

TRAFFIC SIGNS

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Traffic Signs

1201 Definitions, Sign Classification and Regulations

Definitions

1 For the purposes of this Specification the following definitions shall apply:

- (i) Prescribed Signs – Signs which are in accordance with:
 - (a) The “Traffic Signs Manual” published by the Department of Transport; and/or
 - (b) The “Road Traffic (Signs) Regulations, 1997”;
and any subsequent amendments of these documents (including any sign specially authorised by the Minister for Transport).
- (ii) Non Prescribed Signs – Signs, other than the above, which are:
 - (a) Required by the Contract; or
 - (b) Designed by the Contractor and approved by the Employer.

Sign Classification

2 For the purposes of the Contract the following classifications apply:

- (i) Permanent Traffic Signs – Any of the traffic signs complying with sub-Clause 1201.1 part (i) or part (ii)(a), which will remain in position at the completion of the Works; or a traffic sign, traffic cone, cylinder or other traffic delineator to be retained by the Employer;
- (ii) Employer’s Temporary Traffic Signs – Any of the traffic signs specified in the Contract and complying with sub-Clause 1201.1 part (i) or part (ii)(a), which will not remain in position at the completion of the Works;
- (iii) Temporary Traffic Signs – Any of the traffic signs proposed by the Contractor and complying with sub-Clause 1201.1 part (i) or part (ii)(b), which will not remain in position at the completion of the Works.

Regulations

3 Where the Contractor proposes to use Temporary Traffic Signs which are prescribed signs, he shall obtain the approval of the

Employer’s Representative for their intended use and location.

4 Where the Contractor proposes to use Temporary Traffic Signs which are not prescribed signs, he shall obtain the approval of the Employer’s Representative for their intended design, use and location.

1202 General Requirements for Permanent Traffic Signs

1 Signs shall be manufactured and constructed in accordance with the “Certification Scheme, Specification, and Guidance for Construction of Traffic Signs – TS4” published by the Department of Transport / Department of the Environment, Heritage and Local Government or any amendment thereof.

2 Signs shall be in accordance with the requirements of the Contract.

3 Where the requirements of the Contract are in conflict with those for prescribed signs, the Contract requirements shall take precedence.

4 All signs, posts, brackets, caps and other fittings and attachments shall be batched and labelled. The labels shall indicate the sign reference number. Batched items for each sign assembly shall be packaged together with the relevant sign plate.

5 Sign panels of internally illuminated signs and luminaire face panels shall comply with impact Category 1 of BS 873 : Part 5, unless otherwise described in Appendix 12/1.

6 All lit traffic signs shall comply with Category 1 luminance of BS 873 : Part 5, unless otherwise described in Appendix 12/1.

7 All internally illuminated bollards shall comply with BS 873 : Part 3, unless otherwise described in Appendix 12/1.

8 All traffic sign housings shall be provided with vandal and weather resistant locks. The number of different types of lock shall be kept to a minimum.

9 Traffic signs shall be carefully handled to prevent damage, and transported and stored in accordance with the sign face manufacturer’s instructions.

General Requirements for Permanent Traffic Signs

- 10 All posts, brackets, sign frames and the reverse side of signs shall be coloured grey, unless otherwise specified.

1203 Foundations for Permanent Traffic Signs and Signals

- 1 The type and size of foundations for signs and signals shall be as described in the Contract and, unless otherwise stated therein, shall comply with this Clause.
- 2 All excavations for foundations shall be carried out in compliance with Clause 604 of this Specification.
- 3 Traffic signs and signals supported by a single post placed in the ground shall have the post installed centrally in 300 mm diameter augured holes backfilled with Clause 2602 mix ST2 concrete to within 150 mm of the ground surface. All other posts holding signs, except for those specified in sub-Clause 1203.7, shall be supported (to detail) as set out in the Contract with foundations filled with Clause 2602 mix ST2 concrete to within 150 mm of the ground surface.
- 4 Posts shall be supported for a minimum of 3 days after placing the concrete. Backfilling shall not take place until at least 48 hours after placing.
- 5 For traffic signals and illuminated signs provision shall be made for cable entry through the foundation by means of ducting.
- 6 Where pockets are formed for posts in concrete foundations their plan dimensions shall be 150 mm larger than those of the post.
- 7 Any pockets formed in concrete foundations to receive posts shall be temporarily sealed or capped pending installation of the posts and shall be cleaned out immediately prior to the erection of the posts. The posts shall be placed centrally in the pockets and be bedded on mortar designation (i) complying with Series 2600 of this Specification and the pockets shall be filled up to existing ground level with Clause 2606 mix ST2 concrete and compacted to Clause 2602.
- 8 All backfilling of foundations shall comply with Clause 611 of this Specification except that where pipes or buried cables are installed it shall comply with Clauses 505 and 1421 respectively.

- 9 Reinstatement of existing surfaces above foundations shall comply with Clause 706 of this Specification.

1204 Posts for Permanent Traffic Signs

- 1 Posts for Traffic Signs shall be as described in Appendix 12/1 and shall comply with the "Certification Scheme, Specification, and Guidance for the Construction of Traffic Signs – TS4" published by the Department of the Environment and Local Government or any amendment thereof.
- 2 Posts shall not protrude above the top of the sign unless supporting an external luminaire, in which case the protrusion shall be as specified.
- 3 Compartments for electrical equipment shall be as described in the Contract and, wherever practicable, access doors shall be on the side of the compartment furthest from approaching traffic. In the case of signs supported by more than one post, such compartment shall be on the post furthest from the carriageway, unless otherwise specified.
- 4 Flange plates shall have holes or slots to accommodate the attachment system.
- 5 Posts for internally illuminated beacons at pedestrian crossings shall comply with this clause and where appropriate with BS 873 : Part 7.
- 6 Signs erected on a single post shall be positioned so that the post is in the centre of the sign, unless otherwise described in Appendix 12/1.

1205 Location and Erection of Permanent Traffic Signs

- 1 The approximate locations of Traffic Signs are described in the Contract. The exact location of each traffic sign shall be determined on site and recorded by the Employer's Personnel.
- 2 All posts shall be erected plumb and where two or more posts are provided for any one sign, the faces of the posts shall be in the same vertical plane.
- 3 Signs erected on two or more posts shall have each post positioned so that the post centres are not more than 1525 mm apart and no part

- of a sign shall be cantilevered by more than 610 mm from a vertical post support (except on a special frame assembly e.g. H frame) unless otherwise approved by the Employer's Representative.
- 4 Traffic signs, except those mounted on gantries, shall be erected to have their face plumb and be orientated in relation to the carriageway in accordance with the requirements of the Traffic Signs Manual.
 - 5 No traffic sign shall be dismantled, resited or removed without the prior approval of the Employer's Representative.
 - 6 Unless otherwise stated in Appendix 12/1, sign plates shall be fixed, not less than 3 working days, and not more than 10 working days, from the date of erection of their respective posts.
 - 7 Pole caps shall be fitted in advance of, or simultaneously with, the erection of the posts.

1206 Covering of Permanent Traffic Signs

- 1 Where it is required in Appendix 12/1 that permanent traffic signs be blanked-out or have an alternative message, the method to be adopted shall comply with the following, unless otherwise described in Appendix 12/1:
 - (i) for plate signs: A cover plate made from 1.5 mm sheet, compatible with the underlying material, or a loose covering of a material approved by the Employer's Representative, or, for covering periods of up to one year, a self adhesive plastic film to support the temporary sign face sheeting;
 - (ii) for other traffic signs: A loose covering of a material approved by the Employer's Representative.
- 2 Cover plates shall be fixed by means of 5 mm diameter stainless steel bolts, washers and nuts complying with BS 6105 or non-ferrous rivets not more than 600 mm apart, the bolt passing through 5 mm thick and 12 mm diameter plastic distance pieces between the sign face and cover plate. Any holes remaining in the finished sign face shall be filled with rivets covered by a material approved by the Employer's Representative, of a colour to match that part of the face.

- 3 Where self adhesive plastic film is used it shall be compatible with the sign face sheet materials and be applied and removed in compliance with the manufacturer's instructions.
- 4 Any loose covering must be sufficiently opaque to prevent reflection from the covered sign and be securely fastened to the back of the sign. Under no circumstances shall tape or other adhesive material be applied to the face of the sign. Sufficient space shall be left between the covering and the face to permit air flow over the sign.
- 5 Traffic signs which are to be covered shall not be erected on trafficked roads without the covering in place.
- 6 Removal of any covering shall be carried out with the minimum disturbance to traffic and only after the Employer's Representative has given his approval.
- 7 Irrespective of any requirement in Appendix 12/1 to cover signs, any traffic sign erected at such a time that its legend does not relate either wholly or in part to the traffic movement and route in operation, shall have its sign face securely covered with one of the materials in 1206.1 until such time as the Employer's Representative authorises its removal.
- 8 The Contractor shall inspect all covered signs daily and shall immediately replace any covering which is defective.

1207 Employer's Temporary Traffic Signs

- 1 Each Employer's Temporary Traffic Sign may be designated in the Contract as a Category A or a Category B type sign:
 - (i) Category A signs shall comply with all the requirements for Permanent Traffic Signs as set out in Clauses 1202, 1203, 1204, 1205 and 1206.
 - (ii) Category B sign face material shall, unless otherwise specified, be Class II retroreflective sign face sheet material as set out in the "Certification Scheme, Specification, and Guidance for the Construction of Traffic Signs – TS4" and shall satisfy the requirements set out in Appendix 12/1.

- 2 Employer's Temporary Traffic Signs shall also comply with the requirements of Clause 1215.

1208 Temporary Traffic Signs

- 1 The sign face sheet material shall be Class II retroreflective material as set out in the "Certification Scheme, Specification, and Guidance for the Construction of Traffic Signs – TS4".
- 2 The layout, size and use of these signs shall be in accordance with the Traffic Signs Manual or as otherwise approved by the Employer's Representative. These signs shall be mounted and supported in a manner approved by the Employer's Representative and that satisfies any specific requirements set out in Appendix 12/1.
- 3 Temporary Traffic Signs shall also comply with the requirements of Clause 1215.

1209 Permanent Bollards

- 1 Permanent bollards shall be as described in Appendix 12/1 and shall comply with the appropriate Clauses of this Series.
- 2 Internally illuminated bollards and, unless otherwise described in Appendix 12/1 reflective-only bollards, shall be secured by stainless steel holding down bolts, nuts and washers. Holding down bolts and anchorages cast into the foundation shall be capable of complying with the performance requirements of BS 873 : Part 3 when tested as described therein.
- 3 All bolts shall be lightly greased before final installation and tightening to the bollard manufacturer's torque setting.

1210 Reflective Markers

- 1 Reflective markers shall comply with this clause and the requirements of Appendix 12/2.

Materials

- 2 The marker shall consist of one of the following:
 - (i) A rectangle or circle of reflex-reflective beaded or moulded material;
 - (ii) An arrangement of button type reflex-reflectors mounted on a flat circular backing plate;

- (iii) Multi-bi-convex lenses moulded into a circular or rectangular plastics backing plate.

Reflectors and reflecting material used in the construction of the markers shall comply with the requirements of Appendix 12/2.

Size of Marker

- 3 The size of the reflective marker shall have a minimum diameter of 60mm.

Colour of Markers

- 4 The markers shall reflect white, green or yellow as specified by the purchaser. The markers if required shall be capable of:
 - (i) displaying reflector on one side only;
 - (ii) displaying reflectors on two sides with different reflector colour on each face.

The backing plates shall be coloured the same as the reflectors which are mounted on them.

Construction

- 5 Markers fabricated in moulded plastics shall show no sign of twisting or warping. Their exposed surfaces shall be smooth and free from blemishes. The refracting surface shall be accurately moulded with grooved or bevelled edges for securing into a frame or opening designed to hold the marker.

Where button type reflectors are used they shall be fixed to the backing plate.

Fixing

- 6 Reflective markers shall be fixed with corrosion resistant materials.

Marker Posts

- 7 The posts shall be made of an easily bent or broken material and shall present a projected width of not less than 100mm when viewed by a driver.

The height of the top of the post above ground shall be between 600mm and 1500mm. In addition a minimum length of 300mm shall be allowed for fixing in the ground.

The top hollow posts shall be capped or fitted with a plug.

A reflective marker complying with sub-Clauses 1 to 4 of this Clause shall be secured to the post in a vertical position with its upper

edge not more than 50mm from the top of the post. A flat surface shall be provided on the post for receiving the marker. Means of securing the marker to the post shall be vandal-resistant.

The posts shall be fitted with corrosion proof holding down anchors fitted within 300mm from the base of the post.

Foundations for Posts

- 8 The type and size of foundations for marker posts shall be as described in Appendix 12/2 and unless stated therein shall comply with this clause.

All excavations for foundations shall be carried out in compliance with Clause 604.

Unless otherwise described in Appendix 12/2 the post shall be installed centrally in 300 mm diameter augered holes filled in compliance with Clause 2602 with mix ST2 concrete to within 75 mm of the ground surface.

Reflective Markers

- 9 Where specified, the reflective markers shall be mounted on barriers including safety barriers, concrete barriers and bridge parapet railings. The support brackets for the markers shall consist of either aluminium or steel to the dimensions shown on the drawings in the Contract. A rubber isolation pad shall be provided where two different metals are in contact. The marker brackets shall be securely shot fixed to the supporting surface, and the Contractor shall submit details of the proposed fixing method to the Employer's Representative at least 6 weeks prior to the planned commencement of the execution of these Works.
- 10 Reflective markers shall be mounted at a minimum height of 600 millimetres above road level. On bridge parapet railings the nearest rail above the 600 millimetre level shall be used. The alignment and levels of the post mounted reflective markers on the approaches to the barrier mounted section shall be adjusted to ensure a smooth line as viewed by drivers on the road.
- 11 All details relating to the reflectors shall be as specified in Clause 1210, except that a rectangular shape of equivalent area may be used.

1211 Road Markings

General

- 1 Road markings on national roads shall comply with the requirements of this Clause. Requirements for non national roads are specified in Appendix 12/3.

Materials

- 2 Road marking materials shall be one of the following types:
- (i) thermoplastic road marking material or paint in accordance with IS EN 1871, reflectorised by the application of glass beads to the surface of the marking material;
 - (ii) other materials as described in Appendix 12/3.
- 3 The type, colour and dimensions of road markings shall comply with the requirements stated in Appendix 12/3.

Performance Requirements

- 4 Road markings shall satisfy the initial IS EN 1436 performance requirements as specified in Table 12/2 when measured in accordance with Annex B to Annex D of IS EN 1436.

Table 12/2 Initial IS EN 1436 Road Marking Performance Requirements

IS EN 1436 Property	Requirement	Value
Table 6 – Colour *	1. White	x, y co-ordinates given in Table 6
	2. Yellow Class Y1, Y2	x, y co-ordinates given in Table 6
Table 2 - Luminance Factor β	1. Class B4	$\beta \geq 0.50$
	2. Class B2	$\beta \geq 0.30$
Table 7 - Skid Resistance	1, 2. Class S2	SRT ≥ 50
	3. Class S3	SRT ≥ 55
Table 3 Class of R_L for dry road markings	Class R4	$R_L \geq 200$

1. = White lines, 2. = Yellow lines, 3. = Arrows, lettering, chevron markings and yield symbols, etc.
The classes Y1 and Y2 for yellow road markings are intended for permanent and temporary road markings respectively.

- 5 The Contractor shall guarantee the performance, materials and workmanship of permanent road markings for a period of three years from the date of opening to traffic. In the event of failure of the road markings to meet the performance requirements for the guarantee period, the Contractor shall replace the markings such that the performance requirements are met.
- 6 The requirements for the coefficient of retroreflected luminance R_L after two years and three years in service shall be as stated in Table 12/3.

Table 12/3 Minimum Values of R_L during the Guarantee Period

IS EN 1436 Property	Requirement	Value
After 2 years		
Table 3 Class of R_L for dry road markings ***	Class R3	$R_L \geq 150$
After 3 years		
Table 3 Class of R_L for dry road markings ***	Class R2	$R_L \geq 100$

Surface and Weather Condition

- 7 Prior to the application of road marking materials the surface course shall be clean and dry. The Contractor shall ensure that the surface is clear of any loose debris, mud or other materials likely to affect the adhesion between the road marking material and road surface before road marking commences.
- 8 The Contractor shall not apply road markings in wet or cold weather conditions such that the quality of the road markings might be adversely affected. In particular, application of road markings shall not be carried when the road temperature is less than 5°C.

Marking Thickness

- 9 The marking thickness on new surfaces shall be such that the thickness of the marking above the road surface is 4mm +/- 0.5mm.

Raised Rib Road Markings

- 10 Raised Rib Road Markings shall only be used on motorways or other roads (both single and dual carriageway) with at least 1 metre wide hardstrips/ hard shoulders.
- 11 Raised Rib Road Markings shall be white or yellow lines which are continuous over the sections where they are specified in Appendix 12/3. Where specified in Appendix 12/3 gaps shall be provided for drainage purposes.
- 12 The parent white or yellow line shall be 100_mm, 150_mm or 200_mm wide as specified in the Contract.
- 13 Raised Rib Road Markings shall not be used adjacent to central reserve crossings.

Temporary Road Markings

- 14 Temporary road markings shall be constructed from a proprietary preformed road marking material complying with IS EN 1790, shall only be adopted with the prior approval of the Employer's Representative and shall comply with any requirements of Appendix 12/3.
- 15 When temporary road markings are used on surfaces that will continue to be used by public traffic after its removal, any shadow trace remaining after its removal shall be permanently obliterated to the Employer's Representative's satisfaction. Prefabricated materials will not be permitted to be used for this obliteration.
- 16 Temporary road markings constructed from a proprietary prefabricated road marking material shall only be adopted in locations and on types of road surface as approved by the Employer's Representative and shall comply with any other requirement therein. The marking material shall be new and together with any primer shall be stored and installed in accordance with the manufacturer's instructions and within the recommended shelf life. Prefabricated road markings shall only be applied to surfaces that are clean and dry. Upon removal they shall be disposed of off site and if any making good is necessary to the road surface it shall be carried out to the Employer's Representative's satisfaction before the road is opened to traffic.

Road Markings on Porous Asphalt Surfacing

- 17 Spray paint or thermoplastic road markings shall be used for carriageway markings on porous asphalt surfacing. Manual screeding of road markings shall not be permitted except for directional arrows and similar markings.

1212 Road Studs

Retroreflecting Road Studs

- 1 All road studs shall be retroreflecting road studs complying with IS EN 1463. They shall comply with the requirements of this Clause and any additional requirements in Appendix 12/3.
- 2 All road studs shall be installed in accordance with the manufacturer's instructions.

Permanent Road Studs

- 3 Permanent road studs shall be installed in the locations described in Appendix 12/3.
- 4 Permanent road studs shall be embedded as defined in IS EN 1463-1.
- 5 Reflectors for permanent road studs shall be one of the following types as classified under Table 2 of IS EN 1463-1:
 - (i) Type 1 - Glass;
 - (ii) Type 2 - Plastic;
 - (iii) Type 3 - Plastic with abrasion resistant layer.
- 6 The design of permanent road studs shall be one of the following types as classified under Table 3 of IS EN 1463-1:
 - (i) Type A – Non depressible;
 - (ii) Type B – Depressible. The depressible insert shall be made of rubber.
- 7 The classification of the coefficient of luminous intensity (R) of each retroreflective face of a permanent road stud shall be class PRP 1 when tested in accordance with Annex A of IS EN 1463-1.
- 8 The dimensions of permanent road studs shall be H 3 (height) and HD 0 (maximum horizontal dimensions).
- 9 The classification of the retroreflected radiation of a permanent road stud shall be class NCR 1 when tested in accordance with Annex B of IS EN 1463-1.
- 10 The Contractor shall guarantee the performance of the permanent road studs for a period of three years from the date of opening to traffic. In the event of failure of the road studs to meet the performance requirements for the guarantee period, the Contractor shall

replace the road studs as necessary such that the performance requirements are met.

- 11 The permanent road studs remaining in place at the end of the guarantee period shall satisfy class S1, and the average coefficient of luminous intensity (R) shall be at least 50% of the original value (class R2), when tested in accordance with IS EN 1463-2.

Removal and Replacement of Existing Road Studs

- 12 Existing road studs shall be removed from the road by cutting around its edge and its subsequent removal. Loose material and grouting material used to fix the old stud shall be removed.
- 13 The cavity resulting from the removal of the old stud shall be heated, dried and loose material removed with the aid of compressed air.
- 14 Following heating drying and removal of loose material, the base of the cavity shall be lined with 12 mm of A2 grade bitumen or otherwise as approved by the Employer's Representative. The cavity shall then be filled to the level of the existing road surface with 14 mm chippings. The voids in the chippings shall then be filled with A2 grade bitumen or otherwise as approved by the Employer's Representative to a level 5 mm below the finished surface. The Contractor shall provide traffic safety and control measures at sections of the roadway where cavities are not filled immediately following removal of road studs. Details of the traffic safety and control measures shall be submitted to the Employer's Representative in advance. Filling of the cavity resulting from removal of the road stud shall be completed within three hours of removal of existing road studs and in no case shall cavities remain unfilled overnight.
- 15 Road studs, intended for reuse, shall be cleaned in a manner approved by the Employer's Representative. Such studs shall have new inserts installed prior to installation in the road surface.

Reflecting Road Studs on Porous Asphalt Surfacing

- 16 The edges of recesses for reflecting road studs in porous asphalt surfacing shall be dry-sawn or milled when the material has cooled to ambient temperature. Care shall be exercised when removing porous asphalt to form the recess to prevent damage occurring to the cut edges and to prevent detritus clogging the porous asphalt surfacing.

1213 Traffic Cones, Traffic Cylinders, Flat Traffic Delineators and Other Traffic Delineators

General

- 1 Traffic cones and traffic cylinders, hereinafter termed cones and cylinders, shall comply with Designation 1 or Designation 2 of BS 873 : Part 8. Cones shall be to Category A.
- 2 Flat Traffic Delineators, hereinafter termed FTD's, shall comply with sub-Clauses 3 to 17 of this Clause.
- 3 A FTD shall comprise a flat blade fixed to a base. The flat blade may incorporate stiffeners provided that they do not encroach into the white retroreflective area.
- 4 FTD's shall be constructed of rubber or plastic materials. It shall be possible to insert and remove blades without requiring a special tool. The height of the FTD shall be 750_mm or 1000mm as approved by the Employer's Representative. The sides of the blade shall make an angle of $10 \pm 2.5^\circ$ with its vertical axis; the width of the top of the blade shall be 45 ± 10 mm. The base shall have a maximum width measured parallel to the face of the blade of $0.75H$ where H is the height of the FTD and a minimum length measured at right angles to the face of the blade of $0.75H$. The height of its outermost edge shall not exceed 70_mm.
- 5 FTD bases shall be so designed that they will stack without binding and without causing damage to the retroreflective surfaces. Additionally the blades and their attachment to the base or fixing shall be so designed that the blade's face presents throughout its design life a plane to the approaching traffic no more than 12.5° from the vertical.
- 6 FTD bases may be coloured red, black, grey or brown. They may have a 100_mm wide white reflective line placed on one edge of the base provided:
 - (i) the edge of the base where the white line is to be attached comprises a sloping surface which is at an angle to the road surface of no more than 60° and is of such dimensions either to fully accommodate the 100mm wide white line or, where the angle between the road surface and the sloping surface exceeds 30° , to accommodate at least 80_mm of the width of the white line, the excess (maximum 20_mm) being returned onto the top surface of the base;
 - (ii) the material from which the base is manufactured allows proper adhesion or attachment of the white reflective line to prevent it becoming detached during normal use;
 - (iii) the coverage of white reflective material is maintained at more than 70% of the area treated.
- 7 The white reflective strip material shall comply with BS 3262 : Part 1 or BS 6044 as appropriate. Additionally when tested using a portable retroreflectometer the white line shall have a coefficient of retroreflectance of not less than 150 mcd/ (lux/m²).
- 8 FTD blades shall be constructed such that the uppermost part to a depth of 0.25H shall be coloured red; the part between 0.25H and 0.65H from the top shall be coloured white on one face and red on the other or white on both faces; that part below 0.65H from the top to a depth of at least 50mm and any remaining part shall be coloured red. H is the height of the FTD.
- 9 The white portions of the FTD blades shall comply with the chromaticity co-ordinates and luminance factor given in BS 873 : Part 6.
- 10 The red portions of the FTD shall comply with the chromaticity co-ordinates and luminance factor for traffic cones given in BS 873 : Part 8 when measured in accordance with BS 873 : Part 1.
- 11 That part of the blade coloured white shall comprise retroreflective material, complying with the requirements for Class 1 or Class 2 as specified in BS 873 : Part 6, which shall be securely applied or attached to the blade to prevent it becoming detached during normal use.
- 12 The red portions may also be retroreflective.
- 13 The minimum mass of the FTD including any ballast recommended by the manufacturer shall comply with the mass of a traffic cone as defined in BS 873 : Part 8.
- 14 FTDs shall be clearly and durably marked with the following information in the following order:
 - (i) the name, trademark or other means of identification of the manufacturer or vendor;

- (ii) the title and date of this document, i.e. The Specification for Road Works March 2000.

The marking shall be in characters legible at a normal reading distance such that the total area of marking does not exceed 30_{cm}². Additionally, the legend 'DUAL CARRIAGEWAY AND MOTORWAY USE ONLY' shall be applied to the lowermost red portion of the blade, using block capitals of minimum height 15_{mm}, in such a location that it can be clearly seen when the FTD is in position.

- 15 All markings shall be sufficiently durable to last the expected life of the FTD to which they are applied and in no case less than 5 years.
- 16 When checked by inspection and by rubbing lightly, first for 15 seconds with a piece of cloth soaked in water and then for 15 seconds with a piece of cloth soaked in petroleum spirit, followed by 15 seconds with a piece of cloth soaked in diesel oil, the marking shall still be legible.
- 17 FTDs shall be supplied with the following information:
- (i) instructions for ballasting (if required);
- (ii) instructions for fixing blades to bases.
- 18 Other traffic delineators hereinafter termed delineators shall be described in Appendix 12/4.
- 19 The Contractor shall submit to the Employer's Representative a copy of a test certificate confirming that samples of the identical type of cone, cylinder, FTD or delineator as those to be used in the Works and supplied as permanent cones, cylinders, FTDs or delineators under the Contract, have been tested and found to comply with sub-Clauses 1 to 18 of this Clause.

Permanent Cones, Cylinders, FTDs and Other Delineators

- 20 Where required in Appendix 1/5 the Contractor shall arrange for the tests described in sub-Clauses 22 to 56, for cones, cylinders, FTDs and other delineators, to be carried out at an approved testing laboratory. The numbers to be tested, as given in Appendix 1/5, will be selected at random by the Employer's Representative from the batch to be supplied under the Contract. Failure of any test will result in rejection of the batch

unless the Employer's Representative decides otherwise.

Temporary Cones, Cylinders, FTDs and Other Delineators

- 21 The Contractor shall submit to the Employer's Representative certification substantiating that at least 1 in every 500 of any batch of cones, cylinders, FTDs and delineators to be used in temporary Works have passed the tests described in sub-Clauses 22 to 56 of this Clause as appropriate.

Testing

- 22 Cones and cylinders shall be tested in compliance with BS 873 : Part 8.
- 23 FTD's shall be tested in compliance with sub-Clauses 24 to 55 of this Clause.
- 24 Test procedures shall be carried out on each size of FTD and each method of attachment between blade and base.
- 25 When tested in accordance with sub-Clauses 31 to 38 of this Clause with the exception of the white retroreflective material no part of the FTD shall crack, split or deform.
- 26 When samples with retroreflective portions attached are tested in accordance with sub-Clauses 31 to 38 of this Clause the coefficient of luminous intensity, R (as defined in Publication CIE No. 54; Retroreflection, definition and measurement), after testing shall not be less than 80% of the value previous to the test.
- 27 When tested in accordance with sub-Clauses 39 to 43 of this Clause, no part of the FTD with the exception of white retroreflective material, shall crack, fracture or split and any ballast or ballast container shall not have become displaced within the base or separated from it. Any ballast container as either an integral part of the base or enclosed within it shall not have been damaged to the extent that ballast is discharged. Caps or bungs to ballast containers shall not have been forced from their sockets or other fixings.
- 28 When tested in accordance with sub-Clauses 44 to 49 of this Clause, no part of the FTD with the exception of white retroreflective material shall crack, fracture or split. Bases shall remain in contact with the reference surface.
- 29 When tested in accordance with sub-Clauses 50 to 55 of this Clause, no part of the FTD with the exception of white retroreflective

material shall crack, fracture or split. Bases shall remain in contact with the reference surface

- 30 Throughout the tests in sub-Clauses 31 to 38; 44 to 49 and 50 to 55 of this Clause, the blade shall remain fixed in position. On completion of the testing in accordance with sub-Clauses 44 to 49 and 50 to 55 of this Clause the residual deflection of the top of the blade in any horizontal direction, measured 30 seconds to 60 seconds after completion of the tests, shall be not more than 12.5% of the height of the FTD. The height of the FTD, H, is as measured from the reference surface.

Low Temperature Impact Test

- 31 The test shall be conducted using a steel ball swung on a pendulum. The steel ball shall have a mass of 0.9 ± 0.045 kg and be suspended by one or two steel pendulum wires of not more than 1mm diameter so that the pendulum radius is 1750 ± 10 _mm. The point of impact shall be vertically beneath the centre of the radius of the pendulum and at a height on the specimen of $H/2 \pm 10$ _mm where H is the height of a FTD above the reference surface.
- 32 FTDs shall be fixed to the reference surface using the base.
- 33 The test shall be carried out on specimens with and without retroreflective portions attached.
- 34 For samples with retroreflective portions attached, the coefficient of luminous intensity, R, of every such face at an observation angle of 20° and at an entrance angle normal to the face of the blade prior to the conditioning shall be determined; the definitions of observation angle and entrance angle being those given in BS 873 : Part 1.
- 35 All test samples shall be conditioned for a period of not less than 2 hours at a temperature of $-16 \pm 2^\circ\text{C}$. Impact testing shall be carried out within 60 seconds after conditioning.
- 36 Impact shall be made in ambient conditions of not greater than 20°C .
- 37 Within 1 hour of impacting, samples shall be immersed with retroreflective portions attached, in water at $20 \pm 5^\circ\text{C}$ for 10 minutes. After draining for 10 minutes the coefficient of luminous intensity, R, shall be measured in accordance with sub-Clause 34 of this Clause.

- 38 The sample shall be examined and any damage, percentage change in the coefficient of luminous intensity, or any detachment of a blade from its base shall be reported.

Drop Test

- 39 FTDs requiring the addition of ballast shall be ballasted as instructed by the manufacturer.
- 40 The FTD shall be conditioned for a period of not less than 2 hours at a temperature of $32 \pm 2^\circ\text{C}$.
- 41 Within 1 minute after conditioning the FTD shall be suspended with its normal vertical axis horizontal (any cap or bung to a ballast container forming an integral part of the FTD shall be positioned uppermost) and with its lowest part 1500 ± 5 _mm above a solid horizontal surface and dropped once vertically from rest onto the solid surface.
- 42 The test detailed in sub-Clause 41 shall be repeated after conditioning at a temperature of $-16 \pm 2^\circ\text{C}$.
- 43 Any damage observed shall be reported.

Bending Test

- 44 The test shall be carried out on specimens with and without retroreflective portions attached.
- 45 The blade shall be fixed to the base in accordance with the manufacturer's instructions. The blade and its base shall be conditioned for a period of not less than 2 hours at a temperature of $-16 \pm 2^\circ\text{C}$. Within 1 minute after conditioning, the blade shall be bent over about its base line by applying a force to the face of the blade at a point on its vertical centre line $H/2 \pm 10$ _mm from the top, so that the top edge touches the reference surface or a surface coplanar with it. H is the height of the FTD. When the top edge of the blade touches the reference surface the bending force shall be removed immediately.
- 46 From 30 seconds to 60 seconds after completion the maximum residual horizontal deflection of the top of the blade shall be measured from the vertical axis passing through the centre of the base of the blade and perpendicular to the reference surface.
- 47 The test shall be repeated in the opposite direction.
- 48 The procedure in sub-Clauses 45 to 47 of this Clause shall be repeated at a temperature of $32 \pm 2^\circ\text{C}$.

- 49 The deflections, any damage observed, any detachment of the blade from its base, and any movement of the base shall be reported.

Fatigue Test

- 50 The test shall be carried out on specimens with and without retroreflective portions attached. This test is to be carried out on a different specimen to that or those tested in sub-Clauses 31 to 38 and 44 to 49 of this Clause.
- 51 The blade shall be fixed to the base in accordance with the manufacturer's instructions. The test shall be carried out after conditioning the blade and its base for a period of not less than 2 hours at a temperature of $-16 \pm 2^{\circ}\text{C}$.
- 52 By applying a force to the face of the blade at a point on its vertical centre line $H/2 \pm 10_{\text{mm}}$ from the top, the top of the blade shall be oscillated at a frequency of 60 oscillations per minute to 90 oscillations per minute at an amplitude of $H/4$ for 10 minutes with the reference surface held in a horizontal position. H is the height of the FTD. One oscillation is the movement from the upright position to the maximum amplitude in one direction, then to the maximum amplitude in the opposite direction and then the return to the upright position.
- 53 From 30 seconds to 60 seconds after completion the maximum residual horizontal deflection of the top of the blade shall be measured from the vertical axis passing through the centre of the base of the blade and perpendicular to the reference surface.
- 54 The procedure in sub-Clauses 51 to 53 of this Clause shall be repeated at a temperature of $32 \pm 2^{\circ}\text{C}$.
- 55 The deflection, any damage observed and any detachment of the blade from its base shall be reported.
- 56 Other traffic delineators shall be tested in compliance with Appendix 12/4.

1214 Road Danger Lamps and High Intensity Flashing Beacons

- 1 Road danger lamps and high intensity flashing beacons shall comply with BS 3143.

1215 Temporary Signs, Signals, Road Markings and Delineators

- 1 Temporary traffic signs shall comply with this Clause in addition to the requirements of Clause 1208.
- 2 Employer's temporary traffic signs shall comply with this Clause in addition to the requirements of Clause 1207.
- 3 Temporary reflecting road studs shall comply with the following:
- (i) Clause 1212 and only be installed for periods of up to 3 months and thereupon be replaced unless otherwise agreed by the Employer's Representative; or
 - (ii) permanent reflecting road studs complying with Clause 1212 used for temporary purposes and having the Employer's Representative's prior approval.
- 4 Road markings, cones, cylinders and delineators, road danger lamps and high intensity flashing beacons shall comply with Clauses 1211, 1213 and 1214 respectively.
- 5 Portable traffic signals and haul route crossing signals shall comply with Clause 1216.
- 6 Any other signal, lamp, barrier or device shall be suitable for its intended purpose and where relevant shall comply with appropriate British Standards and shall be approved by the Employer's Representative.
- 7 Erection of temporary signs mounted on posts shall comply with Clause 1205.
- 8 Any temporary covering of temporary signs shall comply with Clause 1206. Any temporary covering of road studs and road markings shall be to the approval of the Employer's Representative and comply with any requirements described in Appendix 12/3.
- 9 Removal of temporary signs shall be carried out as soon as they become superfluous or a hazard to traffic. Methods of removal and making good shall be submitted to the Employer's Representative. Making good shall be carried out immediately after removal of the traffic sign, to the satisfaction of the Employer's Representative.
- 10 Posts shall not protrude above the top of the sign unless supporting an external luminaire,

in which case the protrusion shall be kept to a minimum.

1216 Traffic Signals

General

- 1 Traffic signals shall comprise road junction signals, pedestrian crossing signals and haul route signals and shall be of the type described in Appendix 12/5.
- 2 Traffic signals shall comply with sub-Clauses 3 to 15 of this Clause and the requirements described in Appendix 12/5.
- 3 Traffic signal equipment shall comply with the requirements and specification described in Appendix 12/5 including any amendments therein. It shall consist of control equipment including detector loops of a type which has received approval by the Minister for the Environment. They shall be maintained and serviced as described in Appendix 12/5.
- 4 All traffic safety and management measures associated with work on traffic signals shall comply with Clause 117, and any work entailing the switching off of existing signals shall not be carried out until the local authority has been informed and until agreed alternative traffic management measures are in operation to safeguard and control vehicles using the road.

Controllers

- 5 Controllers shall be provided and installed as described in Appendix 12/5. The cabinet shall be mounted on a foundation, with or without an adjacent inspection chamber as described in Appendix 12/5. The foundation shall make provision for the entry of the appropriate number of cable ducts.
- 6 Traffic signal controllers shall, in addition to any testing carried out in compliance with Clause 1424 be tested before delivery to Site and again after installation but before commissioning, to ensure they comply with the specification in Appendix 12/5.

Cabling and Electrical Requirements

- 7 Traffic signal equipment on each post shall be connected to the controller in accordance with the requirements described in Appendix 12/5.
- 8 The installation shall comply with the National Rules for Electrical Installations published by the Electro-Technical Council of Ireland and in particular the External

Lighting Installation requirements and the rules and regulations of the electricity supplier which provides the supply.

- 9 Cables shall, unless stated otherwise in Appendix 12/5, be PVC insulated and sheathed 600/1000V grade with steel wire armouring to BS 6346 and shall be installed in ducts in compliance with Clause 1421 and terminated in compliance with Clause 1423. Reinstatement shall be in compliance with Clause 706.
- 10 Earthing of all posts, push-button boxes and the controller cabinet shall comply with Clause 1420. One conductor in each cable between a post and the equipment cabinet shall be a protective conductor and shall bond the earth terminal at the post to the main earth terminal.
- 11 Cable testing shall be in accordance with Clause 1424. Tests (a), (b), (c), (e), (f), (g), (h) and (j) as defined in sub-Clause 1424.2 shall be conducted and all measurements recorded.

Telecommunications Carrier Interface

- 12 Where a connection interface to the plant of a telecommunications carrier is specified in Appendix 12/5 the installation shall comply with the rules and regulations of that carrier.

Posts

- 13 Posts for traffic signals shall comply with the requirements of Appendix 12/5 and be installed in the locations specified therein in compliance with Clause 1203.

Signal Heads

- 14 All backing boards shall have a border of Class1 retroreflective material (white). Pressure sensitive material shall normally be supplied but vacuum applied material may be used in accordance with the manufacturer's process. Application of pressure sensitive material shall take place on dry surfaces. An ambient temperature of 15°C minimum is recommended for satisfactory adhesion. The material shall have a 50mm width throughout. Where the continuous border bridges each backing board/signal head a distinct cut edge shall be made to avoid any subsequent stretching/shrinkage of dissimilar surfaces. The finished border shall be of a neat appearance and not made up of short lengths of cuttings.

Road Markings

- 15 Road markings associated with traffic signals shall comply with Clause 1211.

1217 Detector Loops

- 1 The layout of the detector loops is described in Appendix 12/5. The exact position of detector loops shall be determined by the Employer's Representative before the commencement of any associated work.
- 2 The final loop positions shall be 1 metre clear, or as specified in Appendix 12/5, of any street furniture, steel covers, gratings, or any temporary surface reinstatement or damaged area.
- 3 The Contractor shall be responsible for marking out all slot configurations.
- 4 The slots shall be cut using a motorised machine fitted with a diamond tipped saw blade. Slot cutting shall not be conducted when the ambient temperature is below 2°C on a falling thermometer.
- 5 All slots shall be cleared of silt and debris using a jet of water and dried immediately prior to installing the cables and backfilling the slot.
- 6 The internal angle at the corners of slots shall not be less than 112°. Where the shape of the loop or the route of the loop cable produces corners which are less than this angle, then the corners shall be cross-cut to increase the internal angle to 112° or more. The depth of any cross-cut shall be the same as the adjacent slots.
- 7 Each loop shall, unless otherwise described in Appendix 12/5, be formed on site and comprise of three turns in a single length of cable complying with the requirements and specification stated in Appendix 12/5.
- 8 The cable for each loop shall be laid evenly in the slots without kinking and lightly tamped into position using a blunt instrument with the layers of cable in contact and at the required depth below the road surface.
- 9 Where the loop cable is laid through an expansion joint in a concrete pavement, dowels or wedges shall be inserted to enable the cable turns to maintain the shape indicated in the drawings to allow for small movements in the carriageway surfaces. At the boundary of each crossing area a suitable mastic or similar material shall be pressed into the slot and so form a temporary dam to contain the flexible, polysulphide based filler to the specified area of the slot. When the dam is in position the dowels or wedges maintaining the cable position shall be removed.
- 10 The slot shall, unless otherwise stated in Appendix 12/5, be backfilled with an epoxy resin to encapsulate the cable and give a depth of cover of 5mm above the top layer of the cable. The resin shall be poured with a viscosity not greater than 50 Poise which shall be achieved within the timescale of 10 to 30 minutes after mixing. It shall have a pot life of up to 90 minutes, and once poured shall develop a surface skin to allow the addition of hot pour bitumen to the slot in 45 minutes or sooner. The Shore A hardness figure of the resin when completely cured and cold shall be between 50 and 60. The remainder of the slot shall be filled with hot pour bitumen compound heated to 180°C and having a viscosity not greater than 80 Poise. The hot pour compound shall totally fill the slot with the surface of the fill approximately 3mm proud of the road surface to allow for settling.
- 11 Loops shall be connected by a feeder cable to detector units housed in a cabinet. The feeder cable shall comply with the requirements and specification described in Appendix 12/5. The installed feeder cable shall not exceed 200 metres in length from the equipment housing to the most distant loop connected to it. The feeder cable armour shall be earthed at the detector housing only. Where loops are positioned more than 200 metres from the controller, remote detector housing shall be used and connected to the controller by multicore armoured cables to BS 6346.
- 12 No joints shall be permitted along the length of any feeder cable. The joint at the termination of a feeder cable and the loop tails shall be subjected to a pull test on each crimp of 4 kgf and any crimp that fails this test shall be completely remade.
- 13 Before and after backfilling the slots, the Contractor shall measure the series resistance, the insulation resistance and the inductance of each loop circuit. In addition, the Contractor shall record on a suitable test certificate the site reference, the loop reference, the length of feeder cable on each loop circuit, the date of test, the prevailing weather conditions and ambient temperature. The results shall be submitted to the Employer's Representative.
 - (i) Series Resistance
The series resistance shall be measured between the two conductors of a feeder cable comprising a loop circuit at the equipment housing. The resistance shall, unless otherwise stated in Appendix 12/5, when corrected to 20°C, be 13.7 ohms per kilometre of conductor.

- The measurement shall remain stable for a period of one minute with normal traffic flow over the loop in question.
- (ii) **Insulation Resistance**
With the two conductors of a feeder cable comprising a loop circuit connected together, the insulation resistance between the feeder cable conductors and a good earth point shall, unless otherwise stated in Appendix 12/5, be 10 megohms or greater measured at a test voltage of 500 V d.c. applied for at least one minute.
- (iii) **Inductance**
The inductance shall be measured at a frequency of 70 kHz \pm 10% between the two conductors of a feeder cable comprising a loop circuit with no vehicles over or traversing the loop and with no other adjacent loop circuit energised. The inductance of the loop circuit shall, unless otherwise stated in Appendix 12/5, not vary by more than 20% from the theoretical value for the loop circuit.
- 14** Sub-surface housings for loop detection equipment shall not be used. Detector housings shall be positioned so as to reduce the possibility of damage in the event of a road traffic accident and shall not present an obstruction or visual intrusion.
- 15** Each feeder cable shall be labelled at its point of entry to the equipment housing, the system of identification to be agreed with the Employer's Representative. The cable marker reference, each detector function and the physical position of each detector module inside the housing shall be shown on a drawing to be fixed to the inside of the equipment housing. The drawing shall be in the form of a self-adhesive label and comply with BS 4781.
- 16** The tests described in sub-Clause 13 of this Clause shall be conducted at the detector equipment cabinet. If a roadside loop connection chamber is used the loop only shall also be tested.
- 17** A plan to a scale of 1:500 with detailed insets at 1:200 of each as-built loop installation shall be submitted by the Contractor to the Employer's Representative. These shall be delivered within one calendar month of the issue of the relevant certificate of Substantial Completion. The drawings shall show:
- (i) street layout and names where applicable;
- (ii) cable runs and type of cable in each run;
- (iii) position of all joints;
- (iv) dimensions of loops and number of turns in each loop.
- 18** The position of loops shall be given with a reference distance to the leading edges of the loops from a permanent piece of street furniture.
- Detector Feeders**
- 19** Loops and feeders shall be joined in the carriageway in a joint slot, with insulated crimp connectors using a ratchet type crimp tool and heatshrink sleeving type of joint. The joint between the loop cable and feeder cable shall be located in the feeder slot not more than 1 metre from the loop. The joint shall be made so as not to produce any slack cable in the joint hole and the joint area shall be covered with a joint capping resin having a Shore D 70 hardness factor. Alternatively where specified in Appendix 12/5 loop tails shall be routed to a carriageway access chamber and then through ducting to an inspection chamber in the footway where the feeder cable and loop tails shall be terminated in accordance with sub-Clause 24 of this Clause.
- 20** Slots cut for feeder cables shall be 4mm wider than the diameter of the cable and cut deep enough to provide a minimum cover of 85mm (40mm in concrete) +10mm -0mm. It is permissible to run two cables in one slot provided that the minimum depth of cover is maintained. The joint slot shall be 10 mm wider and 150mm longer than the overall dimensions of the finished joint, and positioned either at a traffic land boundary or at the crown of the road so that it is not subjected to the greater stresses exerted by road vehicles. Where slots for feeder cables are cut along the crown of the road they shall not obliterate any road markings in part or in whole.
- 21** Backfilling of the slot shall be fine graded macadam wearing course material complying with BS 4987 : Part 1 rammed into the slot and finished with a minimum layer of 20mm hot bitumen complying with BS 3690 : Part 2. The surface of the fill shall be left approximately 3mm proud of the road surface to allow for settling.

22 Cables laid in the footway from the kerb to the detector housing, or cables laid in the footway as an alternative to slot-cutting the carriageway shall be laid:

- (i) in low density flexible polyethylene ducting marked 'TRAFFIC SIGNALS' at 1 metre intervals along its length. Each duct shall be at a depth to allow 75mm of cover and shall be provided with draw wires to allow for future cable installations; or
- (ii) in trenches on a bed of fine sand 75 mm thick with 75mm of fine sand cover. After backfilling, a UPVC or polyethylene tape marked 'SIGNAL CABLE' shall be laid above the line of the cable immediately

23 Where cables enter the footway a small area of carriageway shall be excavated and a high impact resistance PVC duct complying with BS 3506, Class 6 of 7 laid through the kerb for each feeder cable. The duct shall be level with the base of the slot from which the feeder cable emerges. The excavated area shall be backfilled with fine aggregate concrete to this level and the rest of the hole backfilled in compliance with sub-Clause 21 of this Clause.

Detector Feeders – Motorways

24 All loop cables shall be terminated in a road-side chamber using insulated crimp connectors and a ratchet type crimping tool. The whole joint shall then be encapsulated in a polymer acrylic or epoxy resin jointing system comprising a plastic joint surround. All cable ends which are left temporarily unterminated shall be sealed to prevent the ingress of water.

25 The feeder cables shall be run in ducting, fitted with draw ropes complying with sub-Clause 501.8, laid in the verge to a depth of 600 mm. Ducts shall comply with sub-Clause 501.7.

1218 Pedestrian Crossings

- 1** The location and details of pedestrian crossings shall be as described in Appendix 12/5.
- 2** Surfacing of pedestrian crossing areas, where required, shall be laid with materials and to methods detailed in a document submitted to the Employer's Representative and comply with Appendix 12/5. The finished surfacing shall have a minimum skid resistance value of 55 when tested in compliance with:

- (i) BS 3262 : Part 1 for thermoplastic material and prefabricated tiles; or

- (ii) BS 6044 for paint.

3 Non-reflecting road studs shall comply with Clause 1212.

4 Road markings shall be white and comply with Clause 1211 for permanent markings and be of the material described in Appendix 12/5.

5 Traffic signals, related control and other equipment on pedestrian crossings together with installation and reinstatement shall comply with Clause 1216 for permanent traffic signals.

1219 Traffic Signs on Gantries

1 Where traffic signs (including signals) are erected on gantries the signs shall comply with the requirements of the relevant clauses of this Series.

2 Fabricated steel gantries shall be constructed to the requirements described in Appendix 12/6, and to comply with the 1800 Series. Reinforced or prestressed concrete gantries shall be as described in Appendix 12/6 and shall comply with the 1700 Series.

1220 Preparation and Finish of Metal and Other Surfaces

1 The preparation and finish of metal and other surfaces shall comply with the requirements of the "Certification Scheme, Specification, and Guidance for the Construction of Traffic Signs – TS4".

2 Any additional requirements not contained in the specification given in sub-Clause 1 of this Clause, or requirements different to those therein shall be described in Appendix 12/7.