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No.RW/NH-33023/10/97-DO III *Dated, the 11th June, 1997*

To

The Chief Engineers, PWD of all States/UTs, (dealing with National Highways and other Centrally Sponsored Schemes), Director General Border Roads, Director General (Works), Central Public Works Department, Chairman, National Highways Authority of India

Subject: Tentative Specifications for Reflective Pavement Markers (Roads Studs)

Reflective pavement markers or Road Studs are being increasingly used on the roads for lane marking and delineation for night time visibility. At present there are no prescribed specifications for this product issued either by the Ministry or the IRC. Markers available in the market are of varying quality and their performance also varies widely. In order to regulate the quality of pavement markers, tentative specifications for this have been prepared and are enclosed (Annexure). Most of the provisions in the specifications have been based on BS 873 Part-4: 1973 and ASTM D 4280.

2. As per para 7 of the tentative specifications, the Contractor shall obtain from the manufacturer a two year warranty for satisfactory performance including stipulated retro-reflectance of the reflecting panel and submit the same to the Engineer. In addition, a two year warranty for satisfactory infield performance of the finished road marker shall also be given by the contractor who carries out the work of fixing of reflective road markers. In case the markers are displaced, damaged, get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the intimation from the Engineer at his own cost and with no extra remuneration to be paid for such works.

3. The specifications prescribe different values of coefficient of luminous intensity for category 'A' and category 'B' Road studs. It would be desirable to use category 'A' road studs on arterial roads like National Highways, State Highways etc. Category 'B' road studs may be used on minor roads.

4. White reflective road markers may be used for lane markings at locations where lane marking in white colour has been prescribed in IRC-35. Amber colour reflective markers may be used at locations where lane markings in yellow colour have been prescribed in IRC-35 and red colour markers could be used to indicate no entry roads.

5. It is requested that these tentative specifications may be used for works on National Highways. Any suggestions based on field performance of these specifications may please be forwarded to the Ministry for improvement/augmentation of the specifications.

Enclosure to letter No.RW/NH-33023/10/97-DO.III, dated the 11th June, 1997

Annexure

Tentative Specifications for Reflective Pavement Markers (Road Studs)

1. **General**

Reflective pavement marker (RPM) or road stud is a device which is bonded to or anchored within the road surface for lane marking and delineation for night-time visibility. It reflects incident light in directions close to the direction from which it came.

2. **Definitions**

2.1. **Description of Terms Specific to this standard**

2.1.1. **Coefficient of luminous intensity (CIL) or specific intensity** - the ratio of luminous intensity of the retro-reflector in the direction of observation to illuminance at the retro-reflector on a plane perpendicular to the direction of the incident light expressed in terms of millicadelas per incident lux (mcd/lx).

2.1.2. **Horizontal entrance angle** - the angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the marker.

2.1.3. **Observation angle** - the angle at the reflector between the illumination axis and the observation axis.

2.1.4. **Retro-reflection** - reflection in which the radiation is returned in direction close to the directions from which it came. This property being maintained over wide variations of the direction of incident radiation.

2.1.5. **Head** - that part of a road stud which is above the road surface when the road stud is fixed in position in the road.

2.1.6. **Upper surface** - that part of the external surface of road stud which is visible when the road stud is fixed in position in the road.

2.1.7. **Anchorage** - that part of a road stud which is below the road surface when the road stud is fixed in position in the road.

3. **Material**

3.1. Plastic body of RPM/road stud shall be moulded from ASA (Acrylic Strene Acrylonitrite) or HIPS (Hi-impact Polystyrene) or ABS or any other suitable material approved by the Engineer-in-Charge. The markers shall support a load of 13635 kg tested in accordance with ASTM D4280.

3.2. Reflective panels shall consist of number of lenses containing single or dual prismatic cubes capable of providing total internal reflection of the light entering the lens face. Lenses shall be moulded of methyl methecrylate conforming to ASTMD 788 or equivalent.

4. **Design**

4.1. The slope or retro-reflecting surface shall preferably be 35 ± 5 degree to base.

4.2. The area of each retro-reflecting surface shall not be less than 13.0 sqcm.

5. **Optical Performance**

5.1. **Unidirectional and bi-directional studs**

5.1.1. Each reflector or combination of reflectors on each face of the stud shall have a C.I.L. not less than that given in Table 1 or 2 as appropriate.

Table 1 Minimum C.I.L. Values for Category 'A' studs

Entrance angle	Observation angle	C.I.L. in mcd/lx		
		White	Amber	Red
0^{o}U 5^{o} L&R	0.3^{o}	220	110	44
0^{o}U 10^{o} L&R	0.5^{o}	120	60	24

Table 2 Minimum C.I.L. Values for Category 'B' studs

Entrance angle	Observation angle	C.I.L. in mcd/lx		
		White	Amber	Red
0^{o}U 6^{o} L&R	0.3^{o}	20	10	4
0^{o}U 10^{o} L&R	0.5^{o}	15	7.5	3

Note: The entrance angle of 0^{o}U corresponds to the normal aspect of the reflectors when the reflecting road stud is installed in horizontal road surface.

5.1.2. A stud that incorporates one or more corner cube reflectors shall be considered to be included in category 'A'. A stud that incorporates one or more bi-convex reflectors shall be considered to be included in category 'B'.

5.2. **Omni-directional studs**

Each omni-directional stud shall have a minimum C.I.L. of not less than 2 mcd/lx.

5.3. **Tests**

5.3.1. Coefficient of luminance intensity can be measured by procedure described in ASTM E 809 "Practice for Measuring Photometric Characteristics" or as recommended in BS: 873 - Part 4:1973.

5.3.2. Under test conditions, a stud shall not be considered to fail the photometric requirements if the measured C.I.L. at any one position of measurement is less than the values specified in Table 1 or 2 provided that

(i) the value is not less than 80% of the specified minimum, and

(ii) the average of the left and right measurements for the specific angle is greater than the specified minimum.

6. Fixing of Reflective Markers

6.1. Requirements

6.1.1. The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic.

6.1.2. The reflecting portions of the studs shall be free from crevice or ledges where dirt might accumulate.

6.1.3. All road studs shall be legibly marked with the name, trade mark or other means of identification of the manufacturer.

6.1.4. Marker height shall not exceed 20 mm.

6.1.5. Marker width shall not exceed 130 mm.

6.1.6. The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configurated, the outermost faces of the configurations shall not deviate more than 1.3 mm from a flat surface.

6.2. Placement

6.2.1. The reflective marker shall be fixed to the road surface using the adhesives and the procedure recommended by the manufacturer. No nails shall be used to affix the marker as nails are hazardous for the roads.

6.2.2. Regardless of the type of adhesive used, the markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surfacing until the surfacing has been opened to traffic for a period of not less than 14 hours.

6.2.3. The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers, paint and any other material which would adversely affect the bond of the adhesive.

6.2.4. Use a wire brush, if necessary to loosen and remove dirt, then brush or blow clean.

6.2.5. The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom of the marker in a quantity sufficient to result in complete coverage of the area of contact of the marker with no voids present and with a slight excess after the marker has been lightly pressed in place.

6.2.6. For epoxy installations, excess adhesive around the edge of the marker, excess adhesive on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed. Soft rags moistened with mineral spirits or kerosene may be used, if necessary to remove adhesive from exposed faces of pavement markers.

7 Warranty and durability

The contractor shall obtain from the manufacturer a two year warranty for satisfactory field performance including stipulated retro-reflectance of the reflecting panel and submit the same to the Engineer. In addition, a two year warranty for satisfactory infield performance of the finished road marker shall also be given by the contractor who carries out the work of fixing of reflective road markers. In case the markers are displaced, damaged, get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the intimation from the Engineer at his own cost and with no extra remuneration to be paid for such works.

8. **Measurement for Payment**

The measurement of reflective road markers shall be in numbers of different types of markers supplied and fixed.

9. **Rate**

The contract unit rate for reflective road markers shall be payment in full compensation for furnishing all labour, material, tools, equipment including incidental costs necessary for carrying out the work at site conforming to the specifications complete as per approved drawings or as directed by the Engineer.