Experimental use of Thermo-Plastic Pavement-Striping Materials

James H. Havens
Kentucky Highway Materials Research Laboratory

This paper is posted at UKnowledge.
https://uknowledge.uky.edu/ktc_researchreports/1276
MEMO TO:  W. B. Drake
Assistant State Highway Engineer

SUBJECT: Interim Construction Report; Experimental Construction;
"Experimental Use of Thermo-Plastic, Pavement-Striping Material"

I am submitting, herewith, ten copies of an interim construction report on the above-entitled, experimental construction project for your review and transmittal to the Bureau of Public Roads. This report has been prepared in accordance with BPR's PPM 60-2 and PPM 60-2(1). It is a final construction report insofar as some items are concerned, but I have purposely given it interim status inasmuch as some work (I 64-5(16)193, Sub-Section 3, Perma-Line) remains incomplete and inasmuch as other items specifically mentioned in the Division of Construction's final inspection report (attachment 4 of the report) remain pending.

This report encompasses early performance observations and, in that sense, extends beyond the construction stages. Nevertheless, a detailed inspection report and performance summary covering the interim period will also soon be forthcoming and subsequent reports covering seasonal periods are contemplated. Reporting performance at closer intervals seems needless inasmuch as the close-interval inspections originally planned to follow immediately after installation of the lines proved to be un-needed.

The Cataphote Company has indicated an intent to re-touch or repair sections of line mentioned in the final inspection report concerning Test Site 3 and to effect other repairs as may be needed under their warranty clauses -- beginning April 22, 1963. No indication of such intent has been received, as yet, from the Perma-Line Company. In any event, it is my intention to complete a detailed inspection of all projects before-hand.

Respectfully submitted,

Jas. H. Havens
Assistant Director of Research
INTERIM CONSTRUCTION REPORT

EXPERIMENTAL USE OF THERMO-PLASTIC PAVEMENT-STRIPING MATERIALS

Report No. 2
April, 1963

by

Jas. H. Havens
Assistant Director of Research
Kentucky Department of Highways

Project Numbers, Terminals, Station Numbers and Mileages:

Jefferson County; I 264-1(24)16, SP 56-898; Watterson Expressway, 1.231 miles (net), B.C. pavement.

Section A - East end of Bardstown Road Interchange, extending eastwardly, Sta. 515+00 to Sta. 547+00, 0.606 miles; B.C. pavement.

* Sub-Section 1; Sta. 515+00 to Sta. 525+67; 0.202 mi.
** Sub-Section 2; Sta. 525+67 to Sta. 536+34; 0.202 mi.
*** Sub-Section 3; Sta. 536+34 to Sta. 547+00; 0.202 mi.

(Sub-Sections 1 & 2, 1067 ft. ea.; Sub-Section 3, 1066 ft.)

Section B - East end of Taylorsville Road Interchange, extending eastwardly, Sta. 585+00 to Sta. 603+00, 0.341 miles; B.C. pavement.

* Sub-Section 4; Sta. 585+00 to Sta. 591+00; 0.1137 mi.
** Sub-Section 5; Sta. 591+00 to Sta. 597+00; 0.1137 mi.
*** Sub-Section 6; Sta. 597+00 to Sta. 603+00; 0.1137 mi.

(Sub-Sections 4, 5, & 6, 600 ft. ea.)

Section C - East end of Breckenridge Lane Interchange, extending eastwardly, Sta. 633+00 to Sta. 648+00, 0.284 miles; B.C. pavement.

* Sub-Section 7; Sta. 633+00 to Sta. 638+00; 0.0947 mi.
** Sub-Section 8; Sta. 638+00 to Sta. 643+00; 0.0947 mi.
*** Sub-Section 9; Sta. 643+00 to Sta. 648+00; 0.0947 mi.

(Sub-Sections 7, 8 & 9, 500 ft. ea.)
Jefferson County; I 264-1(25)20, SP 56-898; Watterson Expressway; north
end of US 60 Interchange, extending northwardly, Sta. 28+00 to Sta. 105+00, 1.458 miles, PCC pavement.

** Sub-Section 1; Sta. 28+00 to Sta. 53+67; 0.486 mi.
*** Sub-Section 2; Sta. 53+67 to Sta. 79+33; 0.486 mi.
* Sub-Section 3; Sta. 79+33 to Sta. 105+00; 0.486 mi.

Franklin-Shelby Counties; I 64-3(14)34, SP 37-905, SP 106-806; Louis-
ville-Lexington Road; east end of Ky. 53 Interchange, extending eastwardly, Sta. 1418+00 to Sta. 2081+00; 11.965 miles (net), PCC pavement.

*** Sub-Section 1; Sta. 1418+00 to Sta. 1628+63; 3.99 mi.
* Sub-Section 2; Sta. 1628+63 to Sta. 1839+36; 3.99 mi.
** Sub-Section 3; Sta. 1839+36 to Sta. 2081+00; 3.99 mi.
(Sta. 1989+04, WB = Sta. 1988+40, EB = Sta. 2020+00,EB)

Clark-Montgomery Counties; I 64-5(16)93, SP 25-422, SP 87-557; Lexington-
Catlettsburg Road; EKTP Interchange, extending eastwardly,
Sta. 430+00 to Sta. 1053+00; 11.80 miles, BC pavement.

* Sub-Section 1; Sta. 430+00 to Sta. 637+67; 3.933 mi.
** Sub-Section 2; Sta. 637+67 to Sta. 845+34; 3.933 mi.
*** Sub-Section 3; Sta. 845+34 to Sta. 1053+00; 3.933 mi.

Allocation of Sub-Sections
* Control - Kentucky Paint
** Catatherm
*** Perma-Line
A. NATURE AND OBJECTIVES OF EXPERIMENT

The purposes and objectives of this experimental study are:
1) to evaluate the application and performance characteristics of hot-melt plastic, pavement-striping materials which are presently prominent and known commercially as "Catatherm" and "Perma-Line"; 2) to compare the performance of these materials with the performance of painted stripes applied and re-newed according to the current practices of the Kentucky Department of Highways; and 3) to evaluate the economics of these striping materials in terms of cost-per-mile per-day-of-useful-life.

The project is described more fully in the "Proposal..." (approved by Division Engineer, September 7, 1962) and in Report No. 1 (Pre-Construction Report) submitted September 19, 1962. Attachment No. 1 shows the location of the test sites.
B. CONSTRUCTION METHODS

1. Prosecution of Work

Bids were received September 28, 1962. A pre-construction conference was held October 11, 1962, at the District Office in Louisville -- at which time it was decided to accept materials on the basis of the manufacturer's sworn certification (copies: Research Division File P.2.4.1) in lieu of on-the-job sampling and testing by the Department. This action was sanctioned by the Bureau of Public Roads' Area Engineer (Ref.: Memo. from District Engineer to Director of Construction, Nov. 2, 1962; copies: Research Division File P.2.4.1.) and was necessary in order to permit the contractors to begin work immediately upon issuance of the Work Order. Both contractors began work on I 64-3(14)34, Franklin-Shelby Counties, October 12, 1962. The transverse lines were applied there on October 19, 1962. On October 22, 1962, both contractors elected to commence work on I 264-1(24)16 even though Perma-Line had not completed their work in Shelby County. On November 1, 1962, striping began on I 264-1(25)20; and transverse lines were applied there and on I 264-1(24)16, November 2, 1962. This completed the work on I 264, and the Perma-Line Company finished its work in Shelby County on November 11 and 12. Striping began on I 64-5(16)93, Clark-Montgomery Counties, November 14, 1962. Transverse lines were applied November 27. Cataphote completed all work November 28, and all work became subject to final inspection. Perma-Line completed 18,856 lineal feet of right edge-line (eastbound) in Montgomery County and, because of
menacing weather, requested permission to discontinue work until the spring of 1963. Other projects consigned to Perma-Line became subject to final inspection. All control-section lines (Kentucky Paint) which were programmed were applied by the Department concurrently with the application of experimental plastic-striping materials. Attachment No. 2 is a series of strip charts showing the extremities of the experimental sections and the dates of application. Summaries of costs and quantities are shown in Attachment No. 3 (Tables). Excerpts from the Department's final inspection reports are included as Attachment No. 4.

2. Amendments

On November 15, 1962, the Cataphote Corporation requested that the limit on weather temperature for application of striping material be lowered from 50°F to 40°F on Project 164-5(16)93 (Clark-Montgomery Counties). Both Cataphote and Perma-Line agreed to provide 100-percent warranty on the performance of their lines for the first year in consideration of the requested change. The contractors sought the change in the interest of completing the experimental work within the limited time available before the onset of winter. Change orders (No. 6661, Perma-Line; No. 6672, Cataphote) were issued and effective November 15, 1962. Cataphote completed the work, but Perma-Line subsequently requested permission to suspend work until spring.

3. Cataphote's Operations

Application of Catatherm thermoplastic was accomplished by two crews and two automatic, truck-mounted applicators (See Figs. 1 and 2
attached). The pavement was pre-treated with a bonding coat -- of which "Permaseal" or "Plicbond" is the primary ingredient. This material was applied through a push-type spray unit ahead of the striping operations.

Drop-on beads, for initial reflectivity, were applied to the hot plastic about four inches behind the applicating die. Some irregularity was noted in drop-on beading -- due to jamming of the chain-drive bead dispenser. Night inspection of the lines under normal night-driving conditions showed up these irregular areas quite readily. Portions that were considered poorly reflectorized or non-reflectorized were called to the attention of the contractor and were corrected. Jamming of the chain-driven bead dispenser -- by loose gravel -- was a common problem while operating near un-paved shoulders.

During the second day of operations, the bonding qualities of the Catatherm material were checked at various locations -- using a prying action, with a knife blade, large sections could be loosened and peeled from the concrete surface (See Figs. 8 and 9, attached). Operations were suspended by Department inspectors, but the contractor was allowed to resume operation following a meeting between the contractor, the Department, and the BPR officials.

Representatives of the company stated that, in their opinions, the striping material was performing properly and that they were willing to guarantee 100-percent performance for the first year instead of the 90 percent stated in the proposal, on all contracts which the Cataphote Corporation had with the State of Kentucky (Ref.: Memo. from District Engineer to Director of Construction, November 2, 1962. Copy: Research
Division File P.2.4.1. It was claimed by the company that the cold-flow properties of the material would, with time, enhance the bond of the material. Upon resumption of operations, four men with brooms preceded the liner, and "Pliobond" was applied heavier and not less than 300 yards ahead.

When operating on bituminous surfaces some bonding was achieved by melting of the asphalt by the internal heat of the thermoplastic.

Occasionally rocks were drug by the die causing lengthy scars in the line.

4. Perma-Line Operations

Perma-Line used one crew operating a non-self-propelled hand-liner (See Figs. 3, 4, and 5 attached). In later operations an attempt was made to use an automatic liner; however, mechanical difficulties prevented much more than limited use.

The drop-on bead dispensers of both units functioned erratically. On the hand-lining equipment, it was located approximately four inches behind the applying die and automatically cut off when the die was raised at the end of each center-line stripe. This necessitated application of beads by hand to the last four inches of line. Night inspection proved this an unsatisfactory solution to the problem since it created a "flash" of reflected light at the end of each stripe.

Night inspection under normal night-driving conditions also indicated areas of poor bead distribution which were called to the attention of the contractor and corrected.
A bonding material similar to that used by Cataphote was applied by a Kelly-Creswell, self-propelled striker prior to beginning striping operations each day. A much heavier application than that used by Cataphote was used -- creating a brown stripe upon which the plastic was applied. In some instances, "Pliobond" put down the preceding day was utilized -- provided that no precipitation had occurred.

Perma-Line representatives pointed out that they do not normally use a bonding agent on bituminous surfaces if the asphaltic content is greater than six percent.

Laboratory analysis of Perma-Line's plastic raw material confirmed the presence of internal beads.

5. "Control" Operations: Kentucky Paint

The Department's traffic-paint operations involved some items which represent departures from long-standing practices. Previous experience in edge-lining had been rather nominal; and, whereas, inter-mixed beads had been used throughout all center-lines, recourse to topical application of beads on edge-lines (in addition to inter-mixed beads) seemed essential in order to provide initial, night-time reflectivity under the limited-wear conditions normally attributed to the outer edges of multi-lane pavements. The dashed center-lines, thus, received no drop-on beads.

The paints were drawn from stock supplies on hand; drop-on beads were purchased specifically for the control edge-lines and transverse lines.
Whereas the application rate of inter-mixed paint has normally been about 15 gal. per mi. (based on equivalent continuous 4-inch line) -- which has long been suspected as being too sparse, a deliberate attempt was made to provide a more abundant amount of paint on all "control" lines and more specifically so on edge-lines in order to provide a sufficient amount of binder paint to receive the drop-on beads. The over-all average rate of application was 25 gal. per mi.; and, from place-to-place, the rate may have varied between 18 and 35 gal. per mile.

Note: Heavier applications of paint and the addition of drop-on beads (edge-lines and transverse lines) account largely for the increase in cost over that stated in the proposal (7 mils per ft. as compared to about 14 mils per ft. here).

The thicknesses of the transverse lines were perhaps somewhat greater than those of the longitudinal lines; and, as may be noted under Para. 6, lines at Test Site No. 1 do not conform to planned pattern inasmuch as lines scheduled for multiple applications of paint erroneously received applications of drop-on beads between coats and the line scheduled for one application failed to receive drop-on beads.

Figures 6 and 7 (attached) show the striping equipment used by the Department.

6. Transverse Lines

On Project I 264-1(24)16, transverse lines were located 1039 feet east of the beginning station of Section A in order to avoid an acceleration ramp; and, on Project I 64-5(16)93, they were located 435 feet east of the beginning station in order to avoid a deceleration ramp. The
transverse lines at Test Sites 1, 2, and 3 exhibit the following patterns:

1. White, Kentucky Paint (one application)
2. White, Kentucky Paint (two applications - 3-day intervals)
3. White, Kentucky Paint (three applications - 3-day intervals)
4. Yellow, Kentucky paint (one application)
5. Yellow, Kentucky Paint (two applications - 3-day intervals)
6. Yellow, Kentucky Paint (three applications - 3-day intervals)
7. White, Perma-Line
8. Yellow, Perma-Line
9. White, Catatherm
10. Yellow, Catatherm

Note: An error was made in the second and third applications of Kentucky paint lines at Test Site No. 1. Lines No. 1 and 4 received three applications of paint and drop-on beads. Lines No. 2 and 5 received two applications of paint and drop-on beads. Lines No. 3 and 6 received one application of paint but no drop-on beads.

Transverse lines at Test Site No. 4 exhibit the following pattern:

1. White, Catatherm
2. Yellow, Catatherm
3. White, Perma-Line
4. Yellow, Perma-Line
5. White, Kentucky Paint (one application)
6. Yellow, Kentucky Paint (one application)
7. White, Kentucky Paint (two applications - 3-day intervals)
8. Yellow, Kentucky Paint (two applications - 3-day intervals)
9. White, Kentucky Paint (three applications - 3-day intervals)
10. Yellow, Kentucky Paint (three applications - 3-day intervals)

Plastic, transverse lines were all applied with hand liners.

Bonding agent was applied approximately 15 minutes before hand. Kentucky paint lines were applied with a self-propelled, one-man striping unit.

Application of transverse lines is shown in Figs. 2, 5 and 7 (attached).
C. DISCUSSION

The following general observations have been made:

Some areas which were designated for re-beading (from preliminary night-time inspections) were far from satisfactory after the contractor had re-worked them -- that is, attempts to re-trace the lines or to overlay them lightly were not very successful.

Each stripe which crosses an expansion joint has developed one, and in some cases more, crack transverse to the line and parallel to the joint. The foregoing is true for both center-stripes and edge-lines. Later observations of these cracks revealed that the plastic in the immediate vicinity of the cracks had "spalled" off. On asphalt pavement, center-line stripes show transverse, hair-line cracks which are spaced six inches to 12 inches apart throughout the length of the line (See Fig. 12, attached).

Following a rain, the edge-lines impounded water, which in many cases extended onto the roadway as much as 18 inches or more and persisted along the entire edge-line long after the center portion of the roadway had dried. This condition caused an accumulation of de-icing salts along the edges of the roadway and in some instances caused water to drain across the pavement -- thereby, creating an icing hazard (See Fig. 13).

Road-scum following heavy snow temporarily affected the nighttime visibility of the edge-lines until they were subsequently washed by rain. Snow-removal equipment has scarred the stripes in several places (See Fig. 12), and has peeled the stripe up at a few locations.
D. ATTACHMENTS

1. Map Showing Location of Experimental Projects.

2. Strip-Charts of Experimental Sections; Showing Construction Dates and Stations.

3. Tables: Summary of Quantities and Costs; and Subsidiary Summary of Quantities and Costs of Kentucky Paints.

4. Excerpts from Department's Final Inspection Reports.

5. Figures 1 and 2: Photographs Showing Cataphote's Equipment and Operations.


7. Figures 6 and 7: Photographs Showing the Department's Equipment and Operations.

8. Figures 8 and 9: Photographs Contrasting Apparent Low-Adhesion of Catatherm to Concrete.


TEST SITES
Experimental, Thermo-plastic, Pavement-striking Materials

TEST SITE NO. 3
I 64-3(14)34
SP 37-905-24T1
SP 106-806-37T1,38T1

TEST SITE NO. 1
I 264-1(25)20
SP 56-898-48T1,49T1

TEST SITE NO. 2
I 264-1(24)16
SP 56-898-50T1, 51T1

TEST SITE NO. 4
I 64-5(16)93
SP 25-422-26T1
SP 87-557-10T1

TEST SITE NO. 5
I 64-4800
BEG. STA. 28+00
END STA. 105+00

TEST SITE NO. 6
I 64-5(16)93
SP 25-422-26T1
SP 87-557-10T1

END STA. 2081+00
BEG. STA. 1418+00

END STA. 105+00
BEG. STA. 28+00

END STA. 648+00
BEG. STA. 515+00
### SUMMARY OF QUANTITIES AND COSTS

#### Jefferson County: I 264-1(24)16; SP 56-898

<table>
<thead>
<tr>
<th>Sub-Sections</th>
<th>2, 5, &amp; 8</th>
<th>3, 6, &amp; 9</th>
<th>1, 4, &amp; 7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Striping</strong></td>
<td><strong>Material</strong></td>
<td><strong>Catatherm</strong></td>
<td><strong>Perma-Line</strong></td>
</tr>
<tr>
<td>White edge-line (lin.ft.)</td>
<td>8,667</td>
<td>8,667</td>
<td>8,667</td>
</tr>
<tr>
<td>White center-line (lin.ft.)</td>
<td>1,625</td>
<td>1,625</td>
<td>1,625</td>
</tr>
<tr>
<td>White transverse-line (lin.ft.)</td>
<td>24</td>
<td>24</td>
<td>144</td>
</tr>
<tr>
<td>Yellow transverse-line (lin.ft.)</td>
<td>24</td>
<td>24</td>
<td>144</td>
</tr>
<tr>
<td><strong>Total (lin.ft.)</strong></td>
<td>10,340</td>
<td>10,340</td>
<td>10,580</td>
</tr>
<tr>
<td><strong>Unit Cost</strong></td>
<td>$0.3920</td>
<td>$0.3980</td>
<td>$0.0252</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td>$4053.28</td>
<td>$4115.32</td>
<td>$266.34</td>
</tr>
</tbody>
</table>

#### Jefferson County: I 264-1(25)20; SP 56-898

<table>
<thead>
<tr>
<th>Sub-Sections</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Striping</strong></td>
<td><strong>Material</strong></td>
<td><strong>Catatherm</strong></td>
<td><strong>Perma-Line</strong></td>
</tr>
<tr>
<td>White edge-line (lin.ft.)</td>
<td>10,267</td>
<td>10,267</td>
<td>10,267</td>
</tr>
<tr>
<td>White center-line (lin.ft.)</td>
<td>1,925</td>
<td>1,925</td>
<td>1,925</td>
</tr>
<tr>
<td>White transverse-line (lin.ft.)</td>
<td>24</td>
<td>24</td>
<td>144</td>
</tr>
<tr>
<td>Yellow transverse-line (lin.ft.)</td>
<td>24</td>
<td>24</td>
<td>144</td>
</tr>
<tr>
<td><strong>Total (lin.ft.)</strong></td>
<td>12,240</td>
<td>12,240</td>
<td>12,480</td>
</tr>
<tr>
<td><strong>Unit Cost</strong></td>
<td>$0.3920</td>
<td>$0.3980</td>
<td>$0.0252</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td>$4798.08</td>
<td>$4871.52</td>
<td>$314.17</td>
</tr>
</tbody>
</table>

#### Franklin-Shelby Counties: I 64-3(14)34; SP 37-905, SP 106-806

<table>
<thead>
<tr>
<th>Sub-Sections</th>
<th>3</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Striping</strong></td>
<td><strong>Material</strong></td>
<td><strong>Catatherm</strong></td>
<td><strong>Perma-Line</strong></td>
</tr>
<tr>
<td>White edge-line (lin.ft.)</td>
<td>84,229</td>
<td>84,229</td>
<td>84,229</td>
</tr>
<tr>
<td>White center-line (lin.ft.)</td>
<td>15,793</td>
<td>15,793</td>
<td>15,793</td>
</tr>
<tr>
<td>White transverse-line (lin.ft.)</td>
<td>24</td>
<td>24</td>
<td>144</td>
</tr>
<tr>
<td>Yellow transverse-line (lin.ft.)</td>
<td>24</td>
<td>24</td>
<td>144</td>
</tr>
<tr>
<td><strong>Total (lin.ft.)</strong></td>
<td>100,070</td>
<td>100,070</td>
<td>100,310</td>
</tr>
<tr>
<td><strong>Unit Cost</strong></td>
<td>$0.3920</td>
<td>$0.3980</td>
<td>$0.0130</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td>$39,227.44</td>
<td>$39,827.86</td>
<td>$1,307.83</td>
</tr>
</tbody>
</table>
Attachment 3 (Continued)

Clark-Montgomery Counties: I 64-5(16)93; SP 25-422, SP 87-557

<table>
<thead>
<tr>
<th>Sub-Sections</th>
<th>2</th>
<th>3</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Catatherm</td>
<td>Perma-Line</td>
<td>Kentucky Paint</td>
</tr>
<tr>
<td>White edge-line (lin.ft.)</td>
<td>83,068</td>
<td>83,068</td>
<td>83,068</td>
</tr>
<tr>
<td>White center-line (lin.ft.)</td>
<td>15,575</td>
<td>15,575</td>
<td>15,575</td>
</tr>
<tr>
<td>White transverse-line (lin.ft.)</td>
<td>24</td>
<td>24</td>
<td>144</td>
</tr>
<tr>
<td>Yellow transverse-line (lin.ft.)</td>
<td>24</td>
<td>24</td>
<td>144</td>
</tr>
<tr>
<td>Total (lin.ft.)</td>
<td>98,691</td>
<td>98,691</td>
<td>98,931</td>
</tr>
<tr>
<td>Unit Cost</td>
<td>$0.3920</td>
<td>$0.3980</td>
<td>$0.0174</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$38,686.87</td>
<td>$39,279.02</td>
<td>$1,720.83</td>
</tr>
</tbody>
</table>

Total Footage 221,341 221,341 222,301

Total Cost $86,765.67 $88,093.72 $3,609.17

SUBSIDIARY SUMMARY OF QUANTITIES AND COSTS (KENTUCKY PAINTS)

<table>
<thead>
<tr>
<th>County</th>
<th>Jefferson</th>
<th>Franklin-Shelby</th>
<th>Clark-Montgomery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>I 264-1(25)20</td>
<td>SP 56-898</td>
<td>I 264-1(24)16</td>
</tr>
<tr>
<td>Sub-Section</td>
<td>3</td>
<td>1, 4, &amp; 7</td>
<td>2</td>
</tr>
<tr>
<td>White Paint (gal.)</td>
<td>77</td>
<td>365</td>
<td>612</td>
</tr>
<tr>
<td>White Paint (cost @ $2.095)</td>
<td>$161.32</td>
<td>$764.68</td>
<td>$1282.25</td>
</tr>
<tr>
<td>Yellow Paint (gal.)</td>
<td>8</td>
<td>.4</td>
<td>.4</td>
</tr>
<tr>
<td>Yellow Paint (cost @ $2.105)</td>
<td>$ 1.68</td>
<td>$ 0.84</td>
<td>$ 0.84</td>
</tr>
<tr>
<td>Beads (lbs.)</td>
<td>155</td>
<td>1350</td>
<td>1350</td>
</tr>
<tr>
<td>Beads (cost @ $0.11)</td>
<td>$ 17.05</td>
<td>$ 148.50</td>
<td>$ 148.50</td>
</tr>
<tr>
<td>Labor</td>
<td>$286.48</td>
<td>$264.64</td>
<td>$226.44</td>
</tr>
<tr>
<td>Equipment</td>
<td>$113.98</td>
<td>$129.18</td>
<td>$62.80</td>
</tr>
<tr>
<td>Est. Total Cost</td>
<td>$580.51</td>
<td>$1307.84</td>
<td>$1720.83</td>
</tr>
</tbody>
</table>
Attachment 4

FINAL INSPECTION REPORTS

The following is a compilation of remarks from Final Construction Inspection Reports,

Test Site No. 1

Catatherm

Date of Report: Dec. 7, 1962

Satisfactorily completed - No additional work requested at this time. However, it is to be understood by all parties concerned that this inspection and acceptance is only to the extent authorized and to the extent intended by the proposal and specifications governing this contract.

All deficiencies noted in memo dated November 19, 1962, to Director of Construction from Director of Research have been satisfactorily corrected unless specifically noted above within this report.

Attention of all concerned is directed to the following "quote" from the specifications governing this contract. "Before final payment of the stripe work, the contractor shall furnish security for this work in the form of a surety bond, or by depositing cash or securities in the sum of 10% of the contract bid price for the stripes and guaranteeing the maintenance of the material for the stipulated period as herein provided."

* Maintenance Acceptance report will not be submitted at this time; however, they shall be submitted upon completion of period of guaranty and release of security as referred to above.

Perma-Line

Date of Report: Dec. 7, 1962

Satisfactorily completed - No additional work requested at this time. However, it is to be understood by all parties concerned that this inspection and acceptance is only to the extent authorized and to the extent intended by the proposal and specifications governing this contract.

All deficiencies noted in memo dated November 19, 1962, to Director of Construction from Director of Research have been satisfactorily corrected unless specifically noted above within this report.

Attention of all concerned is directed to the following "quote" from the specifications governing this contract. "Before final payment of the stripe work, the contractor shall furnish security for this work in the form of a surety bond, or by depositing cash or securities in the sum of 10% of the contract bid price for the stripes and guaranteeing the maintenance of the material for the stipulated period as herein provided."

* Maintenance Acceptance report will not be submitted at this time; however, they shall be submitted upon completion of period of guaranty and release of security as referred to above.
Test Site No. 2

Catatherm

Date of Report: Dec. 7, 1962

Satisfactorily completed - No additional work requested at this time. However, it is to be understood by all parties concerned that this inspection and acceptance is only to the extent authorized and the extent intended by the proposal and specifications governing this contract.

All deficiencies noted in memo dated November 19, 1962, to Director of Construction from Director of Research have been satisfactorily corrected unless specifically noted above within this report.

Attention of all concerned is directed to the following "quote" from the specifications governing this contract. "Before final payment of the stripe work, the contractor shall furnish security for this work in the form of a surety bond, or by depositing cash or securities in the sum of 10% of the contract bid price for the stripes and guaranteeing the maintenance of the material for the stipulated period as herein provided."

* Maintenance Acceptance report will not be submitted at this time; however, they shall be submitted upon completion of period of guaranty and release of security as referred to above.

Perma-Line

Date of Report: Dec. 7, 1962

Satisfactorily completed - No additional work requested at this time other than the following: Sub-Section 9, eastbound lane, Sta. 464+50 to 648+50 left edge line, poorly reflectorized. This line to be satisfactorily repaired.

However, it is to be understood by all parties concerned that this inspection and acceptance is only to the extent authorized and to the extent intended by the proposal and specifications governing this contract.

All deficiencies noted in memo dated November 19, 1962, to Director of Construction from Director of Research have been satisfactorily corrected unless specifically noted above within this project.

Attention of all concerned is directed to the following "quote" from the specifications governing this contract. "Before final payment of the stripe work, the contractor shall furnish security for this work in the form of a surety bond, or by depositing cash or securities in the sum of 10% of the contract bid price for the stripes and guaranteeing the maintenance of the material for the stipulated period as herein provided."

In the event final estimate is prepared and ready for submission prior to satisfactory accomplishing the above noted repairs, then with the
However, it is to be understood by all parties concerned that this inspection and acceptance is only to the extent authorized and to the extent intended by the proposal and specifications, governing this contract.

All deficiencies noted in memo dated November 19, 1962, to Director of Construction from Director of Research have been satisfactorily corrected unless specifically noted above within this report.

Attention of all concerned is directed to the following "quote" from the specifications governing this contract. "Before final payment of the stripe work, the contractor shall furnish security for this work in the form of a surety bond, or by depositing cash or securities in the sum of 10% of the contract bid price for the stripes and guaranteeing the maintenance of the material for the stipulated period as herein provided."

In the event final estimate is prepared and ready for submission prior to satisfactorily accomplishing the above noted repairs, then with the written consent of the "Bonding Company" a semi-final estimate may be submitted paying all money due on final estimate less lump sum of $850,00 which shall be withheld and paid on final estimate when such repair work has been satisfactorily completed.

* Maintenance acceptance report will not be submitted at this time; however, they shall be submitted upon completion of period of guaranty and release of security as referred to above.

Test Site No. 4

Catatherm Date of Report: Jan. 3, 1963

Satisfactorily completed except as noted below:

As this was an experimental pavement striping project, construction methods and results were studied and reviewed by the Research Laboratory. Reviewing a report from the Research Laboratory under the date of December 11, 1962, of which you received a copy, you will note there was approximately 440 ft. of striping that was found to be poorly reflectorized or non-reflectorized. The contractor was required to rework the sections listed by the Research Laboratory plus an additional section of approximately 130 ft., making a total of approximately 580 ft. reworked. When this final inspection was made, Mr. Riley of your office advised that he and representatives of the Research Laboratory had made a night inspection after these stripes had been reworked, and that the results were unsatisfactory because they were poorly reflectorized; therefore, the contractor is to rework these stripes again. Since it is too late in the season to do this type of work, it is the recommendation of this office that maintenance acceptance be made of the striping that has been completed.
satisfactorily. For the 580 ft. which was not completed satisfactorily, it is suggested that a $750.00 retainage be held until all work has been completed satisfactorily.

Attention of all concerned is directed to the following "quote" from the specifications governing this contract: "Before final payment of the stripe work, the contractor shall furnish security for this work in the form of a surety bond, or by depositing cash or securities in the sum of 10% of the contract bid price for the stripes and guaranteeing the maintenance of the material for the stipulated period as herein provided."

* Maintenance Acceptance report will not be submitted at this time; however, they shall be submitted upon completion of period of guaranty and release of security as referred to above.
Fig. 1. Cataphote's Automatic Striping Train.

Fig. 2. Cataphote's Hand-Liner; Application of Transverse Lines; I 64-5(16)93, Clark-Montgomery Counties.
Fig. 3. Perma-Line’s Striping Equipment.

Fig. 4. Perma-Line’s Hand-Liner.
Fig. 5. Perma-Line's Hand-Liner; Application of Transverse Lines; I 64-5(16)93, Clark-Montgomery Counties.
Fig. 6. Kentucky Department of Highway's Paint-Striping Equipment.

Fig. 7. Hand-Liner; Application of Transverse Lines (Kentucky Paint); I 64-5(16)93, Clark-Montgomery Counties.
Fig. 8. Close-up View of Catatherm Line on Concrete Pavement; No Apparent Adhesion; Material Could Be Peeled Away Rather Easily for a Considerable Time After Application.

Fig. 9. Close-up View of Perma-Line's Line; Showing Evidences of Adhesion.
Fig. 10. View of I 64, Franklin-Shelby Counties; Showing Two Lanes of Separated Roadways, Kentucky Paint Section, Edge Lines. Irregularities are attributed to un-skilled operator. Note: Center-line dashes placed in skips in existing line.

Fig. 11. Transverse Lines; I 64, Clark-Montgomery Counties; February 1, 1963. First two lines in foreground are Catatherm; the second two lines are Perma-Line; and the succeeding pairs of lines are Kentucky paint -- one, two and three applications, respectively. Note cracking in foreground.
Fig. 12: Close-Up View of Plastic Line Showing Short-Interval Cracking and Marks of Snow Plow; I 64, Clark-Montgomery Counties, February 1, 1963.

Fig. 13: Edge-Line; I 64, Clark-Montgomery Counties, February 1, 1963; Showing Drainage-Outlet Cut Through Edge-Line. Water impounded by thick edge-line spread across pavement at places where super-elevations changed from right to left on grades and caused icing hazard.