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MICHIGAN
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# A COMPARISON OF BEADED PAINT AND SHEET REFLECTORIZED STOP SIGNS (RED)

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# A COMPARISON OF BEAD REFLECTORIZED AND SHEET REFLECTORIZED STOP SIGNS (RED)

Two basic sign types were tested simultaneously for evaluation as to their structure, durability, and optical properties. One of the signs tested was a 24-inch octagonal aluminum STOP sign with red painted background and white beaded reflectorized legend and border. The second sign tested was of the type currently in use by the Department. Specifically, it is a 24-inch octagonal aluminum sheet covered with a silver smooth surface reflectorized sheet. Over this a red transparent overlay is placed, giving the effect of a white reflectorized legend and border on a red reflectorized background.

The beaded paint sign was submitted on May 5, 1955 by Mr. W. J. Larkin, Maintenance Division, for Mr. George M. Foster, Chief Deputy Commissioner via Mr. W. W. McLaughlin, Testing and Research Division. The sheet reflectorized sign was taken directly from the Lansing Sign Shop stocks.

Laboratory tests and field observations show the sheet reflectorized sign to be far superior to the beads-on-paint sign. The sheet reflectorized sign was superior in reflectance, weather resistance, visual field observations, and choice of materials. Both signs are well constructed and of good color.

The beads-on-paint sign has two shortcomings when compared with the sheet reflectorized sign. One is the surface dulling and color change of the paint due to accelerated weathering. The other is the use of glass beads embedded in paint as a reflective material. Up to now, this type of reflectorization has been inherently low in reflectance even at its best. It appears that the main advantage to the beads-on-paint sign is its lower cost.

New bead-paint combinations are appearing on the market, however, which may effect a much more favorable comparison of performance at a considerable saving in cost.

## TESTS AND RESULTS

Test panels 2-3/4 in. by 5-7/8 in. were cut from each sign and subjected to the following tests and inspections:

1. Reflectance (specific intensity)
    - A. Pre-accelerated weathering
    - B. Post-accelerated weathering
2. Accelerated Weathering
3. Mandrel Bending (paint film flexibility)
4. Color
5. Visual Field Test
6. Materials, Design and Costs

### Reflectance (Specific Intensity)

Specific intensity tests were run in the laboratory light tunnel. The samples were oriented at combinations of angles to simulate various distances characteristic of field installations. This resulted in a brightness vs. distance relationship. These results are given in Table I.

### Accelerated Weathering

Samples were subjected to 24 cycles of accelerated weathering in an Atlas Twin Arc Weatherometer. These 24 cycles approximate the effects of one year of natural weathering. Each cycle consisted of one hour of water, one and one-half hours of light, two hours of water, and sixteen and one-half hours of light. Results are given in Table II.

TABLE I

REFLECTANCE, BEFORE AND AFTER ACCELERATED WEATHERING

| Effective | Specific Intensity, cp per fc per sq. ft. | | | | | |
|---|---|---|---|---|---|---|
| | Beads-on-Paint (1) | | | Sheet Reflectorized (1) | | |
| Distance | Pre-Weathering | Post-Weathering | Change | Pre-Weathering | Post-Weathering | Change |
| 500 ft. | 2.8 | 2.4 | - 14% | 44 | 34 | - 23% |
| 300 ft. | 2.6 | 2.3 | - 12% | 33 | 26 | - 21% |
| 200 ft. | 2.3 | 2.1 | - 9% | 22 | 19 | - 14% |
| 100 ft. | 2.0 | 1.9 | - 5% | 14 | 12 | - 14% |
| 75 ft. | 2.0 | 1.9 | - 5% | 8 | 6.7 | - 16% |
| 50 ft. | 1.7 | 1.7 | 0 | 5 | 4.6 | - 8% |

Note: (1) Reflectorized legend areas only.

TABLE II

ACCELERATED WEATHERING

| Effects of Accelerated Weathering | Beads-on-Paint Sign: Red painted Background | Beads-on-Paint Sign: Legend, White | Sheet Reflectorized Sign: Background, Red | Sheet Reflectorized Sign: Legend, White |
|---|---|---|---|---|
| Loss of lustre | H | N | N | N |
| Visual color change | H(brownish) | N | N | L (1) |

N = None; L = Light; M = Medium; H = Heavy

Note: (1) The change which took place is considered beneficial. Originally this section was cream colored. The accelerated weathering bleached it out to a color nearer white.

TABLE III

COLOR TEST

| | Beads-on-Paint Sign (1) | Sheet Reflectorized Sign (1) |
|---|---|---|
| Dominant Wavelength | 622.5 millimicrons | 623.8 millimicrons |
| x coordinate | 0.642 | 0.655 |
| y coordinate | 0.305 | 0.303 |

Note: (1) Red portions only, under daylight illumination at $0^\circ$ incidence, $45^\circ$ viewing.

Specific intensity tests were run on these artificially weathered samples to determine the effect of weathering on the reflectance. Sample faces were not cleaned prior to this test. These post-weathering reflectance tests are listed in Table I.

## Mandrel Bending

Flexibility of the red paint used in the beads-on-paint sign was determined by the mandrel test as stated in MSHD Specification 7.26 i, Section C, Paints.

The panels tested showed excellent flexibility properties. No visual signs of checking or peeling were present.

## Color

Spectral tests were run on the red portions of both signs using a Beckman DU Spectrophotometer. Results are shown in Table III.

## Field Observations

A visual test was run by two persons - one from the laboratory staff and one from Maintenance Division. The signs were installed in a normal position relative to the traffic lane and maximum target distance (sign visibility) and maximum legibility distance were determined for each sign independently. These results are shown in Table IV.

TABLE IV

VISUAL FIELD TEST

| | Beads-On-Paint Sign | Sheet Reflectorized Sign |
|---|---|---|
| Maximum target distance (approx.) | 600 feet | 1200 feet |
| Maximum legibility distance (approx.) | 250 feet | 300 feet |

Materials, Design and Costs

Both signs types are well made and of quality materials. The red paint used for the beads-on-paint sign is reportedly an epoxy resin type. Enamels incorporating certain modifications of this type resin do not retain their gloss well on exterior applications despite their high scratch resistance and excellent bonding and flexural properties. The discoloration and dulling caused by the artificial weathering test on the beads-on-paint coating is in accordance with this.

The beads-on-paint sign is the less expensive of the two signs tested, costing about $3.30 each as compared to $6.25 for the sheet reflectorized sign.

## DISCUSSION

The reflectance tests (both laboratory and field) show a marked difference in the two signs. The sheet reflectorized sign is by far superior. Both sign types retained their reflectance relatively well after one year's simulated weathering. Although the sheet reflectorized sign lost a greater percentage of reflectance, its post-weathering reflectance was still generally much higher than the beads-on-paint sigh. The sheet reflectorized sign has the advantage also of being a completely reflectorized unit giving a much greater area for light reflectance.

The red epoxy resin paint used for the background of the beads-on-paint sign showed a pronounced surface dulling and color change in the accelerated weathering test. The flexibility of this paint was found to be excellent. Color tests on the red portions of the signs showed them to have practically the same dominant wavelength (hue). Comparison of color saturations (strength) and chroma (lightness) offer little information since one material is retro-reflective and the other a painted surface.

Visual field tests of the signs resulted in a striking difference of brightness and maximum target distance, the sheet-reflectorized sign being visible twice as far away as the beaded paint sign.

## CONCLUDING REMARKS

While the beaded paint reflectorization is considerably lower in cost, there seems to be no justification for accepting anything less than the best material available for the purpose, since human lives are at stake. Therefore we do not recommend the beaded paint stop sign for use at this time. However, a new package of bead-paint sign materials is appearing on the market, supposedly almost as effective as sheet reflectorizing material. If tests now planned in our laboratory show this to be true, signs made with these materials will compare favorably with reflectorized sheets in performance, with a considerable advantage in cost.