

## OFFICE MEMORANDUM



MICHIGAN

STATE HIGHWAY DEPARTMENT

April 20, 1965

To: W. W. McLaughlin  
Testing & Research Engineer

From: E. A. Finney

Subject: Plastic "Men Working" Sign. Research Project 64 NM-127. Research Report No. R-514.

The subject sign has been tested and evaluated as requested in your memorandum of October 5, 1965 and in H. H. Cooper's memorandum of March 25, 1965. The following specific determinations were requested:

1. Identify the plastic material and its properties.
2. Determine the material's ability to withstand extreme hot and cold.
3. Determine reflectivity of the materials applied.
4. Determine impact durability.

Four signs were received, two of which were reflectorized on one side with yellow Scotchlite and two of which were reflectorized on one side with exposed beads.

The plastic was identified as an acrylonitrile-butadiene-styrene, commonly called "ABS." A number of types of ABS plastic are available, and the type used for these signs was not identified. Some of the more important physical characteristics of high impact and general purpose ABS plastics, along with common plastics such as high impact polypropylene and linear polyethylene, are shown for comparison purposes in Table 1.

It can be seen that the impact strength of ABS plastic is very high in comparison with the other plastics. ABS impact strength at -40 F is approximately equivalent to that of high-impact polypropylene at room temperature. Tensile strength and tensile modulus for ABS are high with respect to other plastics. The flexural modulus or resistance to deformation under flexural load is very high in comparison with other plastics. ABS plastics weather very well. According to J. L. Whitney (Machine Design, September 20, 1962), upon prolonged exposure to sunlight, surface embrittlement of ABS plastic is noticeable with an accompanying loss in impact resistance. Water absorption of ABS is very low in comparison with other plastics. A water absorption test was planned for the sign material to observe adhesion characteristics of the reflective materials. This test was not performed because sample preparation required cutting the sign and thereby exposing unsealed edges of the reflective material which would bias results. The color of the plastic material did match the Federal standard for highway yellow. Reflectivity is reported as specific intensity and is given in the attached Table 2.

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Results of the yellow Scotchlite compare favorably with other samples of Scotchlite previously tested in the laboratory. Recent photometric data for exposed bead materials are not available for comparison.

OFFICE OF TESTING AND RESEARCH

E. A. Finney, Director  
Research Laboratory Division

EAF:MHJ:nl

Attachment

cc: H. H. Cooper

TABLE 1  
PHYSICAL CHARACTERISTICS OF COMMON PLASTICS

Characteristics	High-Impact ABS	General Purpose ABS	High-Impact Polypropylene	Linear Polypropylene
Impact, ft-lb/in. of notch (Izod) <sup>(a)</sup>	9.5	5.0	1.8	1.1
Tensile Strength, psi <sup>(a)</sup>	5100	6400	3400	2500
Tensile Modulus x 10 <sup>3</sup> psi <sup>(a)</sup>	200	300	100	100
Flexural Modulus x 10 <sup>3</sup> psi <sup>(b)</sup>	320	320	125-145 <sup>(c)</sup>	60-115 <sup>(c)</sup>

(a) "High-Speed Tests Evaluate Toughness of Plastics," Product Engineering (August 17, 1964), p. 89.

(b) Modern Plastics 1965 Encyclopedia Issue, p. 174.

(c) Plastic Properties Chart, Modern Plastics 1965 Encyclopedia Issue (insert).

TABLE 2  
SIGN OPTICAL TEST RESULTS\*

Reflectorization	Specific Intensity, cp/ft/sq ft		
	Entrance Angle, deg.	1/5° Div.	1/2° Div.
Yellow, Scotchlite	0	44	23
	30	17	11
Yellow, exposed beads	0	1.2	1.0
	30	0.3	0.2

\* Values are averages of eight samples--two from each sheet of original samples.