

1. Split out two recycled asphalt samples from the medium gradation, or field sample, to a quantity of 2700 g [**6 pounds**] in mass [**weight**]. The 2700 g [**6 pounds**] is an approximate weight to give 70 +/- 5 mm [**2.8 +/- 0.2 inches**] of height after compaction.
2. The recycled asphalt sample should be placed in a container of adequate size for mixing.
3. Field or design moisture contents should be added to each of the recycled asphalt samples and mixed for 60 seconds.
4. The design emulsion content shall be added to each of the recycled asphalt samples and mixed for 60 seconds.
5. The samples shall be placed immediately into a 150 mm [**6 inch**] gyratory compaction mold and compacted to 20 gyrations. If the sample height is not 70 +/- 5 mm [**2.8 +/- 0.2 inches**], the recycled asphalt weight should be adjusted.
6. After compaction, the samples shall be removed from the compaction mold and placed on a flat pan to cure at ambient lab temperature (18-24°C [**65-75°F**]) for 4 hours +/- 5 minutes.
7. The specimens shall be weighed after the curing, just prior to testing.
8. The specimens shall be placed on the raveling test apparatus. Care should be taken that the specimen is centered and well supported. The area of the hose in contact with the specimen should not have been previously used. It is allowable to rotate the hose to an unworn section for testing. The abrasion head (with hose) shall be free to move vertically downward a minimum of 5 mm [**0.2 inches**] if abrasion allows.
9. The samples shall be abraded for 15 minutes and immediately weighed.
10. The % Raveling loss shall be determined as follows: $((\text{Wt. Prior to test} - \text{Wt. After abrasion}) / \text{Wt. Prior to test}) * 100$.
11. The average of the two specimens shall be reported as the % Raveling loss. There should not be a difference of 0.5% Raveling Loss between the two test specimens for proper precision. A difference of >0.5 percent will require the test to be repeated. If both of the samples have a Raveling Loss of >10% the numbers shall be averaged and the precision rule will be waived.

Note: If field mix samples are taken, Steps 2, 3, and 4 shall be omitted.

S-135.8 For questions about the CIR process contact Jerry Geib at (651) 779-5937.

S-136 **(2331) BITUMINOUS PAVEMENT CRACK TREATMENT**
REVISED 1/30/07
SP2005-131

This work consists of sealing random transverse and longitudinal cracks in the bituminous pavement in accordance with the Plans and the applicable Mn/DOT Standard Specifications.

Rout and Seal: Transverse cracks less than or equal to 19 mm [**0.75 inches**] wide shall be routed, cleaned and sealed.

Clean and Seal: Transverse cracks greater than 19 mm [**0.75 inches**] wide and longitudinal cracks shall be cleaned and sealed (without routing) following the same procedures used for routed cracks.

A pre-construction meeting shall be held between the Contractors, sub-contractors, and the Engineer prior to the beginning of any work. Items to be discussed include the traffic control plan, Contractor's documentation requirements, Contractor submittals and material selection. The Contractor shall schedule the pre-construction meeting.

S-136.1 **MATERIALS**

(A) Rout and Seal at Transverse Cracks

The Contractor shall provide certification that the sealant meets the requirements of Mn/DOT 3725 for transverse cracks sealed using Rout and Seal.

(B) Clean and Seal at Transverse and Longitudinal Cracks

The Contractor shall provide certification that the sealant meets the requirements of Mn/DOT 3723 or Mn/DOT 3719 for Clean and Seal cracks. The use of Mn/DOT 3719 sealant may be allowed on more severely cracked longitudinal cracks with approval of the Engineer or as shown on the Plans.

(C) Sealant Requirements

Only those products that meet the requirements of Mn/DOT specifications and have performed satisfactorily based on Chemical Laboratory and field analysis shall be used. A list of certified sources is on file at the Chemical Laboratory, Mn/DOT Maplewood's Office of Materials and Road Research. To obtain the list, call (651) 366-5548 or visit the website at: <http://www.mrr.dot.state.mn.us/materials/materials.asp>

The crack sealant material shall be packaged and shipped in sealed containers. Each container shall be clearly marked with the name of the manufacturer, the trade name of the sealant, mass [**weight**], the manufacturer's batch and lot number, the application/pouring temperature, and the safe heating temperature. The Contractor shall furnish two (2) sample boxes for each lot of sealant used on the Project for field sampling. Each sample box shall have a capacity to hold 2.3 kg [**5 pounds**] of sealant. The boxes shall be Teflon or silicone-lined.

A copy of the manufacturer's recommendations pertaining to the heating and re-heating and application of the joint sealant material shall be submitted to the Engineer before the commencement of the work. The Contractor shall follow these recommendations.

The temperature of the sealer in the field application equipment shall not exceed the safe heating temperature recommended by the manufacturer. Temperatures above the safe heating temperature will result in rejection of the sealant material and will require disposal of the sealant material.

The Contractor shall not place sealant if the temperature of the material is below the manufacturer's recommended minimum application/ pouring temperature.

Mixing of different manufacturer's brands or different types of sealants is prohibited.

(D) Basis of Material Acceptance

Acceptance of the sealant material is based on the certification by the manufacturer that the sealant meets the requirements listed above. Field sampling shall be used to verify that the delivered sealant meets the requirements of the specification. Prior to the sealing operation to begin, the Contractor shall take a sample from the application wand during the first 20 minutes of placing sealant from each melter on the Project. The Contractor shall furnish the Department one (1) sample for each lot of sealant used on the Project. The Engineer reserves the right to obtain a second sample of sealant from the Contractor for each lot of sealant.

The Contractor shall obtain samples of sealant from the application wand in the presence of the Engineer. Each sample shall consist of two (2) Teflon or silicone lined boxes with the capacity to hold 2.3 kg [**5 pounds**] of sealant. The two (2) sampling boxes shall be labeled with SP number, date, time, location, manufacturer and lot number of the sealant. Each box shall be numbered one of two, or two of two. The Engineer reserves the right to conduct supplementary sampling and testing of the sealant material.

The Engineer may randomly pick the time and date of the second sampling per lot of sealant. The Engineer reserves the right to conduct additional sampling and testing of the sealant material at no cost to the Contractor, unless testing reveals the sealant material not meeting Mn/DOT specifications.

The Contractor shall document the locations where the material from each lot number of sealant is placed.

If a field sample fails to meet any of the six (6) physical properties contained in Mn/DOT specifications, the work completed with the material from that lot the field sample represents, shall be subject to a reduction in the Contract unit price for sealant material to 20 percent for each failing property.

S-136.2 CONSTRUCTION REQUIREMENTS

(A) Weather Limitations

Sealant materials shall only be placed during a period of rising temperature after the air and surface temperature in the shade and away from artificial heat sources has reached 10° C [**50° F**] and indications are for a continued rise in temperature. During a period of falling temperatures, which may fall below 10° C [**50° F**], placement of the sealant material shall be suspended until the above conditions are met.

Do not place sealant material if weather conditions are raining or wet. Should the sealant be placed and rain should fall before the sealant has properly cured, the Contractor shall remove and replace the wet/contaminated sealant.

Sealants shall not be placed when the weather or roadbed conditions are unfavorable.

Crack sealing work should be completed in the Northern 'Spring Load Restriction' (SLR) zone before September 16. The Northern SLR zone extends from the northern limits of MN 39 at the Wisconsin state line in Duluth, west along MN 210 to Staples, then US 10 west to the North Dakota state line at Moorhead.

All other SLR zones should be completed before October 1 of the current construction season.

(B) Equipment Requirements

Melting Kettle: shall be double jacketed boiler type, equipped with both agitation and recirculation systems capable of melting and applying the sealant through a pressure-fed hose and wand. The melter shall be capable of starting at ambient temperature and bringing the sealant material to application temperature within one hour, while continuously agitating and recirculating the sealant. The melter shall be equipped with automatic thermostatic controls and temperature gages to monitor the sealant temperature in the applicator lines and temperature of heat transfer oil in the kettle jacket.

The Contractor shall furnish the Engineer daily production data sheet(s) for each melting kettle on the Project.

The Contractor shall furnish, for use by the Engineer, an infrared temperature-measuring gun accurate to 1° C at 204° C [**1° F at 400° F**]. The Engineer may check the pouring temperature of the sealant at the point of discharge into the reservoir. If the sealant falls below the recommended application/pouring temperature, all production shall stop at that melting kettle until the recommended application/pouring temperature is obtained. Should the sealant temperature at the point of discharge exceed the maximum safe heating temperature, the melting

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kettle shall be emptied of all sealant, and the sealant shall be legally disposed of in an environmentally safe method. No payment will be made for this sealant material or the disposal thereof.

Pavement Cutter: Self-propelled pavement cutter capable of providing a cut of uniform depth and width shall be used. Cutter shall have carbide tipped cutters, radial mounted around a flywheel, held in place on hardened steel pins. The cutter shall be adjustable by rearrangement of the holding spacers such that the cutter is capable of achieving a maximum width of 50 mm [**2 inches**] and a minimum depth of cut of 9.5 mm [**0.375 inches**].

The pavement cutter shall be capable of cutting the countersunk design configuration into the pavement, expeditiously, with ease and in one single pass. An engine capable of achieving a minimum of 20 horsepower shall power the pavement cutter.

Air Compressor: shall be capable of producing a continuous stream of clean, dry air through the nozzle at 517 to 1034 kPa [**75 to 150 pounds per square inch**] and 3.5 m³/minute [**125 cubic feet per minute (CFM)**] minimum. The compressed air unit shall be equipped with water and oil traps and must produce sufficient air volume and pressure to remove all debris from the crack (routed or not) and all adjacent road surfaces in a safe manner such that the debris will not re-enter the crack prior to the sealing operation. The traps used to remove moisture and oil shall be checked by the Contractor at least once per day of production and replaced when necessary.

- The use of backpack blowers (leaf blowers) is not allowed.
- The use of vacuum cleaning equipment will be allowed after demonstrating to the Engineer that the vacuum equipment can successfully clean the cracks.

Heat Lance: shall operate with propane and compressed air in combination and be capable of achieving a temperature of heated air at the exit orifice of 982° C [**1,800° F**] and a discharge velocity of 914 m/sec. [**3,000 feet per second**].

(C) Submittals

Melting kettle production data sheets shall be submitted daily for each kettle on the Project with the following information.

1. SP number, control section and route number.
2. Date, ambient air temperature (° C [**°F**]) at the beginning of the shift, mid-day and end of shift.
3. Manufacturer's heating melting rate in kilograms [**pounds**] per hour to application/ pouring temperature.
4. Stated conditions under which the rate of melting/ heating sealant to application/ pouring temperature was determined.
5. Kettle temperature once an hour during working production.
6. Sealant material temperature at the wand once an hour during working production.
7. Beginning and ending locations on Project for the day, including lane and direction.
8. The amount of materials used for the day in kilograms [**pounds**], including lot numbers.
9. Sample(s) taken with Project location recorded.
10. Unique or atypical situations on the Project that may affect the placement or performance of the sealed crack.
11. The Contractor's authorized signature.

Material certification.

Material test samples.

(D) Transverse Crack Preparation

Random transverse cracks measuring less than or equal to 19 mm [**0.75 inch**] wide shall be 'Rout and Sealed' to a width and depth of 19 mm [**0.75 inches**]. Cracks greater than 19 mm [**0.75 inches**] wide shall follow the 'Clean and Seal' method (without routing) of crack repair.

The pavement cutter shall at all times exhibit the capability of expeditiously cutting the design reservoir in one easy pass. The Contractor shall change cutters when it is evident that the reservoir configuration specified is not being achieved in an easy and expeditious manner in conformance with design. The Contractor shall demonstrate the cutters capability of following meandering cracks and maintaining centering of the reservoir over the crack ± 6 mm [**± 0.25 inches**]. The resulting reservoir shall have vertical sidewalls and a uniform, horizontal profile. Anytime that the Contractor cannot meet these requirements, the production of that cutter shall cease until such time as the requirements can be met.

(E) Longitudinal Crack Preparation

Random longitudinal cracks shall follow the 'Clean and Seal' method (without routing) following the same procedures used for the transverse 'Rout and Seal' cracks.

(F) Reservoir, Crack Cleaning and Conditioning Operation

Rout and Seal: Routed reservoirs shall be thoroughly cleaned with a minimum of one pass of the air wand not more than 50 mm [**2 inches**] from each face of the reservoir / crack. Cleaning shall continue until the reservoir / crack is dry and all dirt, dust or deleterious matter is removed. If the air compressor produces dirt or other residue, the Contractor will be required to re-clean the reservoir / crack.

Clean and Seal: Clean and Seal cracks shall be thoroughly cleaned with a minimum of one pass of the air wand not more than 50 mm [**2 inches**] from each face of the reservoir / crack. Cleaning shall continue until the reservoir / crack is dry and all dirt, dust or deleterious matter is removed. If the air compressor produces dirt or other residue, the Contractor will be required to re-clean the reservoir / crack.

Immediately prior to the placement of the crack sealant, the surface of both the sidewalls, as well as the pavement 25 mm [**1 inch**] on either side of their sidewalls shall be conditioned with hot compressed air from a heat lance. The heat lance shall be placed within 75 mm [**3 inches**] of each sidewall of the reservoir/ crack. This treatment shall continue until the affected areas are conditioned. The heat lance shall not scorch the routed reservoir, crack or adjacent pavement surface. The Engineer reserves the right to randomly spot check the reservoirs/ cracks to verify that they are clean and dry. Anytime the Engineer determines that this requirement is not being met, the Contractor shall modify their operation to meet these requirements.

The Contractor shall be required to provide protective screening if cleaning and conditioning operations could cause damage to or interference with traffic in adjacent lanes.

(G) Crack Sealing Operation

The crack sealant shall be placed immediately after the completion of the cleaning and conditioning with the heat lance.

Cracks shall be sealed when the sealant material is at the application/pouring temperature recommended by the manufacturer. The Contractor shall fill the transverse reservoirs / cracks by the use of the double fill method. (Note, the Contractor may need to use additional passing filling the reservoir / crack to meet the level fill requirement). The final level of the filled reservoir shall be flush with the pavement surface, no more than 3 mm [**0.125 inches**] thick, spread uniformly over the entire length of the crack. The width of the overband, including the routed reservoir, shall be 64 mm [**2.5 inches**] wide with a film thickness of the overband limited to 3 mm [**0.125 inches**] deep. The Contractor may be required to use a squeegee to force the sealant material into narrow cracks if the sealant material is not flowing into the crack properly.

Longitudinal cracks using the Clean and Seal method shall be applied using an application wand followed by a "V" shaped squeegee or by a round application head having a concave underside or other methods that meets the requirements for size and shape. The maximum width of the application head shall be 75 mm [3 inches] for standard coverage. The maximum width of the application head shall be 150 mm [6 inches] for multi-crack locations. The maximum film thickness of the overband is limited to 3 mm [0.125 inches] deep.

Care shall be taken in the sealing of the cracks so that the cracks are not overfilled and the final appearance shall present a neat fine line. The applicator wand shall be returned to the machine and the joint sealant material re-circulated immediately upon completion of each crack sealing.

Sealants shall not be removed from their packaging until immediately before it is placed in the melter. The Contractor shall feed additional sealant into the melter at a rate equal to or less than the rate of placement of the sealant in the reservoirs / cracks.

The Contractor may apply toilet paper or a light coating of sand, dust or an approved de-tacking agent for use with the specified sealant to the surface of the newly placed sealant if traffic results in tracking of the crack sealing material. The Contractor shall repair any damage by traffic to treated pavement areas. If the existing pavement markings are obliterated as a result of the crack treatment work, temporary pavement markings shall be placed before the roadway is opened to traffic.

At the end of the workday the Contractor shall clean and remove all debris generated in the area of work operations. The Contractor's operations shall, at all times, be conducted in a manner not deleterious to the public at large, or the Engineering and Labor Forces involved on the Project Site.

(H) Acceptance Sampling

The Contractor shall record the required information on the melting kettle production data sheets as required during the actual working operations. This information is to be recorded by the Contractor. At the end of each day's production, the completed sheets shall be presented to the Engineer, and the Engineer shall place them in a permanent file.

During crack sealing operations, the Engineer may review the sealant temperatures at the melting kettle intermittently during the working operations. If the temperatures are above the manufacturer's specified safe heating temperature, the sealant will be rejected. The Contractor shall empty the kettle of the over-heated material and legally dispose of it in an environmentally safe method.

Transverse cracks, whether sealed by the 'Rout and Seal' or 'Clean and Seal', and longitudinal cracks filled by 'Clean and Seal', will be observed on a crack-by-crack basis for acceptable workmanship. Unsealed cracks will be brought to the attention of the Contractor. The Contractor shall fill all unsealed cracks prior to re-opening the roadway to traffic.

(I) Workmanship

Sealed cracks shall be rejected if there is evidence of poor workmanship or obvious defects, such as, but not limited to the following:

- Routed reservoir not filled completely, flush with pavement surface.
- Lack of bond to the sidewalls of the joint reservoir or crack.
- Excessive debris or moisture in the joint reservoir or crack.
- Contamination of the sealant.
- Excessive pools of sealant on the pavement or shoulder surface.
- Excessively wide, thick sealant overband.

Rejected sealed cracks shall be repaired, the sealant removed and disposed of in a legal and appropriate manner and the cracks resealed as necessary.

(J) Warranty of Rout and Seal Crack Sealing

Contractor's Responsibilities: The Contractor shall provide a written two-year warranty starting from the date the Project is substantially complete or the roadway has been re-opened to traffic. The warranty shall cover 100% the cost of new materials, removal and disposal of failed materials, equipment, mobilization, traffic control and labor necessary to repair the failed rout and sealed cracks.

Definition of Failure: Failure shall be determined on a crack-by-crack basis for cracks sealed using the rout and seal method as:

- Loss of sealant (pull-out) on any portion of the rout and sealed crack or a rout and sealed crack with ten (10%) percent or more of its length in which the sealant has lost its bond with the pavement, or the sealant has torn within the routed crack which could allow water to penetrate the crack.
- Bituminous pavement that breaks, but is still bonded to the sealant, will not be considered a failed rout and sealed crack.

Definition of Catastrophic Failure: If at any time during the warranty period, 30 percent of the routed cracks treated as part of this Contract fail in any road section segment, the Contractor shall correct all such failures as soon as the weather conditions permit. Repair work shall include all sealed cracks damaged by the catastrophic failure, including longitudinal cracks that are pulled out by failed sealant.

Annual Review: The Contractor shall schedule and review the Project in detail with the Engineer annually during the warranty period. The meeting should occur in the early part of the construction season to expedite any repair work that may be required.

The Contractor shall make the necessary repairs to all failed sealed cracks during the current construction season.

Additional Bituminous Cracking: Should additional cracking occur in the bituminous surface during the warranty period, the Engineer may request a proposal from the Contractor to seal these cracks. This work, if applicable, will be paid for as an additional service in accordance with Mn/DOT specifications.

Administrative Requirements: The Contractor must comply with Mn/DOT specifications for bonding, which requires the successful bidder to "furnish a Payment Bond equal to the Contract amount and a Performance Bond equal to the Contract amount".

The Contractor will be required to amend their Performance Bond to cover the warranty period. This bond must be submitted to Mn/DOT. The release of the Performance Bond will take place following the end of the warranty period provided the Contractor has executed the warranty work in good faith.

Failure to Comply with Warranty: Failure to comply with the warranty described will result in forfeiture of the Performance Bond and the Contractor shall be ineligible to enter into work with Mn/DOT bituminous pavement crack sealing or 'Saw and Seal' projects for the remainder of the Contract period and for the next 12 months following the original Contract period.

(K) Final Clean-Up

After the sealant has been placed and cured and before opening the road to traffic, any additional debris left on the roadway surface shall be removed. Any method used to complete this work shall not damage the newly placed sealant; the Contractor shall repair any damage to the sealant.

This work will be measured by the weight of sealant properly placed in the routed cracks in accordance with the requirements put forth herein.

OR

The Engineer will measure sealed cracks by the Road Station of the Project. A road station is defined as a 30.5 m [**100 foot**] segment measured along the centerline of the roadway and includes all lanes of traffic in both directions. Random cracking within the road station to be repaired includes cracks in the traffic lanes, acceleration lanes, deceleration lanes, widened medians, median cross-over lanes, turning lanes, paved shoulders, ramps and all auxiliary lanes, unless shown otherwise on the Plans.

For a divided highway, the road station in each direction will be measured separately.

S-136.4 PAYMENT

Payment will be made in accordance with the schedule set forth below at the Contract bid price per kilogram [**pound**] of sealant placed, which shall include the cost of furnishing all labor, equipment, and materials necessary to complete the work as specified or as ordered by the Engineer.

Item No.	Item	Unit
2331.608	Rout and Seal Bituminous Pavement Cracks.....	kilogram [pound]

OR

Payment will be made in accordance with the schedule set forth below at the Contract bid price per Road Station, which shall include the cost of furnishing all labor, traffic control, equipment and materials necessary to complete the work as specified.

Item No.	Item	Unit
2331.619	Rout and Seal Bituminous Pavement Cracks.....	Road Station

S-137 (2331) BITUMINOUS PAVEMENT CRACK TREATMENT CLEAN AND SEAL

REVISED 1/30/07

SP2005-131.1

This work consists of sealing random transverse and longitudinal cracks in the bituminous pavement in accordance with the Plans and the applicable Mn/DOT Standard Specifications.

Clean and Seal: Transverse cracks and longitudinal cracks shall be cleaned and sealed (without routing).

A pre-construction meeting shall be held between the Contractor, sub-contractors, and the Engineer prior to the beginning of any work. Items to be discussed include the traffic control plan, Contractor's documentation requirements, Contractor submittals and material selection. The Contractor shall schedule the pre-construction meeting.

S-137.1 MATERIALS

(A) Clean and Seal at Transverse and Longitudinal Cracks

The Contractor shall provide certification that the sealant meets the requirements of Mn/DOT 3723 for Clean and Seal cracks. A list of certified sources is on file at the Chemical Laboratory, Mn/DOT Maplewood's Office of Materials and Road Research. To obtain the list, call (651) 366-5548 or visit the website at: <http://www.mrr.dot.state.mn.us/materials/materials.asp>