet 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 10 mm and a maximum thickness of 30 mm. An additional allowance may be made for longitudinal falls.

5 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 provide a Specialist's report to the Overseeing Organisation on the consequences of drilling through or cutting the reinforcement. No drilling or cutting shall take place without the prior written acceptance of the Overseeing Organisation.

6 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.

7 (11/06) Attachment systems shall be tightened to the specified torque and have not less than the minimum thread engagement specified by the manufacturer of the system.

8 Stainless steel bolts, screws and nuts shall comply with BS EN ISO 3506-1 and BS EN ISO 3506-2, Grade A4-80. The dimensions and tolerances of the bolts, screws and nuts shall comply with BS EN ISO 4016, BS EN ISO 4018 and BS EN ISO 4034.

9 Stainless steel washers shall comply with BS 4320 and be made from stainless steel strip designation 1.4401 or 1.4436 to BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10258 and BS EN 10259.

10 The threads of steel anchorages shall be lined with grease having a high resistance to creep and being suitable for hot or cold smearing.

11 All voids in anchorages, attachment systems and base plates shall be filled with a non-setting passive filler.

408 Amendments and Additions to BS 6779

1 BS 6779-1: 1998 (Amd. No. 14290, 21 March 2003)

- (i) clause 2:
 - (a) clause 2.1: first paragraph, third line delete “71” and replace with “65”.
- (ii) clause 5:
 - (a) Table 1 - Designation of vehicle parapets, Item a), delete the existing text under “Designation” and “Clause” and insert “As prescribed in BS EN 1317-1, BS EN 1317-2 and DD ENV 1317-4: 2002”.
- (iii) clause 6:
 - (a) clause 6.1 Levels of containment: delete “clause 6.1.1 to clause 6.1.3” and insert “As prescribed in BS EN 1317-1, BS EN 1317-2 and DD ENV 1317-4: 2002”;
 - (b) clause 6.4.1 delete the “NOTE and following text”;
 - (c) clause 6.4.2: delete paragraphs “d) and e)”;
 - (d) clause 6.5.1.4.1: delete “last paragraph of NOTE 2” (i.e. “Details of approved connections proved in service”);
 - (e) (11/06) clause 6.6.2: Main structure: Replace “Department of Transport Standard BD 37/88” with “Highways Agency Standard BD 37 (DMRB 1.3.14)”;
 - (f) clause 6.6.5: End of Note 1, insert: “The tensile strength of concrete shall be ignored in the calculation.”
- (iv) clause 7:
 - (a) (11/06) clause 7.1.2: Notch toughness: Replace “Department of Transport Standard BD 13/90” with “Highways Agency Standard BD 13 (DMRB 1.3)”;

(b) (11/05) Table 3 - Materials of construction for steel parapets: Delete and insert as follows:

Delete	Insert
BS 4848-2	BS EN 10210-2
BS 4848-4	BS EN 10056-1
BS 6363	BS EN 10219-2
BS EN 10113	BS EN 10025-1, BS EN 10025-3 and BS EN 10025-4
BS 1449-1	BS 1449-1.1
BS 1449-2	BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10258 and BS EN 10259
BS 970-3	BS EN 10277-1 to BS EN 10277-5 (inclusive) and BS EN 10278
BS EN 24016	BS EN ISO 4016
BS EN 24018	BS EN ISO 4018
BS EN 24034	BS EN ISO 4034
BS EN 20898-1	BS EN ISO 898-1
BS EN 24014	BS EN ISO 4014
BS EN 24017	BS EN ISO 4017
BS EN 24032	BS EN ISO 4032
BS EN 24035	BS EN ISO 4035
BS EN 20898-1	BS EN ISO 898-1
BS 6105	BS EN ISO 3506-1 and BS EN ISO 3506-2

(c) Table 4 - Materials of construction for aluminium alloy parapets: Delete and insert as follows:

Delete	Insert
BS 1474:1987, alloys 6061, 6063, 6082, 6005A and 6060	BS EN 515, BS EN 573-3, BS EN 573-4, BS EN 755-1 to BS EN 755-9 (inclusive), BS EN 12020-1 and BS EN 12020-2, alloys EN AW-6061, EN AW-6063, EN AW-6082, EN AW-6005A and EN AW-6060

		Delete	Insert
BS 1471:1972, alloys 6061, 6063, and 6082	BS EN 515, BS EN 573-3, BS EN 573-4, BS EN 754-1, BS EN 754-2, BS EN 754-7 and BS EN 754-8, alloys EN AW-6061, EN AW-6063 and EN AW-6082	BS 6105	BS EN ISO 3506-1 and BS EN ISO 3506-2
BS 4300/1:1967, alloy 5251	BS EN 1592-1 to BS EN 1592-4 (inclusive), alloy EN AW-5251	BS 1449-2	BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10258 and BS EN 10259
BS EN 485-1:1994	BS EN 485-1	BS 1490	BS EN 1559-1, BS EN 1559-4, BS EN 1676 and BS EN 1706
BS 1490:1988, alloys LM6 and LM25	BS EN 1559-1, BS EN 1559-4, BS EN 1676 and BS EN 1706, alloys EN AC-47000, EN AC-47100 and EN AC-47200	(c) clause 9.4.1.2, delete "Laminar defects" from title and clause text, insert "Internal discontinuities";	
		(d) clause 9.4.2, Welding: delete sub-clauses 9.4.2.1 to 9.4.3.2.5 inclusive; and	
		(e) clause 9.4.4, delete whole text.	
BS 1449-1	BS 1449-1.1	(vii) clause 10:	
BS 1449-2: 1983, Grades 316 S31 and 316 S33	BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10258 and BS EN 10259, designation 1.4401 or 1.4436	(a) clause 10.1.1: delete last sentence as follows: "Currently approved systems as listed in Annex F are exempt from this requirement."; and	
BS EN 24016	BS EN ISO 4016	(b) clause 10.1.1: insert additional paragraph as follows:	
BS EN 24018	BS EN ISO 4018		"The designer or manufacturer shall arrange for third party certification that the new vehicle parapet design complies with the requirements of BS EN 1317-1, BS EN 1317-2 and Series 400 (MCHW 1.400). The certification shall be undertaken by a body or testing laboratory in any Member State of the European Economic Area, offering suitable and satisfactory evidence of technical and professional competence and independence. The Overseeing Organisation is likely to require to examine the full record of testing."
BS EN 24034	BS EN ISO 4034		
BS EN 20898-1	BS EN ISO 898-1		
BS EN 24014	BS EN ISO 4014		
BS EN 24017	BS EN ISO 4017		
BS EN 24032	BS EN ISO 4032		
BS EN 24035	BS EN ISO 4035		
BS EN 20898-1	BS EN ISO 898-1		
BS 6105	BS EN ISO 3506-1 and BS EN ISO 3506-2		
(v) clause 8:		2 BS 6779-2	
(a) clause 8.3.1, NOTE: delete last sentence.		(i) clause 5	
(vi) clause 9:		(a) clause 5.1: NOTE, delete "British Rail" and insert "Network Rail";	
(a) clause 9.1.1, delete last sentence from first paragraph;		(ii) clause 6:	
(b) clause 9.2, Table 8 - Values of f_k and γ_m : Delete and insert as follows:		(a) (11/06) clause 6.3: Main structure: Replace "Department of Transport Standard BD 37/88" with "Highways Agency Standard BD 37 (DMRB 1.3.14)".	

- (iii) clause 10:
 - (a) clause 10.1 a): NOTE replace “Department of Transport” with “Highways Agency”; and
 - (b) clause 10.1 d): delete “BS 6105” and insert “BS EN ISO 3506-1 and BS EN ISO 3506-2”, delete “BS 729” and insert “BS EN ISO 1461”.
- (iv) clause 11:
 - (a) clause 11.3.5: delete “BS 6105” and insert “BS EN ISO 3506-1 and BS EN ISO 3506-2”, delete “BS 1449-2” and insert “BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10258 and BS EN 10259”; and
- (v) Table 4 - Values of f_k and γ_m :
 - (a) Anchorage and attachment system: 3rd column, delete BS 6105” and insert “BS EN ISO 3506-1 and BS EN ISO 3506-2”, delete “BS 1449-2” and insert BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10258 and BS EN 10259”.
- (vi) Clause 13:
 - (a) clause 13.2.1: Delete “NOTE For more information on safety fences see BS 6579”; and
 - (b) Clause 13.3.1: Delete “NOTE 1 and NOTE 2” completely.
- (vii) Figure 4: Top right hand side, delete “Grade 316 S 33 to BS 1449: Part 2” and insert “designation 1.4401 or 1.4436 to BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10258 and BS EN 10259”.

409 Inspection and Testing of Vehicle Parapet Posts

1 Unless otherwise described in Appendix 4/1, the components for production posts and all completed production posts shall conform to the acceptance criteria described in clause 9.4.3.2.6.3 of BS 6779-1: 1998 (Amd. No. 14290, 21 March 2003).

2 Unless otherwise described in Appendix 4/1, the Contractor shall only supply vehicle parapet posts of a type which have certification for static destructive testing in accordance with clause 9.4.3.2.6.3 of BS 6779-1: 1998 (Amd. No. 14290, 21 March 2003). Test certificates shall be valid for a period of six

months from the date the posts were tested and certified.

410 (11/06) Site Tests on Anchorages in Drilled Holes for Vehicle Parapets

1 (11/06) The Contractor shall carry out on-site tensile load tests on anchorages in drilled holes. For the purpose of this sub-Clause the types of fixing referred to in clause 1 of BS 5080-1 shall include ‘anchorages’. Where anchorages are tested they shall be loaded incrementally in tension in accordance with BS 5080-1 except that they shall be capable of resisting a test load equal to 10 per cent above the nominal tensile load applied to the anchorage at failure of the vehicle parapet in lieu of testing to failure. The nominal tensile load shall be determined by the vehicle parapet manufacturer. Where the failure of the attachment system (e.g., the holding down bolt) is the prescribed failure mode of the vehicle parapet, 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 at the frequency given in Appendix 1/5 and in accordance with any requirements given in Appendix 4/1.

PEDESTRIAN RESTRAINT SYSTEMS

411 Pedestrian Parapets and Pedestrian Guardrails

1 (11/07) Pedestrian parapets and pedestrian guardrails shall conform to BS 7818, TD 19 (DMRB 2.2.8), the requirements of Appendix 4/1 and the following:

- (i) All components of pedestrian parapets and guardrails shall be designed to achieve a serviceable life of not less than:
 - (a) Metal pedestrian parapets and metal components of combined metal and concrete pedestrian parapets – 30 years;

- (b) Concrete pedestrian parapets and concrete components of combined metal and concrete pedestrian parapets – 120 years; and
 - (c) Pedestrian guardrails – 15 years; and
 - (ii) For metal pedestrian parapets and pedestrian guardrails and metal components of combined metal and concrete pedestrian parapets and pedestrian guardrails the serviceable life shall, except where stated in Appendix 4/1, be obtained without the requirement for any maintenance other than that resulting from accidental damage.
- 2** (11/07) Protection against corrosion for pedestrian parapets and pedestrian guardrails, shall be as described in the Manufacturer's Specification and the following:
- (a) All components of steel pedestrian parapets and pedestrian guardrails, except stainless steel items, shall be galvanised after shop fabrication as described in Clause 1909; and
 - (b) Where required in Appendix 4/1, the surface preparation and protection against corrosion of all steel pedestrian parapets and steel components of combined metal and concrete pedestrian parapets shall comply with Series 1900.

ANTI-GLARE SCREENS

412 Anti-glare Screens

1 Anti-glare screen system shall conform to BS EN 12676-1 and BS EN 12676-2 and the requirements of Appendix 4/1.