

# Asphalt Pavement Crack Filling in Northern Minnesota

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Red Lake and Marshall counties have been changing from the use of asphalt concrete to polymerized crack sealant for their roads. The material changes and application methods showed higher failure rates than expected. The following types of failure were noted: the elasticity limits of the material were exceeded, the sealant pulled away from the edges, routing was inadequate, and the material was unsuitable for the extreme temperature variations experienced in northern Minnesota. The solutions were to specify a proven sealant, change the routing width and depth requirements to provide sufficient reservoir for the sealant, increase the training provided to county employees, set weather condition limits, and develop a new specification with special provisions to address the conditions that northern Minnesota experiences. These conditions, such as extreme variations in seasonal temperatures, heavy clay soils, and high water tables, cause the subsoils and base and pavement surface to move more than those of highways farther south.

**M**any counties and cities in northern Minnesota are still using asphalt concrete-3 (AC-3) as their primary crack sealant for roads. The method of application is the use of pour pots to apply the AC-3 directly to the crack followed by a toilet-paper

cover. Although this method has some benefit, there is 100 percent failure of the crack sealant, usually by November.

## NEW METHODS AND MATERIALS

### Red Lake County

In 1989 Red Lake County tried a new method of routing the cracks and filling them with a rubberized crack sealant specified as "Minnesota Blend." The trial was held on a 9-ton (8.2-metric ton) road a mile (1.6 km) long constructed a few years earlier. The crack routing width and depth were not specified. This trial experienced a failure rate of greater than 30 percent over a 2-year period, which caused the county to abandon the effort and to return to the use of AC-3.

### Marshall County

In 1991 Marshall County tried a similar method using a polymerized crack sealant on a crack routing 1 in. (25.4 mm) wide by 5/8 (15.9 mm) in. deep. The trial took place on several highways with a combined length

of 5 mi (8.1 km). Marshall County personnel used rented equipment. The vendor spent 1 day with the workers training them on the use of the router, tar kettle, compressed air lance, and applicator. A midwinter check on the trial project showed a failure rate of approximately 90 percent, which was unexpected. The primary types of failure were that the elasticity of the material was exceeded and the material pulled away from the edges, generally taking asphalt with it.

## PROBLEM DEFINITION AND SOLUTIONS

### Problem Definition

The counties met with the material supplier and the Minnesota Department of Transportation (MN/DOT) on several occasions in an effort to pinpoint the causes of the unexpected failure rates. In the case of Red Lake County, the material was not elastic enough to accommodate the pavement's movement, and the width of the route was too narrow to provide an adequate material reservoir for the expansive soils encountered. In the case of Marshall County, the primary cause of failure was determined to be inadequate reservoirs for the crack sealant material after routing and, in some cases, the presence of excessive moisture in the crack before placement of the sealant. It was not thought to be a material problem.

### Solutions

The counties discussed many potential solutions with MN/DOT and the material supplier. Marshall County modified the width of its route to 1 1/2 in. (38.1 mm) and the depth to 1/2 in. (12.7 mm). The County Engineer decided to run comparisons and employed an area contractor to have the cracks in 5 mi (8.1 km) of road routed and sealed with the same product used the previous year. In addition, the same equipment used the previous year was rented with the exception of a heat lance instead of a compressed air lance. The vendor retrained the maintenance workers on the equipment. One mi (1.6 km) of failed crack repairs from the previous year was rerouted and the cracks were resealed. Two mi (3.2 km) of failed crack repairs from the previous year were refilled with AC-3 and a 70-37 product when AC-3 was unavailable. An additional 4 mi (6.4 km) of cracks was routed to the new width and depth (1 1/2 in. by 1/2 in.) (38.1 mm by 12.7 mm) by the county maintenance workers, again with the same product used the previous year.

Red Lake County, with MN/DOT's assistance, developed a new specification (1) that would provide an

adequate reservoir for the crack sealant. Key excerpts from that specification are the following (see Figure 1 for details):

#### S-7.1 Description

This work shall consist of sawing or routing, cleaning, and sealing cracks in the existing bituminous pavement. The crack routing shall be 1 1/4" – 1 1/2" (31.7 mm – 38.1 mm) wide and 1/2" (12.7 mm) deep.

#### S-7.2 Materials

The Contractor shall provide certification that the sealant meets the requirements of MN/DOT Specification 3723.

Only manufacturer's material that has been used under MN/DOT's Bituminous Crack Sealing Program, the last two years and has been successful, will be accepted.

#### S-7.3 Weather Limitations

Sealant materials may be placed during a period of rising temperature after the air temperature in the shade and away from artificial heat has reached 40 degrees F and indications are for a continued rise in temperature. During a period of falling temperature, the placement of sealant material shall be suspended when the air temperature, in the shade and away from artificial heat, reaches 40 degrees F. Sealants shall not be placed when, in the opinion of the Engineer, the weather or roadbed conditions are unfavorable.

Routing and sealing will be permitted only during daylight hours between May 15 and October 1.

#### S-7.4 Construction Details

General. The sawing/routing, cleaning and sealing shall extend the full width of the surface, including shoulders as directed by the Engineer. A short six (6) inch segment shall remain unsawn/unrouted at each end of transverse cracks to act as a dam for the flowing sealant.

Sawing/routing. The sawing or routing equipment shall be mechanical and power driven, capable of following and cutting the cracks to the required dimensions, of 1 1/4" to 1 1/2" width by 1/2" depth, without deviation from the crack or creating excessive spalling. Equipment designed to "plow" the cracks to dimension will not be permitted. Wet sawing will not be allowed.

**Cleaning.** Immediately prior to sealing, the entire roadway including the routed crack shall be cleaned of foreign matter and loosened particles and blown to the shoulder (beyond the shoulder when sealing the shoulder) using oil free compressed air. Following the initial cleaning, the routed crack shall be cleaned and dried with a hot compressed air heat lance.

**Sealing.** The sealing of cracks shall immediately follow the heat lance application. . . . First the crack shall be filled to about three-fourths full using a hose applicator. . . . The banding applicator is to be used

to fill and seal the repaired joint. . . . the overband thickness is to be  $1/16''$  at the joint wall and tapers out to  $3/4''$  to  $1\ 1/4''$  from each joint wall.

## RESULTS

In early 1994, Marshall and Red Lake counties checked the projects with very satisfying results. Marshall County's cracks routed to the new width and depth showed very little failure. The previously failed cracks that were refilled (not rerouted) improved from a 90 percent failure rate to a 50 percent failure rate. The cracks refilled with AC-3 or 70-37 had a 100 percent failure rate. Red Lake County experienced less than a 5 percent failure rate. More than 90 percent of those failures appeared to be a result of the router's not being centered over the cracks.

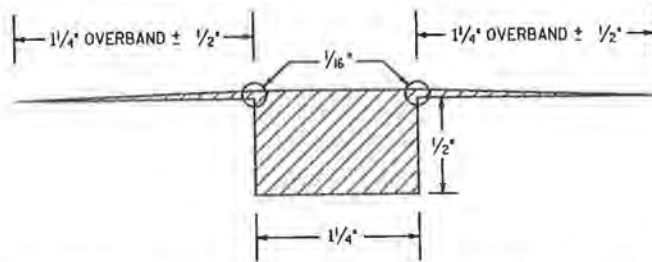


FIGURE 1 Details of new specification for crack filling in Minnesota.

## REFERENCE

1. *Asphalt Pavement Crack Sealing Specification*. Houston County Highway Department, Minnesota, 1994.