
SERIES 400
ROAD RESTRAINT SYSTEMS
(VEHICLE AND PEDESTRIAN)

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ROAD RESTRAINT SYSTEMS (VEHICLE AND PEDESTRIAN)

400 (05/17) Road Restraint Systems General

1 (05/17) This Series is part of the Specification for Highway Works. Whilst this Series is particularly relevant to the subject matter in its title it must be read in conjunction with the general requirements in Series 000 and 100 and with all other Series relevant to the specification for the particular works to be undertaken.

2 (05/17) Road restraint systems (RRS) shall be able to achieve the specified performance at the temperatures described in the National Annex (NA) to BS EN 1991-1-5:2003 figures NA.1 and NA.2 and determined in accordance with Figure 6.1 of BS EN 1991-1-5 and the NA. Additionally, the recommended differences in the note to clause 6.1.6 of BS EN 1991-1-5 shall be taken into account to determine the most severe temperature effect, assuming the rail of a parapet to be equivalent to a structural element in 6.1.6 (1) NOTE.

3 (03/20) Where RRS are required to be connected to other RRS, existing systems or new systems, they shall be compatible with each other such that the required performance of each system is achieved and all other specified conditions are met.

VEHICLE RESTRAINT SYSTEMS

General Requirements

401 (05/17) Vehicle Restraint Systems General

1 (05/17) Vehicle restraint systems (VRS) shall conform to this Series and the requirements stated in contract specific Appendix 4/1. VRS, other than the following, shall conform to BS EN 1317-5 and be CE marked:

- Maintenance of legacy systems, as described in sub-Clause 402.1;
- Transitions;
- Terminals;
- Barrier gates (Removable Barrier Sections); and
- Vehicle parapets and combined vehicle/pedestrian parapets constructed as bespoke.

These systems shall conform to the requirements stated in paragraphs (i) to (iv) below.

- (i) Maintenance of legacy systems, as described in sub-Clause 402.1, shall conform to Clauses 402 and 406.
- (ii) Transitions to and between safety barriers (including vehicle parapets) shall conform to the requirements of DD ENV 1317-4.
- (iii) Terminals shall conform to the requirements of DD ENV 1317-4.
- (iv) Barrier gates (Removable Barrier Sections) shall conform to the requirements of DD ENV 1317-4.
- (v) Vehicle parapets and combined vehicle / pedestrian parapets constructed as bespoke shall conform to Clause 406.

2 (03/20) The minimum Performance Class Requirements (Containment Level, Impact Severity Level [ISL], Working Width Class [W], Vehicle Intrusion [VI], Performance Level, Redirection Zone Class [Z], Permanent Lateral Displacement Zone Class [D], Performance Class [P], Permanent Lateral Displacement Zone [D. y. x.], Exit Box Class [Z] and other requirements such as the Length of Need (as defined in CD 377 (DMRB 2.2.8)), the Setback (as defined in CD 377), the minimum height of parapets, requirement for pedestrian provision and the maximum height of the road restraint that allows the required visibility shall be as described in contract specific Appendix 4/1.

3 (03/20) Like-for-like renewal may be used where:

- (i) localised sections need to be temporarily removed to gain access; or
- (ii) where minor repair work is required; or
- (iii) where the VRS is required to be replaced due to incident damage; or
- (iv) where a length of less than 500 m in a section of safety fence between terminals needs to be dismantled or replaced as part of planned maintenance and the remaining length is greater than 500 m and remains unaltered.

(05/17) **Acceptance of Proposals**

4 (03/20) Details of the vehicle restraint systems proposed by the Contractor for both new installations or for maintenance of existing systems shall be submitted to the Overseeing Organisation at least four weeks before the commencement of vehicle restraint system work for acceptance with the following supporting information demonstrating compliance with this specification, and the requirements set out in contract specific Appendix 4/1. Where a Declaration of Performance is required to be submitted this is as required by the Construction Products Regulation (EU No. 305/2011) (CPR) and the relevant harmonised standard.

- (i) For Safety Barriers (excluding vehicle parapets)
 - (a) A Declaration of Performance demonstrating compliance with the contract requirements for the essential characteristics, plus additional information as necessary to demonstrate that the chosen system(s) meets the location specific design criteria as stated in the contract specific specification.
- (ii) For Vehicle Parapets
 - (a) A Declaration of Performance demonstrating compliance with the contract requirements for the essential characteristics, plus additional information as necessary to demonstrate that the chosen system(s) meets the location specific design criteria as stated in the contract specific specification.
 - (b) When required in contract specific Appendix 4/1 the Contractor shall provide evidence that demonstrates the following: that the declared performance was achieved in testing, in accordance with BS EN 1317 Parts 1 and 2 and that the test vehicle did not in any way touch or take advantage of structures which will not be present on the final bridge installation; that is, if the vehicle dropped down behind the bridge installation, it did not touch soil or other supporting devices, or any other feature.
- (iii) For Crash Cushions
 - (a) Declaration of Performance demonstrating compliance with the contract requirements for the essential characteristics, plus additional information as necessary to demonstrate that the chosen system(s) meets the location specific design criteria as stated in the contract specific specification.
- (iv) For the maintenance and repair of Legacy Safety Barriers, as described in sub-Clause 402.1
 - (a) Documentation showing compliance with and operation of the Quality Management requirements of Clause 104 and associated-quality management schemes listed in Appendix A. This shall include the quality plans required in sub-Clause 104.5 which shall make specific reference to the management of the vehicle restraint operations and all associated operations. The documentation shall identify quality management procedures for each vehicle restraint activity for each system included in the works.
 - (b) For legacy systems documentation showing compliance with the Safety Barrier Systems Drawings such as those detailed in the Non Proprietary Safety Barrier Systems Rev 1 drawings or outwith the Highways England network guidance should be sort from the appropriate Overseeing Organisation.

- (v) For Vehicle Parapets and Combined Vehicle / Pedestrian Parapets constructed as bespoke.
 - (a) Documentation showing compliance with BS 6779-2 as amended by this Series and CD 377 (DMRB 2.2.8).
- (vi) For Combined Vehicle/Pedestrian Parapets
 - (a) Declaration of Performance demonstrating vehicle containment achieves compliance with the contract requirements for the essential characteristics, plus additional information as necessary to demonstrate that the chosen system(s) meets the location specific design criteria as stated in the contract specific specification.
 - (b) For maintenance of legacy systems as described in sub-Clause 402.1 documentation showing compliance with BS 6779-1 as amended by this Series 400 and CD 377 (DMRB 2.2.8) for pedestrian containment.
 - (c) For the pedestrian containment aspects documentation as per the requirements of sub-Clause 401.5. Where such documentation has previously been submitted to the Overseeing Organisation and the system has been listed as described in sub-Clause 104.20 further submission of this documentation may not be necessary. Where the Contractor proposes to use such systems the Contractor shall confirm the relaxation of these documentation requirements with the Overseeing Organisation.
 - (d) When required in contract specific Appendix 4/1 the Contractor shall provide evidence that demonstrates the following: that the declared performance was achieved in testing, in accordance with BS EN 1317 Parts 1 and 2 and that the test vehicle did not in any way touch or take advantage of structures which will not be present on the final bridge installation; that is, if the vehicle dropped down behind the bridge installation, it did not touch soil or other supporting devices, or any other feature.
- (vii) For Transitions between vehicle restraint systems
 - (a) Documentation showing compliance with and operation of the Quality Management requirements of Clause 104 and associated quality management schemes listed in Appendix A, as required in sub-Clause 401.4 paragraph (iv)(a).
 - (b) Documentation demonstrating compliance with DD ENV 1317-4 and the contract performance requirements.
 - (c) Documentation as per the requirements of sub-Clause 401.5. Where such documentation has previously been submitted to the Overseeing Organisation and the system has been listed as described in sub-Clause 104.20 further submission of this documentation may not be necessary. Where the Contractor proposes to use such systems the Contractor shall confirm the relaxation of these documentation requirements with the Overseeing Organisation.
- (viii) For Terminals to vehicle restraint systems
 - (a) Documentation showing compliance with and operation of the Quality Management requirements of Clause 104 and associated quality management schemes listed in Appendix A, as required in sub-Clause 401.4 paragraph (iv)(a).
 - (b) Documentation demonstrating compliance with DD ENV 1317-4 and the contract performance requirements.
 - (c) Documentation as per the requirements of sub-Clause 401.5. Where such documentation has previously been submitted to the Overseeing Organisation and the system has been listed as described in sub-Clause 104.20 further submission of this documentation may not be necessary. Where the Contractor proposes to use such systems the Contractor shall confirm the relaxation of these documentation requirements with the Overseeing Organisation.

(ix) For motorcyclist protection systems

(a) Documentation to confirm compatibility with the associated VRS and to demonstrate compliance with other specification requirements.

5 (03/20) Where specified in sub-Clause 401.4 the following information shall be provided to the Overseeing Organisation. Where required the Contractor shall complete the proforma included in contract specific Appendix 4/2.

(i) Test report in accordance with either BS EN1317-2, Annex A or BS EN 1317-3, Annex A or DD ENV 1317-4:2002, clause 7.8.

(ii) Video/high speed film of test annotated showing date, test number and performance class.

(iii) Still photographs of complete installation including anchorage points.

(iv) Still photographs of vehicle before and after impact.

(v) Full drawings of tested items.

(vi) Certification from the manufacturer that the item tested complies with the drawings supplied.

(vii) Certificate from a test house accredited in accordance with the requirements of sub-Clause 105.4.

(05/17) **Durability**

6 (03/20) Safety barriers, vehicle parapets, terminals, transitions, removable barrier sections 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, removable barrier sections 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 metal 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 contract specific Appendix 4/1, be obtained without the requirement for any maintenance other than that resulting from accidental damage. In addition metal components of combined metal and concrete parapets shall be capable of replacement without damage to the concrete components.

(05/17) **Information Required to be Provided by the Contractor Prior to Installation**

7 (03/20) The following information shall be provided by the Contractor to the Overseeing Organisation, all documentation shall be in English.

For all proposed road restraint systems:

(i) Information as required in sub-Clause 401.4.

(ii) Installation drawings.

(iii) Manufacturer's installation instructions or installation manual including foundation requirements and test methods to verify their performance.

- (iv) Manufacturer's repair and maintenance manual.
- (v) For each organisation undertaking vehicle restraint system work certificate(s) of registration to the relevant National Highways Sector Scheme(s) listed in Appendix A. The certificate(s) of registration shall include in the scope of registration installation of the vehicle restraint system(s) being installed.
- (vi) Where contract specific Appendix 4/1 specifies requirements for loads imposed by road restraint systems on foundations or structures the nominal loads (direct forces, moments and co-existent shears) that will be transferred from the barrier or parapet to the structure or foundation shall be provided.

(05/17) **Information Required to be Provided by the Contractor After Installation**

8 (03/20) The Contractor shall provide to the Overseeing Organisation as-built drawings which shall include plans and details of the constructed system. The Contractor shall also provide to the Overseeing Organisation for each proprietary system installed, a certificate certifying that it has been installed fully in accordance with the manufacturer's instructions.

(05/17) **Marking**

9 (03/20) All components of systems that fall within the scope of the Construction Products Regulation (EU No. 305/2011) (CPR) shall be marked in accordance with the requirements of the CPR and the relevant harmonised standard.

(05/17) **Handling and Storage**

10 (03/20) 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 repaired in accordance with BS EN ISO 1461.

(05/17) **Installation Instructions**

11 (03/20) The Contractor shall ensure that the installation instructions, or installation manual as required by BS EN 1317-5, for a proposed system includes all the information necessary to install the road restraint system in the locations shown on the drawings such that the system will meet its declared performance.

12 (03/20) Installation instructions shall be appropriate to the road restraint system being installed and its location. The use of the system relative to different ground and other conditions of installation and use, including limitations (e.g. permitted temperature range), shall be defined in the installation manual.

The installation manual shall also include the following information and any additional information appropriate to the system proposed and its proposed location.

- (i) Erection:
 - (a) assembly drawings, of the product tested, including tolerances, anchorages, end parts – where relevant, installation height above pavement and/or ground levels, other installation details appropriate to the installation for the specific locations including changes relevant to different set-backs from the edge of carriageway, etc.;
 - (b) description of the installation works, including equipment and specific details for installation on a curve, with minimum allowed radius on a convex curve and concave curve;
 - (c) procedures for installation (erection, assembly, foundations, anchorages and bolt torques when relevant etc.);
 - (d) all tools required to perform a proper installation of the system;

- (e) ambient temperature and humidity at time of installation (if relevant) and how installation should be adjusted for the ambient conditions at the time of installation;
 - (f) details of tensioning (if relevant);
 - (g) particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions);
 - (h) description of the soil, pavement and/or foundations characteristics and conditions suitable for the system and information about conditions which can influence the behaviour of the product;
 - (i) details of any testing of the installation or other on installation specific testing; e.g. post push tests to prove the proposed foundation system;
 - (j) any other relevant recycling information, details of toxic or dangerous materials present in the works.
- (ii) Maintenance and inspection:
- (a) provisions for repair, inspection and maintenance, including indications for disassembling and reassembling or reconstruction of damaged system;
 - (b) in service tolerances including for installation height.
- (iii) The following information is applicable specifically to safety barriers:
- (a) recommended range of length of the safety barrier (minimum / maximum), curve radius etc.;
 - (b) provisions for installing lengths above the minimum;
 - (c) recommended arrangements for dealing with exposed rail ends (e.g. flaring, terminals, etc.);
 - (d) recommended soils, slopes, possibility of plinth installation and specific instructions;
 - (e) recommended arrangements for drainage through and/or in front of the safety barrier;
 - (f) other safety barrier types which can easily be connected with the product.
- (iv) The following information is applicable specifically to terminals:
- safety barrier types which can be connected to the product.

(05/17) **Further installation requirements**

13 (03/20) All VRS shall be installed, refurbished, repaired and maintained by operatives that have been trained under the relevant National Highway Sector Schemes listed in Appendix A or equivalent as stated in sub-Clause 104.11. The Contractor shall, in accordance with sub-Clause 104.10, provide evidence to the Overseeing Organisation to demonstrate that the operatives' accreditation to the relevant scheme(s) is current and valid.

Any non-conformances with the relevant sector scheme shall be notified to the sector scheme Advisory Committee Secretary. A copy of this shall be submitted to the Overseeing Organisation.

402 (05/17) **Components for Maintenance and Repair of Legacy Vehicle Restraint Systems**

1 (05/17) Legacy systems are VRS that are currently on the road network that are not CE marked. The requirements given in this Series with respect to legacy systems are for the maintenance and repair of such systems. All new VRS shall comply with the requirements of Clause 401.

2 (05/17) For the purpose of vehicle parapet requirements, this Clause shall also be read in conjunction with Clause 406.

(05/17) **Materials**

3 (03/20) 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 401.4 and other requirements of this Series. It shall be demonstrated that the materials are within the limits of statistical variation for the specified material and for the material of the prototype tested system. Materials significantly exceeding the original specified strength shall not be accepted.

4 (05/17) 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 contract specific Appendix 26/1.

(05/17) **Protection Against Corrosion**

5 (05/17) Protection against corrosion shall be as described in the manufacturer's specification and the following:

- (i) all steel components except stainless steel items, concrete foundation reinforcing rings and reinforcing bars that will be permanently embedded in concrete shall be galvanized after shop fabrication as described in Clause 1909; and
- (ii) where required in contract specific 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.

(05/17) **Tolerances**

6 (05/17) Fabrication tolerances, including tolerance on hole diameters, shall be as shown and described on the drawings submitted by the Contractor in accordance with sub-Clauses 401.3(iv) and 401.6. Components, which are to be galvanized or metal coated, shall be measured before galvanizing or metal coating.

(05/17) **Welding**

- 7**
- (i) (03/20) 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 401.4 and 401.7, shall be as described in BS EN ISO 2553. Welding shall not be used except as where detailed on the drawings submitted by the Contractor in accordance with sub-Clause 401.4 and 401.7. 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) 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-Clause 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) 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-Clause 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 ISO 9712. 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 ISO 17637 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. All welds to be free of cold lap. 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 ISO 17640. 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 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 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 402.7(iv), except that in sub-Clause 402.7(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 402.7(ii). Welds in aluminium alloys shall not be repaired more than once.

(05/17) **Marking**

8 (05/17) 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) safety barrier, terminal, transition, crash cushion manufacturer's identification mark; and
- (ii) fastener number as referenced on the manufacturer's construction drawings.

(05/17) **Workmanship and Testing**

9 (05/17) 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. Changes in material properties outside those used in the type tests of the systems shall not be permitted.

10 (05/17) Unless otherwise indicated on the accepted drawings submitted by the Contractor to the Overseeing Organisation, all fabrication of components shall be completed before the surface protection is applied.

11 (05/17) 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-Clause 105.4, annually and whenever the production technique is changed.

(05/17) **Quality Management**

12 (05/17) Parapet legacy system components used for repair and maintenance shall be manufactured by an organisation registered to National Highways Sector Scheme 5A for the Manufacture of Parapets for Road Restraint Systems. The Contractor shall submit a certificate of registration to the Overseeing Organisation. The scope of registration shall include the components being installed.

(05/17) **Safety Barriers, Terminals, Transitions, Removable Barrier Sections and Crash Cushions**

403 (05/17) **Installation of Safety Barriers (except vehicle parapets), Terminals, Transitions, Removable Barrier Sections and Crash Cushions - Overall Requirements**

(05/17) **Layout**

1 (05/17) The overall layout and location of safety barriers, terminals, transitions, removable barrier sections (RBS) and crash cushions shall be as indicated on the contract drawings and described in contract specific Appendix 4/1.

2 (05/17) All safety barriers, terminals, transitions and RBS shall be erected to present a flowing alignment. Unless a requirement is given in the manufacturer's installation instructions or installation manual, all safety barriers, terminals and transitions shall be erected in accordance with the following:

- (i) The overall alignment on plan shall not depart from the prescribed alignment by the more onerous requirements of either:
 - (a) the manufacturer's drawings; or
 - (b) more than ± 30 mm, nor deviate in any 10 m length from the straight or required radius by more than ± 15 mm.
- (ii) Vertical alignment – this shall be in accordance with the manufacturer's installation instructions or installation manual except for works in relation to existing legacy safety barrier systems where the installation heights shall be as given on the installation drawings for those products.

(05/17) **Excavation for Concrete Foundations and Anchor Blocks**

3 (05/17) Excavations for concrete foundations and anchor blocks shall be in accordance with the manufacturer's instructions or installation manual, or for legacy systems to the detailed drawings, submitted by the Contractor to the Overseeing Organisation.

4 (05/17) Where the sides of the excavations cannot be maintained vertical until concrete is placed, suitable permanent or temporary formwork shall be used. The formwork shall be installed immediately after excavation and any lateral overbreak of the excavation shall be filled with concrete conforming to BS 8500-2 or the accepted manufacturer's instructions or installation manual submitted by the Contractor to the Overseeing Organisation as appropriate.

5 (05/17) Impermeable plastic sheeting 500 gauge thick shall be laid at the base of an in-situ concrete foundation located in filter drains.

(05/17) **Concrete in Foundations and Anchor Blocks**

6 (05/17) Concrete in foundations and anchor blocks shall be in accordance with the relevant Clauses of this Series and the manufacturer's instructions, or for maintenance and repair works related to existing legacy systems to the Non-Proprietary Safety Barrier System Drawings Rev 1 submitted by the Contractor to the Overseeing Organisation.

7 (05/17) The Contractor shall ensure that any concrete which constitutes part of the road restraint system has reached the specified strength stated on the accepted drawings prior to any tensioning of the road restraint system taking place.

(05/17) **Beams**

8 (03/20) 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, transitions or RBS, beam lengths shall not differ from those described on the accepted drawings submitted by the Contractor in accordance with sub-Clause 401.4 and 401.7.

(05/17) **Posts**

9 (03/20) Where applicable, posts, foundations and post sockets shall be in accordance with the manufacturer's instructions, or for legacy systems to the detailed drawings, submitted by the Contractor in accordance with sub-Clause 401.4 and 401.7.

10 (05/17) Where posts are mounted in cast in post sockets these shall be protected to prevent the collection of detritus in the socket voids.

11 (05/17) When steel posts are driven into the ground this shall be carried out without damage to the post and the protective coating. Any superficial damage to the galvanising shall be treated in accordance with BS EN ISO 1461 unless the manufacturer's instructions require more comprehensive repairs.

(05/17) **Cutting of components**

12 (05/17) No drilling, cutting (including flame cutting) or welding of beams and posts shall be permitted after the corrosion protection to the system has been applied.

13 (05/17) Special closure pieces shall be fabricated before corrosion protection is applied.

(05/17) **Assembly**

14 (05/17) Direct contact between dissimilar metals shall be avoided. Where necessary to prevent direct contact, this shall be achieved by interposing a dielectric separator in accordance with the manufacturer's instructions, or for legacy systems to the detailed drawings, submitted by the Contractor.

(05/17) **Anchorage and Attachment Systems for Surface Mounted Posts**

15 (05/17) Unless otherwise described in contract specific Appendix 4/1, the Contractor shall submit to the Overseeing Organisation, at least 4 weeks before installation, 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, RBS or crash cushion system. Where the ultimate capacity of a safety barrier, terminal, transition, RBS 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 (05/17) Unless otherwise specifically indicated on the accepted manufacturer's instructions or installation manual submitted by the Contractor to the Overseeing Organisation, steel anchorages and attachment systems shall be used for securing surface mounted posts to a concrete or steel base.

17 (05/17) Unless otherwise specifically indicated on the accepted manufacturer's instructions or installation manual submitted by the Contractor to the Overseeing Organisation, where surface mounted posts are to be installed on a highway structure, 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 and BS EN ISO 9445. Unless specifically indicated on the accepted manufacturer's instructions submitted by the Contractor to the Overseeing Organisation direct 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 (05/17) Unless specifically indicated on the accepted manufacturer's instructions or installation manual submitted by the Contractor to the Overseeing Organisation or where surface mounted posts are attached to a steel base the base plate shall be bedded on mortar conforming with Clause 2601 and contract specific 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 (05/17) 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 (05/17) 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 (05/17) 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 (05/17) 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 (05/17) 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, and BS EN ISO 9445.

24 (05/17) Unless expressly prohibited by the manufacturer's instructions or installation manual 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 (05/17) Voids shall be sealed with a durable, non-structural and impermeable filler to prevent ingress of moisture and deleterious substances. Sealing of voids in anchorages, attachment systems and base plates with a non-structural impermeable durable filler is important to prevent water ingress and to avoid corrosion and damage. Fillers may be derived from polymers or elastomers, but shall exclude acrylic or polyester based materials.

404 (05/17) Site Testing for Contract Compliance

(05/17) Anchorages in Drilled Holes for Safety Barriers, Terminals, Transitions and Crash Cushions

1 (05/17) 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”. Unless more onerous or alternative testing is proposed in the manufacturer’s installation manual accepted by the Overseeing Organisation the following testing methodology shall be applied.

- (i) 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.
- (ii) The nominal tensile load shall be determined by the manufacturer of the safety barrier, terminal, transition, RBS 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, RBS 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.
- (iii) 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.
- (iv) The testing frequency shall be in accordance with contract specific Appendix 1/5. In addition, testing shall comply with any special requirements given in contract specific Appendix 4/1.

(05/17) Post Foundations

2 (05/17) The Contractor shall provide the test equipment and carry out loading tests on post foundations to ascertain compliance with the manufacturer’s specification or installation manual for the proposed safety barrier, terminal, transition, RBS 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, RBS and crash cushion system. The testing frequency shall be in accordance with contract specific Appendix 1/5 or the manufacturer’s installation manual if this stipulates a more onerous testing regime.

3 (05/17) Where stated in contract specific 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.

4 (05/17) The Contractor shall install test posts and foundations after completion of the finished ground.

5 (05/17) 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.

405 (05/17) Temporary Safety Barriers

1 (03/20) Where required in contract specific 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 contract specific Appendix 4/1. Temporary safety barriers shall meet the performance and other requirements stated in contract specific Appendix 4/1. Temporary safety barriers shall provide suitable protection for vulnerable features within the works areas.

2 (05/17) 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 contract specific 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 contract specific Appendix 4/1.

3 (03/20) Temporary crash cushions shall have a minimum containment class of N2 and impact severity level not exceeding level B as defined by BS EN 1317. The Contractor shall provide evidence to demonstrate that the crash cushion(s) have been tested and meet these criteria, suitable evidence would be a declaration of performance in accordance with BS EN 1317-5.

(05/17) Vehicle Parapets (including Vehicle / Pedestrian Parapets)

406 (05/17) General

1 (03/20) Unless otherwise described in contract specific Appendix 4/1, vehicle parapets shall be in accordance with the following requirements except where these conflict with BS EN 1317-5 in which event BS EN 1317-5 shall take precedence:

- (i) CD 377 (DMRB 2.2.8);
- (ii) Clause 401, contract specific Appendix 1/5 and contract specific Appendix 4/1;
- (iii) Clauses 407 to 410.

Legacy systems, as described in sub-Clause 402.1, shall be in accordance with Clause 402 and BS 6779-1.

Vehicle parapets and combined vehicle / pedestrian parapets constructed as bespoke in concrete shall be in accordance with BS 6779-2.

2 (03/20) Unless otherwise stated in contract specific Appendix 4/1, metal parapets shall have a plinth upstand of 50mm high with a tolerance of -0/+50mm.

(05/17) Aesthetic Requirements

3 (03/20) Vehicle parapets shall comply with the aesthetic requirements given in contract specific Appendix 4/1.

(05/17) Layout

4 (03/20) The overall layout and location of vehicle parapets shall be as indicated on the contract drawings and described in contract specific Appendix 4/1.

(05/17) Maintenance and Repair

5 (03/20) Components used for maintenance and repair of parapets shall match the performance characteristics of the existing parapet and shall comply with the requirements stated in contract specific Appendix 4/1. Components are to be of identical design, detail, specification and geometry to the parapet components originally installed and are to be installed such that the completed repair is like for like. Except that in addition the requirements and standards current at the time of manufacture of the original parapet shall apply, subject to such revisions and modifications applicable to the parapet type during the period of original manufacture, the capacity of the components shall be comparable to that of the original components as tested.

6 (03/20) The maintenance and/or repair of CE marked parapets shall be undertaken in accordance with the manufacturer's installation manual and requirements for the parapet using components which are identical in design, specification and geometry to the parapet components originally installed.

7 (03/20) Steel parapets shall be galvanised, but not painted unless required for aesthetic reasons.

(03/20) **Masonry and Brickwork Facings**

8 (03/20) Where reinforced concrete parapets are to be faced with masonry or brickwork the following minimum requirements shall apply:

- (i) fixings shall be spaced at not more than 450mm horizontally and 300mm vertically;
- (ii) brick reinforcing mesh shall be incorporated into the bedding joints below those containing the fixings, where this is not practical uncoursed work will not be used where detached masonry would cause a hazard to the public and shall not be used on the front face to the parapet;
- (iii) fixings and reinforcing mesh shall be stainless steel and shall not be placed in contact with carbon steel reinforcement;
- (iv) stone used on the front face shall be close jointed ashlar or smooth blocks with bricks having a smooth surface; and the pointing is to be near flush.

9 (03/20) Where masonry on the front face of the parapet has an irregular surface finish, the plane through the peaks shall be flat for straight vehicle parapets, and follow the nominal vehicle parapet curvature for curved vehicle parapets.

Masonry on the front face of the parapet may have an irregular surface finish, but overall, the parapet should be smooth faced.

Where it is impractical to provide reinforcing mesh, uncoursed work shall:

- (i) only be permitted where there is a low probability of detached masonry presenting a hazard to the public; and
- (ii) not be permitted on the front face of the parapet.

(03/20) **Stone and Precast Concrete Copings**

10 (03/20) Stone and precast concrete copings shall be secured to the concrete backing by fixings capable of resisting at the ultimate limit state a horizontal force of 33kN per metre of coping.

407 (05/17) **Anchorage and Attachment Systems for Vehicle Parapets**

1 (03/20) Unless otherwise described in contract specific 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&2, this Series 400 and CD 377 (DMRB 2.2.8).

2 (03/20) Unless otherwise covered under the CE marked system's Declaration of Performance and its supporting documentation or described in contract specific Appendix 4/1, the Contractor shall submit to the Overseeing Organisation, at least 4 weeks before installation, well attested and documented evidence that the proposed fixings, including all cradles, anchorages and attachment systems, are capable of resisting the applied load effects resulting from collision with 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 anchorages in drilled holes are capable of resisting the ultimate tensile loads resulting from the failure of the attachment system so that an anchorage does not fail within the section embedded within the supporting structure and is able to be reused in the event of the need to replace a parapet that has suffered collision damage.

3 (05/17) Anchorages of an expanding type shall not be permitted.

4 (05/17) Unless otherwise specifically indicated on the accepted manufacturer's drawings submitted by the Contractor to the Overseeing Organisation anchorages shall include an internally threaded component to receive the attachment system.

5 (05/17) 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 all parts of the anchorage shall be of stainless steel designation 1.4401, 1.4436, 1.4362 or 1.4462 to BS EN 10088-1.

6 (05/17) 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.

7 (05/17) Unless specifically indicated on the accepted manufacturer's drawings submitted by the Contractor to the Overseeing Organisation direct 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.

8 (05/17) Unless specifically indicated in the manufacturer's installation manual submitted by the Contractor and accepted by the Overseeing Organisation, or where the vehicle parapet posts are attached to a steel base, the posts shall be bedded on mortar complying with Clause 2601 and contract specific 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.

9 (05/17) 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.

10 (05/17) 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.

11 (05/17) Attachment systems shall be tightened to the torque given in the manufacturer's installation manual and have not less than the minimum thread engagement specified by the manufacturer of the system.

12 (05/17) 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.

13 (05/17) 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 and BS EN ISO 9445.

14 (05/17) Unless expressly prohibited by the manufacturer's drawings, and to facilitate removal of holding down bolts for maintenance or repair, the threads of steel anchorages shall be coated with anti-seize compound having a high resistance to creep, intended for use with the materials that form both component thread faces and being suitable for hot or cold smearing.

15 (05/17) All voids in anchorages, attachment systems and base plates shall be filled with a non-setting passive filler to prevent the ingress of moisture.

408 (05/17) **Amendments and Additions to BS 6779**

1 (05/17) **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) clause 6.6.2: Main structure: Replace “Department of Transport Standard BD 37/88” with “BS EN 1991-2 clause 4.7.3 and the National Annex to BS EN 1992-2”; and
 - (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) clause 7.1.2: Notch toughness: Replace “Department of Transport Standard BD 13/90” with “BD 13 (DMRB 1.3)”;
 - (b) 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 1387	BS EN 10255
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 ISO 9445
BS 970-1	BS EN 10087
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
BS 4395-1	BS EN 14399

(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 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
BS 1471:1972, alloys 6061, 6063 and 6082	BS EN 515, BS EN 573-3, 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 4300/1:1967, alloy 5251	BS EN 1592-1 to BS EN 1592-4 (inclusive), alloy EN AW-5251
BS EN 485-1:1994	BS EN 485-1
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
BS 1449-1	BS 1449-1.1
BS 1449-2: 1983, Grades 316 S31, and 316 S33	BS EN 10029, BS EN 10048, BS EN 10051, and BS EN ISO 9445, designation 1.4401 or 1.4436
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

(v) Clause 8:

(a) clause 8.3.1, NOTE: delete last sentence.

(vi) Clause 9:

(a) clause 9.1.1, delete last sentence from first paragraph;

(b) clause 9.2, Table 8 – Values of f_k and γ_m : delete and insert as follows

Delete	Insert
BS 6105	BS EN ISO 3506-1 and BS EN ISO 3506-2
BS 1449-2	BS EN 10029, BS EN 10048, BS EN 10051, and BS EN ISO 9445
BS 1490	BS EN 1559-1, BS EN 1559-4, BS EN 1676 and BS EN 1706

(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.

(vii) Clause 10:

- (a) clause 10.1.1: delete last sentence as follows: “Currently approved systems as listed in Annex F are exempt from this requirement.”; and
- (b) clause 10.1.1: insert additional paragraph as follows
“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.”

2 (05/17) BS 6779-2: 1991

(i) Clause 0.2

Delete first sentence and replace with “The specification requirements are based upon the results of tests on panels of 2.1 m and 3.0 m lengths and it is considered reasonable to extrapolate to include panel lengths from 2.0 m to 3.5 m.”

(ii) Clause 5

- (a) clause 5.2: NOTE 2, delete “British Rail” and insert “railway or tramway operator”.

(iii) Clause 6:

- (a) clause 6.3: Main structure: Replace “Department of Transport Standard BD 37/88” with “BS EN 1991-2 clause 4.7.3 and the National Annex to BS EN 1992-2”.

(iv) Table 2

Delete title of table and replace with “Table 2 — Equivalent static nominal loads for in situ and precast concrete parapets applicable to panel lengths (L) 2.0 m to 3.5 m.

(v) Clause 7

- (a) clause 7: delete “BS 5400-2” and insert “BS EN 1990 and BS EN 1991-1-7”.

(vi) Clause 10:

- (a) clause 10.1 delete initial paragraph and replace with: “Concrete parapets are likely to be directly affected by de-icing salts, traffic fumes and other corrosive elements: therefore they shall be constructed in accordance with Specification for Highway Works Series 1700. In particular they shall comply with the following:”
- (b) clause 10.1 (a). Note: delete the note in its entirety;
- (c) clauses 10.1(a), (b) and (c): delete and replace with
“(a) Concrete exposure classes shall be in accordance with BS 8500-1. The minimum allowable concrete exposure classes shall be XC3 + XD3 + XF4. Exposure classes XS and XA shall be suitable for the site conditions.
(b) The minimum grade of concrete shall be C32/40 as specified in BS 8500-1.
(c) The nominal cover to reinforcement shall be as specified in BS 8500-1 (see also 11.3.2).”;
- (d) 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”.

- (vii) Clause 11:
 - (a) clause 11.2.4: delete “BS 5400-3” and insert “BS EN 1993-1-1:2005, BS EN 1993-1-5:2006, BS EN 1993-1-8, BS EN 1993-1-10 and BS EN 1993-2”;
 - (b) 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 and BS EN ISO 9445”.
- (viii) 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 and BS EN ISO 9445”.
- (ix) Clause 12
 - (a) Delete “and shall not be less than 1.5 m” and replace with “and shall not be less than 2.0 m”.
- (x) 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.
- (xi) Figure 4:
 - (a) 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 and BS EN ISO 9445.

409 (05/17) Inspection and Testing of Vehicle Parapet Components

- 1 (05/17) Inspection and testing of vehicle parapet posts shall be carried out by the Contractor as per the manufacturer’s installation manual.
- 2 (05/17) When required in contract specific Appendix 4/1 components of legacy systems shall comply with the following.
 - (i) The components for parapet posts and all completed parapet posts shall conform to the acceptance criteria described in clauses 9.4 and 9.5 of BS 6779-1.
 - (ii) 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.

410 (05/17) Site Tests on Anchorages in Drilled Holes for Vehicle Parapets for Contract Compliance

- 1 (05/17) 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 (05/17) Unless specifically indicated on the accepted manufacturer’s instructions submitted by the Contractor to the Overseeing Organisation 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 (05/17) The Contractor shall test the anchorages at the frequency given in contract specific Appendix 1/5 and in accordance with any requirements given in contract specific Appendix 4/1.

PEDESTRIAN RESTRAINT SYSTEMS

411 (05/17) **Pedestrian Parapets and Pedestrian Guardrails**

(05/17) **General**

1 (03/20) Pedestrian parapets and pedestrian guardrails shall conform to the requirements of this Clause, contract specific Appendix 4/1, CD 377 (DMRB 2.2.8) and the following.

- (i) Pedestrian parapets or guardrails assembled from factory manufactured parts and assembled on site:
 - (a) BS 7818.
- (ii) Bespoke pedestrian parapets manufactured from concrete on site:
 - (a) In Accordance with the loading described in BS 6399-1 Table 4 Class C5 (x) and BS EN 1992-2.

(05/17) **Durability**

2 (05/17) Pedestrian parapets and pedestrian guardrails shall conform to 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.
- (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 contract specific Appendix 4/1, be obtained without the requirement for any maintenance other than that resulting from accidental damage.

3 (05/17) Protection against corrosion for pedestrian parapets and pedestrian guardrails, shall be as described in the manufacturer's specification and the following:

- (i) all components of steel pedestrian parapets and pedestrian guardrails, except stainless steel items, shall be surface protected after shop fabrication as described in Clause 1909; and
- (ii) where required in contract specific 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.

(05/17) **Aesthetic Requirements**

4 (05/17) The design of pedestrian parapets shall comply with the aesthetic requirements given in contract specific Appendix 4/1.

(05/17) **Information Required to be Provided by the Contractor Prior to Installation**

5 (05/17) The following information shall be provided by the Contractor to the Overseeing Organisation for acceptance. All documents shall be in English.

- (i) Manufacturer's specification.
- (ii) Installation drawings.

- (iii) Manufacturer's installation instructions or installation manual including foundation requirements and test methods to verify their performance.
- (iv) Manufacturer's repair and maintenance manual.
- (v) A certificate of registration to National Highways Sector Scheme 2A for the Design and/or Supply, Installation and Repair of Fences for Infrastructure Works.

(05/17) Workmanship and Testing

- 6** (05/17) All components shall be manufactured so as to permit the construction of the accepted systems within the tolerances described in sub-Clause 403.2 and in accordance with the manufacturer's drawings.
- 7** (05/17) Unless otherwise indicated on the manufacturer's drawings submitted by the Contractor to the Overseeing Organisation, all fabrication of components shall be completed before the surface protection is applied.
- 8** (05/17) The Contractor shall provide the Overseeing Organisation with evidence that the manufacturer has arranged for tensile tests to destruction and analysis of composition to be carried out by a testing laboratory, accredited in accordance with sub-Clause 105.4, annually and whenever the source of material or the production technique is changed.

The testing shall include at least the determination of the yield/proof strength of the material, ultimate strength and the extension at break. It shall be demonstrated that the materials are within the limits of statistical variation for the specified material and for the material of the prototype tested system. Materials significantly exceeding the original specified strength shall not be accepted.

(05/17) Handling

- 9** (05/17) 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 repaired in accordance with BS EN ISO 1461.

(05/17) Information Required to be Provided by the Contractor After Installation

- 10** (05/17) The Contractor shall provide to the Overseeing Organisation as-built drawings which shall include plans and details of the constructed system.

ANTI-GLARE SCREENS

412 (05/17) Anti-glare Screens

- 1** (05/17) Anti-glare screen systems shall conform to BS EN 12676-1 and BS EN 12676-2 and the requirements of contract specific Appendix 4/1. The Contractor shall supply the Declaration of Performance which shall demonstrate that the anti-glare screen system meets the performance requirements stated in contract specific Appendix 4/1. The Contractor shall provide information to the Overseeing Organisation in English to demonstrate that the screens are compatible with the vehicle restraint system on which the screens are proposed to be mounted and do not adversely affect the performance of the vehicle restraint system.