



**RWANDA
STANDARD**

**DRS
312**

Second edition

2023-mm-dd

**Road traffic safety — Traffic control
devices — Requirements**

ICS 93.080.30

Reference number

DRS 312: 2023

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Contents

Page

1	Scope.....	1
2	Normative references.....	1
3	Terms and definitions	1
4	General principles of road traffic control devices	3
5	Classification and use of road traffic control devices.....	4
5.1	Classification	4
5.2	Use of road traffic control devices	4
5.3	Road traffic signs	4
6	Signing system	4
7	Design and use of signs and road markings.....	4
7.1	7.1 General	4
7.2	Legibility.....	4
7.3	Regulatory signs	5
7.4	Warning signs.....	7
7.5	Information signs	8
7.6	Supplementary signs	9
7.7	Traffic light signals.....	10
7.8	Road markings.....	12
7.9	Signs at road works	14
8	Positioning of road signs and road markings.....	16
8.1	Road signs	16
8.2	Siting.....	17
8.3	Position relative to the edge of the carriageway.....	18
9	Manufacture of road signs and road markings	19
9.1	Sign lettering.....	19
9.2	Construction	21
9.3	Reflectorisation	21
9.4	Frames supports and fittings	22
9.5	Back support frame.....	23
9.6	Sign plate preparation and coatings	23
9.7	Installation of signs.....	24
9.8	Road markings.....	25
9.9	Reflective road studs	26
9.10	Maintenance of signs and road markings.....	27

Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 312 was prepared by Technical Committee RSB/TC 9, *Civil engineering and building materials*.

In the preparation of this standard, reference was made to the following documents:

- 1) SANS 1519 -1:2006, *Road signs - Part 1: Retro-reflective sheeting material*
- 2) SANS 1519 -2:2006, *Road signs- Part 2: Performance requirements for road signs*
- 3) *Traffic signs manual - Nepal*

The assistance derived from the above source is hereby acknowledged with thanks.

This second edition cancels and replaces the first edition (RS 312: 2016), [clauses] which has been technically revised.

Committee membership

The following organizations were represented on the Technical Committee on *Roads and highway engineering* (RSB/TC 55) in the preparation of this standard.

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EDITRACE LTD and General Reliance

JV CSC&EC (Property) and Fair Construction Ltd

MININFRA

NPD Ltd

Rwanda Inspectorate Competition and Consumer Protection Athority (RICA)

Rwanda Transport Development Agency (RTDA)

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Introduction

Clear and efficient signing is an essential part of the road network for the enforcement of traffic regulations and for road safety, and a road with poor signing or with badly maintained signs is an unsatisfactory road.

This standard provides details of the traffic control devices which are used on roads in Rwanda, including their layout and symbols, the circumstances in which each sign may be used and rules for siting and positioning them.

The standard also provides guidance on the temporary traffic measures required at roadworks.

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Road traffic safety — Traffic control devices — Requirements

1 Scope

This Draft Rwanda Standard specifies requirements for road traffic safety signs, signals and markings for use on new and existing roads.

This standard also specifies requirements for temporary road traffic safety signs for use on road works.

This standard applies to all classes of roads.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ASTM D 4956 -16a, *Standard Specification for Retroreflective Sheeting for Traffic Control*

RS EAS 293-1, *Road marking materials — Part 1: Physical properties*

RS ISO 4998, *Continuous hot-dip zinc-coated carbon steel sheet of structural quality*

3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

3.1

traffic control devices

all signs, signals, markings, and other devices used to regulate, warn, or guide traffic, placed on, over, or adjacent to a street, a road, pedestrian facility, parking facility or bikeway by a competent authority

3.2

road

the entire surface of any way or street open to public traffic

3.3

carriageway

part of a road normally used by vehicular traffic; a road may comprise several carriageways clearly separated from one another by, for example, a dividing strip or a difference of level exit of the definition

3.4

lane

part of a road which has been marked out for use by one moving line of vehicles

3.5

bicycle lane

part of a carriageway designated for cycles. A bicycle lane is distinguished from the rest of the carriageway by longitudinal road markings

3.6

intersection

any level crossroad, junction or fork, including the open areas formed by such crossroads, junctions or forks

3.7

level-crossing

any level intersection between a road and a railway or tramway track with its own track formation driver any person who drives a motor vehicle or other vehicles (including a cycle)

3.9

pedestrian crossing

part of a road which is painted with white stripes, also known as a "zebra crossing"

3.10

road user

anyone using the road or travelling, or present on a road, or in a vehicle on a road

3.11

traffic

moving vehicles or pedestrian

3.12

traffic island

a raised area or marked over which vehicles may not pass, or placed at a street junction, or between opposing traffic lanes

3.13**vehicle**

any machine propelled along the road by any power, pedal cycles, hand carts, or animal drawn carts

4 General principles of road traffic control devices

4.1 Signs shall give road users their message clearly and at the correct time. The message shall be unambiguous and speedily understood. Using standard signs assists in their quick recognition, as does uniformity of shape, colour and lettering for each type. To obtain the fullest benefits of uniformity, there shall not only be uniformity of signs, but also uniformity in their use, installation and illumination.

4.2 Signs are provided to control and guide traffic and to promote road safety. They should only be used where they can usefully serve these functions.

Signs are only effective if:

- a) they are visible,
- b) they are legible,
- c) they are understandable,
- d) the road users know what they mean, and
- e) the road user is motivated to behave correctly.

Items a) and b) depend on the correct installation or fixing and maintenance of signs; item c) depends on the design of the signs and symbols being as self-explanatory as possible; items d) and e) depend on the implementation of education and enforcement.

4.3 It is important that the message be presented in a simple way. A picture or symbol can be much more effective than words, and can be understood by those who cannot read. Use worded signs only where there is no alternative.

4.4 Signs should be sited where the background will not distract the eye from the sign.

4.5 The symbols and legends on signs shall be easy to read. This means that the symbols and lettering need to be large enough to enable drivers to read it at the required distance.

4.6 Traffic signs shall be clearly visible at night. It is not sufficient to rely on illumination by vehicle headlights, and signs shall be reflectorised either wholly or in part.

4.7 Traffic signs should be constructed and erected so that they will last for the design life of the intended road without any attention apart from occasional cleaning.

5 Classification and use of road traffic control devices

5.1 Classification

Road traffic control devices are classified according to their functions (see 5.3).

5.2 Use of road traffic control devices

Road traffic control devices shall be used by all road users in compliance with laws and regulations on road traffic applicable in Rwanda.

5.3 Road traffic signs

Traffic signs (including road markings) shall be divided into three broad types:

- a) Regulator signs which give instructions, prohibitions or restrictions which road users shall obey;
- b) Warning signs which warn of hazards on the road ahead; and
- c) Information signs which give directions and distances to destinations or which provide other information that may be relevant to road users.

6 Signing system

There are three basic types of traffic sign: signs that give orders, signs that warn and signs that give information. Each type has a different shape. A further guide to the function of a sign is its colour. All circular signs give orders, most of all triangular signs warn, all rectangular signs inform.

Another important group of signs are road markings. These can regulate, warn and inform, and some help clarify or emphasise the message given by other signs.

7 Design and use of signs and road markings

7.1 7.1 General

In order to simplify the design of the regulatory and warning road signs defined in this standard, the size of the signs shall be specified in terms of the designation of the road on which they shall be erected. Where additional impact is required, it may be necessary, in certain circumstances, to specify a larger sign than the road designation requires. This can generally be done where a sign is erected on or at the end of a section of road where vehicle speeds have not been constrained by road surface condition or geometry. It may also be necessary to increase the size of a sign where experience has shown that drivers ignoring a sign, has led to accidents.

7.2 Legibility

7.2.1 The size of the information signs and supplementary plates shall be governed by the lettering height of the lettering used on the sign.

The sizes of information signs containing text shall be determined by the size of text required. This is defined in terms of the height of an upper case "A" or lower case "x" and is referred to as the "A- height" and the "x-height" respectively (See figure 3).

7.2.2 A sign shall be capable of transmitting its message clearly and at the right time to road users travelling at the normal speed for the road during day and night. To achieve this, a sign shall have correct legibility distance, appropriate target value, simple content and layout, and effective reflectorisation by the use of appropriate reflective sheet made from either micro prisms, or encapsulated lenses and glass beads for road painting. Signs shall also be adequate in design and construction.

7.2.3 The legibility of signs shall be determined by the size of the symbol or lettering used. Contributory factors include the use of adequate colour contrast between the symbols or lettering and the background and the type of any alphabet used.

The factors which determine the distance over which a sign message is legible shall include:

- a) size of symbol or text;
- b) number of messages to be scanned;
- c) lateral distance of the sign from the edge of carriageway; and
- d) The speed of the approaching vehicle

7.3 Regulatory signs

7.3.1 Use

7.3.1.1 Regulatory signs shall put into practical effect the road traffic regulation or control of traffic.

Regulatory signs are either mandatory/obligatory or prohibitory.

7.3.1.2 The mandatory signs shall give instructions to drivers about what they shall do.

7.3.1.3 Mandatory signs shall be circular in shape with a white symbol and border on a blue background.

7.3.1.4 The prohibitory signs shall give instructions to drivers about what they shall not do. Prohibitory signs shall be circular in shape with a red border.

7.3.1.5 Regulatory signs shall only be used where it is considered essential that traffic be controlled for safety reasons or for efficient use of the road system.

7.3.1.6 Portable STOP signs shall not be used except for emergency and temporary traffic control zone purposes.

7.3.2 Sizes and siting

7.3.2.1 The size of the regulatory signs shall depend upon the designation of the road on which they were erected. The size of sign shall be as shown on Table 1

Table 1 – Sizes of regulatory signs

Road designation	Diameter of Sign (mm)
National roads, Districts and City of Kigali roads and that of other urban areas - Class One	600
Location on national roads, Districts and City of Kigali roads and that of other urban areas - Class One	750
Town and urban roads	600
Town and urban roads where space is limited	450
Signs attached to traffic signal columns	300
NOTE The definition of “where additional impact is required” is to be found in 7.1.	

7.3.2.2 Signs giving effect to traffic regulation orders, and intended to be read from a moving vehicle, shall be of sufficient size to enable drivers to recognise them and assimilate the information in time. They shall therefore need to be of a size appropriate to the prevailing traffic speed on the road on which they are used.

7.3.2.3 Exception to the standard sizes shall be on Stop signs, Go signs and Give Way signs which shall be 750 mm except within urban areas where there may be a case for a 600 mm sign.

7.3.2.4 Regulatory signs shall be sited at or near the point where the instruction applies. It is important to make sure that there is no confusion about which road they refer to. Drivers shall be able to see the sign from at least 60 m away (75 m on National roads) so that they have time to read the message and act on it.

Regulatory signs shall be placed at the right- hand side of the road, but a second sign on the left-hand side may be used where extra impact is needed.

7.3.3 Traffic speed restriction signs

Speed limits should be both reasonable and enforceable. Departures from the National speed limit should only be imposed where the situation is such that it is definitely unsafe for vehicles to maintain the higher speed.

This should only be used in urban areas with considerable pedestrian traffic and for traffic crossing a bailey

bridge. Traffic calming measures such as road humps should be incorporated to introduce an element of “self-enforcement”.

Note Drawings of each of the regulatory signs are shown in the relevant laws and regulations applicable in Rwanda.

7.4 Warning signs

7.4.1 Warning signs shall be used to alert drivers to danger or potential danger ahead. They shall indicate a need for extra caution by road users and may require a reduction in speed or other manoeuvre.

7.4.2 Adequate warning signs can greatly assist road safety. To be most effective however, they should be used sparingly. Their frequent use to warn of conditions which are otherwise readily apparent tends to detract from their effectiveness.

7.4.3 Warning signs shall not be used in situations where the problem is obvious, or is so minor that no extra care is necessary. Side road junctions for example are not usually a danger when traffic speeds are low.

7.4.4 Warning signs shall be triangular in shape with a red border encompassing a black symbol on a white background. The black symbol shall normally be a diagram of the hazard.

7.4.5 Additional information should be put onto a supplementary plate below the main sign. There shall always be a distance clear of obstructions in advance of the sign. The sign should not be sited just after an obstruction or a sharp bend. Drivers shall be able to see the sign from at least 60 metres away and 75 metres on National roads so that they have time to read the message. Warning signs shall be placed at the right-hand side of the road.

7.4.6 It takes time for a driver to act on the message given by a sign and slow his/her vehicle down to a safe speed. Therefore, signs shall be sited sufficiently far ahead of the hazard to allow for this. Signs shall also be large enough to be read clearly by drivers travelling at above average speeds. In general, the sizes and distances are determined by the design speed, however in order to simplify the specification of warning signs, Table 2 stipulates the size and distances in terms of road designation. If it is necessary to site the sign away from the standard position, the distance to the hazard should be indicated on the supplementary plate

Table 2 – Sizes and siting of warning signs

Road Designation	Size of sign (Height of triangle in mm)	Distance of Signs from hazard (m)
National roads	750	180
Locations on national roads where additional impact is required	900	180
District roads	750	100
Town and urban roads	600	50

Locations of signs in town and on urban roads where additional impact is required.	750	50
Note The definition of “where additional impact is required” is to be found in 7.1.		

Note Drawings of each of the warning signs are shown in the relevant laws and regulations applicable in Rwanda

7.5 Information signs

7.5.1 Direction signs

7.5.1.1 These signs shall give drivers information to enable them to find their way to their destination.

7.5.1.2 Good direction signing should help to reduce delay and frustration; to keep traffic flowing smoothly and safely through junctions; and to promote commerce and tourism.

Direction signs belong to the following groups:

- a) advance direction signs which give a driver information about his route ahead before he reaches a road junction;
- b) direction signs which give route information at a junction; and
- c) route confirmatory signs which give confirmation and often additional information about the route ahead after a road junction.

7.5.1.3 Direction signs used on national roads shall have a capital letter height of 150 mm. Direction signs used on other roads including feeder roads shall have a text height of 100 mm.

The text height for route confirmation signs shall be 100 mm for capital letters irrespective of the road designation.

7.5.2 Other information signs

These information signs may serve one of the following purposes:

- a) they may give advance information of prohibitions or restrictions ahead or they may indicate the end of a restriction or prohibition;
- b) they may give civic or geographical information such as the name of a town or village; and
- c) they may give information about facilities ahead such as parking places, lay-bys, picnic areas, hotel, police station, hospital, touristic destination etc.

7.5.3 Overhead signs

7.5.3.1 An overhead sign may be required:

- a) where the message is applicable to a particular lane (or lanes), over which the sign is placed;
- b) on a roadway of two or more lanes in one direction where heavy traffic may interfere with the visibility of a roadside sign;
- c) where roadside development with brightly lit commercial signs seriously detract from the effectiveness of a roadside sign;
- d) where vertical or horizontal curvature limits the visibility of a roadside sign;
- e) for consistency, where other signs on a section of a road are overhead;
- f) on an overhead structure, to indicate a low clearance;
- g) to identify a cross street or a turn control at a signalized intersection; and
- h) where it is deemed necessary to place a warning sign assembly with a large backboard and/or flashing light overhead for emphasis.

7.5.3.2 Overhead mounted signs shall provide a vertical clearance of not less than 4.8 m to the sign, light fixture, or sign bridge, over the entire width of the pavement and shoulders except where a lesser vertical clearance is used for the design of other structures.

7.5.3.3 Overhead sign should be illuminated for emphasis at night.

7.5.4 Information signs lettering

For direction signs, the upper and lower case lettering shall be used. The direction signs, with the exception of temporary diversion signs, shall use either white lettering and symbols on a dark green background or black lettering and symbols on a white background. Temporary diversion signs will use black lettering and symbols on a yellow background. The background on the signs which are dark green should not be reflectorised, but the letters and symbols should be. Other direction signs should not be reflectorised.

Note Drawings of each of the information signs are shown in the relevant laws and regulations applicable in Rwanda.

7.6 Supplementary signs

Supplementary plates shall give additional information or clarify the message given by the main signs. They are mostly used with regulatory or warning signs. They shall not be used on their own. The supplementary plates shall be mounted 75 mm below the primary sign. The text shall have a capital letter height of 60 mm. Note Drawings of each of the supplementary signs are shown in the relevant laws and regulations applicable in Rwanda.

7.7 Traffic light signals

7.7.1 This group of signs comprises of two categories:

- a) signs for the control of vehicles; and
- b) signs for the control of pedestrian crossing movements.

7.7.2 The signal head should be mounted so that its lower edge is about 2.3 m above carriageway level. The signal should be close to the kerb or edge of the carriageway, but sufficient clearance shall be left to prevent the signal head being struck by vehicles. The signal lenses should have hoods to prevent them being seen by drivers on other approaches.

7.7.3 Where appropriate, a 300 mm diameter version of a regulatory sign (such as “no right turn”) may be displayed at the side of the signal head, preferably level with the green light.

7.7.4 The traffic signals ahead warning sign may be needed on the approaches to the junction.

7.7.1 Signs for the control of vehicles

7.7.1.1 The primary purpose of a traffic signal installation at a road junction shall be to reduce conflict between traffic streams. Conflict at a junction is manifested as an increase in delay and an increase in the accident rate. The installation should be designed to achieve safety and efficiency within the confines of the available road space.

7.7.1.2 Traffic control shall be done by means of red, amber and green light signals, supplemented by additional green, amber and red arrow light signals and regulatory signs as necessary.

7.7.1.3 Traffic light signals shall be placed on the nearside of each approach and shall be known as primary signals. Additional primary signals may be required on one-way streets. The stop line and STOP letter shall be marked on the carriageway 1.3 m in advance of the signal. The signal and stop line may be set back to accommodate a pedestrian crossing, or to make turning movements easier for long vehicles.

7.7.1.4 Each road which meets at the junction shall be described as an arm of that junction and each arm shall be considered as having one or more approaches depending on the intended direction of travel of the traffic stream on leaving the signalled area.

7.7.1.5 Additional displays may be included beyond the junction and shall be known as secondary signals.

7.7.1.6 The main purpose of the secondary signal shall be to indicate to vehicles close to the stop line, the same information as the primary signal. In certain circumstances the secondary signal may not be positioned beyond the junction on a particular approach. On these occasions the secondary may be on the entry side of the junction, preferably on the offside and beyond the stop line.

7.7.1.7 Each traffic stream shall have clear vision of the primary signal on its approach and the additional displays which are associated with it. The sequence signalling shall be red, green, amber and red.

7.7.1.8 The instruction conveyed by each coloured light signal is defined as follows:

- a) Red light - Denotes that traffic is prohibited from proceeding beyond the stop line.
- b) Green light - Indicates that vehicular traffic may proceed beyond the stop line, and may turn in any direction, subject to the normal priority rules being observed and provided that the turn is not prohibited by a supplementary light signal (red arrow) or a regulatory traffic sign.
- c) Amber light - Conveys same prohibition as red signal except where vehicles are so close to the stop line that they cannot safely stop before stop line, they should proceed. This phase is usually displayed for three seconds.

7.7.1.9 Additional green arrows may be fitted as follows:

- a) on the left of the three light display indicating a movement to the left. The arrow light may also be lit when the main signal is red to indicate that vehicles may turn left only.
- b) on the right of the three light display, indicating a movement to the right.

7.7.1.10 When green arrows are used, drivers have come to expect an exclusive right of way. Therefore, there should be no conflict with traffic already using the junction.

7.7.1.11 An additional amber left arrow may be fitted on the left of the three light display indicating a movement to the left even when ahead may be shown as a red signal. The amber left arrow indicates that it is permissible to go left provided that vehicles give way to traffic using the junction. This type of arrow should not be used in conjunction with a pedestrian crossing.

7.7.1.12 An additional red light arrow may be fitted on the right of the three light display indicating that a turn to the right is prohibited when the arrow light is lit.

7.7.1.13 Wherever green or amber narrow lights are used, the arrow light shall flash for 3 seconds before it is turned off. Red arrow lights shall not flash before being turned off.

7.7.2 Signals to control pedestrian movements

7.7.2.1 Pedestrian signals shall only be used in conjunction with traffic lights. Signal-controlled pedestrian crossings are appropriate at sites where traffic speeds are high or where pedestrian flow is very heavy.

Crossings with pedestrian signals can also be incorporated in junctions controlled by traffic lights.

7.7.2.2 The light signals to be displayed on a pedestrian signal are red, green and flashing green. Phasing of Pedestrian signal with traffic signal is detailed in Table 3. The instructions conveyed by each coloured pedestrian signal are:

- a) Red standing man - Denotes that pedestrians are prohibited from crossing the road.
- b) Green walking man - Denotes that pedestrians may cross the road with care.
- c) Flashing green man - Denotes that pedestrians are prohibited from crossing the road except where they have started to cross the road, in which case they should continue to cross the road.

Table 3 – Phasing of Pedestrian signal with traffic signal

SNo	Pedestrian Signal	Vehicle Signal	Period
1	Red standing man	Green	Dependent upon cycle time
2	Red standing man	Amber	3 seconds
3	Red standing man	Red	Minimum to clear traffic in the junction
4	Green walking man	Red	6-12 seconds depending upon carriageway width and pedestrian density(see note below)
5	Flashing green man	Red	See note below
6	Red standing man	Red	1-3 seconds, but see note below

Note Timings for green man may not apply for signal controlled junctions. The time of periods 5 and 6 together (in seconds) are equal to the width of the carriageway in meters divided by 1.2. When the green man pedestrian signal is lit, it may be justified to use a simultaneous audible signal.

7.7.2.3 The signal head is normally sited on the same post as the traffic light. The signals controlling pedestrian movements shall face across the road so that the signal can be clearly seen by pedestrians. This signal lenses shall be hooded to prevent the signal being seen by drivers.

7.8 Road markings

7.8.1 Classification of markings

7.8.1.1 Road markings are classified as follows:

- a) transverse lines which are laid across the road at right angles to the flow of traffic:
 - 1) Stop lines; and
 - 2) Give way lines
- b) Markings at pedestrian crossings;
- c) Longitudinal lines which are laid along the road parallel to the flow of traffic:
 - 1) Lane lines;
 - 2) Barrier lines;
 - 3) Traffic island markings; and

- 4) Edge of carriageway
- d) marking for parking restrictions; and
- e) traffic lane arrows

7.8.1.2 The purpose of road markings shall be to control, warn, or guide road users. They may be used to supplement other traffic signs or they may be used alone. Their major advantage is that they can give a continuing message to the driver. Thus they can be used to guide drivers in the correct positioning of their vehicles so that the traffic flows smoothly and safely.

7.8.1.3 Road markings should be considered in detail at the design stage of new or improved junctions. The markings for existing junctions are often best considered on plan before the work is undertaken.

Note Drawings of each of the road markings are shown in the relevant laws and regulations applicable in Rwanda.

7.8.2 Reflectorisation

7.8.2.1 At night it becomes much more difficult to see and understand the road and junctions ahead. Road markings can be of great help, especially if they are reflectorised. This is achieved by the addition of glass beads known as ballotini which is either incorporated in the paint mix or applied after the marking is laid.

The improved efficiency of reflectorised lines is substantially reduced when the lines are wet, although reflectorized lines including paints, cold applied plastics, thermoplastic, self-adhesive tapes, modified epoxy resins and raised pavement markers using special glass beads (retroreflective beads) are still at least as good as unreflectorised lines. Because of their advantage over unreflectorised lines in dry weather much more use of reflectorised lines is justified.

The following road markings should be reflectorised to improve the visibility:

- a) transverse stop lines;
- b) continuous white lines (barrier lines);
- c) all markings at major junctions; and
- d) centre and edge of carriageway lines on sections of main road with many curves or gradients.

7.8.2.2 White coloured reflective road studs should be considered for continuous white lines along the centre line of the road and around traffic island markings. Red coloured reflective road studs should be considered for outlining physical traffic islands. There may also be situations where white coloured reflective road studs are proposed to improve longitudinal markings for lane line and hazard warning line markings.

7.8.3 Road centre line marking

A continuous road center line marking shall be provided to prohibiting overtaking on lengths of road where visibility is limited. The system shall use a single 120 mm wide line which is continuous where overtaking is

prohibited. Where additional impact is required, the width of the line should be increased to 150 mm. Where overtaking is not prohibited, but it may be dangerous to overtake, a hazard warning line shall be provided.

Details of each of the types of road markings are shown RS EAS 293-1.

7.9 Signs at road works

7.9.1 General

7.9.1.1 When any work is carried out on or close to a road or street adequate measures shall be taken to warn and protect both road users and road workers.

7.9.1.2 Good signing on road works should warn, inform and direct road users. It should warn road users that there is a hazard ahead, so that they can be ready to take action. It should inform them of what kind of thing to expect, so that they know what manoeuvre or action to be made and it should direct them how to pass through the hazard in a safe manner. Good signing should also help protect the workers on the road and keep traffic delays to a minimum.

The road works site Engineer shall:

- a) plan ahead - It is his/her responsibility to sign the works safely and think what signs and cones needed before leaving the site;
- b) provide high visibility- All persons working on or near the road shall wear brightly-coloured clothing, preferably an orange or yellow waistcoat/jacket;
- c) face the traffic when setting out signs - The Road Works Ahead warning sign shall be put out first and then moved towards the works site, and always the site Engineer should face the traffic when setting out the signs and cones;
- d) fix the signs properly - The signs shall be secured so that they cannot be blown over or dislodged by moving traffic. Signs that are mounted on a metal or wood frame which keeps the sign face off the ground should be used. A sand bag or rock placed across the base of the frame should be used to stop the sign being blown over. The signs should be checked regularly to see if they are all still in place;
- e) ensure the signs are visible at night - The road works site Engineer should make every effort to finish the work before dark, but, if this is not possible, reflective signs and cones shall be used, and preferably they should be supplemented with flashing lights;
- f) remove unnecessary signs - The road works site Engineer shall never leave signs on the road once they are no longer needed;
- g) keep the site tidy - The road works site Engineer should take up as little road space as possible, and store construction materials and equipment off the road;
- h) always use the standard signs - The road works site Engineer or his/her representative shall not design his own. All signs shall be authorized by the competent authority before using them.

7.9.2 Basic sign needed

7.9.2.1 The Road Works Ahead sign - shall be the first sign to be seen by the driver. It shall be placed well before the work site about 30 m in town and 60 m on rural roads, but on a high-speed national road, it should be 200 m away. Put the sign where it can be seen from a distance. For example, if the works are just after a bend in the road, put the sign before the bend. This sign has a black symbol on a white background, all within a red triangle.

7.9.2.2 The Road narrows ahead sign – shall warn drivers which side of the road is obstructed. It should only be used on high-speed national roads.

This sign should be placed midway between the Road Works Ahead sign and the works site. This sign has a black symbol on a white background, all within a red triangle.

7.9.2.3 Keep left or, if appropriate, Keep right – These signs shall be placed at the beginning and end of the works at the point where the works extend furthest into the road. These signs have a white arrow on a light blue background.

7.9.2.4 A line of traffic cones – Shall be used to guide pedestrian and vehicle traffic past the works. Some working space shall be left between the line of cones and the actual excavation or works area. Traffic cones should be red, and, if used at night, should preferably have white reflective sleeves.

7.9.2.5 STOP / GO signs - Where there is a lot of traffic or the works site is very long, the traffic shall be controlled manually using these STOP / GO boards operated by a responsible adult. If the obstruction is less than 30 m long and is on a straight section of road, a single board operating at one end or in the middle shall be used. Flags should be used by an experienced adult for not confusing road users.

Sign plates for use on high-speed roads should be 750 mm high. On low-speed (50km/h or less) roads, 600 mm high signs should be used.

The basic traffic signs for road works are illustrated in the Figure 1

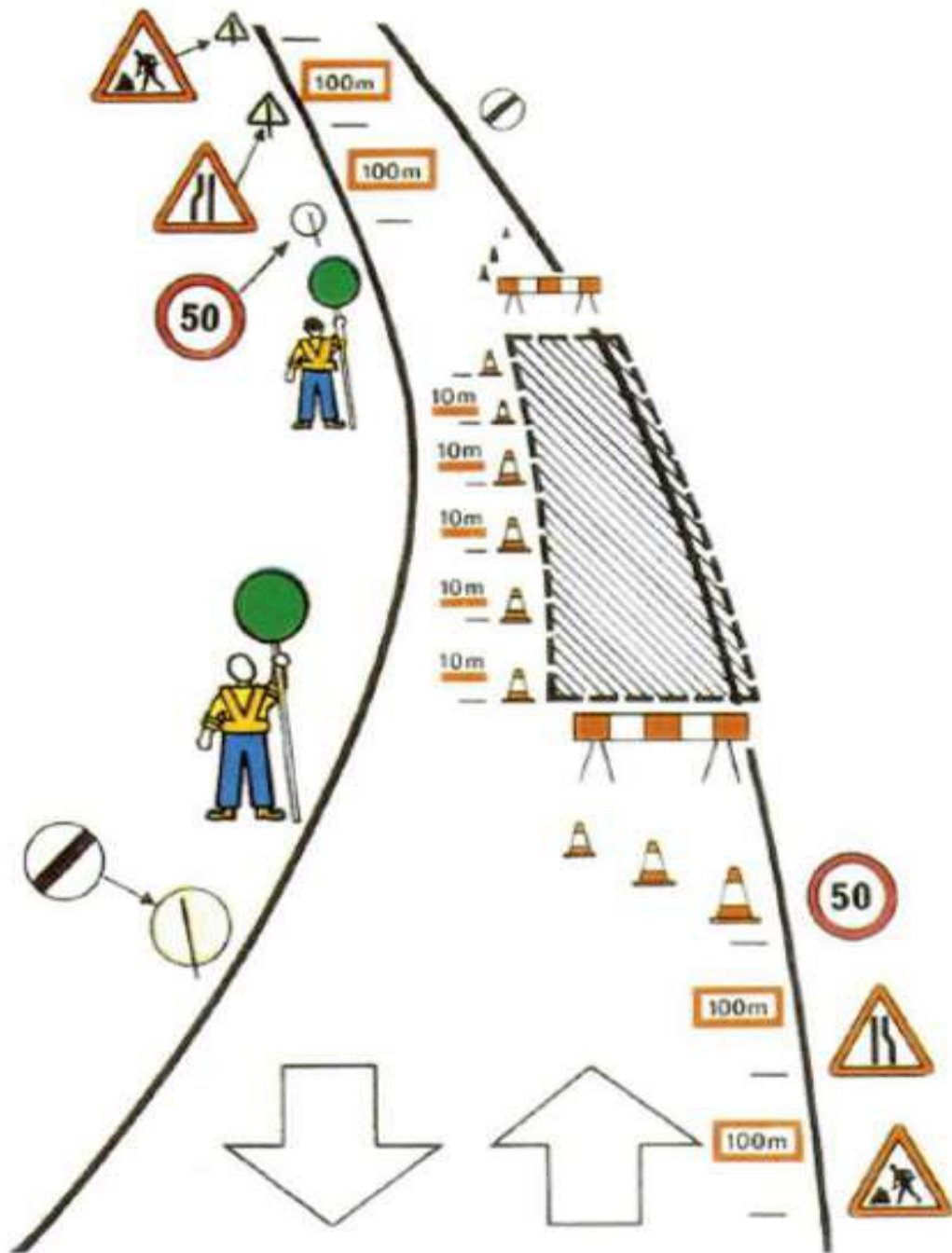


Figure 1 — Illustration of basic road work signs

8 Positioning of road signs and road markings

8.1 Road signs

Three things shall be considered when positioning a traffic sign:

- a) its siting in relation to the junction, hazard, etc., to which it refers;
- b) Its position in relation to the edge of the carriageway; and
- c) the height of the sign plate and its angle to the road.

The following should be checked before sign positioning:

- a) the signs are clearly visible;
- b) there is no confusion about which road they refer to;
- c) the signs do not obstruct the view of drivers; and
- d) the signs are not placed where they could be struck by vehicles.

8.2 Siting

8.2.1 Drivers shall be given the message at the right time, neither too late for the driver to take action, nor too soon that the driver has forgotten it by the time he has to act on it.

8.2.2 Regulatory signs shall be sited at or near the point where the instruction applies.

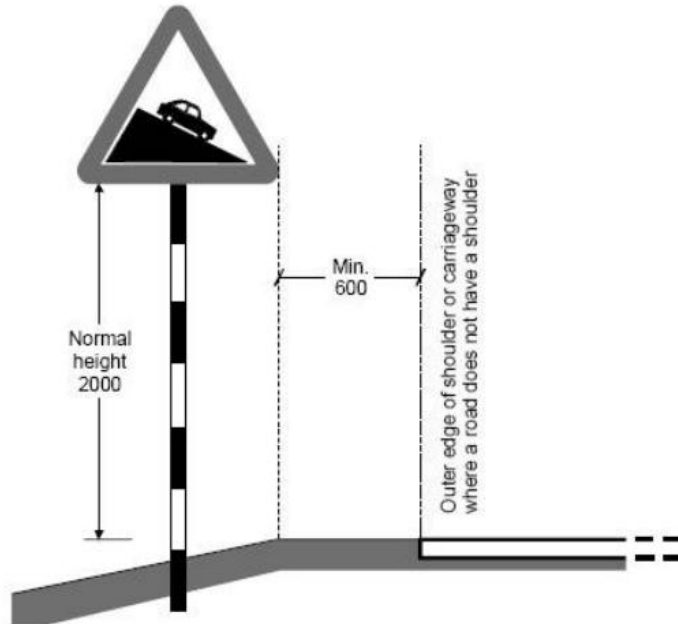
8.2.3 Each sign shall be designed to be read from a certain distance, which is determined by the road designation. The sign shall be sited where it can be seen from this distance.

8.2.4 Signs should generally be sited on the right-hand side of the road. However, at sharp right-hand bends, it may be better to put the sign on the left-hand side of the road where it can be more noticeable.

8.2.5 Most warning signs, and some direction signs, shall be sited in advance of the hazard or junction to which they relate. The distance depends on the road designation. When signs need to be sited far away from their standard position, a supplementary plate may be used to give the distance to the junction or hazard. The distance between a sign and the junction or hazard to which it relates should be increased, rather than being decreased.

8.3 Position relative to the edge of the carriageway

8.3.1 Signs should be placed so that no part of the sign is closer than 600 mm from the outer edge of the shoulder, or carriageway in the case of roads without shoulders (see Figure 1).



Dimensions in millimetres

Figure 2 — Mounting height

8.3.2 This also applies to signs positioned on traffic islands. This is to reduce the risk of them being hit by passing vehicles. The siting of signs at places where vehicles stop or park on the shoulder should be avoided.

8.3.3 Height and angle of the sign plate Signs should be mounted so that the lower edge of the sign plate is 2 000 mm above the level of the carriageway (see Figure 1). This helps to discourage vandals and bill posters from defacing the sign plate.

8.3.4 Signs should never be mounted less than 2000 mm above ground level.

8.3.5 Where two warning signs are to be mounted on the same post, the sign that relates to the nearest hazard should be at the top.

8.3.6 Temporary road signs should be mounted on a frame which keeps the sign above ground by at least 300 mm.

8.3.7 Signs erected over footways and in urban areas shall be high enough to enable pedestrians to walk beneath them. The lower edge of the sign place should be about 2.0 metres above the surface of the footway.

8.3.8 Sign plates shall be mounted so that they face the driver. On unlit roads, the plate should be angled slightly away from the road to avoid mirror reflection when illuminated by vehicle headlights (see Figure 2).

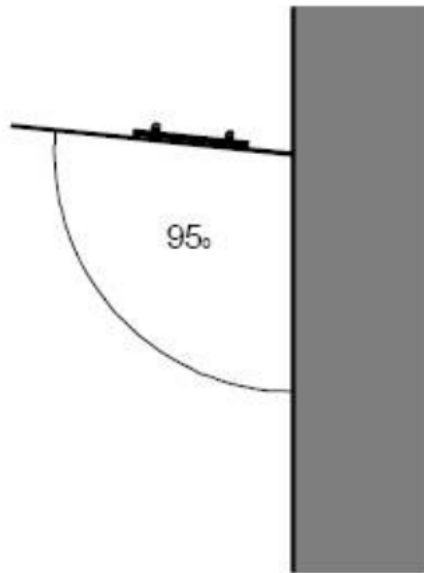


Figure 3 — Angle of sign plate

9 Manufacture of road signs and road markings

9.1 Sign lettering

9.1.1 The size of the lettering shall be referred to in terms of the capital letter height. This shall be the height of the uppercase letter.

9.1.2 To ensure correct lettering spacing when forming a word, the characters in each alphabet should be placed on tiles. The tiles shall vary in width, according to the size of the character, and shall have a fixed height which ensures correct line spacing. For the purpose of design, the line spaces shall be measured to the edge of the tiles and not to the actual characters. The tile height is given on Figure 3 below.

9.1.3 Details of the lettering are shown in Table 4. Each letter has been put onto a tile which is related to the height and width of each letter of the alphabet.

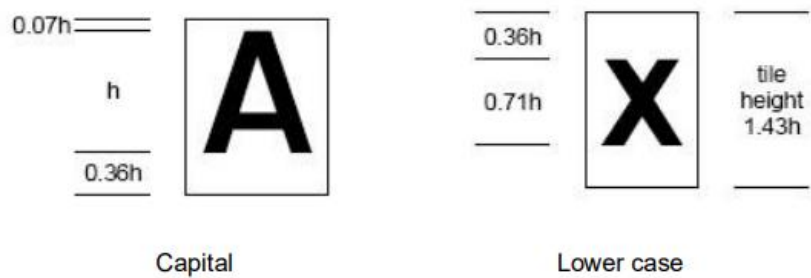


Figure 4 — Lettering tile

Table 4 – Capital and tile heights for lettering

Sign type	Capital height (mm)	Tile height (mm)
Place identification signs	200	285
Direction signs on national roads	150	215
Bridge name plate sign (Name of bridge)	150	215
Direction signs on feeder roads and other minor roads	100	145
Supplementary plates	60	85

The standard lettering style is given in Table 5.

The widths of letters and numerals are given in terms of their capital height h .

Table 5 – Widths of letters and numerals

Upper case		Lower case		Numerals	
Letters	Widths	Letters	Widths	Numbers	Widths
A	1.01	a	0.79	1	0.60
B	1.04	b	0.87	2	0.89
C	1.08	c	0.76	3	0.97
D	1.07	d	0.85	4	0.99
E	0.97	e	0.79	5	0.93
F	0.86	f	0.56	6	0.92
g	1.11	g	0.84	7	0.76
H	1.14	h	0.85	8	0.99
I	0.52	i	0.39	9	0.92
J	0.68	j	0.51	0	1.04
k	0.99	k	0.81	Punctuation marks	
L	0.84	l	0.45	&	0.91
M	1.33	m	1.24	(0.82
N	1.20	n	0.85)	0.82
O	1.13	o	0.82	?	1.04
P	0.96	p	0.86	.	0.40 full stop
Q	1.15	q	0.86	:	0.40 colon
R	1.06	r	0.61	,	0.49 comma
S	1.04	s	0.71	-	0.51 hyphen
T	0.84	t	0.60		
U	1.12	u	0.86		
V	0.95	v	0.76		
W	1.38	w	1.14		
X	0.93	x	0.79		
Y	0.91	y	0.76		
Z	0.85	z	0.66		

9.2 Construction

The materials used in the signs and the method of construction shall comply with ASTM D 4956. Retroreflective sheeting used for the construction of sign plates is a type of material which is capable of reflecting light in the general direction of the light source. For simplicity this shall be referred to hereafter as reflective sheeting.

9.3 Reflectorisation

9.3.1 Signs should be fully reflectorised except for those parts of the sign which are coloured black. If a sign is required to have a reflectorised background, the sign face shall be made of reflective sheeting.

9.3.2 Signs which are intended to be positioned parallel to the direction of traffic flow such as parking sign shall not be reflectorised.

The reflective sheeting shall conform to the following requirements:

- a) the sheeting shall have high reflectivity normal to vehicle headlights dependent on the angle of incidence. The reflective material shall be sharp and glareless and directed towards the light source at an approved angle of incidence;
- b) the surface of the sheeting shall be smooth and flexible. No cracking shall occur when bent. Reflective sheeting shall have high durability under all weather conditions, heat and moisture and be strongly fungus-resistant.
- c) the sheeting shall not delaminate, blister, crack, peel and chip during the manufacturing process and during its expected service life;
- d) the sheeting supplied shall be free from dirt, solid lumps, scales, ragged edges and non-uniformity of colour;
- e) the colour of the sheeting shall be even and free from any spots or loss of colour. The colour shall not fade appreciably under local weather conditions during its expected service life;
- f) colours of sheeting used shall correspond to the colours of the sheeting supplied as samples;
- g) the reflective surface of the sheeting shall be durable and remain sharp during its expected service life. Bad weather conditions such as rain, dew, etc. shall not considerably reduce the reflectivity;
- h) the reflective surface of the sheeting shall be easily cleaned with soap and water with no adverse effect on its reflectivity and durability when used on the roads; and
- i) the adhesive used on the backing of the sheeting shall give a high quality bonding to clean, smooth and grease free aluminium or other sign plates approved by the sheeting manufacturer. The adhesive shall withstand the conditions without allowing the sheeting to peel.

9.4 Frames supports and fittings

9.4.1 Steel frames shall be free from scale and rust by blast cleaning or pickling and protected by one of the following methods:

- a) thermally spraying with aluminium or zinc to a nominal thickness of 100 mm;
- b) hot dip galvanising in accordance with RS ISO 4998 followed by a coat of suitable pre-treatment primer where a finishing coat is to be applied;
- c) applying two coats of inhibitive primer followed by one of undercoat;
- d) applying a plastics coating.

9.4.2 When the frame is of welded construction, the weld areas shall be freed of scale and treated to give a protection equivalent to that given to the remainder of the frame. The frame shall be fabricated prior to the application of any finishing coat.

9.4.3 Steel fittings and accessories such as clips, brackets, screws, bolts, nuts, rivets and washers shall be prepared and finished as above.

9.4.4 The reverse of signs should have a top coat finish colour of either grey or black. All post shall be painted in alternate black and white stripes at 200 mm to 250 mm band widths.

9.5 Back support frame

Unless otherwise specified, aluminium sign plates, and steel sign plates greater than 0.4 m² in areas, shall be supplied with a back support frame of a size and design to avoid the plate being deformed due to wind pressure, or manipulation by vandals (other than severe attack). The frame shall normally be made of a steel angle riveted or bolted to the sign plate, and shall incorporate brackets to enable the sign plate to be bolted to the sign post.

All screws, bolts, nuts, washers, rivets, etc., shall be protected against corrosion. Steel fixings that come into contact with aluminium must be coated with zinc or cadmium to prevent corrosion through electrolytic action.

The complete sign when mounted on its support in accordance with the manufacturer's instructions shall be rigidly locked in position to resist twisting.

9.6 Sign plate preparation and coatings

The choice of aluminium or steel shall be governed by the type of sign being manufactured. The sign plates for all fully reflective signs should be aluminium.

Non-reflective or partially reflective signs shall use steel sign plates. Wood or reinforced concrete shall not be acceptable as materials for sign plates.

9.6.1 Aluminium

If aluminium is chosen, the aluminium sheeting shall be 2 mm thick unless otherwise specified. After any cutting and punching has been completed all sharp edges shall be uniformly rounded off and smoothed down.

The metal plate shall be degreased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth, plain surface.

After cleaning, metal shall not be handled except by a device or clean canvas gloves.

There shall be no opportunity for metal to come into contact with grease, oil, or other contaminants prior to the application of the reflective sheeting.

9.6.2 Steel

9.6.2.1 If steel plate is chosen, the steel plate shall be 1.25 mm thick. However, plate thicknesses of 1.6 mm which is more generally available, or 2.0 mm are acceptable. Also the steel plate is provided depending on the type of roads. After any cutting, welding and punching has

been completed, all sharp edges shall be uniformly round off and smoothed down.

9.6.2.2 All physically adhering contaminants shall be removed and the surfaces abrasive-blasted and then thoroughly cleaned and degreased. Unless the application of a primer follows within 4 hours of the abrasive blasting and before any oxidation of the prepared surfaces takes place, the surface shall be given one coat of wash primer immediately after blasting.

9.6.2.3 The prepared surface shall be given two coats of a zinc chromate primer. The first coat is to be applied within 12 hours in the case of wash-primed surfaces and within 4 hours, but before any oxidation of the surface takes place, in the case of abrasive-blasted surfaces that have not been wash-primed.

9.6.2.4 There shall be no opportunity for the metal to come into contact with grease, oil or other contaminants prior to the application of the reflective sheeting.

9.6.3 Coating

Parts of the sign plate not covered by reflective sheeting (including the reverse of the plate and the back support frame) shall be coated using either by painting, stove enameling or powder coating processes. The colour of the reverse of sign plates and support frame shall be grey or black.

9.7 Installation of signs

9.7.1 Mounting posts

Mounting posts should be installed in accordance with the accepted practice of manufacture. The steel tube, to be used should have at least 50 mm internal diameter, however 78 mm by 38 mm C- channel should be equally acceptable and has the added advantage of giving a flat surface on which to bolt the sign plate. Posts constructed from wood or reinforced concrete will not be acceptable.

Before using other types of steel section for posts, the competent authority shall need to be consulted that the proposed post shall not suffer any permanent deformation or other form of failure when it is subjected to the estimated working stresses.

9.7.1.1 Fixing

9.7.3.1.1 The method of fixing the sign plate (and frame if used) to the mounting post(s) should be such as it shall facilitate its removal for replacement purposes. A typical method of fixing unframed signs to a circular post is by the use of half clips which are riveted, bolted or welded to the sign plate. A typical method for fixing a larger framed sign is for the back support frame to have two flanges one at the top and one at the bottom.

The sign is then fixed to the sign post by bolting through the flanges.

9.7.3.1.2 Each type of sign plate and mounting post presents its own fixing problem, but the aim should be to provide a fixing for the sign plate (and frame if used) so that although it can be easily removed for replacement purposes, it is held firmly enough to withstand the loading to which it will be subjected. All nuts, bolts, washers etc, shall be protected against corrosion. Steel fixings that come into contact with aluminium shall be coated with zinc or cadmium to prevent corrosion through electrolytic action.

9.7.3.1.3 In order to help prevent theft of the sign, the ends of the threads of fixing bolts should be filled down, deformed with a hammer or the thread spot welded.

9.7.3.1.4 Where a sign is mounted on a single post, care should be taken to prevent the forced rotation of the sign round it. In the case of a circular post, this may be achieved by means of a pointed grub screw in the clip which is screwed into the post.

9.7.3.1.5 Care should be taken to prevent the rotation of the post in its foundation. This may be achieved by passing a length(s) of bar through holes drilled in the base of the post below ground level. For additional rigidity, the bar can be welded to the base of the post.

9.7.1.2 Foundations

9.7.3.2.1 The type of foundations required, particularly for larger direction signs, shall vary with the local soil conditions. These may be in mass concrete or reinforced concrete. The buried section should be at least one-third the overall length of the post. Unless otherwise specified the foundation for a single post should be at least 450 mm x 450 mm and 600 mm deep. The concrete should be a 1:3:6 cement: sand: gravel mixture.

After pouring, it should be properly compacted with a tamper. The top surface should be smooth with a slight slope outwards from the post to ensure proper drainage. The top surface of the finished concrete should not be proud of the surrounding ground surface as the provision of foundation blocks or plinths can enable vandals to reach the sign plate more easily.

9.7.3.2.2 The foundation should be designed and placed at such a depth that it shall safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil. Special precautions should be taken to ensure the adequacy of foundations in made up ground. Foundation for the large directions signs should not be covered up until they have been inspected and approved by the Engineer.

9.7.3.2.3 Temporary struts should be used to hold the post in position until the foundation is complete, making sure that the post is vertical and that the sign plate is level and at the correct angle to the road. The installation date should be painted on the back of the sign.

9.8 Road markings

9.8.1 The paint used for road markings should be manufactured specifically for this purpose and should comply with RS EAS 293-1. It should be quick-drying, durable, and have a good skid-resistance.

9.8.2 The paint may be applied by brush or machine, however before ordering paint, the proposed method of application should be specified to the manufacturer to ensure that the correct type of paint is ordered. Hot sprayed plastic or thermoplastic may also be used.

9.8.3 Markings shall not be laid until the correct temporary traffic signs are in place. The road surface shall be clean and dry, and completely free from dirt, grease or any other material that might prevent the paint from adhering properly. The outline of the marking should be marked on the road surface with chalk or paint spots.

It is worth making templates for the more complicated markings such as arrows. The paint may be applied by brush or by machine. Traffic shall not be allowed over the markings until they are dry. On completion the longitudinal lines should present a smooth visual flow to the eye with no kinks or sudden bends.

9.8.4 Carriageway markings may be laid either by hand or by machine. The choice shall depend on such factors as the type of material, the pattern of the marking, how frequently the pattern is repeated, and on the amount to be laid. In busy urban areas, consideration shall be given to clearing the street of parked vehicles; the only alternative may be to operate at night, or at weekends.

9.8.5 All types of carriageway markings should be skid-resistant in wet conditions. Adequate skid resistance is particularly important where the camber or crossfall is steep and at junctions where turning traffic includes an appreciable number of two-wheeled vehicles.

9.8.6 As it is not possible to lay carriageway markings to precise dimensions and in order to allow for the markings "spreading" in service, certain tolerances in the prescribed dimensions may be permitted.

These are:

- a) 3 m or over Plus or minus 15%;
- b) 300 mm or over, but under 3 m Plus or minus 20%; and
- c) Under 300 mm Plus 30% or minus 20%

9.8.7 The maximum projection of the line marking above the surface should be 6 mm. This should not be exceeded because of the danger to traffic, especially to two-wheeled vehicles, and to pedestrians. Where markings are relaid over existing markings after surface dressing of the carriageway, care should be taken to ensure the overall projection of the markings should also not exceed 6 mm.

9.9 Reflective road studs

The following points should be considered when specifying studs:

- a) glass lenses are much more resistant to wear than plastic;
- b) corner cube reflectors have a greater reflective performance than bi-convex lenses but tend to be more expensive; and
- c) strong fixing is vital for safety - road nails plus epoxy glue is advisable for asphalt, however using anchored road studs on surface dressed road is not advised as it is likely to result in a weakness in the impermeable surfacing which could lead to local failure.

9.9.1 Installation of bonded road studs

9.9.1.1 Bonded road studs should be fixed in accordance with the manufacturer's instructions.

9.9.1.2 The road surface should be cleaned and dust, oil, grease and other contaminants removed. The surface should, where possible, be allowed to weather and compact for a minimum period of 6 weeks to 8 weeks depending on traffic conditions prior to the installation of permanent studs.

9.9.1.3 Road studs should not be installed on white lines or on joints in the road surface. They should be installed when the road surface is completely dry unless the manufacturer of the adhesive recommends that it is suitable for use in other conditions.

9.9.1.4 A blowlamp may be used to prepare the road surface in damp or cold weather, but care should be taken not to overheat the road surface as this can weaken it.

9.9.1.5 In cases of doubt, the adhesive manufacturer's advice should be obtained on whether the adhesive is appropriate to the surface in question.

9.9.2 Method of use of adhesive

9.9.2.1 Any settling of fillers or pigments in the adhesive components should be completely dispersed by stirring before the components are mixed.

9.9.2.2 Just before use, the components should be thoroughly mixed to give a homogeneous mixture of uniform colour. The manufacturer's instructions should be followed regarding the application of the adhesive and any safety precautions. The adhesive should be used as quickly as possible after mixing and never after it has started to set in the container.

9.9.2.3 The whole of the bottom surface of the road stud should be allowed to set sufficiently before allowing traffic to over run the stud.

9.9.3 Installation of anchored road studs

Anchored road studs should be fixed in accordance with the manufacturer's instructions.

The cavities formed in bituminous surfaces should be thoroughly cleaned. In cold weather, the temperature of the bituminous material immediately surrounding the cavities formed to accept the anchored part of an anchored road stud, may be gently heated in order to prevent rapid cooling of any heated bituminous adhesive or grout used in the cavity.

Care is taken not to overheat the road surface as this can weaken it.

9.10 Maintenance of signs and road markings

9.10.1 General

9.10.1.1 Traffic signs, traffic lights and carriageway markings, including reflecting studs, shall be maintained to fulfil their purpose.

9.10.1.2 All signs and markings including reflecting road studs, should be inspected at regular and frequent intervals both by day, and when appropriate, for reflectance at night. They should be renewed as necessary. Signs become less effective not only when characters or colouring deteriorate, but also when dirty or damaged or displaced as a result of accidents. Damaged or dirty signs lessen road users' respect for the signs. A periodic inspection of signs should be made to ensure their early repair and/or replacement when necessary, and after dark inspections should be made of reflectorised signs.

9.10.1.3 Regular cleaning of all signs shall be done.

9.10.1.4 To ensure proper maintenance, a suitable schedule should be established for the inspection. Cleaning of signs should occur at least twice a year and signs should be replaced immediately when damaged or missing. One inspection per year should be carried out at night to ensure adequate brilliance of reflectorized surfaces.

9.10.1.5 Care should be taken that vegetation does not obstruct the sight line of a traffic sign. Deep snow may require the seasonal raising of sign heights.

9.10.1.6 For illuminated signs, a regular schedule of lamp replacement should be maintained so that lamps are renewed before they are normally expected to burn out.

9.10.1.7 Markings should be renewed or relaid after resurfacing or on the completion of road works which may have interfered with them.

9.10.1.8 Arrangements should be made to protect road studs during surface dressing operations.

9.10.1.9 Road law enforcement, maintenance staff and other public agencies whose duties require that they travel on the roadways should immediately report a damaged, deteriorated or obscured and missing sign at the first opportunity.

9.10.2 Maintenance regime

9.10.2.1 Proper record-keeping and regular inspection should be the key to good maintenance. An inventory of markings, signs, and other road furniture should be helpful. In addition to a description of the item and its location, it can usefully include installation and inspection dates, and repair details. The inventory number should be painted on the back of the sign plate.

9.10.2.2 Inspections should be made at least twice a year, preferably after routine cleaning has been done. The things to look for are:

- a) signs that are missing or in the wrong location;
- b) signs that are pointing the wrong way or are tilting;
- c) signs that are hidden by trees or bushes;
- d) posts that are loose in their foundations;
- e) sign plates that are loose;

- f) corrosion of sign plates and posts;
- g) accident or other damage;
- h) flaking or faded sign faces and painted surfaces;
- i) poorly reflecting sign faces (best checked at night);and
- j) worn or faded road markings.

9.10.2.3 The faults that are found and the action taken shall be recorded.

9.10.3 Cleaning

Signs should be cleaned at least twice a year, and priority should be given to low-mounted signs. Any long grass, bushes or tree branches which hide the sign face shall be cut back. Water and a mild detergent to wash the sign should be used and care not to scratch the surface shall be taken.

The sign in clean water to remove all traces of detergent shall be rinsed. Road tar can be cleaned off with petrol or white spirit, but the cleaner shall be careful not to dissolve the paint.

9.10.4 Repairs

Minor repairs and repainting can be done on-site. Repainting should only be done in dry weather and after

proper preparation of the surface. Paint shall not be applied to reflective sheeting, because this makes it nonreflective. Similarly, ordinary road paint shall not be used on reflectorised road markings.

9.10.5 Storage and transport of signs

Signs shall always be stored where they cannot be damaged. They shall be stacked vertically, if possible, and sheets of cardboard or thick paper shall be put between them to prevent the sign faces from getting scratched.

Care shall be taken when loading signs on and off trucks, and they shall not be allowed to bounce around while being transported.

9.10.6 Assessment of effectiveness of signs and road markings

As part of the maintenance programme, the location and frequency of accidents should be recorded. From these records, it can be established where accidents on the road network most frequently occur. Accident sites should be looked at in more detail to establish whether better signing or road marking would improve safety and reduce accidents.

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