801. TRAFFIC SIGNS

801.1. General

801.1.1. The colour, configuration, size and location of all traffic signs for highways other than Expressways shall be in accordance with the Code of Practice for Road Signs, IRC: 67 or as shown on the drawings. For Expressways, the size of the signs, letters and their placement shall be as specified in the Contract drawings and relevant Specifications. In the absence of any details or for any missing details, the signs shall be provided as directed by the Engineer.

801.1.2. The signs shall be either reflectorised or non-reflectorised as shown on the drawings or as directed by the Engineer. When they are of reflectorised type, they shall be of retro-reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed over aluminium sheeting as per these Specifications.

801.1.3. In general, cautionary and mandatory signs shall be fabricated through process of screen printing. In regard to informatory signs with inscriptions, either the message could be printed over the reflective sheeting, or cut letters of non-reflective black sheeting used for the purpose, which must be bonded well on the base sheeting as directed by the Engineer.

801.2. Materials

The various materials and fabrication of the traffic signs shall conform to the following requirements:

801.2.1. Concrete : Concrete shall be of the grade shown on the Contract drawings or otherwise as directed by the Engineer.

801.2.2. Reinforcing steel : Reinforcing steel shall conform to the requirement of IS: 1786 unless otherwise shown on the drawing.

801.2.3. Bolts, nuts, washers: High strength bolts shall conform to IS: 1367 whereas precision bolts, nuts, etc., shall conform to IS: 1364.

801.2.4. Plates and supports : Plates and support sections for the sign posts shall conform to IS: 226 and IS: 2062 or any other relevant IS Specific, lions.

801.2.5. Aluminium : Aluminium sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminium alloy conforming to IS: 736-Material designation 24345 or 1900.

801.2.6. Signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5 mm thick. All others shall be at least 2 mm thick. The thickness of the sheet shall be related to the size of the sign and its support and shall be such that it does not bend or deform under the prevailing wind and other loads.

801.2.7. In respect of sign sizes not covered by IRC: 67, the structural details (thickness, etc.) shall be as per the approved drawings.

801.3. Traffic Signs Having Retro-reflective Sheeting

801.3.1. General requirements: The retro-reflective sheeting used on the sign shall consist of the white or coloured sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface. It shall be weather-resistant and show colourfastness. It shall be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory, by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of High Intensity Grade with encapsulated lens. The type of the sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

801.3.2. High intensity grade sheeting : This sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent water-proof plastic having a smooth surface. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM Standard E: 810) as indicated in Table 800-1.

TABLE 800-1. ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR HIGH INTENSITY GRADE SHEETING (CANDELAS PER LUX PER SQUARE METRE)

Observation angle (in degrees)	Entrance Angle (in degrees)	White	Yellow	Orange	Green/Red	Blue
0.2	-4	250	170	100	45	20
0.2	+30	150	100	60	25	11
0.5	-4	95	62	30	15	7.5
0.5	+30	65	45	25	10	5.0

When totally wet, the sheeting shall not show less than 90 per cent of the values of retro-reflectance indicated in Table 800-1. At the end of 7 years, the sheeting shall retain at least 75 per cent of its original retro-reflectance.

801.3.3. Engineering grade sheeting : This sheeting shall be of enclosed lens type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water-proof plastic, resulting in a non-exposed lens

optical reflecting system. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM Standard : E-810) as indicated in Table 800-2.

TABLE 800.2. ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR ENGINEERING GRADE SHEETING (CANDELAS PER LUX PER SQUARE METRE)

Observation angle (in degrees)	Entrance Angle (in degrees)	White	Yellow	Orange	Green	Red	Blue
0.2	-4	70	50	25	9.0	14.5	20
0.2	+30	30	22	7.0	3.5	6.0	11
0.5	-4	30	25	13.5	4.5	7.5	7.5
0.5	+30	15	13	4.0	2.2	3.0	5.0

When totally wet, the sheeting shall not show less than 90 per cent of the values, of retro-reflection indicated in Table 800-2. At the end of 5 years, the sheeting shall retain at least 50 per cent of its original retro-reflectance.

801.3.4. Messages/borders: The messages (legends, letters, numerals etc.) and borders shall either be screen-printed or of cut-outs. Screen-printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. Cut-outs shall be of materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer.

801.3.5. For screen-printed transparent coloured areas on white sheeting, the co-efficient of retro-reflection shall not be less than 50 per cent of the values of corresponding colour in Tables 800-1 and 800-2, as applicable.

801.3.6. Cut-out messages and borders, wherever used, shall be made out of retro-reflective sheeting (as per Clause 801.3.2 or 801.3.3 as applicable), except those in black, which shall be of non-reflective sheeting.

801.3.7. Colour: Unless otherwise specified, the general colour scheme shall be as stipulated in IS: 5 "Colour for Ready Mixed Paints", viz.

Blue	-	IS	Colour	No. 166: French Blue
Red	-	IS	Colour	No. 537: Signal Red
Green	-	IS	Colour	No. 284: India Green
Orange	-	IS	Colour	No. 591: Deep Orange.

The Colours shall be durable and uniform in acceptable hue when viewed in day light or under normal headlights at night.

801.3.8. Adhesives : The sheeting shall either have a pressure-sensitive adhesive of the aggressive-tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, or a tack free adhesive activated by heat, applied in a heat-vacuum applicator, in . a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type of material of the base plate used for the sign. The adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. In case of pressure-sensitive adhesive sheeting, the sheeting shall be applied in accordance with the manufacturer's Specifications. Sheeting with adhesives requiring use of solvents or other preparation for adhesive shall be applied strictly in accordance with the manufacturer's instructions.

801.3.9. Refurbishment: Where existing signs are specified for refurbishment, the sheeting shall have a semi-rigid aluminium backing pre-coated with aggressive-tack type pressure sensitive adhesive. The adhesive shall be suitable for the type of material used for the sign and should thoroughly bond with that material.

801.3.10. Fabrication :

801.3.10.1. Surface to be reflectorised shall be effectively prepared to receive the retro-reflective sheeting. The aluminium sheeting shall be de-greased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting/primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting.

801.3.10.2. Complete sheets of the material shall be used on the signs except where it is unavoidable; at splices, sheeting with pressure sensitive adhesives shall be overlapped not less than 5 mm. Sheeting with heat-activated adhesives may be spliced with an overlap not less than 5 mm or butted with a gap not exceeding 0.75 mm. Where screen printing with transparent colours is proposed, only butt jointing shall be used. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut-outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

801.3.11. Warranty and durability : The Contractor shall obtain from the manufacturer a seven-year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of high intensity grade and a five year warranty for the adhesive sheeting' of engineering grade, and submit the same to

the Engineer. In addition, a seven year and a five year warranty for satisfactory in-field performance of the finished sign with retro-reflective sheeting of high intensity grade and engineering grade respectively, inclusive of the screen printed or cut out letters/legends and their bonding to the retro-reflective sheeting shall be obtained from the Contractor/supplier and passed on to the Engineer. The Contractor/supplier shall also furnish a certification that the signs and materials supplied against the assigned work meets all the stipulated requirements and carry the stipulated warranty.

Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and, following cleaning, shall show no appreciable discolouration, cracking, blistering or dimensional change and shall not have less than 50 per cent of the specified minimum reflective intensity values (Tables 800-1 and 800-2) when subjected to accelerated weathering for 1000 hours, using type E or EH Weatherometer (AASHTO Designation M 268).

801.4. Installation

801.4.1. Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally, signs with an area upto 0.9 sq. m. shall be mounted on a single post, and for greater area two or more supports shall be provided. Sign supports may be of mild steel, reinforced concrete or galvanised iron (G.I.) Post- end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant Specifications as specified.

801.4.2. All components of signs and supports, other than the reflective portion and G.I. posts shall be thoroughly descaled, cleaned, primed and painted with two coats of epoxy paint. Any pan of mild steel (M.S.) post below ground shall be painted with three coats of red lead paint.

801.4.3. The signs shall be fixed to the posts by welding in the case of steel posts and by bolts and washers of suitable size in the case of reinforced concrete or G.I. posts. After the nuts have been tightened, the tails of the bolts shall be furred over with a hammer to prevent removal.

801.5. Measurements for Payment

The measurement of standard cautionary, mandatory and information signs shall be in numbers of different types of signs supplied and fixed, while for direction and place identification signs, these shall be measured by area in square metres.

801.6. Rate

The Contract unit rate shall be payment in full for the cost of making the road sign, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

802. OVERHEAD SIGNS

802.1. General

802.1.1. Overhead signs may be used in lieu of, or as an adjunct to, ground signs where the situation so warrants for proper information and guidance of the road user .The following conditions may be considered while deciding about the provision of overhead signs:

1. Traffic volume at or near capacity
2. Complex interchange design
3. Three or more lanes in each direction
4. Restricted sight distance
5. Closely spaced interchanges
6. Multi-lane exits
7. Large percentage of commercial vehicles
8. High speed traffic
9. Consistency of sign message location through a series of interchanges
10. Insufficient space for ground mounted signs
11. Background of street lighting
12. Distances of important places enroute highways at suitable intervals.

802.1.2. From safety and aesthetic standpoints, overhead signs shall be mounted on overhead bridge structures wherever possible. Where these are required to be provided at some other locations, the support system should be properly designed based on sound engineering principles, to safely sustain the dead load, live load and wind load on the completed sign system. For this purpose, the overhead signs shall be designed to withstand a wind loading of 150 kg/m2 normal to the face of the sign and 30 kg/m2 transverse to the face of the sign. In addition to the dead load of the structure, walkway loading of 250 kg concentrated live load shall also be considered for the design of the overhead sign structure.

802.2. Height

Overhead signs shall provide a vertical clearance of not less than 5.5 m over the entire width of the pavement and shoulders except where a lesser vertical clearance is used for the design of other structures. The vertical clearance to overhead sign structures or supports need not be greater than 300 mm in excess of the minimum design clearance of other structures.

802.3. Lateral Clearance

802.3.1. The minimum clearance outside the usable roadway shoulder for expressway signs mounted at the road side or for overhead sign supports either to the right or left side of the roadway shall be 1.80 m. This minimum clearance of 1.80 m shall also apply outside of an unmountable kerb. Where practicable, a sign should not be less than 3 m from the edge of the nearest traffic lane. Large guide signs should be farther removed preferably 9 m or more from the nearest traffic lane, unless otherwise specified. Lesser clearances, but not generally less than 1.80 m, may be used on connecting roadways or ramps at inter-changes.

802.3.2. Where a median is 3.6 m or less in width, consideration should be given to spanning over both roadways without a central support. Where overhead sign supports cannot be placed at a safe distance away from the line of traffic or in an otherwise protected site, they should either be so designed as to minimise the impact forces or protect motorists adequately by a physical barrier or guard rail of suitable design.

802.4. Number of Signs at an Overhead Installation

In no case should there be more than three signs displayed at any one location, including regulatory or warning signs, either on the overhead structure or on its support.

802.5. Materials for Overhead Sign and Support Structures

802.5.1. Aluminium alloy or galvanized steel to be used, as truss design supports shall conform to relevant IS. These shall be of sections and type as per structural design requirements as shown on the plans. 802.5.2. After steel trusses have been fabricated and all required holes punched or drilled on both the horizontal truss units and the vertical and support units, they shall be galvanized in accordance with IS Specifications.

802.5.3. Where aluminium sheets are used for road signs, they shall be of smooth, hard and corrosion resistant aluminium alloy conforming to IS 736- Material Designation 24345 or 1900. The thickness of sheet shall be related to the size of the sign with minimum thickness of sheet as 1.5 mm.

802.5.4. High strength bolts shall conform to IS: 1367 whereas precision bolts, nuts etc. shall conform to IS: 1364.

802.5.5. Plates and support sections for sign posts shall conform to IS: 226 and IS: 2062.

802.5.6. The overhead signs shall be reflectorised with high intensity retro-reflective sheeting preferably of encapsulated lens type.

802.6. Size, Locations, etc. of Signs

802.6.1. The size of the signs, letters and their placement shall be as specified in the Contract drawings and Specifications.

802.6.2. In the absence of details or for any missing details in the Contract documents, the signs shall be provided as directed by the Engineer.

802.7. Installation

802.7.1. The supporting structure and signs shall be fabricated and erected as per details given in the plans.

802.7.2. Sign posts, their foundations and sign mountings shall be so constructed as to hold signs in a proper and permanent position to adequately resist swaying in the wind or displacement by vandalism.

802.7.3. The work of construction of foundation for sign supports including excavation and backfill, forms, steel reinforcement, concrete and its placement shall conform to the relevant Specifications given in these Specifications.

802.7.4. The structures shall be erected with the specified camber and in such a manner as to prevent excessive stresses, injury and defacement.

802.7.5. Brackets shall be provided for mounting signs of the type to be supported by the structure. For better visibility, they shall be adjustable to permit mounting the sign faces at any angle between a truly vertical position and three degree from vertical. This angle shall be obtained by rotating the front lower edge of the sign forward. All brackets shall be of a length equal to the heights of the signs being supported.

802.7.6. Before erecting support structures, the bottom of each base plate shall be protected with an approved material which will adequately prevent any harmful reaction between the plate and the concrete.

802.7.7. The end supports shall be plumbed by the use of leveling nuts and the space between the foundation and base plate shall be completely filled with an anti-shrink grout.

802.7.8. Anchor bolts for sign supports shall be set to proper locations and elevation with templates and carefully checked after construction of the sign foundation and before the concrete has set.

802.7.9. All nuts on aluminium trusses, except those used on the flanges, shall be tightened only until they are snug. This includes the nuts on the anchor bolts. A thread lubricant shall be used with each aluminium nut.

802.7.10. All nuts on galvanized steel trusses, with the exception of high strength bolt connections, shall be tightened only to a snug condition.

802.7.11. Field welding shall not be permitted.

802.7.12. After installation of signs is complete, the sign shall be inspected by the Engineer. If specular reflection is apparent on any sign, its positioning shall be adjusted by the Contractor to eliminate or minimize this condition.

802.8. Measurements for Payment

802.8.1. Aluminium or steel overhead sign structure will be measured for payment by the specific unit (each) complete in place or for each component of the overhead sign structure as indicated in the Bill of Quantities and the detailed drawing(s).

802.8.2. Flat sheet aluminium signs with retro-reflective sheeting thereon shall be measured for payment by the square metre for each thickness, complete in place.

802.9. Rate

802.9.1. The structural steel part of the overhead sign shall be measured in tonnes while the sign board shall be measured in sq. m. Other items like excavation for foundation and concrete in foundation to be measured and paid in cu. m. separately. The Contract unit rate for overhead sign structure shall be payment in full compensation for furnishing all labour, materials, tools, equipment, excavation, fabrication and installation and all other incidental costs necessary to complete the work to the Specifications.

802.9.2. The Contract unit rate for aluminium sheet signs shall include the cost of making the sign including all materials and fixing the same in position and all other incidental costs necessary to complete the work to the Specifications.