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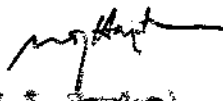
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Ref: in HO 4/3/81  
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Date: 1st October, 1984.

To: \_\_\_\_\_  
Your Ref. \_\_\_\_\_  
dated \_\_\_\_\_

DISPATCHED  
- 1 OCT 1984  
Highways Office  
Headquarters

Thermoplastic Road Marking Materials  
Guide Notes for Site staff

Attached is 30 copies of a guide note, Appendix 1 to Road Note 7, prepared by HOSDU to use at your staff in administering the specialist contractor on Contract 38/1/83. More copies are available from HOSDU should they be required.



(Name Typed)

for Principal Government Highway Engineer

21/1/84

c.c. to 30/1/83

HIGHWAYS OFFICE  
RESEARCH AND DEVELOPMENT UNIT

Thermoplastic Road Marking Materials  
Guide Notes for Site Staff

1. Thermoplastic Material

BS 3262 : 1976, amended 1982, defines thermoplastic material as "consisting of a light coloured aggregate, pigment and extender, bound together with a thermoplastic resin, plasticized as necessary". The addition of small glass beads to the material gives enhanced reflectorization properties.

The material is melted and applied hot to roads, by either a screed or spray application and is a thin road marking. It is used for centre lines, edge lines, pedestrian crossing strips, directional arrows and the like.

2. Specification for Material

The material is fully specified in BS 3262 and amendments; AMD 3610, AMD 3786, AMD 4048 (BS 3262 may be inspected at HORDU). Note that the BS has been amended for use in Hong Kong to raise the Softening Point of the material to a minimum value of 85°C and the Flow Resistance shall not be more than 25% after 48 hours at 40°C ± 2°C (effective 31.8.84). An amendment to Road Note No. 7 has similarly been prepared and circulated.

3. Preparation of the Road Surface

The road surface should be clean and dry. Oil and grease must be removed. On some surfaces, it is necessary to apply an approved priming coat before application of thermoplastic material and in the case of concrete pavements the use of a priming coat is mandatory.

Problems may be encountered if laitance is present on concrete road slabs and this should be removed by wire-brushing before primer application. Primer is generally applied by a pressure sprayer mounted on a hand cart or truck but hand application may be approved if appropriate. The primer must be allowed to dry before applying the thermoplastic markings.

4. Preparation of Thermoplastic Material for Spraying

The material is supplied in either block or powder form.

(i) Block

The material is generally supplied in drums and must be broken out in lumps. Care must be taken when initially adding the blocks to the melting hopper to avoid the overheating of small quantities.

(ii) Powder

The material is supplied in plastic bags which can generally be added complete to the hopper without debagging, once an initial charge of material is in the hopper. (Check this point with the Contractor)

Melting of Material

With both forms of the material, it cannot be overemphasised that the initial charge must be small and the quantity of heat supplied should be just enough to melt, but not raise the material to spray temperature. The material should only be raised to spray temperature after filling the heating hopper to about half of its nominal capacity.

During the melting operation, the stirrer must be used continuously to avoid overheating of the thermoplastic material. Overheating of thermoplastic material often gives rise to a creamy or off-white colour for white lines and a yellow/green colour for yellow lines. Severe overheating also causes the material to deteriorate rapidly and to powder, resulting in a very much reduced life.

Supervisors must insist that the operator has a thermometer available and that he uses it at all times. The temperature during melting should not exceed 230°C. It is good practice to melt small amounts of material continuously rather than large amounts at any given time. In this way the operator will not have large amounts of material in the hopper at the end of a shift. All unused material, at the end of a marking shift should be removed from the hopper and thrown to waste (reheating is difficult to accomplish without overheating).

5. Application of Thermoplastic Material

The specification requires the contractor to apply markings in spray or screeded form, as directed by the Engineer. For line markings, the spray form of application is the preferred method of application and should be used whenever possible. A screed machine would normally be used for box junctions, arrows, letters, characters and other similar markings, although the last HO specialist contractor frequently used his spray machine for "straight ahead" arrows and similar.

The use of spray machines are preferred, as a more consistent line thickness is achieved. A spray machine always incorporates a mechanical agitator or stirring device which ensures that all the aggregates, resins, pigments and added glass beads are thoroughly mixed. The spray machine is invariably pressure driven which ensures a constant supply of material to the gun which in turn ensures a consistent line thickness and consequent economic use of materials.

The use of a screed, or hand pushed, machine, should only be permitted where it is not practical to use a mechanical spray machine. The use of a screed machine, requires a lot of care by the operator. Not only must the operator concentrate on maintaining a constant speed (to get even thickness) but he must also pay attention to following a premarked line as well as operate all the necessary valves to turn the material on and off. On rough or uneven road surfaces, the screed machine tends to "bridge" high-spots and fill in small depressions thus giving uneven film thickness of material. Uneven film thickness

often given rise to irregular cracking patterns due to differential drying rates of the film. It has also been noted that screeding invariably gives rise to a series of transverse ridges in the marked line resulting from irregular forward motion.

6. Application of Glass Beads

The specification requires the addition of surface applied beads at the rate of 400-500 g/m<sup>2</sup>. You must ensure that the beads are applied. They are very expensive and it has been noted that contractors may be somewhat "miserly" in this respect. Particular attention must be given by the contractor when applying beads by screed as uneven motion of the unit will result in erratic bead application. The broadcasting of beads by hand is unacceptable and should not be permitted under any circumstances.

It is important to get the right proportion of beads to ensure proper reflectorization. More than 20% beads mixed in the material causes problems with flaking and powdering whilst less than 10% doesn't give any reflective effect at all. If the beads are spread haphazardly on the surface so as to be all in one location, dark marks will appear as dust gets trapped in the interstices of the beads and the reflective action will be lost. This is very apparent at night when uneven reflectorization is very easily noted. Non-reflectorization can also be caused by dropping beads onto very hot (+230°C) material. In this instance the beads sink into the material. If the material is too cold, the beads will not adhere to the film and will be rapidly lost through traffic and weather action.

7. Possible Problems

(i) Blackening of marks

This appears to be a common problem all over the world however it appears to be particularly prevalent in Hong Kong. Many suppliers have been asked for advice and many different answers have been received. It appears that the problem

may, in part, be related to the softening-point of the material. On a recent contract, the material supplied had a softening point of approximately 75°C. Extensive blackening was noted, particularly on yellow box junctions. Following discussions with the Contractor the softening point was raised to approximately 100°C and to date, 10.9.84, significant improvements have been noted.

Given normal weather conditions, it appears that the black deposits are removed by rain and tyre action. The best explanation for the appearance of the deposits is that a buildup of oil, tyre rubber and mineral matter occurs in dry spells and is held by the material laitance. When the markings are applied the resins form a type of laitance on the surface that either goes brittle or remains soft, dependant on the softening point of the material. The deposits get immersed in this laitance and remain on the marking until the laitance is removed. Scrubbing by hand does not appear very effective in removing the black marks and the only effective removal is by natural weathering and tyre action.

(ii) Pinholes in the surface

The occurrence of pinholes on the film surface has been noted on a few jobs recently. It can generally be ascribed to laying material on relatively uncured or new concrete or to laying material on primer that has not dried or on damp pavements.

(iii) Cracking

If not related to the road surface, cracking can generally be ascribed to poor control of thickness giving rise to varying rates of drying, as described above.

(iv) Flaking-off

Poor pre-treatment by primer or poor preparation of road surface. Wet road surface or cold surface temperature (adopt a minimum surface temperature of 10°C).

(v) Colour - also described above

White becomes creamy or off-white caused by overheating.  
Yellow becomes dark green - mixing old previously heated  
material with new material.

Research and Development Unit  
Highways Office

September, 1984

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