MICHIGAN
STATE HIGHWAY DEPARTMENT
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State Highway Commissioner

# NON-SKID BITUMINOUS SURFACE TREATMENTS

## PROJECT M5-17, C2 AND M89-5, C3

By

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## NON-SKID BITUMINOUS RESURFACE TREATMENT ON PROJECTS M5-17,C2 AND M89-5,C3

In June, 1940 the Department constructed a non-skid bituminous surface on project M5-17,C2 in Antrim County using asphaltic materials MC-1B for the prime coarse and a blended native lake asphalt (LNA) for the surface course. At the same time project M89-5,C3 in adjoining Otsego County was constructed using tar T-3 for the prime coarse and tar T-9 for the surface course. Both projects prior to receiving the surface treatments had normal gravel road surfaces. The surface treatments were applied to both projects under similar working conditions by the same contractor, A. E. Hodgkiss, of Petoskey, Michigan.

Project M5-17,C2 is located on route US 131 between Mancelona and Elmira and project M89-5,C3 extends from Elmira to Gaylord on route M 32. See Figure 1. The type of surface treatment which each project received is described below in Table I. Specifications for the materials used in the work are given in Tables II A, B, C and D at the end of the report.

Table I

Comparison of Surface Treatments

| | Project M5-17,C2 | Project M89-5,C3 |
|---|---|---|
| Prime Coat and Cover | MC-1B at 0.2 gal./sq. yd.<br>2SB aggregate, 10#/sq. yd. | T-3 at 0.2 gal./sq. yd.<br>2SB aggregate, 10#/sq. yd. |
| 1st Surface Course | LNA at 0.2 gal./sq. yd.<br>2SB aggregate, 20#/sq. yd. | T-9 at 0.2 gal./sq. yd.<br>2SB aggregate, 20#/sq. yd. |
| 2nd Surface Course | LNA at 0.2 gal./sq. yd.<br>32A aggregate, 20#/sq. yd. | T-9 at 0.2 gal./sq. yd.<br>32A aggregate, 20#/sq. yd. |

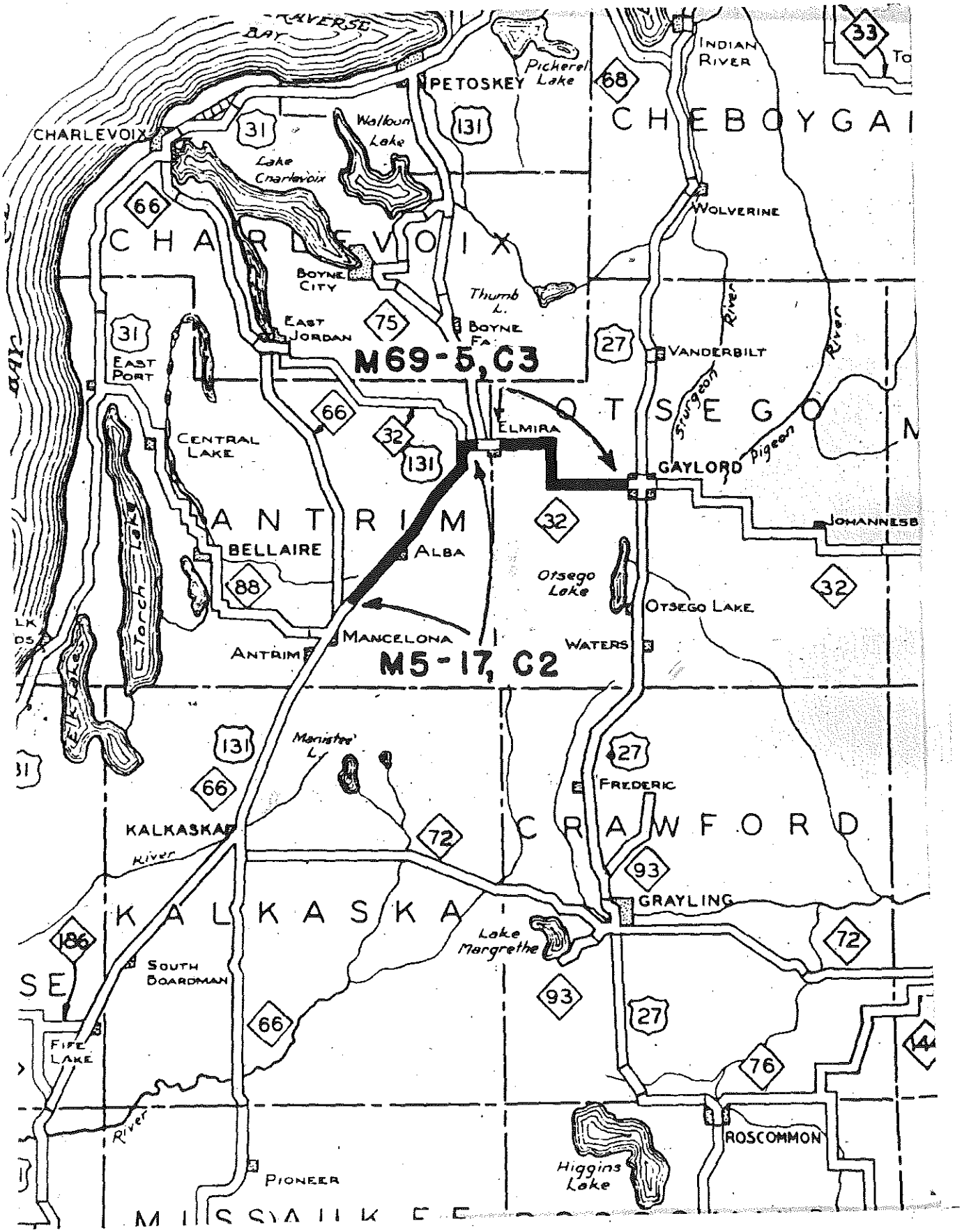
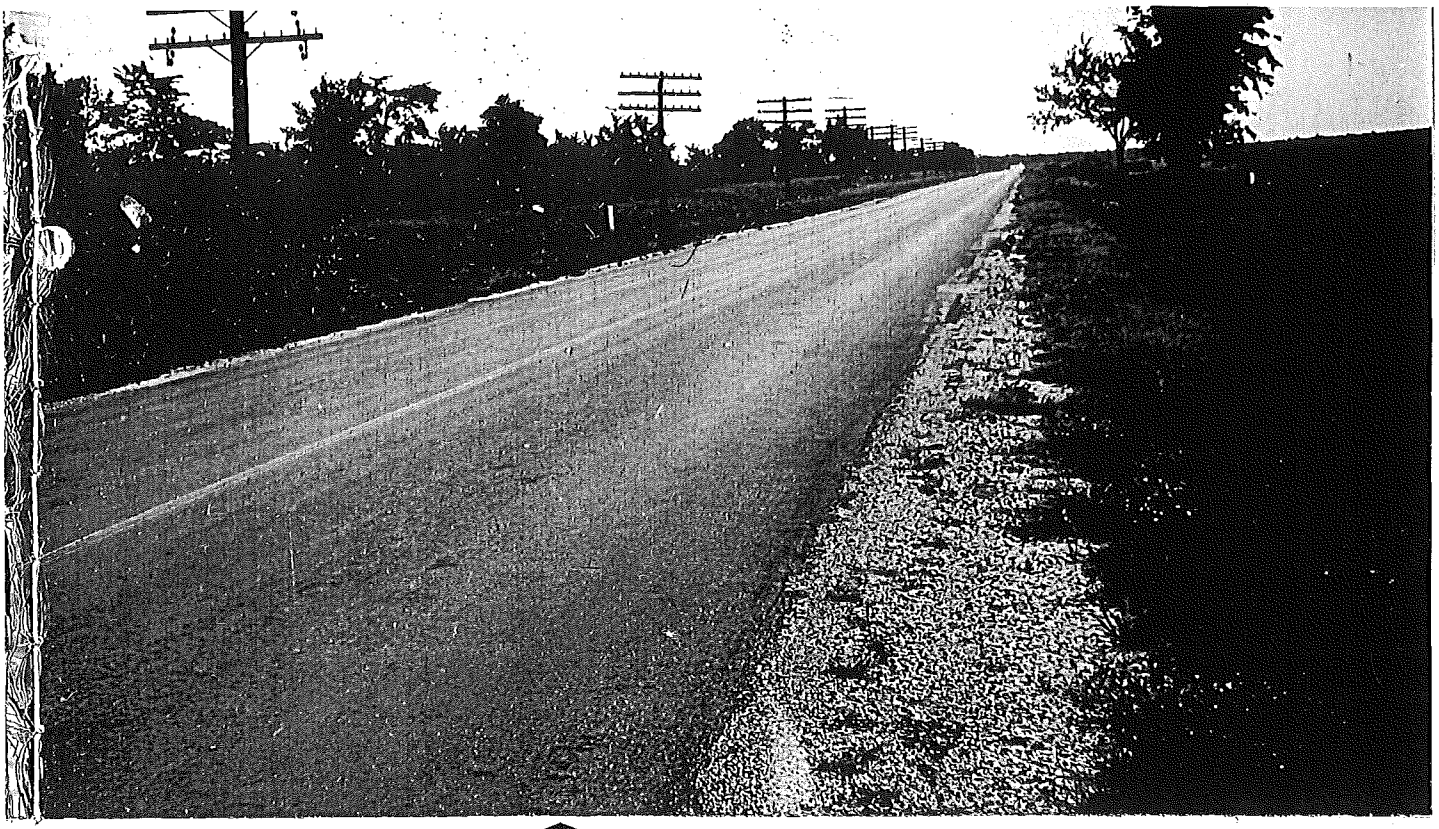

TRAVERSE BAY
PETOSKEY
Pickerel Lake
INDIAN RIVER
CHEBOYGAN
CHARLEVOIX
Walloon Lake
Lake Charlevoix
WOLVERINE
CHARLEVOIX
BOYNE CITY
Thumb L.
EAST JORDAN
BOYNE FA
M69-5, C3
VANDERBILT
EAST PORT
CENTRAL LAKE
ELMIRA
OTSEGO
Sturgeon River
Pigeon River
GAYLORD
ANTRIM
BELLAIRE
ALBA
JOHANNESB
Otsego Lake
OTSEGO LAKE
Torch Lake
MANCELONA
ANTRIM
M5-17, C2
WATERS
Manistee L.
FREDERIC
KALKASKA
River
CRAWFORD
GRAYLING
KALKASKA
Lake Margrethe
SOUTH BOARDMAN
FIFE LAKE
River
ROSCOMMON
Higgins Lake
PIONEER

Figure 1

A visual survey was made of both projects on September 5, 1946 for the purpose of evaluating the relative service behavior of these two types of surface treatments. Unfortunately for the purpose of our study, the two projects had been given a single seal coat treatment in 1945 consisting of tar and gravel. Consequently, no conclusions could be drawn from the relative appearance of the two surfaces, although both projects were in excellent condition due to the recent surface treatment. See Figures 2 and 3. In applying the single seal coat, tar T-6 was used on project M5-17,C2 over the asphalt surface treatment and T-9 was used on M69-5,C5. The gravel material in both cases was Mis. In spite of the fact that both projects appeared in excellent condition, it was quite evident that the tar project M69-5,C5 had received extensive edge patching throughout the entire length which was not true in the case of the asphalt project M5-17,C2. This fact is clearly brought out in Figures 2 and 3. Traffic records indicate that project M69-5,C5 receives slightly more traffic than M5-17,C2. For example, 1941 traffic records give an average 24 hour daily traffic flow of 747 vehicles on M69-5,C5 as compared to 660 vehicles on M5-17,C2.

Since it was practically impossible to evaluate the service performance of the two projects by visual inspection, because of the recent surface treatment, a study was made of maintenance cost records for the period 1940 to 1945. A summary of maintenance costs for these years are presented in Table II. The cost figures in Table II show that the average yearly maintenance costs on these two projects are materially different. In fact the average yearly maintenance cost for the asphalt project M5-17,C2, as shown in Table II, is approximately 1/3 that of project M69-5,C5.

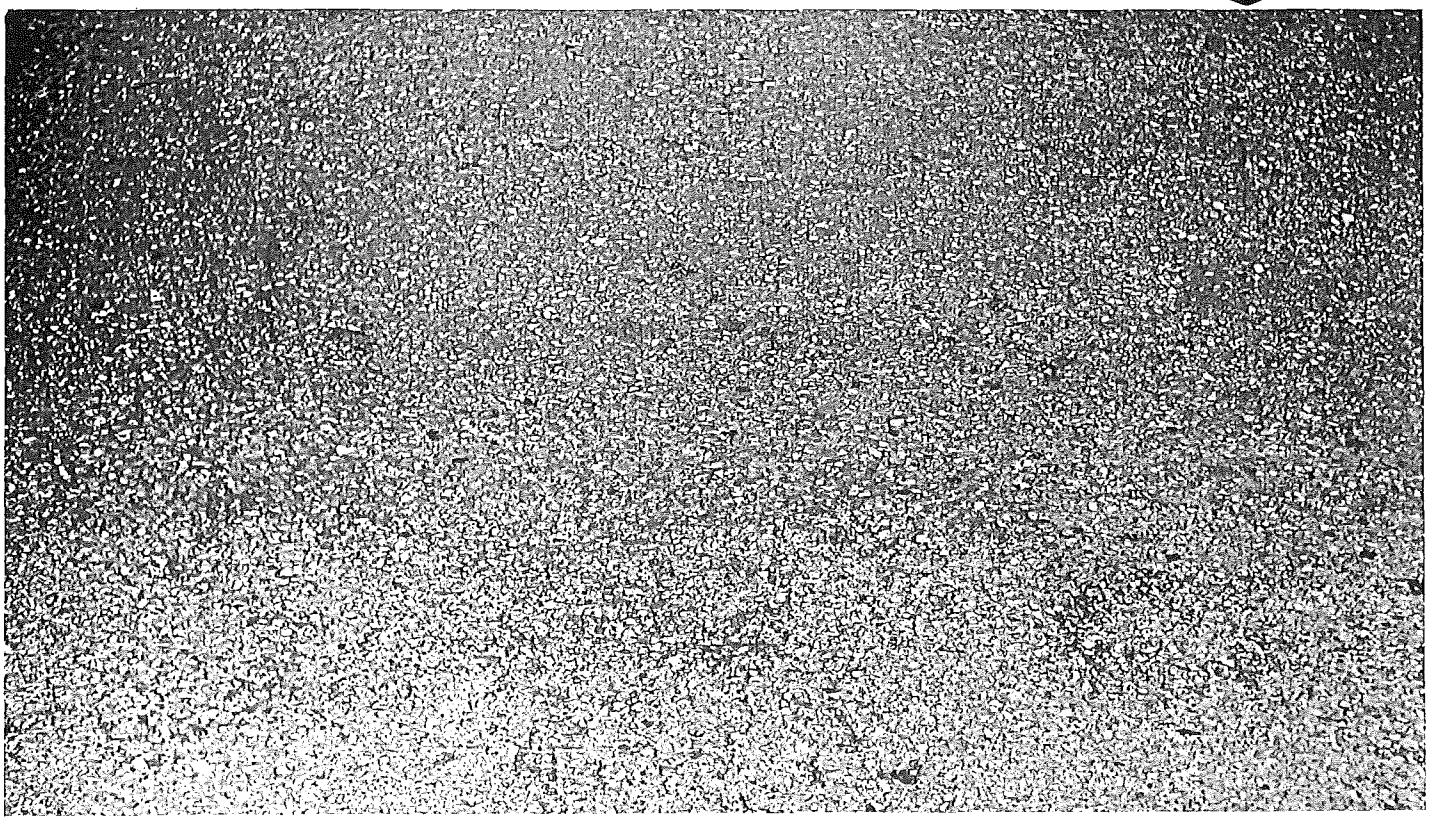


GENERAL VIEW

# CONDITION OF SURFACE
# PROJECT 5-17 C2 ____ 1946

(FIGURE 2.)

TEXTURE of SURFACE



GENERAL VIEW

# CONDITION OF SURFACE
# PROJECT M69-5, C3____1946

( AFTER 2ND SURFACE TREATMENT FIGURE 3 )

TEXTURE of SURFACE

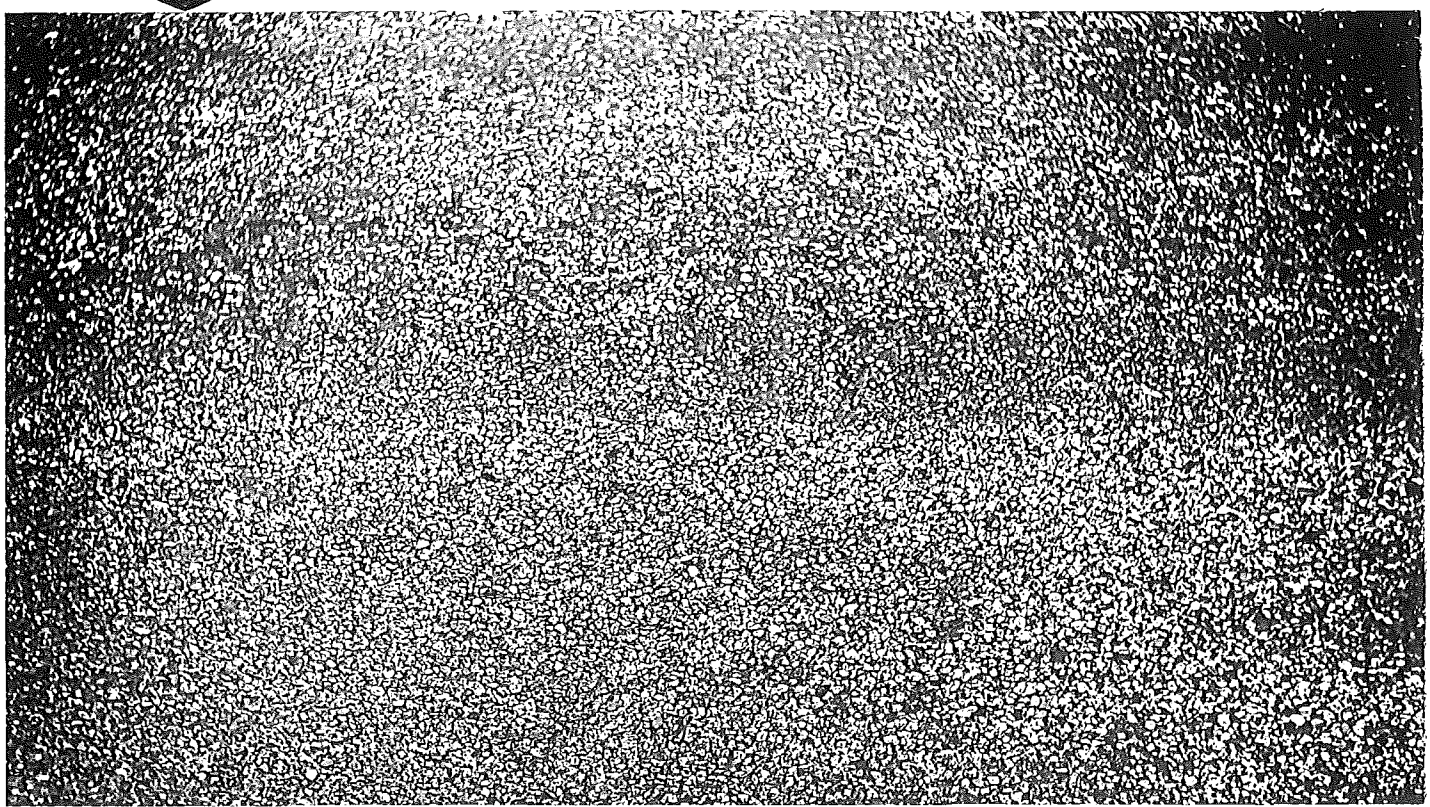


TABLE II

SUMMARY OF MAINTENANCE COSTS, PROJECTS M5-17,C2 AND M89-5,C3

| Year | Routine Surface Patching | Bituminous Surface Treatment | Total Cost | Average Cost Per Mile |
|---|---|---|---|---|
| Project | M5-17,C2 | Length 12.5 M | $20,035.95 | $1,602.87 |
| 1940 | 588.43 | 189.72 | 778.15 | 62.25 |
| 1941 | 836.69 | - | 836.69 | 66.93 |
| 1942 | 619.04 | 276.65 | 895.69 | 71.65 |
| 1943 | 466.28 | *12,834.11 | 466.28 | 37.30 |
| 1944 | 857.90 | 84.00 | 941.90 | 75.35 |
| 1945 | 608.81 | - | 608.81 | 48.71 |

Total Average Maintenance Cost Per Mile . . . . . $80.65

| Project | M89-5,C3 | Length 10.0 M | $15,375.24 | $1,537.52 |
|---|---|---|---|---|
| 1940 | 1,061.44 | 23.31 | 1,084.75 | 108.40 |
| 1941 | 5,530.74 | 25.31 | 5,574.05 | 557.41 |
| 1942 | 2,055.71 | - | 2,055.71 | 205.57 |
| 1943 | 1,548.56 | *12,601.42 | 1,548.56 | 154.86 |
| 1944 | 519.93 | - | 519.93 | 51.99 |
| 1945 | 2,350.04 | - | 2,350.04 | 235.00 |

Total Average Maintenance Cost Per Mile . . . . . $195.56

* Total cost of single seal coarse which was laid in 1943 is not included in average yearly maintenance costs.

The information presented above would indicate that the surface treatment containing native lake asphalt for the binder material was giving better performance than the surface treatment constructed with tar products, a fact which should not be overlooked by the Department.

TABLE II-A

SPECIFICATIONS FOR CUT BACK ASPHALT MC-15

1940

The material shall be homogeneous and free from water, shall not foam when heated to the required temperature for proper application, and shall conform to the requirements given below.

| | |
|---|---|
| Flash Point (Tayliabus Open Cup) degrees C . . . . . | 26.7+ |
| Viscosity, Saybolt Furol, sec. . . . . | 40 - 150 |
| Distillation, percent by volume | |
| To 190°C. . . . . | 0 |
| To 225°C. . . . . | 10+ |
| To 315.5°C. . . . . | 25+ |
| To 360°C. . . . . | 45- |
| Distillation Residue | |
| Penetration at 25°C., 100 g., 5 sec. . . . . | 100 - 300 |
| Ductility at 25°C., cm. . . . . | 60+ |
| Solubility in C $Cl_4$, percent . . . . . | 99.5+ |
| Oliensis Spot Test . . . . . | Negative |

TABLE II-B

SPECIFICATIONS FOR LIQUID ASPHALT, LMA

1940

The liquid asphalt shall be a blended native lake asphalt. It shall be homogeneous, free from water and shall not foam when heated to the required temperature for proper application. It shall confora to the following requirements:

| | Min. | Max. |
|---|---|---|
| Specific Gravity, 15.5°/15.5°C . . . . . | 1.02 | |
| Flash Point (Cleveland Open Cup) degrees C . . . . . | 190.5 | |
| Float Test at 50°C., Sec. . . . . | 100 | 150 |
| Total Bitumen (Soluble in $CS_2$) per cent . . . . . | 90 | |
| Non-bituminous material naturally occurring therein (Insoluble in $CS_2$) per cent . . . . . | | 5 |
| Loss on Heating at 163°C., 50g., 5 hrs., per cent . . | | 2 |
| Asphalt Content of 100 penetration when evaporated at 232.2°-260°C. per cent . . . . . | 80 | |

Car heating equipment will be required to maintain a heat of 500-550°F. to facilitate unloading tank cars and to load the distributor. A pressure distributor will be required which is equipped to maintain a temperature of 300-325°F. for application.

TABLE II-C

SPECIFICATIONS FOR TARS T-3, T-8 AND T-9

All tars shall be homogeneous and shall be a product consisting entirely of materials derived from the high temperature carbonization of coal, refined to the specified consistency as necessary to conform to the requirements of the type or grade specified for the work.

| Michigan Designation | T-3 | T-9 | T-8 |
|---|---|---|---|
| Year | (1940) | (1940) | (1942) |
| Water, percent by volume | 2.0- | 0 | 0 |
| Specific Gravity, 25°/25°C. | 1.09+ | 1.14+ | 1.14+ |
| Specific Viscosity Engler at 40°C. | 15-22 | - | - |
| Float test at 32°C., sec. | - | 120-200 | 80-120 |
| Total Bitumen Percent by weight | 88+ | 78+ | 78+ |
| Distillation, Test on Water Free Material, percent by weight | | | |
| To 170°C. | 7.0- | 1.0- | 1.0- |
| To 270°C. | 50.0- | 15.0- | 15.0- |
| To 300°C. | 40.0- | 25.0- | 25.0- |
| Softening Point, R&B, of Distillation Residue, degrees C. | 85-90 | 55-65 | 55-65 |

TABLE II-D

SPECIFICATIONS FOR COARSE AGGREGATE COVER MATERIAL

The coarse aggregates shall conform to the material grading and physical requirements given in the following table.

| Michigan Designation | 26B | 52A | 53B |
|---|---|---|---|
| Year | (1940) | (1940) | (1942) |
| Material | Gravel | Gravel | Gravel |
| **Grading Requirements** | | | |
| Passing 1 inch sieve % | | | |
| Passing 3/4 inch sieve % | | | |
| Passing 1/2 inch sieve % | 100 | | |
| Passing 3/8 inch sieve % | 65-85 | 100 | 100 |
| Passing No. 4 inch sieve % | 15-45 | 55-75 | - |
| Passing No. 10 inch sieve % | 0-10 | 0-15 | 0-15 |
| **Physical Requirements** | | | |
| Deval Abrasion | | | |
| Uncrushed, % max. | 15 | 15 | 15 |
| Crushed, % max. | 25 | 25 | 25 |
| Loss by washing, % max. | 3.0 | 3.0 | 3.0 |
| Thin and elongated pieces, % max. | 10 | 10 | 15 |
| Soft particles, % max. | - | - | 5 |
| Crushed material, % max. | 50 | 40 | 40 |