6.5 ROAD MARKINGS

6.5.1 Description

This work shall consist of the provision and installation of reflecting road studs and application of continuous or intermittent lines, stop lines, arrows, letters or figures as shown on the Drawings or directed by the Engineer. The work shall include the supply of all labour, tools and equipment, materials, traffic signs as necessary for the safe and efficient completion of the entire work.

6.5.2 Materials

Materials for permanent road markings shall be thermoplastic material as described in Section 6.5.2.1 or road marking paint as described in Section 6.5.2.2. Kerb markings shall be painted with road marking paint as described in Section 6.5.2.2. Road markings shall be white or yellow as shown on the drawings. Reflecting road studs are described in Section 6.5.2.3.

6.5.2.1 Hot Applied Thermoplastic Materials

The thermoplastic material shall be factory mixed, from an approved manufacturer and shall be of a tropical grade suitable for application, by the means proposed, to the specified road surfaces, and must demonstrate skid resistance appropriate to local traffic conditions. The material shall comply with BS3262 : 1987 ‘Specification for Hot-applied Thermoplastic Road Marking Materials’.

The material shall be supplied in containers which do not contaminate the contents and which protect the contents from contamination and shall be stored in accordance with the manufacturer’s instructions.

Ballotini (glass beads) may be incorporated in the mixture during the manufacture of the thermoplastic material. The quantity of ballotini included shall be between 13% and 22% by weight of the total mix and shall be counted as part of the aggregate. The Ballotini shall comply with BS6088 : 1981 (1993) ‘Specification for Solid Glass Beads for use with Road Markings’.

Alternatively the Ballotini (glass beads) may be applied to the surface of the thermoplastic immediately application is complete. Application of the beads shall be at least 300 grams / square metre or as otherwise directed by the Engineer. The Ballotini shall comply with BS6088 : 1981 (1993) ‘Specification for Solid Glass Beads for use with Road Markings’.

6.5.2.2 Road Marking Paint

All paints shall be road marking paint conforming to BS6044 : 1987 ‘Specification for Pavement Marking Paints’ and made by an approved manufacturer and suitable for application, by the means proposed, to the specified road surfaces.

The paint shall be suitable for applying by brush or mechanical means. The following particulars of the paint shall be supplied:

1) composition (analysis by weight)
2) application (brush or spray)
3) type and maximum amount of reducer (thinner)
4) drying time (wheel dry)
5) setting time (to recoat)

6) recommended coverage (litres per linear kilometre of 100 mm stripe)

7) heat resistance i.e. maximum road temperature

8) details of any primer, undercoat or tack coat required.

The paint shall be supplied fresh and ready for use in sealed containers which shall be stored in accordance with the manufacturer’s instructions.

If required Ballotini (glass beads) may be applied to the surface of the paint immediately application is complete. Application of the beads shall be at least 300 grams / square metre or as otherwise directed by the Engineer. The Ballotini shall comply with BS6088 : 1981 (1993) ‘Specification for Solid Glass Beads for use with Road Markings’.

6.5.2.3 Reflecting Road Studs

Reflecting road studs shall conform to BS 873 : Part 4: 1987 ‘Road Traffic Signs and Internally Illuminated Bollards – Specification for Road Studs’. Road studs shall show red or white and be uni-directional, bi-directional or omni-directional, as shown on the Drawings or as otherwise directed by the Engineer. They shall incorporate one or more corner cube retroreflective lenses, and the area of lens facing each direction of traffic shall be at least 300 square millimetres. The studs shall be capable of withstanding impacts and no contact shall be possible between the lenses and the vehicle tyres. The studs shall not project more than 20 mm above the level of the surrounding road surface and the lowest part of the lenses shall be more than 5 mm above the surrounding road surface. The studs may be either bonded to, or anchored within, the road surface. The design shall be such as to ensure ample key to the road pavement with adequate load distribution and such that it shall not be possible for heavy equipment such as road rollers and tracked vehicles travelling in the direction of the road axis to meet with any sharp edges whereby the removal of the stud might be facilitated.

6.5.3 Construction Methods

6.5.3.1 Thermoplastic Materials

A) Preparation of Road Surface

The material shall be applied only on a surface which is clean and dry. It shall not be laid over loose detritus, mud or similar extraneous matter, or over an old paint marking, or over an old thermoplastic marking which is faulty. New surfaces must be allowed to weather and compact for at least 72 hours before applying the marking. In the case of smooth polished surfaces, e.g. smooth concrete, old asphalt surfacings with smooth polished surface stones, and/or where the method of application requires or the Engineer directs, a tack coat shall be applied to the surface prior to the application. The tack coat shall be as recommended by the manufacturer of the thermoplastic material and to the approval of the Engineer. Faulty thermoplastic markings shall be removed if required by the Engineer.

B) Preparation of Thermoplastic Material

The material shall be melted in accordance with the manufacturer’s instructions in a heater fitted with a stirrer to give a smooth consistency to the thermoplastic and such that local overheating shall be avoided. The temperature of the mass shall be within the
range specified by the manufacturer and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material shall be used as expeditiously as possible and for thermoplastics which have natural resin binders or are otherwise sensitive to prolonged heating, the material shall not be maintained in a molten condition for more than 4 hours.

C) Laying of Thermoplastic Material

Markings may be applied by hand-screeding, hand propelled machine or by self propelled machine as approved or directed by the Engineer. After transfer to the laying apparatus the material shall be maintained within the temperature range specified by the manufacturer and stirred to maintain the right consistency for laying.

In the case of screeded application, material shall be laid to a thickness of not less than 3 mm or more than 6 mm, unless specifically authorised by the Engineer. In the case of sprayed application, the material shall be laid to a thickness of not less than 1.5 mm unless specifically authorised by the Engineer. In all cases, the surface produced shall be uniform, appreciably free from bubbles and streaks.

The Contractor shall not proceed with the marking work until the equipment, method of application, and rate of application, as established by a test section, have been approved by the Engineer.

The work shall be carried out very carefully to a regular alignment in accordance with the Drawings. Straight edges and templates shall be used if required by the Engineer.

Where applicable the Ballotini (glass beads) shall be applied to the surface of the thermoplastic immediately application is complete and shall be applied in a controlled manner by use of a spreading device which will permit an even spread from a fixed height of between 300mm and 400mm or otherwise as the Manufacturer may recommend. (A wheel mounted, variable width, funnel applicator may be suitable). The loss of glass beads after 3 weeks traffic shall not exceed 10 percent of the total applied.

D) Re-use of Thermoplastic Material

At the end of the day’s work, as much as possible of the material remaining in the heater and/or laying apparatus shall be removed. This may be broken and used again, provided that the maximum heating temperature has not been exceeded and that the total time during which it is in a molten condition does not exceed the requirements.

6.5.3.2 Road Marking Paint

A) Preparation of Road Surface

The paint shall be applied only on a surface which is clean and dry. It shall not be laid over loose detritus, mud or similar extraneous matter or over a thermoplastic marking or over an old paint marking which is faulty or incompatible with the paint being applied. New surfaces must be allowed to weather and compact for at least 72 hours before applying the marking. If a primer or undercoat is necessary to ensure proper adhesion of the marking paint to the road surface without bleeding or discoulouration, the primer or undercoat shall be fully compatible with the marking paint and the road surface, and shall be applied only if, and at the rate of application approved by the Engineer.

B) Preparation of Paint
All cold-applied paint shall be thoroughly field mixed before applying in order to keep the pigments in uniform suspension. Hot-applied paints shall be heated in a properly designed heater, to the correct laying temperature at which it shall be maintained as required for the method of application. The paint shall on no account be allowed to exceed the maximum temperature specified by the paint manufacturer. The use of thinner or other additives shall not be permitted unless otherwise agreed to by the Engineer.

C) Laying of Paint

Markings shall be applied by brush, spray, hand-propelled or self-propelled machine according to the marking configuration and the type of paint approved for use or as directed by the Engineer. The rate of application of paint for each coat shall be that recommended by the manufacturer and shall produce a minimum total cover rate of unthinned paint of 0.5 litre per square metre, unless otherwise directed by the Engineer.

Where a spray machine is to be used the Contractor shall not proceed with the marking work until the equipment, method of application, and rate of application, as established by a test section, have been approved by the Engineer.

When more than one coat is used, the succeeding coat shall not be applied until the previous coat has fully set.

The work shall be carried out very carefully to a regular alignment in accordance with the Drawings. Straight edges and templates shall be used if required by the Engineer.

Where applicable the Ballotini (glass beads) shall be applied to the surface of the paint immediately application is complete and shall be applied in a controlled manner by use of a spreading device which will permit an even spread from a fixed height of between 300mm and 400mm or otherwise as the Manufacturer may recommend. (A wheel mounted, variable width, funnel applicator may be suitable). The loss of glass beads after 3 weeks traffic shall not exceed 10 percent of the total applied.

D) Protection of Paint Markings

All markings shall be protected from traffic until they have dried sufficiently.

6.5.3.3 Reflecting Road Studs

Road studs shall not be installed over road markings or joints in the road surface. The road surface shall be cleaned, and dust, oil, grease and other contaminants removed. New surfaces shall be allowed to compact and weather for at least 72 hours prior to the installation of the studs. Acceptable methods of fixing include: bonding with an adhesive; anchoring with a road nail; and setting the stud into a drilled cavity in the pavement. However, the method of fixing, including any adhesive or grout used, must be suitable for the specified road surface and the tropical climate. The studs shall be fixed in accordance with the manufacturer’s instructions. Studs which become loose or free during the defects liability period will be considered a defect.
6.5.3.4 Tolerances

All forms of line marking and road studs shall be subject to the following tolerances where applicable:

a) Longitudinal lines such as centre lines, edge lines and other lines of a continuous nature shall not vary from the design longitudinal dimensions by more than 10%. Transverse dimensions (line width) shall have a tolerance of $-0\% + 10\%$.

b) Longitudinal lines such as centre lines, edge lines, other lines of a continuous nature and road studs shall not vary from the designed alignment by more than 300mm on a curve or 150mm on a straight section.

c) Transverse and other incidental road markings shall not vary from the specified dimensions by more than $\pm 5\%$ of the overall dimension. Alignments shall not vary by more than 20mm from the designed alignment except in the case of centre line chainage location which shall not vary by more than 0.5 metres.

6.5.3.5 Defective Materials of Workmanship

Materials which are defective or have been applied in an unsatisfactory manner or to incorrect dimensions or in a wrong location shall be removed, the road pavement made good and the materials replaced, reconstructed and/or properly located, all at the Contractor’s expense and to the satisfaction of the Engineer.

6.5.3.6 Protection of Traffic

The Contractor shall protect pedestrian, vehicular and other traffic adjacent to the working area against damage or disfigurement by construction equipment, tools and materials or by splatters, splashes and smirches of paint or other construction materials and shall during the course of the work provide and maintain adequate signs and signals for the warning and guidance of traffic.

6.5.4 Measurement

Markings shall be measured for payment by the area in square metres completed and accepted in place. Where the width or length of laid marking proves to be greater than that specified and is accepted by the Engineer, the specified width or length shall be used when calculating areas for payment. Where the width or length of laid marking proves to be less than that specified and is accepted by the Engineer, the actual width or length of laid marking shall be used when calculating areas for payment.

Temporary markings will not be measured as such, the payment therefore shall be considered incidental to the lump sum for maintenance of traffic.

Reflecting road studs shall be measured by the actual number of studs supplied, installed and accepted.

6.5.5 Payment

The work measured as provided above shall be paid for at the Contract unit prices for each of the items listed in the Bill of Quantities.

The payment shall be full compensation for providing and applying the materials including all labour, equipment, tools and incidentals necessary to complete the work.

Pay items shall be:
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/5/1</td>
<td>Road Marking - Thermoplastic Material</td>
<td>Square Metre</td>
</tr>
<tr>
<td></td>
<td><em>(indicate whether screed or spray application is required)</em></td>
<td></td>
</tr>
<tr>
<td>6/5/2</td>
<td>Road Marking - Road Marking Paint</td>
<td>Square Metre</td>
</tr>
<tr>
<td>6/5/3</td>
<td>Reflecting Road Studs</td>
<td>Number</td>
</tr>
<tr>
<td>6/5/4</td>
<td>Application of Ballotini</td>
<td>Square Metre</td>
</tr>
<tr>
<td></td>
<td><em>(indicate whether Ballotini is to be applied to the surface of the marking or mixed in)</em></td>
<td></td>
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</tbody>
</table>