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Specification for Road Restraints Systems (Vehicle and Pedestrian)

CC-SPW-00400

June 2020

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TII Publications



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Updates to TII Publications resulting in changes to Specification for Road Restraints Systems (Vehicle and Pedestrian) CC-SPW-00400

Date: June 2020

Amendment Details:

This Standard supersedes the November 2015 version of CC-SPW-00400. The principle changes from the previous version are as follows:

- a) References have been updated from NRA to TII and document references have been updated to TII Publications numbers;
- b) Relevant updates to the Highways England Series 400 document published in May 2017 have been introduced including requirements for information to be submitted pre and post installation of RRS and sections in relation to maintenance of RRS;
- c) Requirements for maintenance and repair of RRS included;
- d) Requirements for the provision of identification labels for RRS have been introduced including reference to new Standard Construction Details for identification labels;
- e) Minimum training requirements for those involved in RRS installation on national roads have been added to the document;
- f) Requirement for ground profile to be adjusted by the installer as necessary and as per manufacturers requirements to ensure correct installation added;
- g) Requirements for the reinstatement of ground following safety barrier installation has been added;
- h) Requirements for corrosion protection of reinforcement strands used in permanent concrete restraint systems has been added;
- i) The requirements for terminating the upstream end of in-situ concrete barriers have been updated;
- j) Requirements for the certification of ground conditions and associated reporting by a Chartered Engineer have been revised to specify certification and reporting to be undertaken by an independent Chartered Engineer from TII's register of approved Independent VRS Chartered Engineers in accordance with CC-REQ-04009 Independent Vehicle Restraint Systems Chartered Engineer Requirements;
- k) The Ground Testing Requirements for post foundations for VRS have been updated. The ground testing procedure is to be in accordance with BS 7669 Part 3 Annex B however the forces to be applied during testing and the permitted displacement of the post is to be as specified within the manufacturers installation instructions/ manual for the specific system being installed.
- l) Updated to require the Contractor to initially carry out measures to improve the ground to ensure that it provides adequate resistance should push tests demonstrate that ground conditions are not suitable for the RRS. If such measures do not improve the ground conditions to meet the manufacturers requirements, a different system may be required or a system with longer posts.

The use of concrete foundations shall only be allowed if it is permitted on the CE Certificate for the system, included in the installation instructions/ manual and the manufacturer has provided adequate information regarding its use.

- m) Minimum requirements for the contents of a manufacturer's installation instructions/ manual have been included.
- n) Requirements for the provision of information (prior to and after installations) has been updated;
- o) Requirements for the avoidance of services added;
- p) Minimum requirements for Torque / Tensioning of connections added;
- q) Requirements for the repair of damaged galvanising introduced;
- r) Standard Construction Detail introduced to TII Publications to ensure chevron markings are applied correctly to the ends of full height terminals and referenced from this Specification; and
- s) Requirements for the use of reflectors on RRS included within this document.

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1. General

1.1 Road Restraint Systems

Road Restraint Systems (RRS) are defined in I.S. EN 1317-1 and comprise systems to contain errant vehicles (Vehicle Restraint Systems) and systems to provide restraint for pedestrians (Pedestrian Restraint Systems). The categories of RRS are detailed within Figure 1.

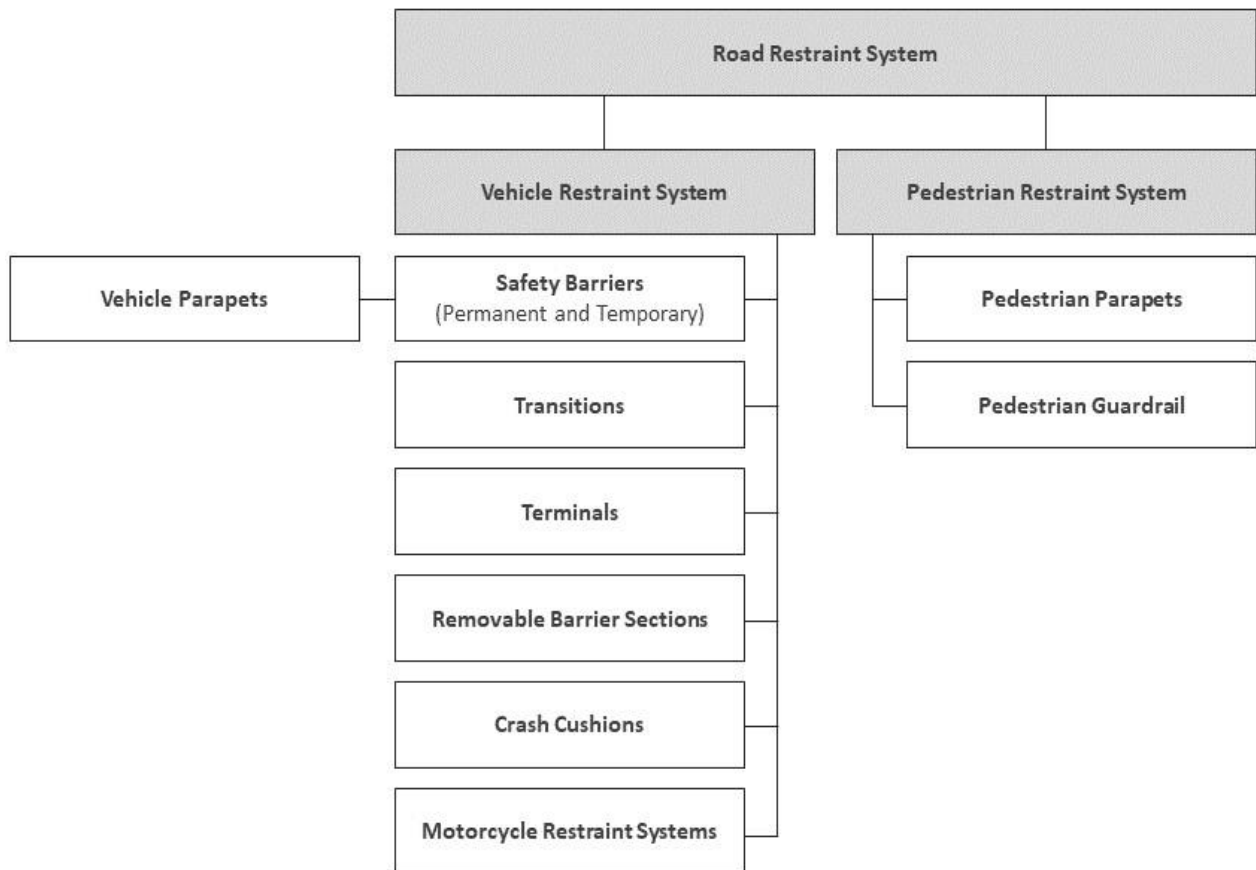


Figure 1 Road Restraint System Types as per EN 1317:1

The Employer's Representative shall ensure that all RRS which are proposed by the Contractor:

- i. Comply with this Specification, and
- ii. Comply with the Contract specific requirements contained within Appendix 4/1 to 4/7 as relevant.

EN Standards have not been harmonised for all categories of RRS as illustrated in Table 1. The following sections describe the requirements for both categories of RRS covered and not covered by harmonised EN Standards.

RRS Categories covered by EN Standard
Permanent and Temporary safety barriers (I.S. EN 1317-2)
Vehicle parapets (I.S. EN 1317-2)
Crash cushions (I.S. EN 1317-3)
RRS Categories not Covered by EN Standard
Terminals
Transitions
Pedestrian restraint systems
Motorcycle road restraint systems
Proprietary RRS
Bespoke parapets

Table 1 RRS covered and not covered by a harmonised European Standard

1.1.1 RRS covered by a Harmonised European Standard

All RRS which are covered by a harmonised European Standard shall conform to I.S. EN 1317-5 and be CE marked products in accordance with the relevant part of EN 1317 as listed in Table 1.

1.1.2 RRS not covered by a Harmonised European Standard

All RRS which are not covered by a harmonised European Standard shall conform to the requirements as listed within this section.

- i. Terminals shall conform to the requirements of I.S. prEN 1317-7 as available in the Downloads section of the TII Publications website and shall have been assessed as compliant under the procedure contained within:
 - DN-REQ-03080 Terminal Assessment Procedure.
- ii. Transitions shall conform to the requirements of I.S. ENV 1317-4 and shall have been assessed as compliant under the procedure contained within:
 - DN-REQ-03081 Transition Assessment Procedure.
- iii. Pedestrian restraint systems shall comply with the requirements of this Specification and any Contract specific requirements contained within Appendix 4/2.
- iv. Motorcycle road restraint systems shall comply with prEN 1317-8, Road restraint systems.
- v. Proprietary RRS of steel, concrete (in-situ and pre-cast) or other materials, shall comply with the requirements of this Specification.
- vi. Bespoke vehicle parapets shall comply with the requirements of Section 4.3 of this Specification and any Contract specific requirements contained within Appendix 4/7.

2. Road Restraint Systems – General Requirements

2.1 Durability

2.1.1 Serviceable Life

Road Restraint Systems shall conform to the following:

All components of RRS shall be designed to achieve a serviceable life of not less than:

- i. 20 years for metal safety barriers, terminals, transitions, removable barrier sections and crash cushions;
- ii. 50 years for concrete safety barrier systems, except for temporary safety barriers where the serviceable life shall be not less than 10 years;
- iii. 50 years for metal vehicle parapets and metal components of combined metal and concrete vehicle parapets;
- iv. 30 years for metal pedestrian parapet and metal components of combined metal and concrete pedestrian parapets; and
- v. 120 years for both concrete vehicle parapets and concrete pedestrian parapets and concrete components of combined metal and concrete vehicle or pedestrian parapets;
- vi. For metal vehicle or pedestrian parapets and metal components of combined metal and concrete parapets the serviceable life shall, except where stated in Contract specific Appendix 4/7, 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; and
- vii. 15 years for pedestrian guardrails.

Where an embankment/verge width behind a safety barrier on approach to a bridge structure is less than the working width of the safety barrier immediately adjacent to bridge abutments, and foundation details are provided in accordance with CC-SCD-00412 and CC-SCD-00414 as a result, the durability requirements for the concrete shall be as per the main structure.

2.1.2 Ambient Temperature

All Road Restraint Systems shall operate over an ambient temperature range of -20°C to +50°C without any reduction in performance.

2.2 Corrosion

Protection against corrosion shall be as described in the Manufacturer's Specification and the following requirements:

- All steel components, except stainless steel items, reinforcing rings and reinforcing bars, shall be galvanised after shop fabrication as described in CC-SPW-01900;
- Stainless steel bolts, studs, screws, nuts and anchors shall conform to I.S. EN ISO 3506-1 and I.S. EN ISO 3506-2, Grade A4-80;
- The surface preparation and protection against corrosion of all steel parapets, and steel components of combined metal and concrete parapets shall comply with CC-SPW-01900;

- As an alternative to a combined galvanised and painted system, steel parapets may be protected by galvanising only, provided that the galvanising coverage rate is in accordance with I.S. EN ISO 1461;
- The finished galvanised surface shall be smooth and free from sharp projections; and
- Steel reinforcement strands used in permanent in-situ concrete safety barriers shall be protected against corrosion using one of the systems listed below:
 - Epoxy coated reinforcement;
 - Hot dip galvanised reinforcement;
 - Stainless steel reinforcement; or
 - An approved alternative protection system that can demonstrate corrosion resistance throughout the serviceable life of the system.

Regardless of the corrosion protection system proposed, the Contractor shall submit evidence to the Employer's Representative demonstrating the corrosion protection system proposed is capable of providing corrosion resistance for the serviceable life of the safety barrier

2.3 Information to be Supplied

2.3.1 New Installations

Details of the RRS proposed by the Contractor for new installations shall be submitted to the Employer's Representative for acceptance at least four weeks before the commencement of the RRS installation work.

The Contractor shall also submit the installation instructions/ manual and proposals for ground testing of the specific RRS to be installed to the Independent VRS Chartered Engineer (as defined in CC-REQ-04009, see Section 3.2.2) in advance of the ground testing. The Contractor shall also supply the Independent VRS Chartered Engineer with the relevant scheme drawings and appendices from the Works Requirements.

All documentation required to be submitted shall be in English.

Supporting information as listed in the following sub-sections, demonstrating compliance with this Specification and the requirements set out in Contract specific Appendices 4/1 to 4/7 as relevant, shall also be submitted to the Employer's Representative for acceptance. Time frames for the submission of information are included in Table 2.

2.3.1.1 For all products covered by Harmonised European Standards (safety barriers, vehicle parapets, crash cushions, combined vehicle / pedestrian parapets)

- A Declaration of Performance as required by the Construction Products Regulation (EU No. 305/2011) and the relevant harmonised standard demonstrating compliance with the Contract requirements for the essential characteristics plus additional information as necessary to demonstrate compliance with the other requirements in the Contract specific specification.
- The Employer's Representative may request a Type Test Report if necessary, to demonstrate that the chosen system(s) meet the location specific design criteria as stated in the Contract specific specification.
- CE Certificates.

- Manufacturer's installation instructions/ manual including foundation requirements and test methods to verify their performance (see Section 3.2.2).
- Manufacturer's repair and maintenance manual.
- System Working Drawings.
- Ground condition testing report (as certified by the Independent VRS Chartered Engineer in accordance with CC-REQ-04009) as relevant.
- For each organisation undertaking RRS work, system specific installation training certificate(s) to show compliance with Section 2.9 of this Specification.
- Details of the typical foundation types permitted to be used for each system which may be applicable to the system for particular ranges of ground conditions (if required) as certified by the relevant Notified Body.
- Details and samples of reflectors (if required).
- Where Contract specific Appendix 4/1 and 4/7 specify requirements for loads imposed by restraint systems on foundations or structures, the nominal loads (direct forces, moments and co-existent shears) that will be transferred from the RRS to the structure or foundation shall be provided.

2.3.1.2 For Vehicle Parapets and Combined Vehicle / Pedestrian Parapets Constructed as Bespoke

- Documentation showing compliance with BS 6779-2 ,2, DN-REQ-03034 The Design of Road Restraint Systems (Vehicle and Pedestrian) for Roads and Bridges and any Contract specific requirements contained within Appendix 4/7.

2.3.1.3 For Transitions

- Documentation showing compliance with DN-REQ-03081 Transition Assessment Procedure. Where such documentation has previously been submitted and approved by TII, i.e. the system is on the TII Compliant Transitions list available in the Downloads section of the TII Publications website, further submissions may not be necessary. Transitions are only approved for the specific barrier systems that they are assessed for. If either of the two systems is different in any way from the original the approval is no longer valid and a further submission to TII is required as per DN-REQ-03081.
- Documentation showing system performance parameters demonstrating compliance with the Contract specific requirements plus additional information as necessary to demonstrate compliance with the other requirements in the Contract specific specification.
- Manufacturer's installation instructions/manual including foundation requirements and test methods to verify their performance.
- System Working Drawings.
- List of components and associated codes.

2.3.1.4 For Terminals

- Documentation showing compliance with DN-REQ-03080 Terminal Assessment Procedure. Where such documentation has previously been submitted and approved by TII, i.e. the system is on the TII Compliant Terminals list available in the Downloads section of the TII Publications website, further submissions may not be necessary. Where connecting to a restraint system which differs from the original, a further submission to TII is required as per DN-REQ-03080.

- Documentation showing system performance parameters demonstrating compliance with the contract requirements for the essential characteristics plus additional documentation to show compliance with the other requirements in the contract specific specification.
- Manufacturer's installation instructions/ manual including foundation requirements and test methods to verify their performance.
- List of components and associated identification/ traceability codes.
- System Working Drawings.
- For each organisation undertaking terminal installation work, system specific installation training certificate(s) to show compliance with Section 2.9 RRS related training and competency requirements of personnel.
- Details of the permitted foundation types to be used.

2.3.1.5 For Anchorages and Attachment Systems for Surface Mounted Posts

- 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 restraint system, terminal, transition, removable barrier section or crash cushion. Where the ultimate capacity of a restraint 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 systems.

2.3.1.6 Installation Team

- At least four weeks prior to the incorporation of any RRS into the Works, the Contractor shall provide suitable evidence to the Employer's Representative that those installing the system have been provided with adequate training in the system installation by the restraint system manufacturer.

2.3.1.7 Motorcycle Restraint Systems

- Suitable information to confirm that the Motorcycle restraint system does not affect the performance of the safety barrier it is attached to.

2.3.1.8 In-situ Concrete Safety Barriers

- Evidence demonstrating the corrosion protection system proposed for the steel reinforcement strands is capable of providing corrosion resistance for the serviceable life of the safety barrier.

Information to be supplied				
Item Description	New Installations	Time Frame	Maintenance	Time Frame
Declaration of Performance	✓	4 weeks	✓	2 weeks
CE Certificates	✓	4 weeks	✓	2 weeks
Installation instructions/manual	✓	4 weeks	✓	2 weeks
Repair and maintenance manual	✓	4 weeks	✓	2 weeks
Type Test Report (if required)	✓	4 weeks	✓	2 weeks
System working drawings	✓	4 weeks	✓	2 weeks
Proposed VRS Chartered Engineer	✓	4 weeks	✓	2 weeks
Ground condition testing report	✓	2 weeks	✓	1 week
Permitted foundation types for the installation	✓	2 weeks	✓	1 week
Training certificates of installers	✓	4 weeks	✓	2 weeks
Details and samples of reflectors (if required)	✓	4 weeks	✓	2 weeks
Details of nominal loads (direct forces, moments and co-existent shears) that will be transferred from the RRS to the structure or foundation	✓	4 weeks	✓	2 weeks
Bespoke Parapets	✓	4 weeks	✓	2 weeks
Additional Requirements for Transitions				
Compliance with DN-REQ-03081	✓	4 weeks	✓	2 weeks
System performance parameters	✓	4 weeks	✓	2 weeks
List of components and associated codes.	✓	4 weeks	✓	2 weeks
Additional Requirements for Terminals				
Compliance with DN-REQ-03080	✓	4 weeks	✓	2 weeks
List of components and associated codes.	✓	4 weeks	✓	2 weeks

Table 2 Information to be Supplied prior to RRS Installation Works Commencing

2.3.2 Maintenance or Repair

In addition to the requirements of Section 2.3.1, details of RRS proposed by the Contractor for use in maintenance or repair work shall be submitted to the Employer's Representative for acceptance. The timeframe for submission of information can be reduced from that required for new installations, as agreed with the Employer's Representative, but shall be submitted in advance of the commencement of the RRS work. Time frames for the submission of information for both new and maintenance or repair work are detailed in Table 2. The following supporting information demonstrating compliance with this Specification and the requirements set out in Contract specific Appendices 4/1, 4/2, 4/3 and 4/4 shall also be submitted for acceptance:

- Quality Management Processes of the company undertaking maintenance or repair works.
- Documentation indicating compatibility with the existing RRS.
- Ground condition testing report as per Section 3.2.2 and the requirements of CC-REQ-04009 should the length of section to be maintained or repaired be greater than 50m in length.

Where an entire length of RRS is to be replaced as part of maintenance or repair works, the requirements for new installations shall apply.

2.4 Handling and Storage

2.4.1 Protection from Damage

All components shall be protected from damage and handled and stacked in such a way that permanent damage is not caused, particularly to threaded components. Transport and storage arrangements shall comply with the recommendations of the system manufacturer and current versions of I.S. EN ISO 1461, I.S. EN 10346 and I.S. EN 13369 as appropriate. In particular, means shall be provided to avoid damage to galvanised coatings and any damage that does occur shall be made good in accordance with the recommendations of I.S. EN ISO 1461. For wire rope restraint systems, component ropes and tail ropes shall be supplied on reels with a barrel diameter that will avoid twisting and kinking of the ropes.

2.4.2 Damage Repair

Care shall be taken on installation not to damage the zinc coating of beams and posts. Any beams or posts which have deep scratches or evidence of corrosion pits cannot be repaired and must be replaced. Minor scratches to beams and posts shall be cleaned and then repaired with a brush applied zinc-rich coating to achieve a minimum coating thickness of 100µm in accordance with manufacturer's guidelines and I.S. EN ISO 1461:2009, such that the damage shall not have any impact on the systems serviceable life.

2.5 Installation

2.5.1 Installation Instructions/ manual

The Contractor shall ensure that the installation instructions / manual as required by I.S. EN 1317-5, for a proposed system includes all the information necessary to install the RRS in the locations shown on the drawings such that the system will meet its declared performance.

Installation instructions/ manuals shall be appropriate to the RRS 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 instructions/ manual.

Details of permitted modifications to the system, as per I.S. EN 1317-5, shall be included in the installation instructions/ manual.

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

- 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 torque when relevant etc.);
 - d) details of all tools required to perform a proper installation of the system;
 - e) ambient temperature and humidity at time of testing (if relevant) and how installation should be adjusted for the ambient conditions at the time of installation;
 - f) details of tensioning required (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 foundation characteristics and conditions suitable for the system and information about conditions which can influence the behaviour of the product;
 - i) specific requirements for ground testing e.g. details of post push tests for safety barriers to prove the proposed foundation system including the horizontal force to be applied and the acceptable post displacement for the specific product;
 - j) any other installation specific testing including the parameters to be achieved for the particular system;
 - k) any other relevant recycling information and, details of toxic or dangerous materials present in the works.
- Maintenance and inspection:
 - a) provisions for repair, inspection and maintenance, including indications for disassembling and reassembling or reconstruction of damaged systems;
 - b) in service tolerances including for installation height.
- 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 barrier;
 - f) other RRS types which can easily be connected with the product.
- The following information is applicable specifically to transitions and terminals:
 - a) RRS types which can be connected by or to the product.

The Employers Representative may reject a proposed system if the installation instructions / manual submitted does not comply with the requirements of this Specification.

2.6 Terminals

All full height terminals shall comply with the performance criteria as described in Appendix 4/3 and shall be assessed for compliance with DN-REQ-03080 Terminal Assessment Procedure.

In all other respects, terminals shall comply with the requirements of this Specification for RRS.

2.7 Transitions

All transitions proposed shall be assessed for compliance with DN-REQ-03081.

Details of the safety barriers that the transition has been approved to connect to shall be supplied.

Transitions used with terminals must be the same as those tested with the terminal. Transitions shall be fabricated in the factory prior to protective coating being applied. Normal system beams cannot be modified on site to substitute a transition.

In all other respects, transitions shall comply with the requirements of this Specification for RRS.

2.8 Identification

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

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 I.S. EN ISO 898-1, fasteners shall be clearly marked with the following:

- restraint system, terminal, transition, crash cushion manufacturer's identification mark; and
- fastener number as referenced on the manufacturer's construction drawings.

All new RRS installed shall have identification labels attached at the start and end of the system and at any changes in performance within the system length. Separate identification labels are required on safety barriers, terminals, transitions and crash cushions. The requirements for identification labels on safety barriers are detailed within CC-SCD-00416. The requirements for identification labels on transitions, terminals and crash cushions are detailed within CC-SCD-00417.

2.9 Training

The RRS installation crew shall consist of a Lead RRS Installer supported by team members. The Lead Installer shall be present on site where RRS installation work is taking place.

All RRS shall be installed, refurbished, repaired and maintained by operatives that have been trained under the relevant UK National Highway Sector Schemes. The Contractor shall provide evidence to the Employer's Representative to demonstrate that the operatives' accreditation to the relevant scheme(s) is current and valid.

The minimum training requirements for those involved in the installation of RRS on the national road network are as follows:

RRS Lead Installer

- Qualifications:
 - Attendance at and successful completion of the TII VRS design training course.
 - LANTRA NHSS 10b foundation course (green card).
 - LANTRA NHSS 10b installer course (blue card).
 - System specific training for the installation of all road restraint systems proposed for the scheme (evidence of training for the specific products to be installed to be provided).
- Experience:
 - A minimum of two projects of a similar nature and scale to the proposed project within the past 3 years involving the installation and/or repair of RRS.

RRS Installer:

- Qualification:
 - LANTRA NHSS 10b foundation course (green card)
 - LANTRA NHSS 10b installer course (blue card)
 - System specific training for the installation of all systems proposed for the scheme (evidence of training for the specific products to be installed to be provided).

2.10 Modifications

A modified RRS is a RRS that was previously certified to I.S. EN 1317-5, which has been changed by material design or dimension in such a way that can affect characteristics, which are subject to the requirements in I.S. EN 1317-5. Modifications are classified in accordance with Table A.1. within I.S. EN 1317-5 and are presented below:

Category	Change	Description
A	Slight	Modifications requiring no mechanical changes to the RRS.
B	Moderate	Modifications to one or more components where their effects on the performance of the RRS can be determined by static or dynamic analysis or other appropriate means.
C	Significant	Modifications in excess of A or B.

Table 3 Categories of Modifications as per EN 1317:5

Where a modification is proposed, the Contractor shall submit information supplied by the manufacturer to show the modification has been certified appropriate to the modification category described in I.S. EN 1317-5.

Any category B or category C modification shall be certified by a Notified Body or other specialist with respect to how the modification impacts the declared performance of the product. The Employer's Representative may request further information about the modification as necessary.

A non-exhaustive list of cases of possible modifications to the requirements of Clauses 4, 5 and 6 of I.S. EN 1317-5 is presented in CC-GSW-00400 Notes for Guidance to the Specification for Road Restraint Systems (Vehicle and Pedestrian).

3. Installation of safety barriers, terminals, transitions, crash cushions and removable barrier sections

3.1 Installation

3.1.1 Layout

The overall layout and location of restraint systems shall be as indicated in the Contract Works Requirements including Appendices 4/1, 4/2, 4/3 and 4/7.

The Contractor shall ascertain and install the minimum overall length of road restraint system, as per the installation instructions/ manual, which is required in order that the system will perform as designed, including where this length is more than the overall length of need determined in accordance with Standard DN-REQ-03034 and listed within the Contract Works Requirements Appendix 4/1. Where the minimum tested length is greater than the length of need, and site conditions can facilitate the minimum tested length, the length to be installed shall be agreed with the Employer's Representative prior to installation. If the site conditions cannot facilitate the installation of the minimum tested length, a reduced length shall be agreed with the Employer's Representative prior to installation; any reduced length shall be at least equal to the length of need specified in Appendix 4/1.

All restraint systems shall be erected to present a flowing alignment and in accordance with the following:

- a) The overall alignment on plan of restraint system shall not depart from the prescribed overall layout by more than $\pm 30\text{mm}$, nor deviate in any 10m length from the straight or required radius by more than $\pm 15\text{mm}$;
- b) The restraint system shall be at the height shown in the manufacturer's details for the installation. The height of the restraint system shall be measured from the edge of the road pavement if the set-back is less than 1.5m. Elsewhere, the height shall be measured from the underlying ground level; and
- c) The ground within the set-back and working width dimensions shall be generally level as per Section 3.1.5 and free from obstructions as they will affect the performance of the restraint system.

3.1.2 In-situ Concrete Safety Barrier

In-situ concrete barriers shall be CE marked in accordance with EN 1317-5 and their manufacturers must issue a Declaration of Performance in line with Regulation (EU) 305/2011.

Slots are to be provided in all in-situ concrete barriers at a maximum of 50m centres where the carriageway has normal crossfall and spacing is to be decreased to a maximum 10m centres where the carriageway is in superelevation. Slots shall be either rectangular (150mm wide by 100mm high) or circular (150mm diameter) with an invert level of slots 30mm above the pavement level. Slots are only to be provided at the base of vertical saw cuts.

In cases where a bifurcation of an in-situ concrete barrier is required, the length of the bifurcation shall be dependent on the rate of change of the barrier alignment applied on each side of the bifurcation, relative to the centreline of the in-situ concrete barrier. This rate of change shall be less than or equal to a maximum rate of 1 in 20.

In-situ concrete barriers shall comply with the requirements of CC-SCD-00407.

Exposed vertical and horizontal faces shall be saw cut at 3m centres, or as recommended by the manufacturer whichever is less. The saw cut shall be 40mm minimum deep and 5mm wide.

In-situ concrete barriers shall be treated with spray on curing compound applied at a rate of application as prescribed by the manufacturer.

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

- a) Downstream terminals may be ramped down on dual carriageways. The length of the terminal shall be dependent on the rate of decrease of the safety barrier height applied over the terminal. This rate of change shall be less than or equal to a maximum rate of 1 in 4.
- b) The upstream end of in-situ concrete safety barriers shall either transition to a suitable full height terminal or be protected by a crash cushion.

3.1.3 Excavation for Concrete Foundations and Anchor Blocks

Excavations for concrete foundations and anchor blocks where required shall be in accordance with the manufacturer's installation instructions/ manual, or for legacy systems to the detailed drawings, submitted by the Contractor to the Employer's Representative.

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.

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

3.1.4 Concrete in Foundations and Anchor Blocks

Concrete in foundations and anchor blocks shall be in accordance with the relevant Clauses of CC-SPW-1700 and CC-SPW-2600 and the system manufacturer's requirements.

For tensioned systems, the Contractor shall ensure that any concrete which constitutes part of the restraint system has reached the specified strength stated by the system manufacturer prior to any tensioning taking place.

3.1.5 Reshaping or Re-Profiling of Verges

Further to 3.1.1 c), where required (e.g. on the legacy road network) it shall be the Contractor's responsibility to ensure that the receiving verge is adequately level and profiled and compacted such that ground in the vicinity of the restraint system does not negatively affect the performance criteria of the system or the manner in which an errant vehicle shall impact the system. Any manufacturer's requirements in this regard as set out in the installation instructions/ manual shall be complied with.

Whenever re-shaping or re-profiling of verges is to be undertaken, and where fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments, cuttings, other fills and excavations, such faces shall be benched or otherwise shaped as required in Appendix 6/3 immediately before placing the subsequent fill.

Re-shaping or re-profiling works to verges shall at all times consider and facilitate the efficient shedding of surface water directly into the nearest drain and prevent water being trapped on or adjacent to the road pavement or the restraint system posts/ footings.

Where the works are carried out during the winter or non-growing months, top soiling and grass seeding shall be carried out by the Contractor during the following sowing season.

Where existing verges are simply scraped back to allow for the installation of the restraint system, these areas shall also be grass seeded by the Contractor.

Reinstatement of the verge following installation of the restraint system shall ensure that the ground is left level, free from large rocks or debris, grass seeded, and is maintainable.

3.1.6 Beams

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 Section 3.1.1 can be met. With the exception of any special closure pieces necessary to complete lengths of safety barriers, terminals, transitions or removable barrier sections, beam lengths shall not differ from those submitted for approval by the Contractor in accordance with Section 2.3. In the case of a special closure piece, a temporary piece shall be cut, fitted, measured and installed and the Employer's Representative shall be notified of any such temporary installations. Thereafter, the Contractor shall arrange for a piece of the same length to be galvanised and return to site to replace the temporary piece.

3.1.7 Posts

The selection of the most appropriate post and foundation arrangement shall be determined by the ground conditions encountered on site. The requirements for the testing of ground conditions are included in Section 3.2.2.

Posts, foundations and post sockets shall be in accordance with the manufacturer's installation instructions/ manual, or for legacy systems to the detailed drawings, submitted by the Contractor in accordance with Section 2.3.

Where posts are mounted in cast-in post sockets these shall be sealed with a durable, non-structural and impermeable filler to prevent ingress of moisture and deleterious substances in the socket voids.

Any damage to galvanising incurred during the driving of posts shall be treated in accordance with I.S. EN ISO 1461.

The required embedment depth for steel posts installed in verges shall not include the depth of any topsoil e.g. topsoil on embankments shall not be included in the minimum embedment depth specified by the Manufacturer.

3.1.8 Cutting and Drilling of Components

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

Special closure pieces shall be fabricated by the system manufacturer before the application of any protective coating.

3.1.9 Torque and Tension

Torque in all connections shall be set to the correct values indicated in the manufacturers installation instructions/ manuals and shall be measured with a calibrated torque wrench in accordance with I.S. EN ISO 6789-2.

3.1.10 Dissimilar Metals

Direct contact between dissimilar metals shall be avoided by interposing non-metallic sleeves, washers or coatings as detailed by the restraint system manufacturer, or for legacy systems to the detailed drawings, where available, submitted by the Contractor.

3.1.11 Reflectors

Reflectors on safety barriers shall be installed in accordance with Chapter 6 of the Department of Transport, Tourism and Sport (DTTAS) Traffic Signs Manual.

3.1.12 End Terminal Chevron Plates

Full height end terminal chevron plates shall be orientated so that the chevron points in the direction of the carriageway as per CC-SCD-00415. Advertising, in any form, shall not be permitted within the chevron end plate markings to ensure the chevron covers the full face of the end plate.

3.1.13 Anchorages

The design, fabrication and installation of anchorages shall conform to the manufacturer's drawings and specifications, the requirements of I.S. EN 1317-1, I.S. EN 1317-2 and Standard DN-REQ-03034. All components of anchorages shall be galvanised steel or stainless steel. Zinc plated components shall not be permitted. Anchorages of an expanding type shall not be permitted.

For anchorages in drilled holes, each hole location shall be checked to ensure that the hole will be clear of reinforcement before drilling is carried out. Where it is not possible to locate drilled holes without encountering reinforcement, the Contractor shall submit a report to the Employer's Representative on the consequences of drilling through or cutting the reinforcement from the Specialist responsible for the design or assessment of the affected reinforcement. No drilling or cutting shall take place without the prior written approval of the Employer's Representative.

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.

Where surface mounted posts are to be installed, the anchorages shall include an internally threaded component to receive the attachment system i.e. holding down nut and bolt or stud. Anchorage systems shall incorporate anti-theft devices. All parts of anchorages on bridge decks and other structures (where the anchorage is within 80mm of the upper surface of the supporting concrete or where the anchorage parts are threaded to receive the holding down bolt) shall be of stainless-steel grade designation 1.4401 or 1.4436 to I.S. EN 10088-1. Holding down bolts, studs and nuts shall be stainless steel grade A4-80 to I.S. EN ISO 3506-1 and I.S. EN 3506-2. 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.

Unless expressly prohibited by the manufacturer's installation instructions/ 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.

Intermediate anchors shall be provided to all tensioned restraint (wire rope) systems that are over 1000m long, or in accordance with the manufacturers requirements whichever is less. They shall be spaced approximately at equal distances between end anchors so that the maximum length of unanchored restraint system does not exceed 1000m. The means of terminating tensioned elements shall ensure that there is at least 50 per cent of the normal containment capacity provided at any point within the termination sections.

The minimum overlap distance between anchor blocks within the intermediate termination sections shall be 30m and the maximum distance 60m. These requirements shall be stated within the restraint system manufacturer's details.

3.1.14 Attachment Systems for Surface Mounted Posts

The design, fabrication and installation of attachment systems shall conform to the manufacturer's drawings and specifications, the requirements of I.S. EN 1317-1, I.S. EN 1317-2 and Standard DN-REQ-03034. All components of attachment systems shall be galvanised steel or stainless steel. Zinc plated components shall not be permitted.

Except where surface mounted posts are attached to a steel base, they shall be bedded on mortar complying with CC-SPW-02600 (Bedding Mortar) and Appendix 26/2. The bedding mortar shall have a minimum thickness of 10mm and a maximum thickness of 30mm. An additional allowance may be made for longitudinal falls.

Attachment systems shall be tightened to the specified torque and have not less than the minimum thread engagement specified by manufacturer of the system.

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

Stainless steel washers shall conform to BS 4320 and be made from stainless steel strip designation 1.4401 or 1.4436 to I.S. EN 10029, I.S. EN 10048, I.S. EN 10051 and I.S. EN ISO 9445-1 and ISO EN ISO 9455-2.

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.

3.1.15 Services

The Contractor shall confirm the exact location of all services, prior to carrying out any work (including post driving and foundation excavation) on site. If necessary, this may involve trial holes or slit trenching to record services that may be affected by a proposed RRS.

The Contractor's methods and procedures must reflect the presence of services at all restraint system locations.

The Contractor shall liaise with any Statutory Undertakers or other relevant bodies to coordinate any required service works with the RRS works.

The Contractor shall take account of any restrictions or requirements of the utility company or service provider when planning and executing the works. This may include notifying any relevant Utility Providers where the works affect their plant or ducts and accommodating their representatives who may wish to be present on site in advance of or during such specific works.

The Contractor shall comply with all relevant codes of practice, regulations or Statutory Instruments in relation to services that may be affected by their work, both overhead and underground.

3.2 Testing

3.2.1 Anchorages in Drilled Holes for Safety Barriers, Terminals, Transitions and Crash Cushions

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 instructions/manual the following testing methodology shall be applied:

- a) 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.
- b) 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 time intervals stated above.
- c) 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.
- d) The Contractor shall test the anchorages selected by the Employer's Representative and 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 Appendices 4/1 and 4/3.

3.2.2 Ground Testing Requirements for Post Foundations

The Contractor shall ensure that the selected system post foundation will achieve the correct performance when installed in the finished ground, and therefore shall provide the test equipment and carry out push tests in accordance with BS 7669 Part 3 Annex B to demonstrate that the finished ground provides sufficient resistance to comply with the requirements identified in the road restraint system manufacturer's I.S. EN 1317-5 compliant installation instructions/manual.

Push tests shall be undertaken along the safety barrier length at maximum 50m centres but with a minimum of two test locations between terminals. Push tests shall be undertaken at all terminal locations. Additional or intermediate tests may be required as requested by the Independent VRS Chartered Engineer to account for variations in ground conditions or topography, or similar.

Push testing shall be undertaken where safety barrier repair works are being undertaken if the length of safety barrier to be repaired is greater than 50m in length.

Where posts are mounted in post sockets, the Contractor shall demonstrate by on-site testing that the post sockets remain serviceable and in their correct original position following the collapse of the post.

The Contractor shall inform the Employer's Representative and the Independent VRS Chartered Engineer at least one week in advance of push tests being carried out to enable the Employer's Representative and Independent VRS Chartered Engineer to witness all required testing.

Should push tests demonstrate that ground conditions are not suitable for the RRS in accordance with the manufacturer's installation instructions/manual, the Contractor shall initially carry out measures to improve the ground to ensure that it provides adequate resistance. Such measures may include proper compaction, substitution of unsuitable material with suitable material or other measures as agreed with the Employers Representative. If such measures do not improve the ground conditions to meet the manufacturers requirements, a different system may be required or a system with longer posts. The use of concrete shall only be allowed if it is included in the installation manual and the manufacturer has provided adequate information regarding its use.

On completion of any push tests the Contractor shall remove/ replace any damaged elements of the restraint system, including concrete foundations or sockets, and reinstate the finished ground to meet the requirements of the Contract. Test posts shall not be re-used to support any part of a RRS and shall be removed after any push tests.

All required ground condition testing to be certified by the Independent VRS Chartered Engineer shall be completed in advance of any installation work but must comply with the timeframes stated within Section 2.3 of this Specification. If the push testing for one foundation type fails, push testing for an alternative foundation type must be carried out to demonstrate that it works in the given ground conditions.

An Independent Chartered Engineer from TII's approved register of Independent VRS Chartered Engineers shall certify that:

- a) he/ she has attended site to witness and certify that the pre-installation site testing has been carried out at each proposed RRS location and that the results demonstrate that the proposed RRS will perform in the specific ground conditions;
- b) the push tests carried out by the Contractor in accordance with BS 7669 Part 3 Annex B confirm that the system posts/ foundations proposed (e.g. driven, concreted, surface mounted, longer posts or other) are appropriate for the specific ground conditions at each proposed restraint system location and are covered by the CE Cert and Declaration of Performance; and
- c) site testing requirements i.e. the test method and associated parameters for compliance, proposed by the Contractor, is appropriate for the RRS installation in the specific site conditions.

The Independent VRS Chartered Engineer's report shall be submitted to the Employer's Representative and the Contractor within the timeframes stated within Section 2.3 of this Specification.

4. Vehicle parapets

4.1 I.S. EN 1317 Compliant Parapets

4.1.1 General

Unless otherwise described in Contract specific Appendix 4/7, vehicle parapets shall be in accordance with the following requirements except where these conflict with I.S. EN 1317-5 in which event I.S. EN 1317-5 shall take precedence:

- DN-REQ-03034;
- Sections 1 and 2 of this Specification,
- Contract specific Appendices 1/5, 1/11 and 4/71; and
- BS 6779-1 and BS 6779-2 as amended by DN-REQ-03034.

4.1.2 Aesthetic Requirements

Vehicle parapets shall comply with the aesthetic requirements given in contract specific Appendix 4/7.

Posts for vehicle parapets shall be vertical and parapet rails shall follow the vertical alignment of the bridge, retaining wall or similar structure.

Vehicle parapets shall be set true to line and level, within the tolerances set for bedding, (see Section 4.1.4), where applicable, throughout their length to give a smooth flowing line to the finished parapet.

4.1.3 Maintenance and Repair

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 4/7. 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.

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

Steel parapets shall be galvanised, but not painted unless required for aesthetic reasons.

4.1.4 Anchorages and Attachment Systems for Vehicle Parapets

Unless otherwise described in contract specific Appendix 4/7, the design, fabrication, and installation of the anchorage and attachment system shall conform to the manufacturer's drawings and specifications, the requirements of I.S. EN 1317-1 and I.S. EN 1317-2, this Specification and DN-REQ-03034.

Parapet installations shall be anchored as per the installation type used during the Initial Type Testing. Where it is proposed to use an anchorage different than that used in the Initial Type Testing, the Contractor shall submit to the Employers Representative evidence that the change in anchorage will not affect the performance of the parapet.

Unless otherwise covered under the CE marked system's Declaration of Performance and its supporting documentation or described in contract specific Appendix 4/7, the Contractor shall submit to the Employer's Representative, 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 is able to be reused in the event of the need to replace a parapet that has suffered collision damage.

Anchorage of an expanding type shall not be permitted.

Unless otherwise specifically indicated on the accepted manufacturer's drawings submitted by the Contractor to the Employer's Representative, anchorages shall include an internally threaded component to receive the attachment system.

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 I.S. EN 10088-1.

Holding down bolts, studs and nuts shall be in stainless steel grade A4-80 to I.S. EN ISO 3506-1 and I.S. EN ISO 3506-2.

Unless specifically indicated on the accepted manufacturer's drawings submitted by the Contractor to the Employer's Representative, 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.

Unless specifically indicated in the accepted manufacturer's installation instructions/ manual submitted by the Contractor to the Employer's Representative, or where the vehicle parapet posts are attached to a steel base, the posts shall be bedded on mortar complying with CC-SPW-02600 (Bedding Mortar) 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.

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 Employer's Representative on the consequences of drilling through or cutting the reinforcement. No drilling or cutting shall take place without the prior written acceptance of the Employer's Representative.

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.

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

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

Stainless steel washers shall comply with I.S. EN ISO 7089 and I.S. EN ISO 7090 and shall be made from stainless steel strip designation 1.4401 or 1.4436 to I.S. EN 10029, I.S. EN 10048, I.S. EN 10051 and I.S. EN ISO 9445.

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.

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

4.2 Testing

Inspection and testing of vehicle parapet posts shall be carried out by the Contractor as per the manufacturer's installation instructions/ manual.

When required in contract specific Appendix 4/7, components of legacy systems shall comply with the following:

- 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.
- 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.

4.2.1 Site Tests on Anchorages in Drilled Holes for Vehicle Parapets

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.

Unless specifically indicated on the accepted manufacturer's instructions submitted by the Contractor to the Employer's Representative 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.

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 4/7.

4.3 Bespoke Vehicle Parapets

Bespoke vehicle parapets shall include in-situ or precast concrete parapets, masonry parapets or metal parapets for use in particular circumstances and which have not been tested and certified in accordance with I.S. EN 1317.

Bespoke vehicle parapets shall be designed, fabricated, installed and tested in accordance with the following requirements of:

- a) DN-REQ-03034;
- b) BS 6779-1:1998 (Amd. No. 14290, 21 March 2003) and BS 6779-2:1991 both as amended by DN-REQ-03034, BS 6779-3:1994 and BS 6779-4:1999;
- c) This Specification.

The Performance Class Requirements (Containment Level, Impact Severity Level, Working Width Class) and the parapet height for bespoke vehicle parapets shall be as described in Appendix 4/7.

5. Pedestrian Restraint Systems

Pedestrian Restraint Systems shall comply with BS 7818, with any other requirements described in Appendix 4/2 and the durability and corrosion requirements of Sections 2.1 and 2.2 of this Specification.

Pedestrian parapets shall be set true to line and level, within the tolerances set for bedding as per vehicle parapets, (see Section 4.1.4), where applicable, throughout their length to give a smooth flowing line to the finished parapet.

6. Temporary Restraint Systems

Where required in order to comply with the requirements of Appendix 1/17, or as particularly required in Appendix 4/1, the Contractor shall provide, install and maintain temporary restraint systems which shall include anchorages if required. If required, on completion of the Works, the Contractor shall remove temporary restraint systems to the location stated within Appendix 4/1. Any such temporary restraint systems shall meet the requirements for temporary safety barriers within this specification and the performance and other requirements stated in contract specific Appendix 4/1. Temporary restraint systems shall be installed in accordance with the manufacturer's installation instructions/manual. The end of all temporary restraint systems, which face oncoming traffic, shall be protected.

7. Anti-Glare Screens

Anti-glare screen systems shall conform to I.S. EN 12676-1 and I.S. EN 12676-2 and the requirements of contract specific Appendix 4/5. 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 4/5. The Contractor shall provide information to the Employer's Representative 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.

8. Maintenance of Legacy Vehicle Restraint Systems

Legacy systems are VRS that currently exist on the road network but are not CE marked. The requirements given in this Specification with respect to legacy systems is for the maintenance and repair of such systems.

8.1 General

Unless otherwise described in contract specific Appendix 4/4, vehicle restraints shall be in accordance with the following requirements:

- DN-REQ-03034;
- Sections 1 to 3 of this Specification; and
- Contract specific Appendices 1/5, 4/1 and 4/3.

8.2 Maintenance and Repair

Repairs to pre I.S. EN 1317 VRS shall be carried out in accordance with BS 7669-3:1994-Vehicle Restraint Systems - Guide to the installation, inspection and repair of safety fences.

Components used for maintenance and repair of VRS shall match the performance characteristics of the existing VRS and shall comply with the requirements stated in contract specific Appendix 4/4. Components are to be of identical design, detail, specification and geometry to the VRS 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 VRS shall apply, subject to such revisions and modifications applicable to the VRS type during the period of original manufacture.

When a safety barrier system has gone out of production and the manufacturer can no longer supply components, the system should be scheduled for replacement as it cannot be properly maintained. In the event of a high priority repair being required on such a system, the repair can be carried out using a system with matching performance criteria and profile etc. as a temporary measure until a full replacement of the barrier can be carried out.

When a system scheduled for repair is no longer of an appropriate height as a result of a pavement overlay, consideration shall be given to either raising or replacing the whole system. The contractor shall inform the Employer's Representative of this requirement.

8.3 Tensioning

Tensioning bolts of steel tensioned safety barriers and tension buckles of wire rope safety barriers shall be checked and reset to the correct torque every 2 years or in accordance with the manufacturer's instructions, whichever is less. In general, safety barriers shall be tensioned in sections. The tensioning of a section shall be completed by the end of each working period and in any event before the removal of any traffic management.

Retensioning of safety barriers which rely on tension for their performance (e.g. wire rope, Tension Corrugated Beam, etc.) should be carried out as a cyclic maintenance activity, ensuring the manufacturer's retensioning frequencies are met in full.

Retensioning of existing proprietary safety barriers shall be undertaken in accordance with the manufacturer's instructions. Tension in a wire rope system shall be measured with a calibrated rope tension indicator in accordance with BS 7669-3: 1994 Vehicle Restraint Systems.



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