Asphalt Crack Sealing Practices and Processes

Commissioned by: Communities of Tomorrow
Leveraged Municipal Innovation Fund

Consultant: Stantec Consulting Ltd.
Carlyle Murray

Sponsors: City of Yorkton, City of Regina

Municipal Innovation Network
Asphalt Crack Sealing Practices and Processes

Communities of Tomorrow

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Executive Summary

Communities of Tomorrow commissioned Stantec Consulting Ltd. to research and analyze crack sealing practices as well as examine alternative preservation treatments providing crack sealing benefits.

In addition to an extensive literature review a questionnaire was sent out to a number of municipalities within Saskatchewan as well as jurisdictions outside of Saskatchewan. The intent of the questionnaire was to gather information regarding crack sealing and other preventative maintenance practices of jurisdictions within and outside of Saskatchewan. However, only a limited number of responses were received.

Pavement cracking is a fact of asphalt concrete pavements and plays a major role in pavement deterioration. Pavement cracks are one of the main factors in determining time and method of rehabilitation. Addressing cracks can be carried out through a number of preventative maintenance activities, surface treatments such as seals, full scale pavement rehabilitation in the form of resurfacing, crack sealing or crack filling. Pavement cracks can show up as one or all of the following types, transverse, longitudinal, fatigue, block, reflective, edge and slippage.

Crack sealing has the potential to extend the service life of a pavement as well as maintaining a higher standard of rideability over a longer period of time.

Crack sealing (rout and seal) and crack filling (no routing) are crack treatment activities that have been used to treat pavement having low to moderate crack density. A pavement that has a large number of cracks or severely deteriorated cracks generally indicates a pavement in an advanced state of disrepair. Under such circumstances, crack sealing or filling is ineffective. It should be noted that crack sealing is a longer term treatment while crack filling is considered more of a short term treatment.

In order to have a successful crack sealing program careful consideration must be given to pavement and material selection, crack preparation and crack sealant application. It is important that the crack is routed to the proper size and that the crack is cleaned properly and is dry prior to sealing. As well, ensure that the material selected is designed to be effective for the climate it is going to be used in. It is also important to follow the manufacturer’s instructions for the application of the product.

Equipment requirements will vary in accordance to the treatment method chosen, specification and size of project. Therefore, ensure that the proper equipment is used for the application chosen and that all equipment is in good working order and that the material manufacturer’s recommendations are followed.
Some of the variables impacting unit costs are traffic accommodation requirements, roadway/street classification and configuration, material, method/procedures, documentation, performance evaluation and project size.

There are a number of seals, fog, sand, slurry, chip, cape, micro-surfacing and rejuvenators that can potentially be used to extend the life of the pavement by possibly addressing pavement distresses such as raveling and wear, minor rutting, cracking, flushing and polished aggregate. Some seals can even be used as an interim to an asphalt mix surface. Regardless of the treatment it is important to monitor the performance of the various preventative maintenance treatments.
1.0 Background

Communities of Tomorrow commissioned Stantec Consulting Ltd. to research and analyze crack sealing practices and processes with the objective of developing a beneficial practices document that will potentially improve the level of service provided by current crack sealing programs, as well as examining alternative preservations that provide crack sealing benefits.
2.0 Introduction

Pavement cracking is a fact of asphalt concrete (AC) pavements that maintenance and design personnel have had to contend with for years. Constructing a pavement that will not develop cracks over its service life is virtually impossible. Thermal movement and fatigue due to repetitive excessive loading are the main causes of pavement cracks. Cracking, mainly fatigue, is one of two main concerns considered during the design process with the other major concern being rutting. Cracking more often than not is the primary mode of deterioration in AC pavements which can eventually lead to structural failure. Pavement cracking shows up in many forms: transverse, longitudinal, block and fatigue (alligator) cracks. Cracks are inevitable and need to be treated in a timely manner as they create an opening that allows moisture to penetrate the surfacing structure including the subgrade. Overlooking cracks can lead to moisture or water being trapped, accelerating pavement deterioration resulting in accelerated crack deterioration, pot holes along the cracks and potentially structural failure. Ultimately, the above leads to reduced pavement life, serviceability and potentially increased road user costs.

Since cracking plays such a major role in pavement deterioration it is one of the main factors in determining time and method of rehabilitation. As previously stated, neglecting to repair cracks in a timely manner can lead to accelerated pavement deterioration. Addressing cracks can be carried out through various preventative maintenance activities, such as surface treatments, full scale pavement rehabilitation in the form of resurfacing, crack sealing or filling. The common options exercised by a number of North American jurisdictions are crack sealing and crack filling. These two activities have been carried out on a routine basis for many years. However, it’s only been in the last couple decades or so that the potential benefits of crack sealing as a preventative maintenance activity has been realized.

Pavements expand and contract with seasonal temperature changes. Thus cracks expand and contract with the movement of the pavement. Sealing cracks with a flexible material that bonds to the wall of the cracks and moves with the pavement will assist in preventing water intrusion. Crack sealing as part of a Pavement Management Program can reduce the amount of water that penetrates the base, sub-base and sub-grade helping maintain the pavements structural capability and delaying pavement deterioration. In other words, crack sealing has the potential to extend the service life of the pavement as well as maintain a higher standard of rideability over a longer period of time.
3.0 CRACK TYPES

3.1 TRANSVERSE CRACKS

Transverse cracks extend across the pavement occurring approximately perpendicular to the centerline of the pavement or laydown direction.

These cracks are generally formed by temperature related pavement/sub-grade movement at low temperatures and are usually not load associated. Transverse cracks generally form across the full width of the street or road at approximately 6 meter spacings. Transverse cracks are considered to be “working” cracks >3 mm movement and typically the first cracks to appear developing within approximately 2-3 years on most new pavements and within 1-2 years on overlaid pavements. These cracks can be effectively treated with crack sealants (Chapter 3 Crack Sealing & Crack Filling-Caltrons Flexible Pavements Materials Program – October, 2003).

3.2 LONGITUDINAL CRACKS

Longitudinal cracks develop parallel to the pavement’s centerline or laydown direction and are caused by thermal movement or by poorly constructed construction joints between travel lanes or between a travel lane and shoulder. Longitudinal cracks are usually considered to be low movement “non-working” cracks <3mm movement. Longitudinal cracks can generally be effectively treated with crack sealants.

3.3 FATIGUE (ALLIGATOR) CRACKING

Fatigue or alligator cracking is a series of closely spaced interconnecting cracks that form a block pattern or a pattern similar to an alligator’s skin. The cracks are a result of repetitive traffic loading or high deflections caused by wet base, sub-base or sub-grade. Fatigue cracking is usually a sign of pavement structure failure. This type of cracking can lead to potholes and/or pavement disintegration. Crack sealing or filling is generally an ineffective maintenance treatment for fatigue cracking.

3.4 BLOCK CRACKING

Block cracks are interconnected cracks that generally form rectangular blocks. The cause of block cracking is mainly the result of the asphalt concrete shrinking during cold weather coupled with the asphalt hardening through aging. Crack sealing can be an effective treatment for block cracking.

Block cracking differs from fatigue cracking in that fatigue cracking form smaller, many-sided pieces that have sharp angles.
3.5 REFLECTIVE CRACKS

Reflective cracks are usually caused by cracks in underlying pavement surfaces propagating up through an overlay and can exhibit any of the crack patterns mentioned above.

3.6 EDGE CRACKING

Edge cracks are fairly continuous crescent-shaped or parallel cracks located within 0.3 m to 0.6 m of the outer pavement edge. Edge cracks can be caused by frost-weakened base or subgrade near the edge of the pavement and/or by overloading at the edge of the pavement. Crack sealing as an effective treatment for edge cracking is questionable.

3.7 SLIPPAGE CRACKS

Slippage cracks are characteristically crescent shaped. These cracks are caused when the layer of asphalt shears away from the layer beneath it mainly due to a poor bond between the layers. Crack sealing is ineffective in treating slippage cracking.
Before any type of maintenance treatment for cracked pavement is undertaken the density and general condition of the cracks should be given consideration. If cracks are low to moderate in density, with a high degree of edge deterioration, then maintenance such as partial-depth patching or spot patching may be warranted. Chip seals, slurry seals, etc. may be more appropriate for pavements where cracks are abundant and exhibiting a low degree of edge deterioration. Pavements having low to moderate crack density with little to no edge deterioration can potentially be treated effectively through sealing or filling operations.

As a rule, a large number of cracks, or severely deteriorated cracks, indicates a pavement in an advanced state of disrepair. Crack sealing or filling in this circumstance is likely ineffective thus uneconomical for cracked pavements. Although one Saskatchewan jurisdiction has reported good success in filling cracks on low volume residential streets that had a high density of cracking.

A number of jurisdictions have established policies that specify the type of maintenance to be performed and when to perform it.

4.1 CRACK SEALING

Generally crack sealing refers to the placement of specialized treatment materials above or into “working” (active) cracks using unique configurations to prevent the intrusion of water and incompressibles into the crack (FHWA Report No. FHWA-RD–99–147 materials and procedures for Sealing and Filling Cracks in Asphalt-Surfaced Pavements Manual of Practice).

“Working” (active) cracks are cracks which open and close with the seasons. “Working” cracks are generally transverse oriented. Typically the width of the “working” crack is greater than 3 mm in the summer and 15 to 100 percent wider during the winter. It is recommended for longer term performance that the crack sealing process include routing the crack to a predefined geometry, cleaning and sealing. Routing with a width-to-depth ratio of one or greater than one (W/D=1) provides a profile that enhances sealant performance (Guidelines for Sealing and Filling Cracks in Asphalt Concrete Pavements NRC National Guide to Sustainable Infrastructure).

Crack sealing lasts longer than crack filling and as a Pavement Management activity crack sealing restricts water penetration into the underlying granular structure reducing future pavement deterioration while maintaining structural capacity. Rideability benefits are realized in three to five years by way of reduced pavement deterioration.

The life expectancy of crack sealing is in the range of 2-7 years with some reports stating a life expectancy of 9 years. Generally, crack sealing as an established Maintenance Program is repeated more than once during the pavement life cycle. Typically the first seal is done on
pavements that are in the three to five year age range. A second seal is usually performed after 8 to 10 years on pavements that are in fair condition and providing the crack sealant will remain effective for a minimum of 5 years prior to resurfacing. This puts the pavement life between 13 and 15 years, at which time the pavement could be given consideration to receive a rehabilitation treatment.

4.2 CRACK FILLING

Crack filling is mainly carried out on cracks that show little, if any, movement overtime. These types of cracks, for the most part, are referred to as “nonworking” (non-active cracks). Generally the cracks are less than 3 mm wide. Crack filling usually involves less crack preparation than sealing. Typically the crack filling process consists of cleaning the crack with compressed air prior to the application of an overband of hot-applied sealant, or flush-filled with a cold-applied bitumen emulsion. Crack routing is usually excluded from the process. Crack filling is considered more of a short-term treatment. If properly performed, crack filling results in a reduction of water that infiltrates the crack protecting the pavement system from being weakened by moisture.
5.0 SUGGESTED CRACK SEALING PROCEDURES

To have a successful crack sealing program careful consideration must be given to pavement selection, material selection, crack preparation and crack sealant application.

5.1 PAVEMENT SELECTION

Crack sealing is a preventative maintenance activity. In order for it to be effective pavement selection should be given careful consideration to ensure the preservation and extension of the life of the pavement. In order to be effective crack sealing should be carried out on AC pavements that are in good condition with a relatively smooth ride. However, as previously stated a second seal can be carried out on pavements that are in fair condition. AC pavements selected to be crack sealed should have sufficient structural strength to meet current and foreseeable future needs and should exhibit minor distresses only.

The best candidates for crack sealing are newer pavements in the 1 to 3 year age range with the vast majority of the cracks typically being transverse or longitudinal, having a slight to moderate width and a crack density in the intermittent to frequent range. Refer to Table 5-1 for the description of crack width and density.

Table 5-1: Classes of Crack Widths and Densities. Adapted from Chong et al., 1989

<table>
<thead>
<tr>
<th>Crack</th>
<th>Class</th>
<th>Description</th>
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<tr>
<td>Width</td>
<td>Slight</td>
<td>2 to 12 mm single crack.</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td>13 to 20 mm single or multiple cracks. Crack below 20 mm that show cupping or lipping.</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>Single or multiple cracks with cupping and lipping or cracks larger than 20 mm. Crack below 20 mm that show spalling.</td>
</tr>
<tr>
<td>Density</td>
<td>Intermittent</td>
<td>No set pattern. Less than 20% of pavement surface is affected. Transverse cracks are 30 to 40 m apart.</td>
</tr>
<tr>
<td></td>
<td>Frequent</td>
<td>20 to 50% of surface is affected. Longitudinal cracking can be localized or distributed evenly over pavement section. Transverse cracks are 20 to 30 m apart.</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>Cracking is distributed evenly over more than 50% of pavement surface. Transverse cracks are 10 to 20 m apart.</td>
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Source: Guidelines for Sealing and Filling Cracks in Asphalt Concrete Pavement
A Best Practice by the National Guide to Sustainable Municipal Infrastructure
Issue No. 1.0, Publication Date: March 2003
Created by: 2003 Federation of Canadian Municipalities and National Research Council

Pavements that have alligator cracking, high-density multiple cracking, poor sub-base drainage or structural damage, or cracks greater than 20 mm in width, regardless of density, are
unsuitable candidates for crack sealing. Crack sealing becomes increasingly less effective as cracks approach a width of 20 mm or greater to the point where other pavement treatments should certainly be considered when cracks reach a width of 25 mm.

A rehabilitation treatment is better suited for these pavements versus crack sealing. Also, crack sealing or filling is not recommended during the last several years prior to a rehabilitation treatment.

5.2 MATERIAL SELECTION

Choosing a sealant is extremely important. A cheaper sealant that doesn’t provide the desired performance and/or effectiveness may very well end up costing more in the long term. Hot pour crack sealing products are the thermoplastic bitumen-based materials. The temperature range that these sealants can be poured are between 175º C and 200º C. Whereas cold pour material is usually applied at temperatures below 70º. Thus the designation as hot pour sealants

Cold pour bituminous emulsions are used for crack filling versus crack sealing. Material properties that one may wish to take into consideration when selecting the material include preparation time, workability, cure time, adhesiveness, cohesiveness, flexibility, elasticity, resistance to aging, weathering, abrasion, softening and flow. Different circumstances require different material characteristics in order to achieve maximum performance.

Manufacturers of crack sealing materials provide a list of guidelines for application and usage that should be followed. There are four distinct types of sealants as classified by ASTM D6690 or by American Association of State Highway and Transportation Officials (AASHTO). Type I is designed for moderate climates. Type II is designed to be effective in most climates and is tested at a low temperature of -29º C. Type III is also designed to be effective in most climates, while Type IV is designed to be effective at very cold temperatures.

Manitoba Infrastructure and Transportation specifies that the Hot-Applied Sealant meets the low modulus ASTM D6690 specification for Type IV sealant. Saskatchewan Ministry of Highways and Infrastructure specifies Crafco Road saver 34522 Low Modulus, Manufacturer Crafco Inc. or Beram 195 Low Modulus, Manufacturer McAsphalt Industries Limited.

It is important that materials specified for crack sealing meet ASTM or AASHTO specification and are suitable for local climates and conditions.

5.3 CRACK PREPARATION

To enhance performance cracks should be routed with a width/depth greater than or equal to one (W/D-1). Routing widths should be less than 30 mm as excessive widths provide greater sealant exposure to slow-moving traffic thereby potentially raising the failure rate. Routes of 30 by 15, 25 by 12 and 12 by 12 [W(mm) x D(mm)] have shown to provide good performance.
It is extremely important that routs are square or rectangular as rounded bottoms and V shaped routs create de-bonding issues. Routs should be centered over the crack. All cracks should have both sides routed. Prior to sealing, routs must be cleaned to remove debris and loose AC fragments. Cleaning can be a three step operation. The initial cleaning to remove as much debris as possible from the AC surface so dust is not blown back into the rout just before the rout is sealed. This can be done by a large mechanical sweeper or a large vacuum system. Removing debris and loose AC fragments from the routed crack is the second step. This is best done by using high-pressure air compressors providing at least 700 kpa pressure and 0.7 m³/s flow. A hot-air lance (HAL) may be used has a final step to warm the routed surface and remove moisture ensuring the routed crack is dry.

It is important not to overheat the rout. Over-heating can cause the pavement to become brittle resulting in premature adhesion failure.

5.4 CRACK SEALANT APPLICATION

Prior to the beginning of each day’s operation, ensure the sealant melter/kettle, along with all applicator lines, are cleaned out. Heat the sealant keeping the temperature of the sealant to the lower temperature of the material manufacturer’s recommended range. Ensure cracks and adjacent AC surface are free of debris and are dry. It is also important to follow the crack sealing application methods described by the product manufacturer.

Guidelines for Sealing and Filling Cracks in Asphalt Concrete Pavements NRC National Guide to Sustainable Infrastructure suggests routed cracks should be flush sealed or bridged. The Guidelines further suggest a bridge of 5 to 10 mm overlap with the asphalt on either side of the rout to be considered optimal. Wide bridges can lead to failure as a result of excessive contact with tires of slow-moving traffic. Likewise, too thick a bridge can lead to damage by snow ploughing operations. For the effect of crack opening and the time of work on sealant strain refer to Figure 5-1. For a material placement configuration refer to Figure 5-2.

Configurations A through I show the material being applied directly to the crack channel. Occasionally, configurations J, K & L, a backer rod or bond breaker material is placed within a crack to prevent the sealant from sticking to the reservoir bottom and forming a three-sided bond with the reservoir perimeter. Also, backer rod can restrict the sealant depth to the upper portion of the crack.

Backer rod may enhance the sealant’s potential performance. However, backer rod should only be considered if the cost of installing the backer rod is considered to be less than the cost benefits of improved performance and if the cracks to be sealed are relatively straight.
Figure 5-1: Effect of Crack Opening and Time of Work on Sealant Strain

Crack / Rout Width

Winter

Spring, Autumn

Summer

Time of Work

Winter

Spring, Autumn

Summer

Source: Guidelines for Sealing and Filling Cracks in Asphalt Concrete Pavement
A Best Practice by the National Guide to Sustainable Municipal Infrastructure
Issue No. 1.0, Publication Date: March 2003
Created by: 2003 Federation of Canadian Municipalities and National Research Council
Figure 5-2: Material Placement Configuration

Source: FHWA Report No. FHWA-RD-99-147
Materials and Procedures for Sealing and Filling Cracks in Asphalt-Surfaced Pavements
Manual of Practice
Created by: Federal Highway Administration – U.S. Department of Transportation
Strategic Highway Research Program – National Research Council
6.0 CRACK SEALING EQUIPMENT

Equipment requirements will vary in accordance to the treatment method chosen, specification and size of the project. Some items of equipment used for crack sealing and crack filling include but are not necessarily limited to the following.

- Crack routers
- Concrete saw
- Hot compressed-air (HCA) heat lance
- Air compressor
- Oil jacketed melting kettles/Thermostatic heat controls/Continuous agitation/over-heating safety controls
- Pour Pots
- Squeegee

Refer to Appendix A for Marathon Equipment Inc., CRAFCO Inc., Cimline and SealMaster equipment information.

It is important that the hot applied sealant melters/kettles/applicator are in good working order, all gauges are accurately calibrated and all heating, agitation, pumping systems, valves, thermostats are functioning properly.

Ensure proper wand tips are used for the desired application and sealant configuration. Ensure routing equipment is in good working order with no missing, chipped, rounded or broken teeth. Air compressors should have sufficient pressure and volume to clean cracks adequately. Direct heating kettles, pouring pots or gravity-fed sealant applicators are not recommended for sealing cracks.
7.0 CRACK SEALING CHALLENGES/ISSUES

7.1 MATERIALS

One of the main problems is the non-conformance of material to the required specification. On larger projects testing the sealant material for conformance can help to minimize the problem. Overheating the material or heating the material to the recommended application temperature for prolonged periods of time can cause the sealant not to set up or cure. This problem can be minimized by monitoring the temperature of the sealant in the melting kettle/applicator and discarding material that has been heated for a prolonged period of time. Prolonged heating periods for most hot applied material range between 6 & 12 hours. Most hot applied material may be reheated once. Should there be a prolonged heating period, or if the material is going to be reheated, more material should be added if at all possible. As well, it is recommended that any material remaining in the equipment at the end of the day should be discarded and the equipment thoroughly cleaned.

7.2 PREPARATION

Problems associated with crack preparation are cleanliness of the crack and damage to the adjoining pavement during the routing operation and/or use of a HAL overheating the crack. Adhesion failure to the pavement is often the result of improper cleaning and drying of cracks and over-heating of the cracks.

7.3 APPLICATION

Problems associated with sealant application are the sealant material becoming brittle due to overheating and/or prolonged heating and overfilling of the crack. Overfilling can result in the sealant being abraded or leading to snow plough damage in the winter. A flush seal or slightly bridged configuration can help reduce the concern that the sealant will be pulled out by snow ploughing operations.

7.4 PAVEMENT AGE

Risk of poor performance of rout and seal increases significantly with pavement age. (Minnesota Department of Transportation Research 2008-54 Recommended Practices for Crack Sealing HMA Pavement).

7.5 TRAINING

For sealants to perform adequately proper installation is required, which requires good workmanship. However, more often than not there is a high turnover of crews on a yearly basis. As a result workmanship suffers. It is also important that supervisors and inspectors have a thorough knowledge of crack treatment steps and procedures. The responsibility for proper training lies with the Municipalities/Jurisdiction and Contractors.
Following is a partial list of items that could impact crack sealing or crack filling unit costs:

- Traffic Accommodation (dependent on roadway/streets classifications and configuration)
- Material
- Method/procedure
- Documentation
- Performance evaluation
- Project size
- Intersections

Unit prices received from contractors ranged from $3.00 per lineal metre (/lm) to $8.00/lm. Individual contractor unit prices on a project by project basis could vary by $1.00 to $2.00/lm depending on job size, intersections and other associated issues that they felt could impact productivity. It was alluded that there could potentially be cost savings due to quantity and reduced mobilization if municipalities worked together to increase the size of projects as well as coordinating the timing of projects. As stated above, coordinating timing has the potential to reduce mobilization costs.

Based on the information in the finite number of questionnaires returned, unit prices ranged from a low of $2.30/lm to a high of $6.00/lm. The common unit cost for hot pour crack sealing, based on limited available information, was in the $3.50 to $4.00 range per lineal metre. Two jurisdictions reported unit costs of $6.00 and $6.40/lm respectively. The $6.00/lm included contractor and in-house unit costs while the unit cost of $6.40/lm was for crack sealing work done in-house.

Of the eleven jurisdictions that returned questionnaires one reported lane km unit costs, another reported km unit costs, two provided budgets for their crack sealing/crack filling program (s) and one left the unit cost question blank. The remainder reported unit costs per lineal metre.
9.0 PERFORMANCE EVALUATION

The Federal Highway Administration (FHWA) FHWA-RD-99-147 Report No FHWA manual of practice provides guidelines that can be used to assist in evaluating the performance of crack treatments. Included in the guidelines is the following table illustrating steps involved and factors for consideration in the crack treatment process.

Table 10-1 Steps in a Crack Treatment Program

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1    | Obtain and review construction and maintenance records.  
• Pavement age, design, repairs, and so on. |
| 2    | Perform pavement/crack survey.  
• Record distress types, amounts, and severities. |
| 3    | Determine appropriate type of maintenance for cracked pavement based on density and condition of cracks.  
• High density of cracks having moderate to no edge deterioration * pavement surface treatment.  
• Moderate density of cracks having moderate to no edge deterioration * crack treatment.  
• Moderate density of cracks having high level of edge deterioration * crack repair. |
| 4    | For crack treatment determine whether cracks should be sealed or filled.  
• Cracks typically showing significant annual horizontal movement * crack sealing.  
• Cracks typically showing very little annual horizontal movement * crack filling. |
| 5    | Select materials and procedures for crack treatment operation based on the following considerations:  
• Climate (dry-freeze, dry-nonfreeze, wet-freeze, wet-nonfreeze)  
• Traffic (high, medium, low)  
• Crack characteristics (width, deterioration).  
• Available equipment  
• Available manpower  
• Cost-effectiveness (anticipated treatment cost and performance) |
| 6    | Acquire materials and equipment. |
| 7    | Conduct and inspect crack treatment operation. |
| 8    | Periodically evaluate treatment performance. |
It is suggested in the FHWA Report No FHWA A-RD-99-147 manual of practice that monitoring the performance of crack treatments is a good practice that can be accomplished relatively quickly with reasonable accuracy.

The FHWA Manual of Practice recommends that a yearly evaluation should be carried out during mid-winter to chart rate of failure and plan for subsequent maintenance. Carrying out the evaluation in mid-winter will, for the most part, show treatment effectiveness during the time when the pavement crack is at its maximum opening.

A representative sample of the pavement, minimum of 150 m length, should be selected for the evaluation of the treatment.

The following are indications of treatment failure:

- Adhesion loss for the full depth of the sealant
- Cohesion loss for the full depth of the sealant
- Pull out of the sealant material
- Spalling
- Secondary cracks
- Potholes (The crack is not completely sealed allowing water to enter, deterioration continues leading to pumping ultimately pothole formation).

FHWA Manual of Practice uses the following equation to provide a good estimate of the percentage of treatment that has failed (percentage of the treatment allowing water infiltration).

\[
\% \text{Fail} = 100 \frac{L_f}{L_t}
\]

Where \( \% \text{Fail} \) = Percentage of treatment length failed.

\[
L_f = \text{Length of treatment failure, m.}
\]

\[
L_t = \text{Total treatment length, m of the evaluation section.}
\]

FHWA Manual of Practice then determines treatment effectiveness by subtracting the percentage of treatment from 100 percent.

\[
\% \text{Eff} = 100 - \% \text{Fail}
\]

Where \( \% \text{Eff} \) = Percentage of treatment length that is effective.

\[
\% \text{Fail} = \text{percentage of treatment length failed.}
\]

After a number of inspections a graph of effectiveness versus time can be developed.
10.0 CONTRACTOR AVAILABILITY

There are contractors within and outside the province that, in the past, have provided hot pour crack sealing services to various jurisdictions in Saskatchewan, including the Ministry of Highways and Infrastructure.
11.0 SASKATCHEWAN CRACK SEALING PRACTICES

Questionnaires were sent to 19 municipalities, responses were received from 9. However, one of the responses provided no data as the individual just started work with the municipality and didn’t have knowledge of what the municipality did.

Performance rating of the crack sealing programs varied from poor to very good. However, no municipality had a formal field evaluation to rate the crack sealing performance.

All those municipalities that responded stated they had a crack sealing program. For the most part crack sealing took place between May and September.

Eight of the nine reported using hot pour sealant. However, the material used by one of the jurisdictions is actually a cold pour material. One municipality used both hot and cold pour while another municipality used only cold pour: Five municipalities stated they routed the crack prior to sealing. Four used compressed air to clean the crack, two used hot compressed air lance and one used compressed air and the hot compressed air lance.

Responses to the in province questionnaire are provided in Table 12-1
## Crack Sealing Practices & Processes Within Saskatchewan

| Municipality        | Does The Municipality Crack Seal? | If Yes, What Months? | Type Sealant Used & Reason | Average Unit Cost | In-House or Contractor | Type/Width of Crack | Method of Prepare/ Clean Cracks | How Many Years been Sealing | Waiting period prior to sealing after surfacing/ resurfacing | How often seal section of roadway | Encountered difficulties resurfacing after crack sealing? | Preventative Maint. Treatments | Does the Municipality Have A Performance Evaluation | Rate Performance of Program | Application Factors Recorded |
|---------------------|----------------------------------|----------------------|---------------------------|-------------------|------------------------|---------------------|-------------------------|-------------------------------|---------------------------------|---------------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|-----------------------------|
| Humboldt           | Yes                              | June, July & Aug.    | Crafco Hot pour - lowest price contractor | $3.50/lm          | Contractor              | Less than 32mm     | Routing & hot compressed air lance | One                           | Varies based on road surface condition/field inspection | Once                            | No                              | Sturdy seal & micro-surfacing   | No                              | Fair                            | Total length of transverse crack sealed | Location                  |
| Moose Jaw           | Yes                              | May & June           | Crafco Hot pour - Cold weather spec. | $2.30/lm          | Contractor              | 2mm - 25mm         | Routing                     | Three                         | One                             | Once                            | No                              | Fires asphalt in raveled areas | No                              | Good                            | Location                     |                             |
| North Battleford   | Yes                              | May & June           | HF 250 S Hot Pour - Experienced with product | $60,000/yr.       | In-House                | Max width           | Compressed air               | Over 40 yrs.                 | When cracks appear             | Collector/ Arterial oncey - High volume Residential | No                              | Micro-surfacing                  | No                              | Fair                        | Location                     |                             |
| Prince Albert      | Yes                              | May                  | Golden Bear cold pour - Works very good | $6,000/yr.        | In-House                | Width 25mm - 50mm    | Compressed air               | Three                         | Three                           | One                             | No                              | Micro-surfacing, fog seal, asphalt rejuvenators | No                              | Poor                            | Date and time, air temp, location, total length of longitudinal and transverse cracks | Location                  |
| Regina              | Yes                              | May, June, Aug., Sept. | Crafco Hot pour - Best product for resiliency | $3.50/lm - 2099 costs | Contractor              | Transverse "working" cracks > 2mm wide | Routing, Hot compressed air lance | Three years of roul and seal | Two - five years               | Once                            | No                              | Micro-surfacing, fog seal, asphalt rejuvenators | No                              | Poor                            | Date and time, location, total length of longitudinal and transverse cracks | Location                  |
| Saskatoon          | Yes                              | May                  | Crafco 522 Hot pour & CFR emulsion - Meet ASTM D6890 CFR apply quickly & inexpensive | $6.00/lm          | Hot pour & Contractor CFR In House | Hot pour - 10mm wide/thermal | CFR Compression air             | Hot Pour                     | Routing & Hot compressed air | Once                            | No                              | Micro-surfacing, sand seal, crack filling, asphalt rejuvenators | No                              | Very good                       | Date and time, location, total length of longitudinal and transverse cracks sealed. |                             |
| RM of Sherwood     | Yes                              | May & June           | Hot pour HF 150P & HF 150S Cold pour HF 250 Dries quickly without blotting. HF 150 proven best on high volume roads. | $3.50/sqm & $413/lane km & $1.96/lm on runways | Contractor & In-House | Transverse, longitudinal, meandering, paving joints. | Routing & compressed air | As required Power Broom | > 30 years                      | Two                             | Yes                              | Slurry seal, chip seal, crack filling, micro-surfacing, sand seal, fog seal & asphalt rejuvenators | No                              | Good                            | Date and time, location, total length of longitudinal and transverse cracks sealed. |                             |
12.0 OUT OF PROVINCE PRACTICES

The questionnaire was sent to ten jurisdictions outside of the province. Three responses were received, all from Alberta.

Of the three, two jurisdictions have crack sealing work done by contractors while the third does the work-in house. Two of the three rout the cracks and clean them by compressed air. The performance rating of their crack sealing programs were good to very good.

Two of the jurisdictions indicated they have a field evaluation for crack sealing performance.

Responses to the out of province questionnaires are provided in Table 13-1.
## Table 13-1 Out of Province Questionnaire

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Does The Municipality Crack Seal?</th>
<th>If Yes, What Months?</th>
<th>Type Sealant Used &amp; Reason</th>
<th>Average Unit Cost</th>
<th>In-House or Contractor</th>
<th>Type/width of Crack</th>
<th>Method of Prepare/ Clean Cracks</th>
<th>How Many Years been Sealing</th>
<th>Waiting period prior to sealing after surfacing/ resurfacing</th>
<th>How often section of roadway</th>
<th>Encountered difficulties resurfacing after crack sealing?</th>
<th>Preventative Maint. Treatments</th>
<th>Does the Municipality Have A Performance Evaluation</th>
<th>Rate Performance of Program</th>
<th>Application Factors Recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airdrie</td>
<td>Yes</td>
<td>June, July, August &amp; September</td>
<td>Hot Pour Sealant - Beram 195L - soft compound</td>
<td>$6.43/lm</td>
<td>In-House</td>
<td>3mm to 25mm</td>
<td>Compressed air &amp; hot compressed air</td>
<td>Two</td>
<td>One year</td>
<td>Other</td>
<td>No</td>
<td>Crack filling</td>
<td>Yes</td>
<td>Very good</td>
<td>Date, location, total length of transverse crack sealed and total length of longitudinal cracks sealed</td>
</tr>
<tr>
<td>Edmonton</td>
<td>Yes</td>
<td>June, July, August, September &amp; October - weather permitting</td>
<td>Hot Pour Sealant - SPI - 6942 - most consistent performance</td>
<td>$3.24/meter</td>
<td>Contractor</td>
<td>Hairline</td>
<td>Routing &amp; hot compressed air &amp; vacuum</td>
<td>Over 30 yrs.</td>
<td>Two years</td>
<td>Once</td>
<td>No</td>
<td>Micro-surfacing</td>
<td>No</td>
<td>Good</td>
<td>Date and time, location, total length of transverse crack sealed and total length of longitudinal cracks sealed</td>
</tr>
<tr>
<td>Red Deer</td>
<td>Yes</td>
<td>June, July, August and September</td>
<td>Hot Pour Sealant - Beram 195 - meets our Spec and it is what our contractor uses</td>
<td>$3.24/meter</td>
<td>Contractor</td>
<td>Hairline</td>
<td>Routing &amp; compressed air</td>
<td>Twenty-five</td>
<td>Two years - approximately seven years after surfacing a roadway &amp; two years after resurfacing</td>
<td>Once</td>
<td>No</td>
<td>Crack filling</td>
<td>Yes</td>
<td>Good</td>
<td>Date and time, location, air temperature, sealant temperature, total length of transverse crack sealed and total length of longitudinal cracks sealed</td>
</tr>
</tbody>
</table>
13.0 OTHER PREVENTIVE MAINTENANCE TREATMENT FOR AC-SURFACED PAVEMENTS

13.1 BENEFITS

The main benefit of seals and rejuvenators is to economically extend the life of an existing pavement by preventing or delaying costly corrective measures. Various seal treatments can be used to possibly address pavement distresses such as raveling and wear, minor rutting, cracking, flushing and polished aggregate. Some seals can be used as an interim to an asphalt mix surface.

NOTE: Not all seal coats address all of the above mentioned distresses.

13.2 FOG SEALS

A fog seal is the application of an asphalt emulsion. Typically the emulsion is diluted up to 50/50 and is sprayed onto the asphalt surface by using an asphalt distributor. The purpose of a fog seal is generally to reduce or delay raveling, water proof an open texture pavement improving the ability to keep water from penetrating the granular structure and subgrade. Fog seals are one of the least expensive seals as generally only a distributor is required to apply a fog seal.

13.3 SAND SEAL

A sand seal consists of an application of an asphalt emulsion followed by an application of clean sand or fine aggregate. For maximum aggregate retention the sand should be applied immediately following the application of the asphalt emulsion. The sand seals have the potential to fill fine cracks in the pavement surface, increase skid resistance, and delay/reduce raveling. A distributor and a sand spreader are required to apply a sand seal. A pneumatic-tire roller is desirable but not required. A mechanical broom should be available to remove excess sand.

13.4 SLURRY SEAL

A slurry seal is a mixture of fine aggregate, asphalt emulsion, and fillers generally based on a mix design. Water is also added for workability. Typically slurry seals are mixed and applied by using a special slurry truck equipped with a pug mill. The slurry seal is applied through a drag box that is towed behind the vehicle that spreads the slurry in a uniform layer. The drag box is equipped with a rubber squeegee strike off.

Common types of slurry seals and usage are as follows:

- Type I - 1/8” minus - Fine aggregate mixtures are used for maximum crack penetration and low traffic areas.
• Type II - ¼” minus - Type II seals are used on moderate to heavy traffic roadways. Type II seals, corrects moderate to severe raveling and improves skid resistance.

• Type III - 3/8” minus – Type III slurry seals are used on heavy traffic roadways and address more severe surface conditions along with providing a wearing surface.

California Pavement Maintenance Co.’s RoadSaver II®

Source: CPM – California Pavement Maintenance Company, Inc.
http://www.cpmamerica.com/roadsaver2.html
copyrights © 2007 California Pavement Maintenance Co, Inc.
13.5 CHIP SEAL

A chip seal is an application of binder in the form of hot asphalt cement, cut back asphalt or emulsified asphalt immediately followed by the application of a graded aggregate. In addition to a distributor and chip spreader a pneumatic tired roller is used to reorient and seal the aggregate particles. A mechanical broom is used to remove the excess aggregate. Chip seals provide a high friction wearing course; help seal small cracks, waterproof old pavement surfaces extending the life of the pavement. Chip seals can also be used to cover base course surfaces. Different surface textures for chip seals can be obtained by using different maximum size aggregates, 3/4 inch (19 mm) or 1/2 inch (12.5 mm) for course texture and 3/8 (9.5 mm) or ¼ inch for (6 mm) finer texture.
13.6 CAPE SEAL

A cape seal is a chip seal followed a few days later by the application of a slurry seal.

A cape seal lasts longer than a chip or slurry seal and is smoother than a chip seal. The treatment produces a surface with virtually no loose aggregate.

13.7 MICROSURFACING

Micro-surfacing is similar to a slurry seal. It is a cold mixed asphalt consisting of binder, graded aggregate, mineral filler (cement, lime, limestone dust, fly ash), additives and water. Mix and set times are influenced by the additives. Micro-surfacing can be used to fill ruts up to 35 mm and correct minor leveling problems as it can be placed in thicker layers than slurry seals. Micro-surfacing can also be used to improve skid resistance and to seal and protect the pavement surface.

13.8 REJUVENATORS

Asphalt rejuvenation is the process of restoring chemical properties of the asphalt binder that have been deteriorating as early as the initial hot plant production. Asphalt rejuvenators are manufactured products having the ability to penetrate into the pavement revitalizing the asphalt binder components that have been lost due to oxidation. Rejuvenators also seal the pavements against air and water slowing oxidation, reducing raveling and extending the life of the pavement.

Asphalt rejuvenators were first introduced in the 1960's.

Potential candidates for rejuvenators or seals are residential streets, urban collector streets and low volume rural roads.

Below is a partial list of products that have been used as rejuvenators.

- Reclamite
- CRF
- Pass-QB
- RejeuvaSeal
14.0 CONCLUSIONS

- Although crack sealing and crack filling have been part of routine maintenance for many years it has only been the last couple decades that the potential benefits of crack sealing as a preventative maintenance activity have been realized.
- Crack sealing is an ineffective pavement maintenance activity for some types of cracks.
- Follow the sealant material manufacturer’s instructions/recommendations
- The general condition of the pavement surface and cracks should be given consideration prior to undertaking any type of maintenance treatment.
- Pavement cracking is a fact of AC pavements.
- Practices that could potentially improve the performance of a crack sealing program are:
  - Pavement Selection
    - Pavements in the 1 to 3 year age range generally in good condition with a relatively smooth ride having low to moderate crack density with little to no edge deterioration. A second seal can be carried out on pavements in the 8 to 10 year age range that are in fair condition.
  - Material Selection
    - It is important that materials specified for crack sealing meet ASTM or AASHTO specifications and are suitable for local climates & conditions.
  - Crack Preparation
    - To enhance performance cracks should be routed with a width/depth greater than or equal to one with a routing width less than 30 mm.
  - Crack Sealant Application
    - Ensure cracks and adjacent AC surface are free of debris and are dry by using compressed air and hot compressed-air lance.
    - Ensure the material manufacturer’s application methods/guidelines are followed.
    - Ensure the material placements configuration is compatible for the roadway classification and maintenance procedures.
o Crack Sealing Equipment
  - Equipment requirements will vary in accordance to the treatment method chosen, specification and project size.
  - Ensure equipment is in proper working order, gauges accurately calibrated and all heating, agitation, pumping systems, values, thermostats are functioning properly and that the equipment has been properly cleaned.

- Know the condition of the pavement prior to sealing, monitor the sealant operation and performance of the crack treatments.
- There are a number of challenges/issues that can impact the performance of crack sealing such as materials, preparation, application, pavement age and training.
- It is important that supervisors and inspectors have a thorough knowledge of crack treatment steps and procedures.
15.0 SUGGESTED NEXT STEPS

- Municipalities monitor crack sealing activities to better establish crack sealing performance, practices and benefits.
- Collaboration among jurisdictions to establish a working group meeting once per year or as required to share information and ideas such as but not limited to their practices/processes, what worked well, what changes if any, they plan to incorporate regarding crack sealing and other preventative maintenance activities. The working group could include jurisdictions inside and outside of Saskatchewan, suppliers and contractors.
- Municipalities work together to determine the benefits, if any, of rejuvenators, microsurfacing and various seals as preventative maintenance treatments.
- Establish a training program ensuring supervisor’s and inspectors have a thorough knowledge of crack treatment steps and procedures.
- Establish policies/practices that specify the type of pavement maintenance to be performed and when to perform it.
- Establish a performance evaluation and monitor the performance of crack treatments.
- Establish practices such as the following to improve the performance of a crack sealing program:
  - Pavement Selection
    - Pavements in the 1 to 3 year age range generally in good condition with a relatively smooth ride having low to moderate crack density with little to no edge deterioration. A second seal can be carried out on pavements in the 8 to 10 year age range that are in fair condition.
  - Material Selection
    - It is important that materials specified for crack sealing meet ASTM or AASHTO specifications and are suitable for local climates & conditions.
  - Crack Preparation
    - To enhance performance cracks should be routed with a width/depth greater than or equal to one with a routing width less than 30 mm.
  - Crack Sealant Application
    - Ensure cracks and adjacent AC surface are free of debris and are dry by using compressed air and hot compressed-air lance.
    - Ensure the material manufacturer’s application methods/guidelines are followed.
- Ensure the material placements configuration is compatible for the roadway classification and maintenance procedures.
  
  - Crack Sealing Equipment
    - Equipment requirements will vary in accordance to the treatment method chosen, specification and project size.
    - Ensure equipment is in proper working order, gauges accurately calibrated and all heating, agitation, pumping systems, values, thermostats are functioning properly and that the equipment has been properly cleaned.

- Develop a pavement preservation check lists such as:
  - Application checklist
  - Quality control checklist
  - Construction inspection checklist
- Develop crack sealing specifications.
16.0 References

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Unified Facilities Criteria (UFC) UFC 3-270-02 – 15 March 2001 – O & M Asphalt Crack Repair

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Yetkin Yildirim, Ahmed Qatan, and Jorge Prozzi, January 2006. Field Manual for Crack Sealing in Asphalt Pavements
Appendix A  Equipment

A.1  MARATHON EQUIPMENT INC
A.2  CRAFCO INC.
A.3  CIMLINE
A.4  SEALMASTER
A.1 MARATHON EQUIPMENT INC
Oil Jacketed Melting Kettles

145, 250 & 400 Gallon Capacity, Diesel or Propane

*SUPPLIED WITH OUR PATENTED OIL HEATED HOSE SYSTEM

Designed for high production crack filling, these diesel powered pump kettles feature our patented heated hose delivery system. This innovative design eliminates hose clogs and the need for hose clean out. Quality built and designed for performance these units also feature a low, anti-splash, reverse loading door.

Features & Benefits

Patented Heated Hose System

- Sealant delivered by a hydraulically driven 2” helical gear pump.
- 23 ft. heated hose and wand assembly.
- Durable heated hose constructed of aircraft grade stainless steel lined with Teflon.
- Oil heated hose system provides fast heating and eliminates the need for costly, failure prone systems.
- Hose support system minimizes operator fatigue, prolongs hose life and promotes safe kettle operation.
- Material is dispensed on demand with a trigger controlled applicator wand.
- Sealant pressure and flow is controlled by a variable bypass control system.

Power & Heating

- Power is provided by a rugged, low maintenance, 17hp or 23hp Lombardini diesel engine with high temperature and low oil pressure safeties.
- A 12 volt continuous ignition diesel burner provides quick heating times and eliminates the need for costly, failure prone control systems.
- A standard 110 volt, 1500 watt electric overnight heater maintains heat to reduce daily startup time.
- A reliable, easy to use Automatic Temperature Controller is conveniently mounted curbside to provide
safe, accurate temperature control with built in out-fire protection.

Agitation

- Precise agitation control is achieved with a hydraulically driven, reversible agitator.
- The reciprocating agitator is designed with safety in mind and will not jam with solid material.
- The floating agitator gently scrapes the walls of the vat to reduce coking on the vat walls and to minimize material heat up time.

Body

- All welded construction using heavy steel panels that exceed the thickness used in competitive equipment.
- The oil jacketed material vat heats up quickly due to its large surface area.
- The lowest profile kettle in the industry provides safe, easy loading of material.
- The low center of gravity provides towing stability with high visibility for maximum operator safety.
- The kettle is well insulated with safety and fuel economy in mind.
- Reverse loading, lockable, anti-splash material door(s) provide safe loading of material.
- Increased corrosion resistance with epoxy primer and standard orange paint finish.

Trailer

- Heavy duty channel iron frame.
- Long lasting all welded construction - not bolted.
- Heavy duty, industrial grade wide tandem axles with leaf springs and electric brakes.
- Adjustable hitch with 3” pintle eye and safety chains.
- Conveniently located heavy duty, top wind jack.
- All necessary stop and directional signal lights.

Options

- Propane fired heating systems.
- 23 hp liquid cooled, diesel engine.
- 80 cfm compressor.
- Power wheel.
- 200,000 BTU hand held torch with 15 ft. hose and a propane bottle holder.
- 10 lb. fire extinguisher with bracket.
- Electric breakaway switch with battery.
- Hydraulic surge brakes.
- Strobe light.
- Customers choice of paint colour.
KERA145HDC shown with optional, removable, 80 cfm air compressor.

KERA260HD features dual material loading doors and is designed with productivity in mind for larger contractors.

Hose boom keeps hose off of ground to improve longevity and reduce operator fatigue.
Precise temperature control is built into our reliable, easy to use Automatic Temperature Control Unit.

Sealant pump service is a breeze with our quick access design. No need to dismantle the kettle to remove the pump.

Easy to read, rear mounted thermometers, accurately monitor oil and sealant temperature.

A sturdy frame mounted guard protects the powerful 17 HP, 2 cylinder diesel engine.

Controls for sealant delivery and variable speed, reversing agitation are centrally located for ease of use.

Achieve fast morning startup with our standard electric overnight heater.
g. Low profile trailer allows safe towing with maximum visibility. All units are built on a heavy-duty tandem axle trailer.

h. Patented heated hose improves productivity and eliminates the need for flushing and bulky heated cabinets.

i. Unique swivel applicator shoe saves labour. Wand mounted trigger accurately controls flow of sealant.

j. Easy access provided to our high output diesel burner. QUick disconnects allow service in seconds.

k. 3/8" grade 70 adjustable safety chains are standard on all models.

l. Full sweep, floating, reciprocating agitation prevents agitator jams caused by unmelted solid materials.
<table>
<thead>
<tr>
<th>Models</th>
<th>KERA145HD</th>
<th>KERA260HD</th>
<th>KERA400HD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipping Weight</td>
<td>3750 lb (1705 kg)</td>
<td>4950 lb (2250 kg)</td>
<td>5650 lb (2568 kg)</td>
</tr>
<tr>
<td>Dimensions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Length</td>
<td>171&quot; (434 cm)</td>
<td>180&quot; (457 cm)</td>
<td>200&quot; (508 cm)</td>
</tr>
<tr>
<td>Overall Width</td>
<td>80&quot; (203 cm)</td>
<td>89&quot; (226 cm)</td>
<td>89&quot; (226 cm)</td>
</tr>
<tr>
<td>Overall Height</td>
<td>78&quot; (198 cm)</td>
<td>82&quot; (208 cm)</td>
<td>82&quot; (208 cm)</td>
</tr>
<tr>
<td>Loading Height</td>
<td>48&quot; (122 cm)</td>
<td>52&quot; (132 cm)</td>
<td>52&quot; (132 cm)</td>
</tr>
<tr>
<td>Capacities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material Vat</td>
<td>145 gal (548 L)</td>
<td>260 gal (983 L)</td>
<td>400 gal. (1512 L)</td>
</tr>
<tr>
<td>Heat Transfer Oil</td>
<td>30 gal (113 L) 4</td>
<td>41 gal (145 L)</td>
<td>56 gal (212 L)</td>
</tr>
<tr>
<td>Diesel Fuel Tank</td>
<td>32 gal (121 L)</td>
<td>32 gal (121 L)</td>
<td>32 gal (121 L)</td>
</tr>
<tr>
<td>Hydraulic Oil Tank</td>
<td>27 gal (102 L)</td>
<td>27 gal (102 L)</td>
<td>27 gal (102 L)</td>
</tr>
<tr>
<td>Engine</td>
<td>17hp liquid cooled, electric start, Lombardini diesel</td>
<td>17hp liquid cooled, electric start, Lombardini diesel</td>
<td>23hp liquid cooled, electric start, Lombardini diesel</td>
</tr>
<tr>
<td>Burner</td>
<td>One 320,000 BTU diesel</td>
<td>One 360,000 BTU diesel</td>
<td>Two 320,000 BTU diesel</td>
</tr>
<tr>
<td>Suspension</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axles</td>
<td>Tandem, drop center</td>
<td>Tandem, drop center</td>
<td>Tandem, drop center</td>
</tr>
<tr>
<td>Capacity</td>
<td>7000 lb (3182 kg)</td>
<td>12000 lb (5454 kg)</td>
<td>12000 lb (5454 kg)</td>
</tr>
<tr>
<td>Tires - size</td>
<td>(4) 225/75R15</td>
<td>(4) 235/85R16</td>
<td>(4) 235/85R16</td>
</tr>
</tbody>
</table>

* All units are also produced with propane heating systems.

Specifications subject to change without notice.
Oil Jacketed Melting Kettles

Gravity Pour Delivery

145. 245 & 400 Gallon Capacity, Diesel

UCMK245DT

These gravity feed units are oil jacketed, diesel fired and diesel powered. They are designed for crack filling and waterproofing. They also offer the convenience and safety of a single fuel source making them efficient and economical to run.

Features & Benefits

- Heavy duty channel iron frame.
- Long lasting all welded construction – not bolted.
- Industrial grade wide track axles with leaf spring suspension and electric brakes.
- Adjustable hitch with 3” pintle eye and safety chains.
- Thick sheet metal panels exceed the standard used in competitive products.
- 2” material dispensing valve.
- Low center of gravity for safe towing, superior rear visibility and ease of operation.
- Automatic temperature control for quick heating, self-igniting diesel burner with built-in out-fire safety protection.
- Reverse loading material lid provides safe, anti-splash loading of material.
- Well insulated material vat and firing chamber provides optimum fuel economy.
- Full sweep, reciprocating, non-jamming agitation is hydraulically driven.
- Easy to read, rear mounted material and oil thermometers.
- Conveniently located heavy duty, adjustable screw type jack.
- Exhaust stack(s) with rain cover.
- All necessary stop and directional signal lights.
- Increased corrosion resistance with epoxy primer and standard blue paint finish.
UCMK245DT

Options

- 200,000 BTU hand held vapour propane torch with 15 ft. hose.
- 110 volt, 1500 watt overnight heater(s) – may require (1) or (2).
- Electric breakaway switch with battery.
- Hydraulic surge brakes.
- 10 lb. fire extinguisher with bracket.
- 3" material dispensing valve.
- Tool box.
- Strobe light.
- Customer's choice of paint colour.

---

<table>
<thead>
<tr>
<th>Models</th>
<th>UCMK145DT</th>
<th>UCMK245DT</th>
<th>UCMK400DT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipping Weight</td>
<td>2950 lb (1341 kg)</td>
<td>3400 lb (1545 kg)</td>
<td>3800 lb (1727 kg)</td>
</tr>
<tr>
<td>Dimensions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Length</td>
<td>148&quot; (375 cm)</td>
<td>172&quot; (437 cm)</td>
<td>182&quot; (462 cm)</td>
</tr>
<tr>
<td>Overall Width</td>
<td>80&quot; (203 cm)</td>
<td>80&quot; (203 cm)</td>
<td>80&quot; (203 cm)</td>
</tr>
<tr>
<td>Overall Height</td>
<td>56&quot; (142 cm)</td>
<td>68&quot; (173 cm)</td>
<td>64&quot; (162 cm)</td>
</tr>
<tr>
<td>Loading Height</td>
<td>48&quot; (121 cm)</td>
<td>52&quot; (132 cm)</td>
<td>56&quot; (142 cm)</td>
</tr>
<tr>
<td>Material Capacity</td>
<td>145 gal (548 L)</td>
<td>245 gal (926 L)</td>
<td>370 gal (1399 L)</td>
</tr>
<tr>
<td>Heat Transfer Oil Capacity</td>
<td>28 gal (106 L)</td>
<td>35 gal (132 L)</td>
<td>55 gal (208L)</td>
</tr>
<tr>
<td>Diesel Fuel Capacity</td>
<td>21 gal (79 L)</td>
<td>21 gal (79 L)</td>
<td>21 gal (79 L)</td>
</tr>
<tr>
<td>Diesel Engine</td>
<td>6hp Kubota</td>
<td>6hp Kubota</td>
<td>6hp Kubota</td>
</tr>
<tr>
<td>Diesel Burner</td>
<td>One 280,000 BTU</td>
<td>One 320,000 BTU</td>
<td>Two 320,000 BTU</td>
</tr>
<tr>
<td>Suspension</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axle(s)</td>
<td>Single, drop center</td>
<td>Tandem</td>
<td>Tandem</td>
</tr>
<tr>
<td>Capacity</td>
<td>7000lb (3182 kg)</td>
<td>12000 lb (5454 kg)</td>
<td>12000 lb (5454 kg)</td>
</tr>
<tr>
<td>Tires - size</td>
<td>(2) 225/75R15</td>
<td>(2) 8&quot; x 14.5&quot; 10 ply</td>
<td>(4) 8&quot; x 14.5&quot; 10 ply</td>
</tr>
</tbody>
</table>

Specifications subject to change without notice.

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MarathonEquipmentInc.com
Oil Jacketed Melting Kettles

Gravity Pour Delivery

145. 245 & 400 Gallon Capacity, Propane

UCMK145T

These oil jacketed gravity fed kettles are designed for crack filling and waterproofing. The heat transfer system consists of the oil vat and the oil expansion reservoir. As the transfer fluid is heated, the material is provided with an indirect heating source.

Features & Benefits

- Heavy duty channel iron frame.
- Long lasting all welded construction – not bolted.
- Industrial grade wide track axle(s) with leaf spring suspension and electric brakes.
- Adjustable hitch with 3" pintle eye and safety chains.
- Thick sheet metal panels exceed the standard used in competitive products.
- 2" material dispensing valve.
- Low center of gravity for safe towing, superior rear visibility and ease of operation.
- Reverse loading material lid provides safe, anti-splash loading of material into kettle.
- Well insulated material vat and firing chamber provides optimum fuel economy.
- Full sweep, reciprocating, non-jamming agitation is mechanically driven.
- Easy to read, rear mounted material and oil thermometers.
- Conveniently located heavy duty, adjustable screw type jack.
- Exhaust stack(s) with rain cover.
- 100 lb. propane bottle holder comes complete with hold down straps.
- All necessary stop and directional signal lights.
- Increased corrosion resistance with epoxy primer and standard blue paint finish.
### UCMK145T

- **Options**
  - Automatic temperature control.
  - 200,000 BTU hand held vapour propane torch with 15 ft. hose.
  - 110 volt, 1500 watt overnight heater(s) – may require (1) or (2).
  - Electric breakaway switch with battery.
  - Hydraulic surge brakes.
  - 5 lb. or 10 lb. fire extinguisher with bracket.
  - 3” material dispensing valve.
  - Tool box.
  - Strobe light.
  - Customers choice of paint colour.

### Specifications

<table>
<thead>
<tr>
<th>Models</th>
<th>UCMK145T</th>
<th>UCMK245T</th>
<th>UCMK400T</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shipping Weight</strong></td>
<td>2150 lb (977 kg)</td>
<td>2500 lb (1136 kg)</td>
<td>3300 lb (1500 kg)</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Length</td>
<td>148” (376 cm)</td>
<td>162” (411 cm)</td>
<td>164” (416 cm)</td>
</tr>
<tr>
<td>Overall Width</td>
<td>80” (203 cm)</td>
<td>80” (203 cm)</td>
<td>80” (203 cm)</td>
</tr>
<tr>
<td>Overall Height</td>
<td>56” (142 cm)</td>
<td>66” (167 cm)</td>
<td>66” (167 cm)</td>
</tr>
<tr>
<td>Loading Height</td>
<td>47” (119 cm)</td>
<td>52” (132 cm)</td>
<td>54” (137 cm)</td>
</tr>
<tr>
<td><strong>Material Capacity</strong></td>
<td>145 gal (548 L)</td>
<td>245 gal (926 L)</td>
<td>370 gal (1399 L)</td>
</tr>
<tr>
<td><strong>Heat Transfer Oil Capacity</strong></td>
<td>28 gal (106 L)</td>
<td>35 gal (132 L)</td>
<td>55 gal (208L)</td>
</tr>
<tr>
<td><strong>Engine</strong></td>
<td>5.5hp Honda</td>
<td>5.5hp Honda</td>
<td>5.5hp Honda</td>
</tr>
<tr>
<td><strong>Propane Burner</strong></td>
<td>One 410,000 BTU with out-fire protection.</td>
<td>One 410,000 BTU with out-fire protection.</td>
<td>Two 410,000 BTU with out-fire protection.</td>
</tr>
</tbody>
</table>

- **Suspension**
  - Axle(s): Single, drop center
  - Capacity: 3500 lb (1591 kg) x 6
  - Tires - size: (2) 225/75R15

- **Engine**
  - Honda: 5.5hp

### Additional Information

*Specifications subject to change without notice.*
Oil Jacketed Melting Kettles

Gravity Pour Delivery

65 Gallon Capacity, Propane

UCMK65T

This kettle has been designed for smaller jobs and elevator accessibility. The kettle is made up of a material vat situated within an outer vat containing heat transfer fluid. The heat transfer fluid is heated via a fire chamber, providing indirect heating to the material while constantly being agitated.

Features & Benefits

- Heavy duty channel iron frame.
- Long lasting all welded construction – not bolted.
- Industrial grade axle(s) with leaf spring suspension and electric brakes.
- Adjustable hitch with 3” pintle eye and safety chains.
- Thick sheet metal panels exceed the standard used in competitive products.
- 2” material dispensing valve.
- Low center of gravity for safe towing, superior rear visibility and ease of operation.
- Reverse loading material lid provides safe, anti-splash loading of material into kettle.
- Well insulated material vat and firing chamber provides optimum fuel economy.
- Full sweep, reciprocating, non-jamming agitation is mechanically driven.
- Easy to read, rear mounted material and oil thermometers.
- Conveniently located heavy duty, adjustable screw type jack.
- Exhaust stack(s) with rain cover.
- 100 lb. propane bottle holder comes complete with hold down straps.
- All necessary stop and directional signal lights.
- Increased corrosion resistance with epoxy primer and standard blue paint finish.
Options

- Automatic temperature control.
- 200,000 BTU hand held vapour propane torch with 15 ft. hose.
- Electric breakaway switch with battery.
- Hydraulic surge brakes.
- 5 lb. or 10 lb. fire extinguisher with bracket.
- 3" material dispensing valve.
- Tool box.
- Strobe light.
- UCMK65 skid mounted with four 8" diameter caster wheels.
- Customer's choice of paint colour.

<table>
<thead>
<tr>
<th>Models</th>
<th>UCMK65S</th>
<th>UCMK65T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipping Weight</td>
<td>1350 lb (614 kg)</td>
<td>1950 lb (841 kg)</td>
</tr>
<tr>
<td>Dimensions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Length</td>
<td>62&quot; (157 cm)</td>
<td>116&quot; (294 cm)</td>
</tr>
<tr>
<td>Overall Width</td>
<td>35&quot; (89 cm)</td>
<td>71&quot; (180 cm)</td>
</tr>
<tr>
<td>Overall Height</td>
<td>50&quot; (127 cm)</td>
<td>60&quot; (152 cm)</td>
</tr>
<tr>
<td>Loading Height</td>
<td>38&quot; (96 cm)</td>
<td>49&quot; (124 cm)</td>
</tr>
<tr>
<td>Material Capacity</td>
<td>65 gal (246 L)</td>
<td>65 gal (246 L)</td>
</tr>
<tr>
<td>Heat Transfer Oil Capacity</td>
<td>16 gal (59 L)</td>
<td>16 gal (59 L)</td>
</tr>
<tr>
<td>Engine</td>
<td>3hp Honda</td>
<td>3hp Honda</td>
</tr>
<tr>
<td>Propane Burner</td>
<td>One 300,000 BTU with out-fire protection.</td>
<td>One 300,000 BTU with out-fire protection.</td>
</tr>
<tr>
<td>Suspension Axle(s)</td>
<td>N/A</td>
<td>Single, drop center</td>
</tr>
<tr>
<td>Capacity</td>
<td>N/A</td>
<td>3500 lb (1591 kg)</td>
</tr>
<tr>
<td>Tires - size</td>
<td>N/A</td>
<td>(2) 225/75R15</td>
</tr>
</tbody>
</table>

Specifications subject to change without notice.
Oil Jacketed Melting Kettles

Gravity Pour Delivery

10 Gallon Propane Walk-Behind

KERA10

This oil jacketed melting kettle is designed for quick heating and dispensing of rubberized crack filler and is well suited for use by smaller asphalt contractors and electrical contractors.

Features & Benefits

- A low cost melting kettle that has many of the features of our larger oil jacketed melters.
- Ideal size and design for small asphalt and electrical contractors.
- Automatic temperature control safely controls heating of the heat transfer oil.
- Single 53,000 BTU vapour propane safety burner with out-fire protection.
- Fast heating of material with a full wrap around oil jacket.
- Single 200,000 BTU hand held propane torch.
- Manual full sweep agitation speeds up melting while minimizing overheating of material.
- Oil and material temperature thermometers.
- Large diameter rear wheels and swivel front caster improve maneuverability.
- Hinged cover for easy material loading and improved heat retention.
- Precise material flow achieved with a 3/4” bronze valve with controls at the handle bar.

Specifications

- Weight 195 lb.
- Overall dimensions: 60"L x 24"W x 38"H
- Convenient loading height 25"
- 10 gallon material capacity
- 3 1/2 gallon heat transfer oil capacity

Options

- 3” wide spring loaded squeegee

Specifications subject to change without notice
Direct Fired Melting Kettles

Wheeled Applicators

10 Gallon Direct-Fired Melter/Applicator
Everything you need to do quality crack sealing but the sealant and propane bottle. The fastest and most efficient method for the application of hot applied crack sealants. Propane fired burner with hose and regulator. Capable of melting and applying material. The 10 gallon melter/applicator is mounted on steel wheels and is equipped with spring loaded hand control release valve, hand agitator, temperature gauge and steel shoe for striking off sealant in a uniform width.

Dimensions: 47"Lx27"Wx36"H
Weight: 125 lb.

8 Gallon Heated DQ Bander
This push style wheeled bander is designed with a heat jacket to maintain the material temperature. 13 1/2" diameter steel wheels easily follow meandering cracks. Equipped with a spring loaded hand control release valve and a steel strike off shoe to provide a uniform band width.

Specifications subject to change without notice
10 Gallon Melter
This propane fired melter is equipped with a hand agitator, temperature gauge, propane burner, hose and regulator, bottle holder, hinged lid, lifting handles and draw-off valve.

Dimensions: 40"Lx29"Wx33"H
Weight: 102 lb.

Specifications subject to change without notice
Direct Fired Melting Kettles

Wheeled Applicators

10 Gallon Direct-Fired Melter/Applicator
Everything you need to do quality crack sealing but the sealant and propane bottle. The fastest and most efficient method for the application of hot applied crack sealants. Propane fired burner with hose and regulator. Capable of melting and applying material. The 10 gallon melter/applicator is mounted on steel wheels and is equipped with spring loaded hand control release valve, hand agitator, temperature gauge and steel shoe for striking off sealant in a uniform width.

Dimensions: 47"Lx27"Wx36"H
Weight: 125 lb.

8 Gallon Heated DQ Bander
This push style wheeled bander is designed with a heat jacket to maintain the material temperature. 13 1/2" diameter steel wheels easily follow meandering cracks. Equipped with a spring loaded hand control release valve and a steel strike off shoe to provide a uniform band width.

Specifications subject to change without notice
Applicators / Pots

4 Gallon Wheeled Pour Pot
This pull style wheeled pour pot eliminates back strain. Provides a material band width of 3" and has an adjustable depth screed.

3 1/2 Gallon Pouring Cone
An easy and convenient way to apply hot rubber to random cracks or joints. Allows crew to get into tight places and close to curbs. Fill the cone, lift the plunger and follow the cracks. Available with 1" or 3/4" spout.
Weight: 12 lb.

Specifications subject to change without notice
Hot Air Lance

Specifications

Torch Length: 47 1/2"
Torch Weight: 10.7 lb
Air Outlet Temperature: 2500°F
BTU Rating: 120,000 BTU/hr
Propane Supply: 20 psi (Use min. 100 lb. - vapor withdrawal tank)
Propane Hose: 3/8" x 40 ft. hose with propane regulator
Propane Consumption: 5.57 lb/hr @ 20 psi
Compressed Air Consumption: 80 CFM @ 100 psi
Air Hose: 5/8" x 40 ft. hose with compressor fittings
Torch: All stainless steel construction with igniter button, air valve, propane valve, deflector assembly and adjustable shoulder strap.
Options: Stainless steel wheel kit

Specifications subject to change without notice.
Crack Routers

Pavement Router

CR250K

The Marathon Pavement Crack Router offers a more productive method of routing random cracks in asphalt or concrete. The balanced weight distribution, in-line wheels and cutter head, plus extended handle, effectively reduces operator fatigue and allows for smoother, more accurate maneuverability.

Features & Benefits

- Best balanced router design on the market.
- Sturdy all welded chassis manufactured from 1/4" thick steel plate reduces vibration and operator fatigue.
- Powerful and reliable KOHLER V-twin engines.
- Three-stage air filtration system for optimum performance and maximum engine protection.
- Convenient electric start, 12 volt battery and charging system.
- Corrosion proof, durable polypropylene fuel tank.
- Triple banded V belt coupled to optimum sized pulleys provide the perfect router head speed to maximize productivity while extending cutter life.
- Premium wheel assemblies are provided with tapered roller bearings on 1 1/4" axles for greater durability and ease of operation.
- 12" diameter cutter head fabricated from 1" steel plate.
- Routing is performed by six of our patented carbide tipped router blades strategically positioned on the router head.
- Routing widths up to 2".
- Easy access to the router head allows for quick blade changes.
- Handlebar mounted, fingertip operated, linear actuator switch adjusts the cutting depth to a maximum of 1 3/4".
- Indicator plate is provided for cutting depth guidance.
- Engine safety kill switch is conveniently located on the handle control panel.
- Adjustable handles provide a comfortable working position for a variety of different operator heights.
- Large 16" diameter treadsed tires provide low rolling resistance and excellent machine control.
- Safety chain guards and rubber flaps provide protection from flying debris.
- Safe loading and unloading is accomplished with the balanced lifting eye.
- Standard paint colour is orange.

Options

- Weight package.
- Safety control lever.
- Routers can be customized to customer specifications.
Easy access for blade replacement

Carbide Tipped Router Blades

Marathon’s patented carbide tipped router blades have been proven to outlast ordinary hardened alloy steel cutters and provide a more accurate and consistent cutting depth over a prolonged period of time.

(suitable for use with all existing makes of routers)

*Patented in Canada & U.S.A.

<table>
<thead>
<tr>
<th>Models</th>
<th>CR200K</th>
<th>CR250K</th>
<th>CR250KL</th>
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<tbody>
<tr>
<td>Approx. Weight</td>
<td>510 lb (232 kg)</td>
<td>575 lb (261 kg)</td>
<td>575 lb (261 kg)</td>
</tr>
<tr>
<td>Engine</td>
<td>20hp Kohler</td>
<td>25hp Kohler</td>
<td>25hp Kohler, liquid cooled</td>
</tr>
<tr>
<td>Premium Air Filtering System</td>
<td>Standard</td>
<td>Standard</td>
<td>Standard</td>
</tr>
</tbody>
</table>

Specifications subject to change without notice.
Crack Routers

Random Concrete

RCR25

Marathon has engineered a concrete router to effectively rout meandering cracks in concrete prior to sealing. An electric start 25hp Kohler engine powers this rugged machine through the most demanding conditions. Long life diamond blades cleanly rout cracks, eliminate spalls and reduce costly blade change time. An electric actuator maintains accurate, consistent depth of cut.

Features & Benefits

- Best balanced router design on the market.
- Specialized design allows operator to effectively rout cracks in concrete.
- Sturdy all welded chassis manufactured from 1/4" thick steel plate reduces vibration and operator fatigue.
- Powerful and reliable KOHLER V-twin engine.
- Three-stage air filtration system for optimum performance and maximum engine protection.
- Convenient electric start, 12 volt battery and charging system.
- Corrosion proof, durable polypropylene fuel tank.
- Easily accessible blade guard for fast blade changes.
- Handlebar mounted, fingertip operated, linear actuator switch adjusts the cutting depth.
- Engine safety kill switch is conveniently located on the handle control panel.
- Indicator plate is provided for cutting depth guidance.
- Adjustable handles provide a comfortable working position for a variety of different operator heights.
- Water attachment reduces dust and extends blade life.
- Premium wheel assemblies are provided with tapered roller bearings on 1 1/4" axles for greater durability and ease of operation.
- Large 16" diameter treded tires provide low rolling resistance and excellent machine control.
- Safe loading and unloading is accomplished with the balanced lifting eye.
- Standard paint colour is orange.
### Electric Linear Actuator and Depth Gauge.

**8” diamond blades**
- available for concrete and asphalt cutting.

### Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>RCR25</td>
</tr>
<tr>
<td>Approx. Weight</td>
<td>525 lb (239 kg)</td>
</tr>
<tr>
<td>Engine</td>
<td>25hp Kohler</td>
</tr>
<tr>
<td>Premium Air Filtering System</td>
<td>Standard</td>
</tr>
<tr>
<td>Blade</td>
<td>8” (20 cm) diameter x 1/2” (1.2cm) wide. High concentration diamond blade specially formulated for dry cutting. Other sizes also available. Up to 3/4” wide.</td>
</tr>
</tbody>
</table>

*Specifications subject to change without notice.*
A.2 CRAFCO INC.
Melter/Applicators, Routers, Patchers, SealCoaters, Adhesive Applicators & Storage Tanks

Crafco provides our customers with the most comprehensive line of Pavement Preservation Products available. Crafco's engineering and understanding of the industry sets the industry standards with quality performance products. Crafco Pavement Preservation Products are efficient, long lasting and cost effective.

SuperShot Melters | EZ Pour Melter | EZ Series II Melters | Patcher II | Spray Injection Patcher Router | Box 250 | Super Sealcoater | Mini Melters | Emulsion Tanks

**Super Shot Melter/Applicators** - Ultimate in efficiency and ease of use. Digital controls accurately regulate the heating temperature of the sealant and transfer oil. A patented internal pumping system eliminates clean out and features a hydraulic flow rate adjustment. There are no valves, no hose pressure build up and fewer moving parts. Super Shot melters will out-perform any comparable sized machine available. One-year warranty, more options and greater safety.

**E-Z Pour 50 Melter/Applicator** - Featuring one-hour heat-up time, handles field mix or packaged material and heats and applies all hot pour sealants. Precision engineering and construction make it trouble-free and safe to operate with the lowest operating cost in the industry. Safety features include a splash-proof lid, curb side controls and a low profile for easy sealant loading. The E-Z Pour is a flush-free clean-up system requiring no solvents.

**E-Z Series II Melter/Applicators** - The EZ Series II internal heat tower and heat jacket fins provide the highest heat efficiency ratio and the fastest heat up time of any machine on the market. The EZ Series II also comes equipped with electronic controls and modular design features making it the highest efficiency machine available. Automatic electronic controls add to the usability of the Series II.

The EZ Series II offers heated or unheated applicator hose options, the largest commercial air compressor as well as such labor saving options as the auto loader and integrated engine gauges. The heat jacket fins and the heat tower coupled with the best insulation provide a fast heat-up and recovery time.

A two inch rugged sealant pump coupled with true on demand pumping give the Series II the ability to apply hot pour, fiber and coal tar sealants quickly and efficiently.

**Patcher** - The Patcher II has two large openings for easy material loading. Advanced digital temperature controls maintain accurate material and oil temperatures and feature an auto flame shut down for safety. The products are thoroughly mixed by a horizontally mounted internal shaft with sweep paddles. To clean the Patcher for material type changeover, load the Patcher with clean aggregate, run the mixer and then empty. The Crafco Patcher Series Melter is also available as a smaller capacity model the Patcher I. The Patcher I's large volume easily handles large production projects. The Patcher I is designed for smaller patching tasks. The Patchers are designed to efficiently melt TechCrete and PolyPatch products.
Spray Injection Patchers - Spray injection patching is the most cost effective method for distressed pavement repair. Ideal for potholes, deteriorated shoulders, utility cuts, fissures, and skin patching. Crafo Spray Injection Patchers clean, tack coated, and filled pavement distresses in minutes with one operator in one continuous operation.

LITERATURE
NEW ROUTER 25

VIDEO
No Sound

VIDEO
"Why Rout?"

BAX 250 Flexible Marker Adhesive Applicator - The BAX 250 will heat 250 pounds of adhesive per hour and applies 20 "shots" per minute for a high application rate. The BAX comes skid mounted and equipped with a 10 foot heated hose and a 24" wand, providing maneuverability and efficient production. Optional hose and wands are available as well as 60 gallon unit.

ADDITIONAL
BAX 250 INFORMATION
LITERATURE

The Crafo Super SEALCOATER standard features are considered options on all other competitive seal coat machines. Quality parts and superior construction make the Super SEALCOATER the machine of choice for everyday rigorous use. Features such as the unbreakable steel tank and the oversize hydraulic system set this unit apart from all the others. Built with Crafo quality and engineered to last, choose the Super SEALCOATER for your next seal coat machine.

ADDITIONAL
SEALCOATER INFORMATION

VIDEO
No Sound

The Mini 30 is an air jacketed, hand agitated 30 gallon capacity unit that can be used in conjunction with the Mini 10 or the Crafo Pour Pot with Wheels.

ADDITIONAL
MINI INFORMATION
VIDEO
No Sound

The Mini 10 is a hand agitated, 10
Crafco Emulsion Storage Tanks conveniently store emulsions on site for immediate use at truck load prices. They are available in 2, 3, 4, 5, 6, 8, and 10 thousand gallon sizes. The Emulsion tank has 3" insulation with a 10-gauge steel secondary containment shell featuring an electric top-mount mixer. Options include an electric timer, mechanical float gauge, and an access ladder with cage.

The Heat Lance is used to dry and prepare pavement cracks, potholes and distressed pavement surfaces for repair. Featuring separate valves which control the mixture of fuel and compressed air at the point of combustion.
GENERAL
The purpose of these specifications is to describe a double-boiler type melter applicator that is specifically designed for and shall be capable of heating and applying all grades of asphalt rubber sealant, fiber modified asphalt sealant and specification joint sealant without further equipment modification. It may be used for the application of resinous, colored sealant and fillers. This unit shall be the manufacturer’s current production model manufactured in the United States of America. The machine shall be capable of starting at ambient temperature and bringing the sealant material up to application temperature in one hour or less. All qualified bidders must have and maintain a complete inventory of repair parts and have experienced factory-trained service personnel for this equipment. A comprehensive safety manual and an operational/maintenance CD shall be supplied with each unit. A factory-trained person shall be made available for initial start-up and training in the operation of the melter. The material should be heated in a kettle or melter constructed as a double boiler, with space between the inner and outer shells filled with oil or other heat-transfer medium. Thermostatic control for the heat-transfer medium shall be provided and shall have sufficient sensitivity to maintain sealant temperature within the manufacturer’s specified application temperature range. Temperature indicating devices shall have intervals no greater than 5°F (2.8°C) and shall be calibrated as required to assure accuracy. The melter shall have continuous sealant agitation and a mixing system to provide uniform viscosity and temperature of material being applied. Do not attempt to apply 2-component products with this unit.

REQUIRED SAFETY FEATURES
The unit shall have a safety shut-off feature on the lid that automatically stops the agitator when the lid is opened.

TOWING FRAME AND JACK
This unit shall be trailer mounted. The longitudinal side frames and tongue members of the trailer shall be on one continuous piece construction composed of hot rolled steel channel having the minimum dimensions of 5 inches (12.7 cm) web, 325 inch (825 cm) thickness with 1.885 inch (4.78 cm) flanges. The configuration of the channels shall be cold formed with the flanges on the outside resulting in a one-piece frame member with no cross welding of or on the flanges to avoid any possibility of flange stress cracking. The tongue shall be equipped with an appropriate heavy duty ball or pintle hitch and shall be adjustable in height above ground level from a minimum of 14 inches (35.6 cm), to a maximum of 32 inches (81.3 cm), permitting practical level towing with a wide range of towing vehicles. The towing hitch shall be bolted to the hitch plate for easy height adjustment and/or conversion to other type hitches. A screw-post tongue jack shall be furnished. It shall be a heavy duty type with a load capacity of 7,000 pounds (3,175 kg) and it shall be side mounted and swing away for positive road clearance while under tow.

RUNNING GEAR
The unit shall be equipped with dual independent rubber torsional suspension each having a safe load capacity of 6,000 pounds (2,721 kg), electric brakes, modular wheels and ST235/80 R16 tires (Load Range E). This suspension eliminates springs and shock absorbers. The tires reduce the risk of rolling and reduce ground clearance. The melter shall have dual taillights, stop lights and turn signals. Lights shall be ICC approved. A license plate holder shall be attached to the side of the melter. All melter fluid tank shall be positioned no lower than the deck level, mounted on top of the channel frame members to assure proper ground clearance. The unit shall also be equipped with two safety chains not less than 48 inches (121.9 cm) of 3/8 inch (9.7 cm) coil proof chain, attached to the tongue with a drilled type clevis pin on the end attached to the frame and screw type clevis pin on the opposite end. Total shipping weight is approximately 6,700 pounds (3,039 kg). Gross Vehicle weight shall be 12,168 pounds (5,519 kg).

HEATING TANK
The heating tank shall be a minimum of 64.25 inches (163.19 cm) diameter by 28.75 inches (73.03 cm) deep having a minimum capacity of 396 gallons (1500 l) at ambient temperature. The tank will have a rear discharge from the pump and rear plug outlet. A double boiler type jacket with internal oil column shall create a reservoir that shall hold a minimum of 43.0 gallons (162.72 l) of heat transfer oil at 70°F (21°C). (Note: at 500°F (260°C) the heating oil will expand approximately 18%). The jacket shall wrap around 100% of the outside area of the circular material tank and bottom and allow for complete circulation of the heated transfer oil. The heat transfer oil tank design shall provide a center tower of a minimum 18 inches (45.7 cm) in height to provide efficient melting and uniform product heating. At no point in the tank shall there be a distance of greater than 27.8 inches (70.6 cm) from a heat surface. The tank and jacket shall be made of not less than 3/16 inch (4.8 cm) rolled steel. There shall be one plug to allow the entire heat transfer oil system to be drained. The heat transfer oil shall be of ISO grade 68. The efficiency rating shall be a minimum of 95% as determined by the ratio of the material tank surface area to the HTO tank surface area. Units with an efficiency ratio of less than 95% are unacceptable.

EXPANSION TANK
A sealed expansion tank for heat transfer oil shall be provided to minimize oil oxidation and prevent moisture condensation into the heat transfer oil. Overflow down tubes are unacceptable.

HYDRAULIC SYSTEM
The hydraulic system shall incorporate a single hydraulic pump to power the agitation and pumping system. All valves shall be solenoid operated by toggle switch. The controls will allow for bi-directional operation of the sealant pump. A flow control valve will be mounted on the rear of the unit to allow the operator to adjust the pump operational speed. All controls shall be mounted at the rear on the trailer for easy access by the operator. Hydraulic controls located at the side or forward portion of the trailer are unacceptable. The minimum 24 gallon (90.8 l) hydraulic tank will be equipped with an internal 10-micron full flow filter. The filter shall be equipped with a restriction indicator to indicate the need for service. A sight gauge level indicator equipped with a thermometer to measure oil temperature will be mounted on the tank and located where it is easily viewed.
INSULATION
The heating tank shall be insulated with a minimum of 1 1/2 inch (3.81 cm) thick high temperature ceramic insulation and covered by a 22-gauge (.07cm) steel outer wrapper. Fiberglass and rock wool insulation are unacceptable due to their moisture retention properties resulting in a significant loss of their insulating value over an eighteen-month period.

LOADING HATCH
Two low profile angled lid openings for loading shall be required at the top of the material tank and shall be located on the curbside of the machine for operator safety. The loading height shall be a minimum of 56 inches (142.24 cm) for operator safety. Loading heights below 50 inches may expose the operator to splash hazards and flame exposure when loading and are unacceptable. One loading door will allow the operation of the equipment, including sealant loading, from curbside even when equipped with a conveyor loading system. Loading systems that require the operator to step onto the melter are unacceptable. The passenger side opening shall have a minimum area of 384 sq. in. (2,477.4 sq. cm) approximately 16 inches (40.6 cm) by 24 inches (60.9 cm). The drivers side opening shall have a minimum area of 252 square inches (1,625 square cm), approximately 14 inches (35.56 cm) by 18 inches (45.72 cm) and shall be hinged to allow placement of a block of sealant onto lid and closure of lid for easy, anti-splash loading. Each door will have an insulated handle for opening and closing while the unit is hot. The drivers side loading hatch shall be easily adaptable for the addition of a retrofit power loading conveyor with anti-splash tower.

HEATING SYSTEM
The heat transfer oil is heated by one 12-volt 420,000 BTU high efficiency forced air diesel fired burner directly at the bottom of the heat transfer oil tank. The burner shall fire into an easy access removable burner combustion chamber box. The box will be insulated by a high temperature flexible insulation that is resistant to damage from vibration and over the road travel. Rigid insulation is unacceptable. The total area of the heat transfer oil tank exposed to the burner shall be a minimum of 9,921 square inches (64,000 sq cm). The material tank shall have a minimum of 9,448 square inches (60,954 sq cm) of contact with the heat transfer oil. This provides for a melt rate of 2,800 pounds (1,270 kg) per hour.

IGNITION OF BURNER
The burner shall be lit by a constant duty high voltage transformer powering an electric spark ignitor. This ignitor shall work in conjunction with a sensor that detects a lack of burn or ignition and shuts down the fuel supply. The thermostat control is located on the rear curbside of the machine and shall have a toggle switch shut off for operator safety.

INTEGRATED CONTROL SYSTEM
The melter applicator shall have electronic thermostat controls that will automatically regulate hot oil, material and pumping temperature. The control shall have digital readouts for temperatures of hot oil, material, and pumping temperatures. The controls shall operate at temperature ranges needed for proper application of sealant. The controls shall be activated by a single power switch, which will then turn on the agitator at the proper temperature without any action by the operator and allow the operator to turn on the pump with a toggle switch. The interlock for the agitation system will not allow the agitator to be activated until the material temperature reaches 275° and the interlock for the pumping system will not allow the pump to be activated until the material temperature reaches 275°. All temperature controls shall be contained in a weatherproof control box located at the rear passenger side of the machine for operator safety. The control box shall also contain the engine ignition controls, hour meter and any engine gauges. Any operational controls located at the side or forward portion of the trailer are unacceptable.

DRIVE AND DRIVE CONTROLS
The motive force to the agitator and material pump shall be hydraulic motors driven by a single hydraulic pump. The drive controls governing the rotational speed of the material pump shall be controlled by a adjustable hydraulic valves. The drive controls governing the speed of the material pump shall be controlled from the rear of the machine. The material pump will have infinite speed control and is electrically actuated by a toggle switch in the control boxes. The material pump can be reversed by a toggle switch on the control panel as required.

AGITATION
The sealant material shall be mixed by a hydraulically driven, full sweep vertical agitator with two opposing horizontal paddles and vertical risers attached to the ends shall mix the sealant at an ASTM specified tip speed of 250 ft/min. Variable speed agitation is Unacceptable. The surface area of the agitator paddles shall be a minimum of 613 sq. in. (3955 cm). Surface areas of less than 600 sq. in. (3871 cm) are unacceptable. The distance between the wall and the edge of the paddles shall never exceed three inches. This feature ensures that material remains in complete suspension and that the hot material stays in the lower area of the tank and does not get splashed or thrown to the upper areas of the tank. Units that do not comply are unacceptable. The agitation system shall be direct driven from the hydraulic motor to the agitator. The agitator rotates in both directions. For additional safety the agitator will shut off automatically when the loading hatch is opened.

BI-DIRECTIONAL VARIABLE SPEED PUMPING UNIT
The material pumping unit shall be two 2 inch (5.1 cm) positive displacement helical gear pump rated at 20 GPM. The pump shall be hot oil jacketed for fast heating and piped in series with the heat transfer oil circulation pump. All piping and material valves are heated by an enclosed insulated heating chamber. Heat flow to this chamber is controlled with a single slide gate that will separate this chamber from the tank air jacket. The insulated chamber shall have a removable rear panel for easy access to the pump. The heating chamber shall have an insulated door hinged and notched for sealant hose access. The heating chamber shall provide storage for a sealant hose. Pumping of material is controlled by a toggle switch located in the control box. Controls for opening and closing the recirculation valves, application valves, and main tank valves shall be located outside the heating chamber at the rear of the machine for operator convenience. The pump shall be capable of delivering sealant at a rate that exceeds the melt rate of the machine.

HOSE HEATING CHAMBER
The machine, heating chamber, and wand shall be so designed and constructed that under normal day-to-day operations no clean out procedure is required, thereby eliminating the use of hazardous, volatile cleaning solvents and the associated conformity to EPA standards for their disposal. Hose heating chamber shall be equipped with a temperature gauge to insure proper regulation of temperature to hose and application wand while in heating chamber. An adjustable damper will be furnished over the flare vent for the heating chamber. Incorporated in the heating chamber are hose and applicator wand storage racks with drains in the floor. Doors and sidewalks are to be 100% insulated. Hinged doors should be lockable and designed to overlap and interconnect. Provision shall be made for operation of applicator hose while doors are closed to insure continuous heating of piping extraneous to the material tank.
SEALANT HOSE AND APPLICATOR WAND
Unit shall have a non-heated hose and wand applicator. The hoses shall be specifically manufactured for handling liquid asphalt products up to 400°F (204.4°C) at 350 psi (24.13 bar) working pressure. Hose and wand shall not be less than 19 feet (5.8 m) in length. The hose and wand shall have a working radius of 16 feet 6 inches from the center of the machine. For maximum operator safety it shall be made of 1” inch (2.54cm) inside diameter insulated, rubber coated, steel braid reinforced and neoprene lined. A digital readout displays the temperature of material being pumped through the hose. The hand wand shall be constructed of steel with sufficient strength to withstand normal day-to-day operation. Material flow is controlled by a ball valve and recirculation valve. For greater operator mobility, the connection between the wand and hose shall be through a 360° swivel.

The hose is supported by a 7ft 2in. boom (2.18 m), which swivels side to side on dual pillow block bearings. The hose carriage at the end of the boom shall pivot and have 7ft (2.13m) of horizontal linear movement on a roller bearing wheels for further operator comfort. There shall be a minimum of 6ft. 6in. clearance under the booms. Fixed carriage hose booms are unacceptable as they do not allow for easy maneuverability.

ENGINE
The unit shall be equipped with a diesel engine complying with the following specifications:
- Electric Start
- Three Cylinder 25.4 HP (18.84 kw) at 3200 RPM Continuous
- 3.14" (79.7 mm) Stroke
- Constant Speed Mechanical Governor
- 68.6 cu in. (1.12 l) Displacement
- Full Flow Oil Filter
- 3.05" (77.4 mm) Bore
- 22 to 1 Compression ratio
- Water Cooled
- 40 Amp Alternator
- Engine Shutdown Package (low oil pressure & high temperature)

FUEL CAPACITY
The melter shall have a 30 gallon (113.56 l) diesel fuel tank for operation of the entire unit. The unit will be capable of operating for a minimum of 12 hours on one tank of fuel. The tank shall be equipped with full length sight gauges for fuel level indication protected in a steel cover.

PAINT
All painted surfaces shall be coated with DuPont two-part epoxy primer and DuPont two-part urethane paint applied by DuPont certified painters.

OPTIONS (X if to be included):
- 3 inch (7.6 cm) Pinch Hitch
- 18" Hitch Extension
- 28" Hitch Extension
- 39" Hitch Extension
- Dripless Tip Adapter
- 3" Swivel Disk Applicator
- 4" Swivel Disk Applicator
- V-shaped Squeeze (Qty.)
- 1/2 inch round Sealing Tip
- Extra Electric Hose
- Lockable Battery Cover
- Extra Hydraulic Filter
- Auto Loader
- Lockable Engine Cover
- Fire Extinguisher Mounted on the Trailer Frame
- Mast Mounted Strobe Light
- Tool Box
- Overnight Heater
- Custom Paint

TRAINING
An authorized, factory-trained representative will be made available for a full day of training at a facility designated by the bidding agency. At this training session a complete operational, mechanical and safety overview will occur. The CD manual will be viewed and discussed with all concerned personnel. Additionally, the representative will be available at that time for “on the job” safety and field training.

SAFETY AND TRAINING MANUALS
A written Safety Manual will be provided to the bidding agency.

PARTS
Bidders must show proof that a large stock of parts for the model of equipment upon which he is bidding is maintained at his facility.

AWARD
Equipment is for use by the Highway Department and must meet the requirements of that agency as interpreted by the Highway Commissioner. Prior to award the Purchasing Agency may require a visit to the supplier’s facility to assure supplier has plant capacity to manufacturer and deliver equipment on time as required. If it is determined that the supplier cannot supply as requested, this is just cause for cancellation.

WARRANTY
The manufacturer shall warrant the equipment for one year or as otherwise noted in the manufacturer's standard warranty policy,
QUALIFICATIONS OF BIDDERS
No bid will be considered unless the bidder can meet the following conditions:
1. That it has in operation a parts/service location and keeps a sufficient stock of parts on hand at all times.
2. That it is bidding upon the stock model chassis that meets the requirements of the specifications without material changes or modifications. The model is regularly advertised and sold as having a capacity of not less than called for herein. The bidder has been engaged in the manufacture of equipment of the type bid upon for at least twenty-four months.

APPROVED EQUAL
These specifications are not intended to be restrictive, but are meant to describe the kind and size of unit desired to be purchased in detail. If a bidder is basing his proposal on other equipment than what is specified in these bid documents and wishes the equipment he proposed to be considered as an "approved equal," he will submit on a separate sheet attached to the Technical Specifications contained herein, an item by item description of that which he proposes. For purposes of comparison, include only those items on each sheet as given in these technical specifications. Such bidders shall also include, but not as a substitute for the above, any manufacturer's literature or specifications. In addition, if the bidder takes exception to any item, he will note the item and describe in detail the exception. Failure to carry out the provisions noted herein may be cause to deem the bid "non-responsive.

Prior to bid award, the agency may request an on-site demonstration of a like model unit. Upon request from the agency, prospective bidders will have no more than 30 days to provide a demonstration at a location designated by the agency.
GENERAL
The pavement cutter should be of the manufacturer's current production. This unit shall be capable of accurately following random cracks in asphalt or concrete surfaces. A factory-trained person shall be available for the initial start-up and operator training of the unit. A video manual as well as a comprehensive safety manual will be supplied with each unit. A factory-trained person shall be made available for initial start-up and training in the operation of the melter.

FRAME AND ENGINE
The engine shall be mounted on a hinged saddle to permit belt tension. The cutter shall be powered by a Kohler Command series engine with hour meter. This V twin engine shall be capable of producing 30 HP at 3600 RPM. The engine shall have a full flow oil filter and oil cooler. A dual element air cleaner shall be installed on the engine. Additionally, a Donaldson air cleaner with pre-cleaner will be installed. A dirty air cleaner indicator shall be installed between the two air filtration systems. There shall be two axles attached on either side of the frame assembly in line with the cutterhead. Attached to the axles shall be two pneumatic tires with tapered bearings.

CUTTER HEAD
The cutter head shall be mounted on a drive shaft having a minimum diameter of 1½" and is fastened with a minimum of two 1/2" hex head cap screws in conjunction with a minimum 3/8" x 4" key. The cutter head drive shaft shall be mounted by means of two self-aligning ball bearings. The cutterhead shall accommodate a minimum of six - eight tooth carbide tipped cutters. These cutters shall be equally spaced on the cutterhead and revolve on the hardened pins of a length that permits the use of spacers. By rearranging the spacers, the cut width can be varied from 1/2" to 2" wide. The cutter head shall be housed in a steel housing capable of containing the cutter assembly and covering 80% of the total surface area.

The driving force from the engine to the cutter head shall be transmitted through a clutch and twin grooved sheaves and twin matched "V" belts covered with a removable metal guard ventilated to prevent upward suction of pavement debris. The entire assembly of engine, cutter head, cutter head housing and all other part assemblies shall be mounted on a heavy steel frame, electric welded through 100% of the metal thickness at each joint for maximum strength and rigidity.

The cutter head and its protective housing shall be able to raise and lower a minimum of four inches by means of an electric lineal actuator operated by a fingertip control switch mounted on the operator handle. The cutter head shall be in a central location to the frame.

CLUTCH
An electric clutch shall be mounted on the engine in such a manner as to stop the cutterhead on demand without stopping the engine. The clutch switch shall be located on the handle in order to facilitate easy access by the operator.

SAFETY SHIELDS
There shall be safety chain guards and flexible rubber guards surrounding the front and sides of the cutterhead housing in order to protect the surrounding areas from debris.

CARBIDE DRAG PLATE
A pavement cutter shall be equipped with a replaceable carbide drag plate mounted at the rear of the cutterhead housing in order to facilitate stopping of the unit as well as to control the speed during operation.

BATTERY
The unit shall be equipped with a 12-volt battery capable of starting the engine and operating the clutch and actuator. The battery shall also be housed in a fully enclosed box that is weather resistant and heavy duty.
FUEL TANK
The unit shall be equipped with a six-gallon minimum size gasoline tank. The tank shall be safely strapped to the frame and shielded by means of a metal guard that protects the front and corners of the tank. The tank shall also be manufactured from unbreakable, shatterproof, nonmetallic materials.

CUTTERS
The unit shall be supplied with pins, spacers and a complete set of wide hub carbide cutters. A depth control gauge shall be supplied on the unit allowing for a maximum depth of cut of 2".

MISCELLANEOUS
Estimated production rate of 500LM or 1500 LF per hour. An instruction manual containing warranty information, safety instructions, as well as an operation guide shall be provided. The instruction manual shall also contain a complete parts list with detailed service and maintenance instructions.

OPTIONS (X if to be included plus quantity)
- Steel Cutters 4 3/4"
- Carbide Cutters 4 3/4"
- Additional Wide Hub 4 3/4" Cutters
- Spacers
- Cutter Pins

TRAINING
An authorized, factory-trained representative will be made available for a full day of training at a facility designated by the bidding agency. At this training session a complete operational, mechanical and safety overview will occur. The CD manual will be viewed and discussed with all concerned personnel. Additionally, the representative will be available at that time for "on the job" safety and field training.

SAFETY AND TRAINING MANUALS
A written Safety Manual will be provided to the bidding agency.

PARTS
Bidders must show proof that a large stock of parts for the model of equipment upon which he is bidding is maintained at his facility.

AWARD
Equipment is for use by the Highway Department and must meet the requirements of that agency as interpreted by the Highway Commissioner. Prior to award the Purchasing Agency may require a visit to the supplier's facility to assure supplier has plant capacity to manufacture and deliver equipment on time as required. If it is determined that the supplier cannot supply as requested, this is just cause for cancellation.

WARRANTY
The manufacturer shall warranty the equipment for one year or as otherwise noted in the manufacturer's standard warranty policy.

QUALIFICATIONS OF BIDDERS
No bid will be considered unless the bidder can meet the following conditions:
1. That it has in operation a parts/service location and keeps a sufficient stock of parts on hand at all times.
2. That it is bidding upon the stock model chassis that meets the requirements of the specifications without material changes or modifications and which is regularly advertised and sold as having a capacity of not less than called for herein, that it has been engaged in the manufacture of equipment of the type bid upon for at least forty-eight months.

APPROVED EQUAL
These specifications are not intended to be restricted, but are meant to describe the kind and size of unit desired to be purchased in detail. If a bidder is basing his proposal on other equipment than what is specified in these bid documents and wishes the equipment he proposes to be considered as an "approved equal" he will submit on a separate sheet, attached to the Technical Specifications contained herein, an item by item description of that which he proposes. For purposes of comparison, include only those items on each sheet as given in these technical specifications. Such bidders shall also include, but not as a substitute for the above, any manufacturer's literature or specifications. In addition, if the bidder takes exception to any item, he will note the item and describe in detail the exception and how his proposal is an "approved equal". Failure to carry out the provisions noted herein may be deemed sufficient reason to reject the bidder's proposal.
A.3 CIMLINE
Fuel Saving Single Flue Design
Large Maintenance Hatch
Pump or Gravity Feed
250 and 500 Gallon Models
Optional Spray Bar

Cimline puts the latest technology to work with a new Tack Kettle for high performance and reliable heating and application of bituminous emulsions and tack coats. This compact unit employs a unique S-shaped single flue design that offers even, energy-efficient heating. This allows our 40 lb. propane tank to last twice as long as units with the same tank size and ensure all day operation.

Operator features include a 36” x 32” maintenance hatch for easy clean-out, 50-feet of retractable hose, a lightweight spray wand and large solvent/flush box. This easy-to-use kettle rides on a torsion axle with electric brakes for long term, low-maintenance operation.

You know Cimline’s leading cracksealing melter/applicator advantages for municipalities and contractors. Now discover how new technology makes better Tack Kettles for everyday operation.

Simply unbolts and remove large maintenance hatch for easy access.
Choose gravity feed or direct drive hydraulic pump.

Rugged 7 gauge steel tank available in 250 or 500 gallons.

Reliable 5 hp Honda gas engine.

Optional folding spray bar allows an 8-foot swath to be covered in one pass. Fold one side up to cover smaller areas. Hand valves at each nozzle allow the operator to adjust the spray width in one foot increments.
CIMLINE is focused on engineering rugged, durable, safe, operator convenient melter/applicators and a variety of accessories designed for municipalities and contractors.

- First with Oil Jacketed Kettle
- First with Vertical Material Agitator
- First with Duel Temperature Control
- First with Electronic Burner Ignition
- First with Rubber Torsion Axles

**MAGMA SERIES Cracksealers**

CIMLINE achieves the latest in cracksealing technology with our Magma Series melter/applicator line. Carefully engineered and rugged, exclusive features provide advantages for contractors & municipalities.

[The Entire Magma Series](#)

**MATRIX 1500 Cracksealer**

IModern cracksealing technology meets proven pump technology to create the Matrix 1500 melter/applicator designed for budget-conscious buyers.

[Matrix 1500](#)

**TACK KETTLE**

CIMLINE puts the latest technology to work with a new Tack Kettle for high performance and reliable heating and application of bituminous emulsions and tack coats.

[Tack Kettle](#)

**ACCESSORIES**

CIMLINE accessories provide the latest technology in crackcleaning and pavement maintenance.

[Accessories](#)
MATRIX 1500 - Modern cracksealing technology meets proven pump technology to create the Matrix 1500 melter/applicator designed for budget-conscious buyers. We’ve incorporated Cimline’s safe, efficient design with Garlock Equipment’s durable pump system to launch a clean-sheet approach to economical cracksealing for municipal and private asphalt maintenance professionals.

Ease of Operation
Start the engine and Matrix does the rest. Temperature is controlled digitally in one degree increments to prevent scalding. Plus operators are assured of sealing at specified temperatures for maximum adhesion in the crack or joint. Plus Cimline’s recirculation feature ensures even temperatures and fast heat-up.

SuperFlex
The new 20-foot SuperFlex III electrically heated sealing hose is designed to provide the reliability and long life you expect from Cimline. SuperFlex Core Technology and an advanced heating element minimize kinks and flex damage. This new technology provides maximum performance from the lightest weight and smallest outer diameter electrically heated hose.

Options
Use the Matrix 1500 in standard configuration as a long term solution to pavement preservation or add options like on-board air compressor to eliminate extra equipment on-site. Add the optional heat lance and you can blow out cracks, preheat the edges and seal them in one pass. A host of other options add security, convenience and safety features to satisfy every customer’s preferences.

- Tank Size - Oil Jacketed Design
- Heat Transfer oil type/capacity
- Loading Door
- Burner Description
- Burner BTU's
- Burner Ignition type
- Burner fuel type
- Temperature Control
- Pump system description
- Agitation description
- Engine type/description
- Engine Gross H.P.
- Diesel Fuel Capacity (US gallons)
- Trailer Tires
- Trailer suspension type and capacity

- 150 gallons
- 28 gallons ISO#VG 66
- 15"x 26" angled/insulated
- 20" Heated Sealant Delivery Hose
- Direct Drive Vertical Agitator
- Diesel with Engine Management
- 25 hp
- 25 Gallons
- 16" Radial Load range E
- 7000 lb rubber torsion type
Trailer brakes
Trailer hitch type
Trailer frame information
Warning lights
Warranty
Empty Weight

Electric (Std) Surge optional
2.5" Pintle
2"x 6" - "C" with Gussets
LED dual stop, tail and turn lights
One Year Std. manufacturer
3450 lbs.
Value and technology combine in the proven Matrix models. Choose the no-
pump 60-gallon Matrix for pour and go cracksealing with all the core features of
larger models or add the latest pump technology with the 150-gallon Matrix 1500
melter/applicator designed for budget-conscious buyers. We've incorporated Cim-
line's safe, efficient design with our sister company Garlock Equipment's durable
pump system to launch a clean-sheet approach to cracksealing for municipal and
private asphalt maintenance professionals.

Start the engine and the Matrix 1500 does the rest. Temperature is controlled digitally
in one degree increments to prevent scalding. Plus operators are assured of sealing at
specified temperatures for maximum adhesion in the crack or joint. Plus Cimline's re-
circulation feature ensures even temperatures and fast heat-up. Use the Matrix 1500
in standard configuration as a long term solution to pavement preservation or add
options like on-board air compressor to eliminate extra equipment on-site. Add the
optional heat lance and you can blow out cracks, pre-heat the edges and seal them in
one pass. A host of other options add security, convenience and safety features to
satisfy every customer's preferences.

**SAFETY FIRST**
From the low loading height that prevents fatigue and back injuries to the splash free loading door, Matrix is your first choice for operator safety. Compare features not marketing hype – Matrix is the first choice when safety, cost, performance and operator convenience features are considered.

**MATRIX SERIES**

**60-GALLON**
This is the choice for parking lots, driveways or smaller municipal operations. The diesel-fired no-pump approach is as simple as opening the heavy-duty, no-drip spigot and releasing hot sealant into a walk-behind applicator or hand-held pour pot (shown with optional engine enclosure).

**150-GALLON**
Features 250,000 btu diesel burner with electronic ignition for fast heat-up and fool-proof operation. Great stand-alone melter in both pump and no pump configurations.
MULTI-POINT OVERHEAD BOOM
Overhead multi-point boom supports ArmorFlex heated hose to reduce operator fatigue and avoid accidents.

DIESEL POWERED ENGINE
Rugged reliable Isuzu engine provides ample power, optional noise insulated engine cover available.

SINGLE TORSION AXLE
Torsion axle provides maintenance-free operation with maximum maneuverability for tight work areas.

AUTO START - MATRIX 1500
Start the engine and sealant temperature is controlled automatically in one degree increments.
**STANDARD FEATURES**

**HIGH PERFORMANCE TANK**
The tank is possibly the most important part of your melter because it affects heat-up and fuel efficiency. Forty years of design experience has resulted in the oil-jacketed Cimline tank with 40% less transfer oil for faster, even heating in less time. You will use less fuel with this efficient design that will provide payback on your investment every time you use it.

**INTERNAL MATERIAL RECIRCULATION**
Internal Material Recirculation draws hot sealant from the bottom of the tank and continuously circulates the material back to the top. This creates uniform sealant temperature even in cooler weather and accelerates melting of new sealant blocks for fastest recovery. This continuous recirculation extends material pump life by avoiding intermittent operation and provides superior mixing over non-recirculating designs.

**NON-SUBMERGED PUMPING SYSTEM**
Why bury your pump in a sealant-filled tank? This pump is easily accessible for service and can be replaced in only three hours compared to several days for a submerged pump. And there is less waste because the Cimline pump draws from the bottom of the tank. Output from the two-inch gear pump is a healthy 25-30 gpm and it is safely enclosed inside the rear of the machine.

**AUGER ASSISTED AGITATOR**
Multi-directional mixing improves overall heating and flow. The Cimline design raises the material using a spiral and rotates the material with the agitator bar.

**SEALANT LOADING**
Productivity soars while back injuries and fatigue drop because of our low loading heights (48-54") and specially designed loading doors. Our angled doors extend over the fenders for less reach to keep loading safe and simple.
ULTRALITE ALUMINUM WAND
Unique design is available in three configurations – Trigger Flow Control, Ball Valve, or the UltraWand which combines the popular Trigger Flow Control with the ball valve for use on heated hoses. The wand trigger delivers material when depressed, and stops flow and pressure when released. The recirculation process continues inside the machine, eliminating temperature stratification and accelerating heat up time. The ball valve reduces drips and provides better placement of sealant.

ARMORFLEX HEATED HOSE
Our 20-foot ArmorFlex is the latest generation of electrically heated hose that combines flexibility with reliability. Our UltraFlexible Core is surrounded with an armor jacket in the boom area and at the wand for improved operator safety and better protection for the hose — without excessive weight. The silicone impregnated electrical element provides long life due to better shielding.

Floating Ground Protection
ArmorFlex uses a floating ground to protect operators from any possibility of electrical shock. This is the industry standard for mobile equipment and the only safe grounding method.

RUGGED CONSTRUCTION
Only Cimline delivers the rugged construction that equals longer life. Thicker gauge steel, better insulation, six-inch gusseted tube frames and over-designed components deliver unmatched reliability. That's why we include a 1 year bumper-to-bumper warranty and 10-year frame warranty (5-year on Matrix).

WORK ZONE
Operate safer and more efficiently when you are farther from the machine due to better boom placement with less wasted vertical hose length. Reach farther, move faster and get more linear feet of cracks filled in a day with Cimline. Our design allows a wider range of motion to cover more square feet without repositioning the melter. Choose dual hoses for maximum coverage per set-up.
The Generation 3 Magma continues as the workhorse for the industry worldwide. With the most standard features, including: gull wing engine enclosure, ArmorFlex heated hose and heavy-duty material pump, the Magma is the melter/applicator of choice for municipal and contractor customers.

**110-GALLON**
Our smallest pump model with enough capacity for most public works departments and contractors. This a great stand-alone crack sealer or an addition to a fleet with enough capacity to handle parking lots, driveways and light road work.

**230-GALLON**
Our most popular size, the 230 handles road maintenance with ease. Add all the options that will assist your cracksealing crew for long term pavement preservation.

**410 GALLON**
High production cracksealing was the design criteria for this large capacity Magma. Customize this unit from our options list and watch your return on investment as this unit pays for itself over and over with high performance cracksealing.
ACCESSORIES

Ask about Climline Accessories to match the requirements of professional cracksealing.

POUR POT
Rugged 2-gallon pour pot is a valuable addition for pump or no pump models. Simply fill from spigot or wand for high production cracksealing.

PCS-25 SAW
Unmatched production, superior maneuverability and high performance random crack saw.

HEAT LANCE
Our "Hot Rod" heat lance provides all the performance features to ensure cracks are properly prepared for sealant installation.

SQUEEgee
Squages flat over cracks and removes excess to ensure a quality overbonds seal.

PGR-25 ROUTER
Engineered for comfort and control, the PGR-25 provides smooth power with minimum vibration while the adjustable, spring-loaded handle is designed for operators of any height.

BANDER APPLICATOR
Push-style bander/applicator to provide a perfect concrete seat allowing for contracting and expansion of the pavement.
A.4 SEALMASTER
Crack Pro® 3000
Cold Applied Applicator Unit

Features:
- 125 psi air compressor
- Air-diaphragm material pump
- 50 ft. hose
- Basket strainer to reduce clogging
- 5.5 H.P. Honda engine
- Controlled Material Flow - Delivers just the right amount of material where you want it!
- Includes straight pipe and crack shoe applicator assemblies

Specifications:
- Length: 61"
- Width: 21"
- Height: 56"
- Weight: 225 lbs.

Crack Pro® 3500
Cold Applied Applicator Unit

Features:
- Air diaphragm material pump
- Large basket strainer to reduce tip clogging
- 50 ft. hose and applicator wand
- Includes straight pipe and crack shoe applicator assemblies
- 8 H.P. Honda engine

Specifications:
- Length: 66"
- Width: 20"
- Height: 56"
- Weight: 444 lbs.

Stores Nationwide - Call Today (800) 395-7325
sealmaster.net
Discover The Ease, Convenience, Safety And Performance Of SealMaster® Cold Applied Crack Filling Technologies.

SealMaster® Cold Applied Technologies Provide Superior Protection Against Moisture Intrusion - The leading cause of pavement failure.

- Asphalt Pavement
  - Base Materials
  - Unfilled Cracks
  - Filling cracks with Crack Filler helps prevent rain and moisture from flowing through the pavement and causing erosion or failure.

SealMaster® Pouroble Crack Sealant

- Economical Cold Applied Crack Filler.
  - Rubberized for added flexibility and durability.
  - Fast-Drying, ideal for use on roads, streets, parking lots, driveways and more.

FlexMaster™ Pouroble Crack Sealant

- The Cold Applied Crack Sealant With Hot Applied Performance
  - Premium quality elastomeric cold applied crack filler featuring low temperature flexibility.
  - Ideal for roads, streets, parking lots, driveways and more.

Crack Pro•2000 Cold Applied Applicator Unit

- Economical Pump Unit That Plugs Into Any Air Compressor (10 cfm or higher)

Features:
- Use your own air compressor
- Controlled material flow
- 50 ft hose
- Includes straight pipe and crack shoe applicator assemblies

Crack Pro•2500 Cold Applied Applicator Unit

- This Compact Versatile Unit is Ideal For Parking Lot And Driveway Applications

Features:
- Controlled Material Flow - Delivers just the right amount of material where you want it!
- 100 psi air compressor
- Air-diaphragm material pump
- 50 ft hose
- Includes straight pipe and crack shoe applicator assemblies
- Screened suction hose assembly
- Cart holds two 5-gallon buckets
- Swivel wheel steering
Appendix B  Material

B.1  CRACKMASTER
B.2  CRAFCO INC.
B.3  P&T PRODUCT, INC.
B.4  NUVO
B.5  TRICOR REFINING, LLC
B.1 CRACKMASTER
CrackMaster™
Hot Applied Rubberized Crack Sealants

Premium Quality Rubberized Crack Sealants Specifically Formulated For Superior Pavement Protection.

Ideal For Use On:
- Roads/Streets
- Highways
- Parking Lots
- Driveways
- Asphalt
- Concrete
CrackMaster™
Premium Quality Crack Sealants

**CrackMaster™ Supreme**
Our finest hot applied crackfilling material. Designed for use in both direct fire and oil-jacketed kettles. Ideal for all crack filling applications.

**Physical Properties:**
- Recommended Application Temperature: 350 - 400°F
- Maximum Heating Temperature: 450°F
- Cone Penetration at 25°C: 50 Max.
- Flow at 60°C, mm: 0
- Softening Point: 200°F Min.
- Resiliency, %: 60% Min.
- Flexibility D.F.: (1" Mandrel) - PASS
- Specific Gravity: 1.17
- Asphalt Compatibility: Compatible

**CrackMaster™ Parking Lot Grade**
A premium quality crack and joint sealing material that resists tracking at elevated temperatures and remains flexible down to -10°F. Designed for use in oil-jacketed kettles.

**Physical Properties:**
- Recommended Pour Temperature: 370-370°F
- Maximum Heating Temperature: 410°F
- Penetration (150 gr/5 sec.): 35 max.
- Resiliency: 60% Min.
- Flow at 140°F: 0 mm
- Softening Point: 200°F min.
- Viscosity @ 375°F: 25 ± 10 poise
- Specific Gravity: 1.18
- Asphalt Compatibility: Compatible

**CrackMaster™ 3405**

**Physical Properties:**
- Recommended Pour Temperature: 370-370°F
- Maximum Heating Temperature: 410°F
- Cone Penetration at 25°C: 90 Max.
- Resiliency: 60% Min.
- Flow at 140°F: 3 mm Max.
- Bond: -20°F/50% Ext. Passes 3 cycles
- Bond: 0°F/100% Ext. Passes 3 cycles
- Bond, water immersed: Passes 3 cycles at 50% ext. at -29°C
- Specific Gravity: 1.14
- Asphalt Compatibility: Compatible
- Viscosity: 35 ± 20 poise

**CrackMaster™ P.L.**
An economical, high softening point material designed for use on parking lots. Recommended for oil-jacketed kettles.

**Physical Properties:**
- Recommended Pour Temperature: 370-370°F
- Maximum Heating Temperature: 400°F
- Penetration (150 gr/5 sec.): 30-45
- Resiliency: 40% min.
- Flow at 140°F: 0 mm
- Softening Point: 200°F min.
- Ductility @ 77°F: 30 cm
- Tensile Adhesive: 500%
- Viscosity @ 375°F: 60 ± 10 poise
- Flexibility @ 20°F (1" Mandrel): Pass
- Specific Gravity: 1.18
- Asphalt Compatibility: Compatible

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Available at SealMaster® Stores Nationwide
P.O. Box 2277 • Sandusky, Ohio 44870
Phone: 1-800-395-7325
www.sealmaster.net

Date: 4/09
Form No.: SM-21
Hot Pour Crack Fillers

CrackMaster™ 3405


Sizes Available
50 lb. box with two 25 lb. cubes per box.

Coverage
Use the following chart as a guideline for estimating material requirements (based upon pounds of material needed for 100 feet of cracks):

<table>
<thead>
<tr>
<th>Crack Width</th>
<th>Depth</th>
<th>lbs/100 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>3/8&quot;</td>
<td>6.8 lbs.</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>1/2&quot;</td>
<td>12.3 lbs.</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>3/4&quot;</td>
<td>27.8 lbs.</td>
</tr>
</tbody>
</table>

The above coverage rates are only a guideline. Actual material usage may vary due to width of application and thickness of material above pavement surfaces.

Description
A premium quality crack and joint sealing material that resists tracking at elevated temperatures and remains flexible down to -10°F. When melted and properly applied, it forms a resilient crack sealant for both asphaltic and cementitious pavements. CrackMaster™ Parking Lot Grade forms a lasting seal that resists tracking in warm climates.

Uses
CrackMaster™ Parking Lot Grade is designed to seal expansion joints, longitudinal and transverse cracks, joints between concrete and asphalt shoulders, and random cracks in both asphalt and concrete pavements. It is ideally suited for parking lots.

Mixing Procedures
Use material as supplied. Do not blend with other materials. After CrackMaster™ Parking Lot Grade is melted, it should be agitated or recirculated.

Application
Apply heated CrackMaster™ Parking Lot Grade using either a pump and wand system or a pour pot. For best results, the sealant depth to width ratio should not exceed 2 to 1 (i.e., 2-inches deep to 1-inch wide). The cooled sealant height should not exceed 1/8" above surrounding pavement. Using a sealing shoe or squeegee, band the material 2 to 3 inches wide over the crack.

Important
Protective apparel is recommended with application of CrackMaster™ Parking Lot Grade. The extremely hot material will cause severe burns on contact with skin. OSHA Safety Regulations require workers to wear the following types of safety attire (see current OSHA/Safety Regulations for additional information): Hard hat with face shield; long sleeved shirt buttoned at the wrist; heat resistant gloves; long, cuffed pants; and safety toe work boots. Make certain all area around melters is clear of all obstructions and flammable materials. Avoid breathing vapors. Use with adequate ventilation.

Clean Up
Wash tools in water before material dries.

MSDS Sheet  (PDF) Specification Sheet  (PDF)
<table>
<thead>
<tr>
<th>Catalog</th>
<th>Unit Size</th>
<th>Unit Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>View in Catalog</td>
<td>50 lb. box</td>
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</tr>
</tbody>
</table>
Hot Pour Crack Fillers

CrackMaster™ Supreme

Our finest hot applied crackfilling material. Designed for use in both direct fire and oil-jacketed kettles, ideal for all crack filling applications.

Sizes Available
50 lb. box with two 25 lb. cubes per box.

Coverage
Use the following chart as a guideline for estimating material requirements (based upon pounds of material needed for 100 feet of cracks):

<table>
<thead>
<tr>
<th>Crack Width</th>
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<th>lbs/100 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>3/8&quot;</td>
<td>6.2 lbs.</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>1/2&quot;</td>
<td>11.1 lbs.</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>3/4&quot;</td>
<td>25.0 lbs.</td>
</tr>
</tbody>
</table>

The above coverage rates are only a guideline. Actual material usage may vary due to width of application and thickness of material above pavement surfaces.

Description
CrackMaster™ Supreme is a single component, hot-applied, rubberized asphalt crack and joint sealant. CrackMaster™ Supreme is specially formulated for both direct fire and oil-jacketed kettles. It is heat stabilized to withstand temperatures up to 450°F without experiencing polymer degradation. When melted and properly applied, it forms a resilient crack sealant for both asphaltic and cementitious pavements. CrackMaster™ Supreme meets manufacturer's specifications.

Uses
CrackMaster™ Supreme is designed to seal expansion joints, longitudinal and transverse cracks, joints between concrete and asphalt shoulders, and random cracks in both asphalt and concrete pavements. CrackMaster™ Supreme is relatively hard and has a high softening point, which makes it well suited for parking lots and driveways.

Mixing Procedures
Use material as supplied. Do not blend with other materials.

Application
Apply heated CrackMaster™ Supreme using either a pump and wand system or a pour pot. For best results the sealant depth to width ratio should not exceed 2 to 1 (i.e. 2-inches deep to 1-inch wide). The cooled sealant height should not exceed 1/8" above surrounding pavement. Using a sealing shoe or squeegee, band the material 2 to 3 inches wide over the crack.

Important
Protective apparel is recommended with application of CrackMaster™ Supreme. The extremely hot material will cause severe burns on contact with skin. OSHA Safety Regulations require workers to wear the following types of safety attire (see current OSHA/Safety Regulations for additional information). Hard hat with face shield; long sleeved shirt buttoned at the wrist; heat resistant gloves; long, cuffed pants; and safety toe work boots. Make certain all area around material is clear of all debris and flammable materials. Avoid breathing vapors. Use with adequate ventilation.

Clean Up

http://www.sealmaster.net/CrackMaster%20Supreme.shtml
<table>
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<tr>
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<th>Unit Weight</th>
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<tbody>
<tr>
<td>View in Catalog</td>
<td>50 lb. box</td>
<td>50 lbs.</td>
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</tbody>
</table>
1. PRODUCT NAME
   CrackMaster 3405
   Hot Pour Crack Sealant

2. MANUFACTURER
   ThorWorks Industries, Inc.,
   2520 S. Campbell St.
   Sandusky, OH 44870
   Phone: 800-326-1994
   Fax: 419-626-5477
   www.thorworks.com

Additional Plant Locations:
SealMaster has a nationwide network of manufacturing and
distribution facilities.

Phone 1-800-395-7325 or visit
website at www.sealmaster.net
to find the location near you.

3. PRODUCT DESCRIPTION & BENEFITS
   CrackMaster 3405 is a single
   component, hot applied crack
   and joint sealant. When melted
   and properly applied it forms a resilient
   sealant for both asphaltic
   and cementitious pavements.
   CrackMaster 3405 meets ASTM
   D3405, ASTM D6690 Type II and III,
   AASHTO-M301.

   Basic Uses: CrackMaster 3405 is
designed to seal expansion joints, longitu-
dinal and transverse cracks, joints between con-
crete and asphalt shoulders, and random cracks
in both asphalt and concrete pavements.

   Composition: As supplied, CrackMaster 3405 is
supplied in solid blocks comprised of asphaltic resins
and synthetic polymer rubber.

   Sizes: CrackMaster 3405 is supplied
in 50 lb. cardboard cartons
containing two 25 lb. blocks
of material per carton.

   Color: Black.

   Limitations: Do not overheat
material. Crack must be free from
moisture, dust, loose aggregate and
other contaminates prior to
application.

4. TECHNICAL DATA
   CrackMaster 3405 meets the
following material requirements
when tested in accordance with
ASTM D6690 Type II & III, AASHTO
M324, Type II, ASTM D3405, and SS
S-1401C (see chart below).

   Environmental Considerations:
   CrackMaster 3405 is considered a
non-hazardous material.

5. INSTALLATION
   Proper surface preparation will
facilitate adequate adhesion and
consequently the maximum service
life of the sealant. The crack
must be free from moisture, dust, and
loose aggregate. Routing or wire
brushing are preferred methods
followed by a compressed air heat
lance immediately prior to sealing.
The substrate and air temperature
must be above 40°F.

   Methods: CrackMaster 3405 shall
be melted in a conventional oil-
heated tank equipped with an
agitator and temperature control
device for both material and heat
transfer oil. Carefully insert blocks of
material (with plastic bag)
into melting equipment with
agitator turned off. Load material
slowly to avoid splashing. After the
initial load of material has reached
the recommended pouring
temperature (370-390°F), fresh
material may be added as sealant
is used. Melt only enough material
that will be used the same day.
Avoid overheating material.
Excessive heat could cause
material to get in the equipment or
fall in crack

   and joints. A significant viscosity
increase accompanied by
stringiness signals the approach of
gelation. If this occurs, immediately
remove the material from the
melter and dispose of it.

   IMPORTANT: Protective apparel is
recommended with application of
CrackMaster 3405. The extremely
hot material will cause severe burns
on contact with skin. OSHA Safety
Regulations require workers to
wear the following typical safety
attire (see current OSHA/Safety
Regulations for additional
information): Hard hat with face
shield; long-sleeved shirt buttoned
at the wrist; heat resistant gloves;
long, cuffless pants; and safety toed
work boots. Make sure all area
around melter is clear of all debris
and flammable materials. Avoid
breathing vapors. Use with
adequate ventilation.

   Mixing Procedures:
Use material as supplied. Do not
blend with other materials. After
CrackMaster 3405 is melted it
should be agitated or recirculated.

   Application: Apply heated
CrackMaster 3405 using either a
pump and wand system or a pour
pot. For best results the sealant
depth to width ratio should not
exceed 2 to 1 (i.e. 2-inches deep
to 1-inch wide). The cooled sealant
height should not exceed 1/8" above
surrounding pavement. Using a sealing shoe or squeegee,

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### Chemical & Physical Analysis

<table>
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<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>Maximum Heating Temperature</td>
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</tr>
<tr>
<td>Cone Penetration at 25°C</td>
<td>90 Max</td>
</tr>
<tr>
<td>Resiliency</td>
<td>60% Min</td>
</tr>
<tr>
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</tr>
<tr>
<td>Bond: -20°F/50% Ext. Passes 3 cycles</td>
<td></td>
</tr>
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<td></td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>Specific Gravity</td>
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</tr>
<tr>
<td>Asphalt Compatibility</td>
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<td>Viscosity</td>
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CrackMaster® 3405
Hot Pour Crack Sealant

band the material 2 to 3 inches wide over the crack.

Estimating Material Requirements: Use the following chart as a guideline for estimating material requirements (based upon pounds of material needed for 100 feet of cracks):

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<td>6.9 lbs.</td>
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<tr>
<td>3/8&quot;</td>
<td>1/2&quot;</td>
<td>9.3 lbs.</td>
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<td>1/2&quot;</td>
<td>1/2&quot;</td>
<td>12.3 lbs.</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>1&quot;</td>
<td>24.7 lbs.</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>1/2&quot;</td>
<td>18.5 lbs.</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>3/4&quot;</td>
<td>27.8 lbs.</td>
</tr>
</tbody>
</table>

The above coverage rates are only a guideline. Actual material usage may vary due to width of application and thickness of material above pavement surfaces.

Precautions: Cracks must be free from moisture, dust, dirt, and debris. Both substrate and air temperature must be above 40°F. Keep boxes of material dry during storage. Do not store in direct sunlight.

6. AVAILABILITY & COST

Availability: CrackMaster Hot Pour Crack Sealants are supported by a nationwide network of SealMaster facilities along with a national and international network of professional applicators.

Cost: Cost information can be obtained from a local SealMaster CrackMaster applicator. Contact SealMaster for the CrackMaster representative in your area.

7. WARRANTY

SealMaster warrants that CrackMaster 3405 meets the chemical composition and performance requirements set forth in section 4. Liability to the buyer or user of this product is limited to the replacement value of the product only.

9. TECHNICAL SERVICES

Manufacturer: Complete product specifications, material safety data sheets, and technical assistance is available from SealMaster.

Professional Applicators: Your local CrackMaster applicator is available to provide on-site inspections and recommendations to meet your specific needs.

10. FILING SYSTEMS

- SealMaster Online Specification at www.sealmaster.net
- Complete SealMaster Product and Equipment Catalog Available
- Sweet’s Catalog
- Sweet’s CD
- Sweet’s Online
- Sweet’s Directory

The statements made on this specification sheet are believed to be true and accurate and are intended to provide a guide for approved application practices. As workmanship, weather, construction, condition of pavement, tools utilized, and other variables affecting results are all beyond our control, the manufacturer warrants only that the material conforms to product specifications and any liability to the buyer or user of this product is limited to the replacement value of the product only. The manufacturer expressly disclaims any implied warranties of merchantability or fitness for a particular purpose. Warranty is void on multi-coat applications if material made by other manufacturers is used with this product.
B.2 CRAFCO INC.
Sealant, Patching Products, Adhesives, Detack and Cleaners

Crafco Pavement Preservation Sealants are formulated to perform in a wide range of climatic conditions. All sealant specifications meet and exceed Federal and State recommendations. Crafco produces Roadsaver, Parking Lot Sealant, PolyFlex Sealant, PolyPatch, TechCrete, Loop Detector Sealant, Pavement Joint Adhesive, Super Flex Sealant and custom specified sealant.

Crafco Certified Sealants are products by which the performance of the product has been proven by a recognized, non-biased, independent entity verifying the performance levels, and providing the documentation of the performance.

Certification Documentation

NEW PLEXI-melt meltable packaging - no waste, no box recycling.

Click for details.

Crack Sealant & Fillers

Crafco offers up to 100 sealant types for a wide range of application in all climatic conditions and temperatures. To make selection easy for your particular application use, click on “SEALANT SELECTION GUIDE” to the left.

Concrete Joint Sealant & Concrete Repair Products

Joint sealant is designed to keep moisture out of the pavement sub-base, limit spalls and prevent foreign objects (F.O.D.) from pavement surfaces. Crafco has joint sealant for every use, for every climate and varying life cycles. If properly designed and installed the expected life of this procedure is 5 to 7 years in most cases.

Crafco TechCrete is the long-term solution for distressed concrete pavement preservation. Spalled concrete caused by fatigue, freeze/thaw cycles, warping stress, ingress of water, or substrate problems can lead to costly reconstruction.

Parking Lot Sealant

Parking Lot pavements are subject to slow moving vehicle traffic and foot traffic. These areas include but are not limited to: Parking Lots, Parking Garages, Driveways, Collector and Residential Streets, Crosswalks, Walkways and Recreation areas. Due to the nature of these types of pavements, special care should be taken when sealing cracks in these areas because they encounter different types of traffic than highways and high traffic volume roads. Crafco Parking Lot Sealant is specifically formulated for these areas.

Loop Detector Sealant

Crafco Loop Detector Sealant is a single component, hot melt, rubberized asphalt material formulated to be a stiff, yet flexible, sealant which is ideally suited for sealing traffic loop detector cuts. Crafco Loop Detector Sealant is a thin, free flowing fluid which pours easily and penetrates narrow traffic loop detector cuts. This sealant is self leveling. Application use includes both asphalt and Portland Cement Concrete pavement. When cool, Loop Detector Sealant is a well bonded, stiff product that resists tracking or pick-up in pedestrian and slow moving traffic areas. Can be applied using pressure feed or pour pots.

- Single component hot melt
- Thin, free flowing
- Self leveling
- Permanent bond
- Resists tracking or pick-up
- Open to traffic when cool

Patching Products

Crafco offers a wide variety of pavement patching products for asphalt and concrete alike. These performance patching products will satisfy any specific need, whether it’s budget conscious, short term...
or long term repairs we have a product for your application. Listed is a brief description of each product, the application and use. There is a comparison chart to help you better select the proper product for your application that can be accessed by clicking the "additional information" button to the right.

<table>
<thead>
<tr>
<th>PRODUCTS INFORMATION</th>
</tr>
</thead>
</table>

**TechCrete**

Crafco TechCrete is a proven hot pour superior repair solution different from conventional rigid repair methods. Due to its flexibility, high tensile strength, ability to bridge joints and high compressive resistance, TechCrete creates a long lasting concrete repair.

**PolyPatch**

Crafco PolyPatch has been specifically designed for cracks too large for crack sealing and distressed surfaces that are too small for re-paving. It is a versatile hot-applied, pourable, self-adhesive polymer modified asphalt binder containing selected aggregate to ensure good load bearing and skid resistant characteristics. *Compounded with lightweight aggregate.*

**Mastic One**

Crafco Mastic One is designed for large cracks and distressed surface areas too small for re-paving. It is a versatile hot-applied, pourable, self-adhesive polymer modified asphalt binder containing selected aggregate to ensure good load bearing and skid resistant characteristics. *Compounded with standard weight aggregate.*

**HP Cold Patch**

Whether it is repairing utility cuts or patching that reoccurring pothole, HP high performance cold patch is ideal for all weather conditions. HP is specifically formulated for the wide-ranging temperature and climate of all areas. HP is permanent, fully guaranteed against any failure, and most important, does the job right the first time.

**Marker Adhesive**

Crafco Hot-Applied Flexible Marker Adhesive is a hot-applied thermoplastic bituminous material which bonds markers and reflectors to both asphalt and concrete pavement surfaces. Hot-Applied Flexible Marker Adhesive is supplied as a single component material which is easily melted and poured or pumped onto pavement surfaces. Hot-Applied Flexible Marker Adhesive sets up on cooling and is ready for traffic in less than five minutes. Hot-Applied Flexible Marker Adhesive is formulated with premium asphalt, polymers and additives which hold markers in place and remain flexible at temperatures down to 20°F (-7°C).

**Joint Adhesive**

Crafco’s hot-applied modified asphalt composition effectively bonds paving passes together creating a watertight seal during thermal movement resulting in improved long-term performance of the joint with no significant cracking. This product is also effective for waterproofing exposed edges of asphalt concrete pavement areas such as at the curb gutter, and shoulder interfaces. Additionally, waterproofing can be assured where manhole covers and hand valves (gas, water, etc.) are installed in asphalt concrete pavement. Like other Crafco products this product is easy to apply using Crafco's Melter/Applicator equipment.

**Detack**

Open freshly crack-sealed pavements to vehicle and pedestrian traffic immediately and eliminate sealant pick-up and tracking with DETACK. DETACK is an economical, biodegradable liquid from Crafco that eliminates sealant tack when sprayed onto freshly applied hot pour sealant. Now you don’t have to wait until the sealant has cooled before opening the pavement to traffic. DETACK application is a one-man operation that saves money, time, and increases efficiency. DETACK is the smart choice over messy sand, aggregate, or toilet paper applications and reduces set up and tear down time for lane closures. If you’re stuck for an economical, time saving, detackifying solution for hot pour sealant then DETACK from Crafco is your answer.

**Qwik Solutions**

- **QwikStix**
  
  The Crafco QWIKSTIX is a fast and easy way to adhere pavement markers or do small crack repairs. The only tool required is a small torch. Peel back the self release cardboard box and melt just enough to do the job. Single markers or touch up to a crack sealing project are ideal for the QWIKSTIX. QWIKSTIX work equally well on AC or PCCP pavements.

- **Qwikdots**

  Use the Crafco QWIKDOTS system to adhere sign posts, rumble strips, speed bumps, parking bumpers, temporary signs or most anything else to both concrete and asphalt pavements. Crafco QWIKDOTS are pressure sensitive peel and stick modified asphalt adhesive pads.

**QWIKSEAL**

QWIKSEAL is a peel and stick, modified asphalt compound ideal for sealing cracks, seams around pavement patches and concrete.
joints. Applying QWIKSEAL is as simple as blowing the pavement making sure the surface is clean and dry, unrolling QWIKSEAL and applying it to the surface. Warm the edges to assure a long lasting bond. Properly installed, QWIKSEAL prevents water intrusion and the deterioration it causes to the pavement. QWIKSEAL is compounded to perform in a wide range of climates and conditions.

QwikSeal
Three Steps For Proper Sealant Selection

**SEALANT SELECTION GUIDE | APPLICATION INSTRUCTIONS | DATA SHEETS/MSDS**

**Step 1:** Determine the proper type of crack treatment process.

A) Crack Sealing: This process should be performed on pavements that are in good condition. That is defined as a pavement with a sound base and exhibits distress in the form of thermal or working cracks with greater than 1/8 inch movement. The procedure generally consists of sealing transverse cracks spaced 20 feet apart or more in order to prevent moisture from entering and deteriorating the subbase and incompressible material from interfering with thermal movement. See the Crafo Application Instructions for your chosen sealant to get specific directions on preparation and application. Generally, all crack seal operations include mechanically widening the crack. The expected life of this procedure is 5 to 9 years in most cases.

B) Performance Crack Filling: This procedure consists of filling cracks with low (<1/8 inch) movement in order to stop moisture from penetrating to the subbase of the pavement. If moisture is not checked, catastrophic pavement failure such as potholes will form. Another reason for crack filling is to stop crack raveling. Crack filling is a very cost-effective method of pavement repair that will add years to its life. Crack fill pavements that are in fair to poor condition on a regular basis to maintain or slightly improve their condition. A life of 6 to 8 years can be expected in most instances.

C) Joint Sealing: The sealing of concrete pavement joints is required to stop moisture from entering and deteriorating the subbase of the pavements. The most cost-effective method of ensuring optimum performance of a PCC pavement is by constructing a sound joint seal system that will last. For detailed information see the Crafo joint seal Product Data Sheet and Application Instructions.

**Step 2:** Determine Temperature Extremes

On the **Sealant Selection Guide** page find the area of the country you are interested in on the map titled High Temperature map. The dot will correlate to a temperature zone listed on the legend. For extreme traffic conditions (heavy, slow moving, pedestrian, parking lots) when crack filling the high temperature extreme should be increased one or two grades. Next, locate your zone on the Low Temperature map. When this is done you will have two Celsius numbers that represent a range of temperatures. The hot or highest number is always first. Please note that some of the -10°C areas on the low temperature map do not actually get that cold, and will classify as a -4°C area.

**Step 3:** Select Crafo Product

Using the temperature range numbers determined in step two above, use the **Product Selection Grids** below the maps on the Sealant Selection Guide page and select the determined crack treatment process. The grids list recommended products for your specific temperature ranges. By cross referencing the two temperatures you will be able to select the proper sealant for the temperature parameters.

Many products may also be used in other climates, as listed on the Product Data Sheets. Use the Product Summary page to check the specifications, and other characteristics such as if the product is thick or thin or if it has any other unique properties. If you have any further question your Crafo representative will be glad to assist you.

---

B.3  P & T PRODUCTS, INC.
# Product List

## Hot Pour Crack and Joint Sealants

These products seal working cracks and joints in asphalt or concrete pavements.

<table>
<thead>
<tr>
<th>Sealant Name</th>
<th>Climate</th>
<th>Specifications</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dura-Fill 1190</td>
<td>Moderate</td>
<td>ASTM D 6690 Type 1, ASTM D 1190, AASHTO M 324 Type 1, AASHTO M 173</td>
<td>Polymer modified blend of asphalt, oils, and inorganic fillers</td>
</tr>
<tr>
<td>Dura-Fill 1190 NR</td>
<td>Moderate</td>
<td>ASTM D 6690 Types 2 &amp; 3, ASTM D 3405, AASHTO M 324 Types 2 &amp; 3, AASHTO M 301</td>
<td></td>
</tr>
<tr>
<td>Dura-Fill 3405</td>
<td>Cold</td>
<td>ASTM D 6690 Type 4, Modified ASTM D 345</td>
<td>Polymer modified blend of asphalts, oils, and reinforcing fillers</td>
</tr>
<tr>
<td>Dura-Fill 3405 NR</td>
<td>Very Cold</td>
<td>Minnesota DOT 3725</td>
<td>Heat stabilized blend of asphalt &amp; polymers for direct fired kettles</td>
</tr>
<tr>
<td>Dura-Fill 3405 R</td>
<td>All Climates</td>
<td></td>
<td>Polymer modified polyester fiber sealant</td>
</tr>
<tr>
<td>Dura-Fill HS</td>
<td>All Climates</td>
<td></td>
<td>Designed for parking lots</td>
</tr>
<tr>
<td>Dura-Fill Parking Lot Plus Fiber</td>
<td>Moderate to Hot</td>
<td>P &amp; T Products’</td>
<td></td>
</tr>
<tr>
<td>Dura-Fill PF</td>
<td>All Climates</td>
<td>Minnesota DOT 3725</td>
<td>Heat stabilized blend of asphalt &amp; polymers for direct fired kettles</td>
</tr>
<tr>
<td>Dura-Fill PF IV</td>
<td>All Climates</td>
<td>Ohio DOT, Type IV</td>
<td>Polymer modified blend of asphalts, oils, and reinforcing fillers</td>
</tr>
<tr>
<td>Dura-Fill PL</td>
<td>All Climates</td>
<td>P &amp; T Products’</td>
<td></td>
</tr>
<tr>
<td>Dura-Fill PL+</td>
<td>All Climates</td>
<td></td>
<td>Designed for parking lots</td>
</tr>
</tbody>
</table>

## Hot Pour Crack Fillers

These products seal non-working cracks in asphalt or concrete pavements.

<table>
<thead>
<tr>
<th>Filler Name</th>
<th>Climate</th>
<th>Specifications</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dura-Fill 320</td>
<td>Moderate</td>
<td>P &amp; T Products’</td>
<td>Polymer modified blend of asphalts, oils, and reinforcing fillers</td>
</tr>
<tr>
<td>Dura-Fill 420</td>
<td>Moderate to Hot</td>
<td>P &amp; T Products’</td>
<td>Contains a select blend of asphalt and ground tire rubber</td>
</tr>
<tr>
<td>Dura-Fill 620</td>
<td>Moderate</td>
<td></td>
<td>Polymer modified blend of asphalts, oils, and reinforcing fillers</td>
</tr>
<tr>
<td>Dura-Fill 5078</td>
<td>Moderate</td>
<td>ASTM D 5078</td>
<td>Polymer modified blend of asphalts, oils, and reinforcing fillers</td>
</tr>
</tbody>
</table>

## Specialty Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dura-Fill CJA</td>
<td>Cold Joint Adhesive</td>
</tr>
<tr>
<td>Dura-Fill CJA II</td>
<td>Reflective Marker Adhesive</td>
</tr>
<tr>
<td>Dura-Fill MA</td>
<td>Reflective Marker Adhesive</td>
</tr>
<tr>
<td>Rubber Dust</td>
<td>Uniform Mixture of Ground Rubber Buffings</td>
</tr>
<tr>
<td>Rubber Dust 143</td>
<td>Crack Sealant Barrier Material</td>
</tr>
<tr>
<td>Glenzoil 20 Plus</td>
<td></td>
</tr>
</tbody>
</table>

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**P&T Products, Inc.**

472 Industrial Parkway, Sandusky, Ohio 44870
(419) 621-1966 • Fax (419) 621-1988 • (877) 690-4093 • www.P-TProductsInc.com
SPECIFICATION

Nuvo Spec 6690 Type 1 is a next generation hot pour polymer modified asphalt crack and concrete joint sealant that meets all the requirements of ASTM D 6690 Type 1. It is formulated with Intellibond Technology to provide consistent performance in a wide range of climates, superior crack penetration, fast setup times, wide application temperature ranges and fast melt times. Packaged in our exclusive, fully meltble PolySkin Packaging, Nuvo sealants have set a new standard for ease of use, product performance and environmental awareness.

<table>
<thead>
<tr>
<th>Test</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cone Penetration: @ 77°F (25°C), ASTM D 5329</td>
<td>90 max</td>
</tr>
<tr>
<td>Bond: @ -20°F (-29°C), 50% Ext. ASTM D 5329</td>
<td>Pass 5 cycles</td>
</tr>
<tr>
<td>Softening Point: ASTM D 36</td>
<td>176°F (80°C) min</td>
</tr>
<tr>
<td>Asphalt Compatibility: ASTM D 5329</td>
<td>Pass</td>
</tr>
<tr>
<td>Environmental Compliance - There shall be no cardboard or paper waste from packaging</td>
<td>Pass</td>
</tr>
<tr>
<td>Safety Compliance - No sharp objects shall be required to open containers</td>
<td>Pass</td>
</tr>
<tr>
<td>Productivity Enhancement - Materials can go directly from the pallet to the melter without any preparation</td>
<td>Pass</td>
</tr>
<tr>
<td>Storage Concerns - Containers shall be waterproof and interlocking to ensure effective outdoor storage</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Application

Before use, the user must read and follow the Application Instructions for the above referenced sealant. This product may be heated using indirect heating systems or in direct fire melting systems. Equipment must have means of maintaining constant agitation to the material.

Maximum safe heating temperature: 400°F (204°C).
Recommended application temperature: 380°F (193°C).

Warranty

Maxwell Products, Inc. warrants that Nuvo™ Sealants meet the applicable specifications at the time of shipment. Due to the many differing procedures used in preparing and installing sealants, Maxwell Products assumes no liability for sealant failure due to improper installation, equipment failure or operator errors. Any remedies are limited, at Maxwell Products’ option, to replacement of materials or refund (full or partial) of the purchase price from Maxwell Products. Claims must be made within three (3) months of the date of purchase. There is no other warranty either expressed or implied.

NuvoSealants.com

Maxwell Products Incorporated
650 South Delong Street
Salt Lake City, UT 84104
Toll Free 800.266.2090
Fax 801.972.5536
SPECIFICATION

Nuvo Spec 6690 Type II is a next generation hot pour polymer modified asphalt crack and concrete joint sealant that meets all the requirements of ASTM D 6690 Type II (ASTM D 3405) and AASHTO M-301 and exceeds ASTM D 6690 Type I (ASTM D 1190) and AASHTO M-324 Type I. It is formulated with InteliBond Technology to provide consistent performance in a wide range of climates, superior crack penetration, fast setup times, wide application temperature ranges and fast melt times. Packaged in our exclusive, fully meltable PolySkin Packaging, Nuvo sealants have set a new standard for ease of use, product performance and environmental awareness.

<table>
<thead>
<tr>
<th>Test</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cone Penetration: @ 77°F (25°C), ASTM D 5329</td>
<td>90 dmm max</td>
</tr>
<tr>
<td>Flow: @ 140°F (60°C), ASTM D 5329</td>
<td>3 mm max</td>
</tr>
<tr>
<td>Bond: @ -20°F (-29°C), 50% Ext. ASTM D 5329</td>
<td>Pass 3 cycles</td>
</tr>
<tr>
<td>Resilience: @ 77°F (25°C), ASTM D 5329</td>
<td>60% min</td>
</tr>
<tr>
<td>Softening Point: ASTM D 36</td>
<td>176°F (80°C) min</td>
</tr>
<tr>
<td>Asphalt Compatibility: ASTM D 5329</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Environmental Compliance - There shall be no cardboard or paper waste from packaging Pass
Safety Compliance - No sharp objects shall be required to open containers Pass
Productivity Enhancement - Materials can go directly from the pallet to the melter without any preparation Pass
Storage Concerns - Containers shall be waterproof and interlocking to ensure effective outdoor storage Pass

Application

Before use, the user must read and follow the Application Instructions for the above referenced sealant. This product may be heated using indirect heating systems or in direct fire melting systems. Equipment must have means of maintaining constant agitation to the material.

Maximum safe heating temperature: 400°F (204°C). Recommended application temperature: 380°F (193°C).

Warranty

Maxwell Products, Inc. warrants that Nuvo™ Sealants meet the applicable specifications at the time of shipment. Due to the many differing procedures used in preparing and installing sealants, Maxwell Products assumes no liability for sealant failure due to improper installation, equipment failure or operator errors. Any remedies are limited, at Maxwell Products' option, to replacement of materials or refund (full or partial) of the purchase price from Maxwell Products. Claims must be made within three (3) months of the date of purchase. There is no other warranty either expressed or implied.

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Modified 8/11
SPECIFICATION

Nuvo Spec 6690 Type 4 is a next generation hot pour polymer modified asphalt crack and concrete joint sealant that meets all the requirements of ASTM D 6690 Type 4. This product is self-leveling, easy to apply and will not track in summer temperatures common in cooler climates. It is formulated with Intellibond Technology to provide consistent performance, superior crack penetration, fast setup times, wide application temperature ranges and fast melt times. Packaged in our exclusive, fully meltable Polyskin Packaging, Nuvo sealants have set a new standard for ease of use, product performance and environmental awareness.

<table>
<thead>
<tr>
<th>Test</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cone Penetration: @ 77°F (25°C), ASTM D 5329</td>
<td>90 - 150 dmm</td>
</tr>
<tr>
<td>Bond: @ -20°F (-29°C), 200% Ext. ASTM D 5329</td>
<td>Pass 3 cycles</td>
</tr>
<tr>
<td>Softening Point: ASTM D 36</td>
<td>176°F (80°C) min</td>
</tr>
<tr>
<td>Resilience: @ 77°F (25°C), ASTM D 5329</td>
<td>60% min</td>
</tr>
<tr>
<td>Asphalt Compatibility: ASTM D 5329</td>
<td>Pass</td>
</tr>
<tr>
<td>Environmental Compliance - There shall be no cardboard or paper waste from packaging</td>
<td>Pass</td>
</tr>
<tr>
<td>Safety Compliance - No sharp objects shall be required to open containers</td>
<td>Pass</td>
</tr>
<tr>
<td>Productivity Enhancement - Materials can go directly from the pallet to the melter without any preparation</td>
<td>Pass</td>
</tr>
<tr>
<td>Storage Concerns - Containers shall be waterproof and interlocking to ensure effective outdoor storage</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Application

Before use, the user must read and follow the Application Instructions for the above referenced sealant. This product may be heated using indirect heating systems or in direct fire melting systems. Equipment must have means of maintaining constant agitation to the material.

Maximum safe heating temperature: 400°F (204°C).
Recommended application temperature: 380°F (193°C).

Warranty

Maxwell Products, Inc. warrants that Nuvo™ Sealants meet the applicable specifications at the time of shipment. Due to the many differing procedures used in preparing and installing sealants, Maxwell Products assumes no liability for sealant failure due to improper installation, equipment failure or operator errors. Any remedies are limited, at Maxwell Products' option, to replacement of materials or refund (full or partial) of the purchase price from Maxwell Products. Claims must be made within three (3) months of the date of purchase. There is no other warranty either expressed or implied.

NuvoSealants.com

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Fax 801.972.5536

Modified 8/11
SPECIFICATION

Nuvo Spec 3405 is a next generation hot pour polymer modified asphalt crack and concrete joint sealant that exceeds all the requirements of ASTM D 6690 Type II (ASTM D 3405), AASHTO M-301, ASTM D 6690 Type I (ASTM D 1190) and Federal Spec SS-S 1401C. It is formulated with InteliBond™ Technology to provide consistent performance in a wide range of climates, superior crack penetration, fast setup times, wide application temperature ranges and fast melt times. Packaged in our exclusive, fully meltable PolySkin™ Packaging, Nuvo™ sealants have set a new standard for ease of use, product performance and environmental awareness.

<table>
<thead>
<tr>
<th>Test</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cone Penetration: @ 77°F (25°C), ASTM D 5329</td>
<td>90 max</td>
</tr>
<tr>
<td>Flow: @ 140°F (60°C), ASTM D 5329</td>
<td>3 min max</td>
</tr>
<tr>
<td>Bond: @ -20°F (-29°C), 100% Ext. ASTM D 5329</td>
<td>Pass 3 cycles</td>
</tr>
<tr>
<td>Resilience: @ 77°F (25°C), ASTM D 5329</td>
<td>60% min</td>
</tr>
<tr>
<td>Softening Point: ASTM D 36</td>
<td>176°F (80°C)</td>
</tr>
<tr>
<td>Flexibility: 2 Sec. 1” Mandrel: ASTM D 3111</td>
<td>-30°F min (-34°C)</td>
</tr>
<tr>
<td>Asphalt Compatibility: ASTM D 5329</td>
<td>Pass</td>
</tr>
</tbody>
</table>

**Environmental Compliance** - There shall be no cardboard or paper waste from packaging

**Safety Compliance** - No sharp objects shall be required to open containers

**Productivity Enhancement** - Materials can go directly from the pallet to the melter without any preparation

**Storage Concerns** - Containers shall be waterproof and interlocking to ensure effective outdoor storage

**Application**

Before use, the user must read and follow the Application instructions for the above referenced sealant. This product must be heated using indirect heating methods, either a double boiler or hot oil circulating kettle. Equipment must have means of maintaining constant agitation to the material. **Maximum safe heating temperature: 400°F (204°C).**

Recommended application temperature: 380°F (193°C).

**Warranty**

Maxwell Products, Inc. warrants that Nuvo™ Sealants meet the applicable specifications at the time of shipment. Due to the many differing procedures used in preparing and installing sealants, Maxwell Products assumes no liability for sealant failure due to improper installation, equipment failure or operator errors. Any remedies are limited, at Maxwell Products’ option, to replacement of materials or refund (full or partial) of the purchase price from Maxwell Products. Claims must be made within three (3) months of the date of purchase. There is no other warranty either expressed or implied.

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Modified 7/12
**SPECIFICATION**

Nuvo GAP is hot-applied polymer modified asphalt mixed with engineered aggregates and modifiers designed to fill wide cracks and potholes to prevent water infiltration and restore ride quality. Nuvo GAP is designed as a permanent repair solution for wide thermal cracks, potholes, rutting and depressed broken-up areas. It is also recommended for use around solid structures in flexible pavements like manholes, gutters, and drains.

<table>
<thead>
<tr>
<th>BINDER SPECIFICATION</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility: 2 Sec. 1&quot; Mandrel</td>
<td>-15° min. (-26.1°C)</td>
</tr>
<tr>
<td>Resilience: @ 77°F (25°C), ASTM D5329</td>
<td>35% min.</td>
</tr>
<tr>
<td>Tensile Adhesion: ASTM D 5129</td>
<td>400% min.</td>
</tr>
</tbody>
</table>

**AGGREGATE SPECIFICATION:**

- Specific Gravity (As per manufacturer's certification): 1.5
- Porosity (As per manufacturer's certification): 10% poros min
- Shear Strength (As per manufacturer's certification): 30% min

**PACKAGING SPECIFICATION:**

- Melttable/Inclusive Packaging: Packaging shall completely melt into solution at 380°F or lower
- Environmental Compliance: There shall be no cardboard or paper waste from packaging
- Safety Compliance: No sharp objects shall be required to open containers
- Productivity Enhancement: Materials can go directly from the pallet to the melter without any preparation
- Storage Concerns: Containers shall be weather resistant and interlocking for effective outdoor storage

**Application**

Before use, the user must read and follow the Application Instructions for the above referenced sealant. This product may be heated using indirect heating systems or in direct fire melting systems. Equipment must have means of maintaining constant agitation to the material.

**Maximum safe heating temperature: 400°F (204°C).**
**Recommended application temperature: 380°F (193°C).**

**Warranty**

Maxwell Products, Inc. warrants that Nuvo™ Sealants meet the applicable specifications at the time of shipment. Due to the many differing procedures used in preparing and installing sealants, Maxwell Products assumes no liability for sealant failure due to improper installation, equipment failure or operator errors. Any remedies are limited, at Maxwell Products' option, to replacement of materials or refund (full or partial) of the purchase price from Maxwell Products. Claims must be made within three (3) months of the date of purchase. There is no other warranty either expressed or implied.

NuvoSealants.com
Maxwell Products Incorporated
650 South Delong Street
Salt Lake City, UT 84104
Toll Free 800.266.2090
Fax 801.972.5536
**Nuvo™ CS** is a next generation hot pour polymer modified asphalt crack and concrete joint sealant. The workhorse of the Nuvo™ line, our CS products are formulated with Intelibond™ Technology to provide consistent performance in a wide range of climates, superior crack penetration, fast setup times, wide application temperature ranges and fast melt times. Packaged in our exclusive, fully meltable PolySkin™ Packaging, Nuvo™ sealants have set a new standard for ease of use, product performance and environmental awareness.

<table>
<thead>
<tr>
<th>Test</th>
<th>Formulation A</th>
<th>Formulation B</th>
<th>Formulation C</th>
<th>Formulation D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cone Penetration: @ 77°F (25°C), ASTM D 5</td>
<td>50 - 70</td>
<td>30 - 50</td>
<td>25 - 45</td>
<td>20 - 35</td>
</tr>
<tr>
<td>Flexibility: 2 Sec. 1” Mandrel</td>
<td>-20°F (-29°C)</td>
<td>-10°F (-23°C)</td>
<td>20°F (-7°C)</td>
<td>30°F (-11°C)</td>
</tr>
<tr>
<td>Softening Point: ASTM D 36</td>
<td>195 min</td>
<td>205 min</td>
<td>210 min</td>
<td>210 min</td>
</tr>
<tr>
<td>Ductility: @ 77°F (25°C), 5 cm/min.</td>
<td>40 cm min</td>
<td>50 cm min</td>
<td>50 cm min</td>
<td>50 cm min</td>
</tr>
<tr>
<td>Resilience: @ 77°F (25°C), ASTM D 5329</td>
<td>60% min</td>
<td>40% - 55%</td>
<td>35% - 50%</td>
<td>35% - 50%</td>
</tr>
<tr>
<td>Flow: @ 140°F (60°C), ASTM D 5329</td>
<td>5 max</td>
<td>3 max</td>
<td>3 max</td>
<td>3 max</td>
</tr>
<tr>
<td>Environmental Compliance - There shall be no cardboard or paper waste from packaging</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
</tr>
<tr>
<td>Safety Compliance - No sharp objects shall be required to open containers</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
</tr>
<tr>
<td>Productivity Enhancement - Materials can go directly from the pallet to the melter without any preparation</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
</tr>
<tr>
<td>Storage Concerns - Containers shall be waterproof and interlocking to ensure effective outdoor storage</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
</tr>
</tbody>
</table>

**Application**

Before use, the user must read and follow the Application Instructions for the above referenced sealant. This product must be heated using indirect heating methods, either a double boiler or hot oil circulating kettle. Equipment must have means of maintaining constant agitation to the material.

Maximum safe heating temperature: 400°F (204°C).

Recommended application temperature: 380°F (193°C).

**Warranty**

Maxwell Products, Inc. warrants that Nuvo™ Sealants meet the applicable specifications at the time of shipment. Due to the many differing procedures used in preparing and installing sealants, Maxwell Products assumes no liability for sealant failure due to improper installation, equipment failure or operator errors. Any remedies are limited, at Maxwell Products’ option, to replacement of materials or refund (full or partial) of the purchase price from Maxwell Products. Claims must be made within three (3) months of the date of purchase. There is no other warranty either expressed or implied.
B.5 TRICOR REFINING, LLC
CRF® Restorative Seal... is applied to pavements that exhibit more moderate deterioration such as increased raveling, loss of aggregate, brittleness, past the point where Reclamite®, our maltene based rejuvenator would be beneficial. CRF® Restorative Seal remains flexible and resilient to create a “seal in depth”. CRF® is applied in conventional surface spray applications. Drag broom or scrub seal methods can be utilized to even out and work the emulsion/sand combination into the voids and cracks. CRF® Restorative Seal can provide an economical alternative to conventional wear course seals.

CRF® Cold Pour Crackfiller... economical, safe and easy cleanup. Applied as supplied, CRF® is an easy to use emulsion that remains resilient through climatic changes. CRF® is a stable, easy to store emulsion with a long shelf life. Its handling qualities provide many uses from crack filling and spray patching applications to use as a restorative rejuvenator with infrared patching equipment.

Advantages:
- Flexible Emulsion
- Long Storage Life
- Does not Require Heat
- Resilient
- Resists Oxidation

TRICOR REFINING, LLC
PRODUCERS of GOLDEN BEAR PRESERVATION PRODUCTS

TRICOR REFINING, LLC, is a joint partnership of Ergen, Inc. and San Joaquin Refining, Inc.
CRF® provides pavement rejuvenation as well as sealing the pavement surface, unlike standard asphalt emulsion that hardens and becomes brittle. CRF® was designed to be a corrective maintenance product that effectively repairs cracks as a "cold pour crack filler" in concentrated form and provides a pavement "restorative seal" when applied in diluted form.

CRF® Restorative Seal is a petroleum oil and water cationic emulsion. Unlike standard asphalt emulsion, CRF® does not harden or "dry out". Designed as a one component emulsion that effectively repairs cracks in concentrated form, CRF® provides an excellent pavement restorative seal when applied in diluted form.

CRF® Restorative Seal is a modern sand seal product. Sand penetrates the emulsion and adds additional binder strength. This sand/emulsion combination is kneaded by vehicular traffic to provide a long term seal.

CRF® Restorative Seal is superior to standard asphalt emulsions: CSS or SS emulsions. Lower in asphaltenes with rejuvenator qualities, it is less receptive to oxidation. Not just designed to "coat" the surface aggregate, CRF® holds the sand added to it and the emulsion fills surface voids with a very flexible product.

HOW DO YOU APPLY CRF® RESTORATIVE SEAL?

CRF® Restorative Seal is diluted with water 2:1 (2 parts product to 1 part water) or 1:1. Typical cure time is 20 minutes to one hour with minimum ambient temperature of 10°C or 50°F and rising. Product stability is excellent. There is a simple procedure to determine the amount of CRF® Restorative Seal that a pavement can absorb by use of a test kit. The kit contains all the necessary materials and detailed instructions on test procedures to determine the quantity and rate of absorption.

There are several methods of application, which offer excellent results:

• RESTORATIVE SEAL: consists of distributor truck application at a predetermined rate of spread, allowed to cure and then sand is applied.

• BROOM SEAL/ SCRUB SEAL: application of a predetermined rate of spread by distributor truck, sand application after curing followed by a broom system to even out and work the sand into more of the open areas. With traffic's kneading action, CRF® will tighten up and seal the open areas.

• SQUEEGEE SEAL: is an excellent restorative seal method of initially filling open areas with CRF® by working the product into those areas with a rubber blade. A second application can be made, if required, after the first is allowed to cure. Sand and roll using a rubber-tired roller. This method will seal the surface; repair cracks and distressed sections at a low cost. This application is also used for "high production" crack filling.
RECLAMITE

Asphalt pavement rejuvenating agent

Preservative Seal

WHAT IS RECLAMITE® PRESERVATIVE SEAL?

Reclamite® is an emulsion of specific petroleum oils and resins designed to penetrate dry and weathered asphalt pavements. Reclamite® penetrates seeking the asphalt in the pavement in preference to the aggregate. The result is that Reclamite® combines with the asphalt so as to restore its original desirable properties. In some cases the asphalt is improved over the original because of the superior quality of the added components.

Reclamite® stops pavement deterioration where it begins, at the top. The light components or fractions in the asphalt binder referred to as maltenes oxidize from the binder causing asphalt to become dry and brittle. The resulting loss of aggregate, cracking and moisture intrusion furthers pavement deterioration that will eventually without intervention, lead to total pavement failure.

Pavements exhibiting early signs of aging (hairline cracking, raveling, segregation, pitting, dryness) as well as new asphalt pavement are excellent candidates for Reclamite® Preservative Seal treatment. Reclamite® increases penetration values and reduces viscosity values. Reclamite® seals out moisture, restores the asphaltene/maltenes balance. Reclamite® having natural solvency ability because of its naphthenic base, fluxes with the asphalt restoring the aggregate/asphalt bond.

Reclamite® Preservative Seal will preserve an asphalt pavement at one-half to one-third the cost of other conventional treatments.
HOW RECLAMITE® PRESERVATIVE SEAL EXTENDS PAVEMENT LIFE.

Reclamite® has been used successfully for over 40 years. Whether you are dealing with asphalt pavement in the hot, dry southwest United States, humid southern and southeast states or the damp and colder climates experienced in northern climates and Canada, application results are similar; improved durability of the asphalt, (durability being the interdependence between composition and aging), re-balancing the chemistry of the oxidized pavement, ability to delay the aging process and reverse premature aging.

Reclamite® Preservative Seal provides a simple, one step method for sealing and waterproofing the asphalt. It is effective for extending the life of newly constructed pavement.

Reclamite® delays the aging process by replenishing the maltenes and re-constituting the binder. Aged asphalt can be restored to a new and highly durable mix, virtually equal to or better than the original consistency.

Asphalt consists of five basic components: asphaltenes, polar compounds, first acidaffins, second acidaffins and saturated hydrocarbons. The latter four are referred to as maltene fractions. These components in asphalt are subject to weathering and oxidation.

Reclamite® is spray applied. The emulsion is diluted 2:1 (product to water) or 1:1 with water. Application rates are measured in square yards or meters and vary according to pavement absorption and application needs. Normal treatment can provide 5-7 years additional service life. A second application can be considered at that time.

Reclamite® is an emulsion manufactured from a naphthenic crude stock. Naphthenic base is wax free, has a natural low pour point and has excellent natural solvency ability allowing it to penetrate and absorb.

Your Reclamite Representative:
Appendix C  Questionnaires

C.1 WITHIN SASKATCHEWAN
C.2 OUTSIDE SASKATCHEWAN
C.1 WITHIN SASKATCHEWAN
Asphalt Crack Sealing
Communities of Tomorrow
1110000046

Crack Sealing Practices and Processes Questionnaire

Please return completed questionnaire by October 29th, 2012 to carlyle.murray@stantec.com

1. Does your Municipality crack seal asphalt pavement or concrete pavement as part of its Preventative Pavement Maintenance Program?
   □ Yes  □ No

2. If yes, what months does the Municipality crack seal?
   □ April  □ May  □ June  □ July
   □ August  □ September  □ Other___________

3. If yes, what type of sealant is used?
   □ Hot Pour Sealant  □ Cold Pour Sealant
   Brand Name: _______________
   Reason for Choice: __________

4. What is the average unit cost of the Municipality’s crack sealing program ___________?

5. Is the crack sealing done in house or by a contractor?
   □ In House  □ Contractor

6. What type and size of cracks are sealed with the method being used?
   ______________________________________________________
   ______________________________________________________

7. What method is used to prepare/clean cracks prior to sealing?
   □ Wire brush  □ Routing
   □ Compressed air  □ Hot compressed air lance
   □ Sawing  □ Pressurized water
   □ Routing and compressed air  □ Other (specify)___________

8. How many years has the Municipality been crack sealing? ________
9. After surfacing/resurfacing a roadway, how many years does the Municipality wait prior to crack sealing?
   - [ ] 1 Year
   - [ ] 2 Year
   - [ ] 3 Year
   - [ ] 4 Year
   - [ ] Other (specify)

10. How often does the Municipality crack seal a section of roadway?
    - [ ] Once
    - [ ] Twice
    - [ ] Three times
    - [ ] Other (specify)

11. Has your Municipality encountered any difficulties resurfacing a section of roadway as a result of crack sealing?
    - [ ] Yes
    - [ ] No

12. What other preventative maintenance treatments are used by the Municipality?
    - [ ] Slurry seal
    - [ ] Sand seal
    - [ ] Chip seal
    - [ ] Fog seal
    - [ ] Crack filling
    - [ ] Asphalt rejuvenators
    - [ ] Micro-surfacing
    - [ ] Other specify __________

13. Does your Municipality have a field evaluation for crack sealing performance?
    - [ ] Yes
    - [ ] No

14. Rate the performance of your Municipality's crack sealing program.
    - [ ] Poor
    - [ ] Fair
    - [ ] Good
    - [ ] Very good
    - [ ] Other (specify)

15. Are any of the following application factors recorded?
    - [ ] Date and Time
    - [ ] Location
    - [ ] Air temperature
    - [ ] Pavement temperature
    - [ ] Sealant temperature
    - [ ] Total length of transverse crack sealed
    - [ ] Total length of longitudinal cracks sealed
    - [ ] Other factors are recorded (please list)? __________
C.2 OUTSIDE OF SASKATCHEWAN
Crack Sealing Practices and Processes Questionnaire

Please return completed questionnaire by November 14, 2012 to carlyle.murray@stantec.com

1. Does your Jurisdiction crack seal asphalt pavement or concrete pavement as part of its Preventative Pavement Maintenance Program?
   □ Yes          □ No

2. If yes, what months does the Jurisdiction crack seal?
   □ April       □ May       □ June       □ July
   □ August      □ September □ Other ___________

3. If yes, what type of sealant is used?
   □ Hot Pour Sealant       □ Cold Pour Sealant
   Brand Name: ______________
   Reason for Choice: ________

4. What is the average unit cost of the Jurisdiction’s crack sealing program ________?

5. Is the crack sealing done in house or by a contractor?
   □ In House       □ Contractor

6. What type and size of cracks are sealed with the method being used?
   ____________________________________________________________________

7. What method is used to prepare/clean cracks prior to sealing?
   □ Wire brush          □ Routing
   □ Compressed air      □ Hot compressed air lance
   □ Sawing             □ Pressurized water
   □ Routing and compressed air □ Other (specify) __________

8. How many years has the Jurisdiction been crack sealing? ________
9. After surfacing/resurfacing a roadway, how many years does the Jurisdiction wait prior to crack sealing?

- [ ] 1 Year
- [ ] 2 Year
- [ ] 3 Year
- [ ] 4 Year
- [ ] Other (specify)

10. How often does the Jurisdiction crack seal a section of roadway?

- [ ] Once
- [ ] Twice
- [ ] Three times
- [ ] Other (specify)

11. Has your Jurisdiction encountered any difficulties resurfacing a section of roadway as a result of crack sealing?

- [ ] Yes
- [ ] No

12. What other preventative maintenance treatments are used by the Jurisdiction?

- [ ] Slurry seal
- [ ] Sand seal
- [ ] Chip seal
- [ ] Fog seal
- [ ] Crack filling
- [ ] Asphalt rejuvenators
- [ ] Micro-surfacing
- [ ] Other (specify) __________

13. Does your Jurisdiction have a field evaluation for crack sealing performance?

- [ ] Yes
- [ ] No

14. Rate the performance of your Jurisdiction’s crack sealing program.

- [ ] Poor
- [ ] Fair
- [ ] Good
- [ ] Very Good
- [ ] Other (specify)

15. Are any of the following application factors recorded?

- [ ] Date and Time
- [ ] Location
- [ ] Air temperature
- [ ] Pavement temperature
- [ ] Sealant temperature
- [ ] Total length of transverse crack sealed
- [ ] Total length of longitudinal cracks sealed
- [ ] Other factors are recorded (please list)? __________
Appendix D  Checklists

D.1  CRACK SEAL APPLICATION
D.2  QUALITY CONTROL CHECKLIST
D.3  INSPECTION CHECKLIST FOR CONSTRUCTION
D.1 CRACK SEAL APPLICATION
Crack Seal Application Checklist

This checklist is one of a series created to guide State and local highway maintenance and inspection staff in the use of innovative pavement preventive maintenance processes. The series is provided through the joint efforts of the Pavement Preservation Program of the Federal Highway Administration (FHWA), and the Foundation for Pavement Preservation (FP²).

FHWA uses its partnerships with FP², the American Association of State Highway and Transportation Officials, and State and local transportation agencies to promote pavement preservation.

To obtain other checklists or to find out more about pavement preservation, contact your local FHWA division office or FP² (at www.fp2.org), and check into the Pavement Preservation Web page: www.fhwa.dot.gov/infrastructure/asmgmt/resource.htm
Crack Seal Application Checklist

Preliminary Responsibilities

Project Review
- Is this project a good candidate for crack sealing?
- What type of cracking is there?
- What is the frequency and severity of the cracking?
- What is the frequency and severity of other pavement distresses?
- Review project for bid quantities.

Document Review
- Bid specifications
- Special provision
- Traffic control plan (TCP)
- Construction manual
- Agency application requirements
- Manufacturer's sealant installation instructions
- Sealant MSDS
Crack Seal Application

Materials Checks

☐ Sealants are selected based on temperature, traffic, and pedestrian traffic requirements.

☐ Sealant is from an approved source or listed on agency Qualified Products List (QPL) (if required).

☐ Sealant has been sampled and tested prior to installation (if required).

☐ Sealant packaging is not damaged in ways that would prevent proper use (boxes leaking, pails/drums dented or pierced).

☐ If blotter material is to be used, it has been approved by the agency.

☐ If backer rod is to be used, it is compatible with the sealant.
Preapplication Inspection Responsibilities

Surface Preparation
- The surface is clean and dry.
- Other pavement distresses have been repaired.

Equipment Inspections

Hot Applied Sealant Melters
- For hot applied sealants, an indirectly heated double boiler type melter with effective agitation is being used.
- Melter is in good working order with all heating, agitation, pumping systems, valves, thermostats, and other parts functioning.
- Melter heating system is thermostatically controlled.
- Temperature gauges are calibrated and checked for accuracy.
- Proper wand tips for desired application are used.

Other Application Equipment
- Pump for cold applied sealant functions correctly.
- Pour pots are in good working order.
- Material squeegees or other shaping/forming tools are clean, in good condition, and of appropriate configuration to produce desired sealant shape.
Crack Seal Application

Crack Cutting/Cleaning Equipment

☐ Crack cutters/routers are in good working order.
☐ The router/cutter configuration is adjusted to the required reservoir width.
☐ Cutting tools are in good condition, with no missing, chipped, rounded, or broken teeth.
☐ Air compressors have sufficient pressure and volume to clean cracks adequately and meet agency requirements.
☐ Air compressors are equipped with oil and moisture filters/traps that function properly.
☐ Hot air blaster/heat lances (if used) are working properly.
☐ Vacuum cleaning system (if used) is functioning properly.

Weather Requirements

☐ Review of manufacturer’s installation instructions for requirements specific to sealant use is completed.
☐ Ambient and/or surface temperature meet manufacturer and all agency requirements (typically 40°F and rising) for routing and sealing.
☐ Sealing does not proceed if rain is imminent.
☐ Application does not begin if there is any moisture on the surface or in the crack.
**Traffic Control**

- Signs and devices match the traffic control plan.
- The set-up complies with the local agency or Federal Manual on Uniform Traffic Control Devices (MUTCD).
- Flaggers do not hold traffic for too long.
- Any unsafe conditions are reported to a supervisor.
- Traffic is not opened to the sealed pavement until the sealant has adequately cooled or cured to not pick up on vehicle tires.
- Signs are removed or covered when they are no longer needed.

**Project Inspection Responsibilities**

**Reservoir Cutting**

- Routed reservoir is checked for correct configuration (width and depth).
- The asphalt concrete mixture is in sound enough condition to produce the required reservoir configuration without excessive spalling of the pavement during cutting.
- The cut reservoir is centered over the crack, and cutting of both sides of the crack back to sound pavement has occurred.
- Operator is wearing proper personal protective equipment.
- All safety mechanisms and guards on equipment are functioning properly.

---

*Crack Seal Application*
Crack Cleaning (air blowing)

- Dirt and debris are blown from the crack. Dirt has not been blown from one crack to another that has already been cleaned. All dirt and debris are blown off the roadway.

- Check is conducted to verify that the crack has had all loosened dirt and debris removed by running a finger along the crack's sidewalls and examining for loose pavement, dust, and debris. If any dirt is found, crack is recleaned.

- Check is conducted for moisture in the crack and along the reservoir's sidewalls. If moisture is found, necessary steps are taken to remove the moisture.

- Operator is wearing proper personal protective equipment.

- Cleaning operation is positioned just ahead of the sealing operation to guard against debris blowing into cleaned cracks or newly sealed cracks.

Hot Air Blasting

- Hot air blasting is conducted immediately ahead of hot applied sealant installation to minimize condensation formation prior to sealing and to maintain warm temperature (5 minutes maximum time or 50 m [54 yards] maximum distance).

- Heated surfaces is slightly darkened and warmed. **EXTREME CAUTION IS USED** not to burn the existing pavement surface.

- Proper personal protective equipment is worn by operator.
Sealant Application

Hot Applied Sealants

- Manufacturer’s and agency’s temperature installation requirements are being followed.
- Melter heat transfer medium is heated to the correct temperature range.
- Sealant is heated to a minimum of the manufacturer’s recommended pouring or application temperature, but temperature does not exceed the material’s safe heating temperature.
- Sealant is continuously agitated to assure uniformity, except when adding additional material.
- Operator is wearing required personal protective equipment.
- If meter is equipped with a heated hose system, the hose is heated to operating temperature prior to beginning sealant application.
- If meter does not have a heated hose, the hose is verified to be unplugged and clear prior to beginning application.
- Sealant is recirculated through the hose to warm the hose prior to application. During idle periods, or if it is noted that sealant is cooling through the hose, sealant is recirculated through the hose back into the material vat to maintain hose temperature.
- Sealant temperature is checked periodically to assure proper temperatures.
Crack Seal Application

- Melting vat is kept at least one third full to help maintain temperature uniformity.
- Crack channel/reservoir is filled from the bottom up, to the specified level.
- Sealant material is formed/squeegeed/finished (if required) to the specified configuration.
- Sufficient material is applied to form the specified configuration, but not so much as to oversupply squeegee.
- Surface Band-aid applications (if required) are within the specified thickness and width.
- De-tackifier or other blotter is applied to reduce tack prior to opening to traffic, if needed.
- Any sealant over band is centered over the crack.
- Sealant is reapplied to low areas where sealant has settled or where too little material was applied.
- Adhesion is checked by pulling up cooled sealant. Unbonded sealant is removed and crack is resealed.

Cold Applied Sealant

- Manufacturer's installation instructions are followed.
- Sealant is applied using appropriate pumps or other application systems.
- Sealant is applied in the specified configuration.
- Sealant is allowed to cure for sufficient time to resist pick-up prior to opening to traffic.
Cleanup Responsibilities

- Excessive sealant application or spills are removed.
- All loose debris from cleaning is removed from the pavement surface.
- Sealant containers or other miscellaneous debris is removed and disposed of properly.
- Meters or other application equipment are properly cleaned for the next use.

Common Problems and Solutions

(Problem: Solution)

- **Sealant not adhering to crack:**
  1. Crack not clean enough—re-clean.
  2. Wet cracks—allow to dry, or use heat lance.
  3. Low sealant application temperature—verify temperature gauges on melter; heat to correct temperature.
  4. Cold ambient temperature—allow temperature to rise, or use heat lance.
Crack Seal Application

☐ **Sealant pick-up when opened to traffic:**

1. Opened to traffic too soon after application—delay opening.
2. Cracks not clean and/or dry; re-clean or dry.
3. High ambient temperature—seal in cooler temperatures.
4. Excessive sealant application—apply flush with surface.
5. Sealant too soft for climate—use stiffer sealant.
6. Use a detackifier or blotter to reduce initial tack.
7. Overheated or underheated sealant—install at correct temperature; check temperature gauges on melter.
8. Sealant contaminated with solvent or heat transfer oil from tank leak.

☐ **Sealant cracking or debonding in winter:**

1. Sealant too stiff—use softer grade.
2. Excessive pavement distresses.
3. Poor cleaning during installation—improve cleaning.
4. Not providing a widened reservoir—use a widened reservoir configuration.
5. Snowplows pulling out sealant—apply sealant flush with pavement.
6. Sealant installed too deep in crack—use correct depth to width ratio.
☐ Sealant gelling in melter:
   1. Overheated sealant—check melter temperature gauges
   2. Sealant reheated too many times—use fresh sealant
   3. Use of sealant with short pot life—use sealant with longer pot life

☐ Bumps in asphalt concrete overlays; sealant adhering to overlay and interrupting shoving during mix compaction:
   1. Excessive sealant applications on surface—use recessed or surface flushed sealant application.
   2. Seal at least 1 year prior to overlay.
   3. Apply detackifier or blotter to reduce sealant adhesion to overlay.
   4. Use of a pneumatic rubber tire roller as the breakdown roller—use of a dual-drive drum roller does not tend to shove the mix during compaction. Selection of roller type is especially critical for thin hot mix overlays.
   5. Use stiffer tack coat.
Crack Seal Application

Sources

Information in this checklist is based on or refers to the following sources:


Research Program (NCHRP), Transportation Research Board, Washington, DC.

For more information on pavement preservation, visit www.fhwa.dot.gov/infrastructure/asstmgmt/resource.htm or www.fp2.org
D.2 QUALITY CONTROL CHECKLIST
APPENDIX A: QUALITY CONTROL CHECKLIST

To increase the likelihood of extended service life, proper sealant installation is essential. Crack treatment has evolved over several decades, and best practices are most often the result of field experience, which is not always well documented. The following checklist, based on the current Canadian experience, is an update of an earlier one (Smith and Romine, 1993a). The greater the number of check marks (✔), the greater the possibility of a successful crack treatment.

1. Climatic Conditions
   - 1.1 Ambient temperature is at least 5°C to 7°C and rising.
   - 1.2 Fog/dew is absent.
   - 1.3 Early morning operations are in direct sunlight.

2. Routing
   - 2.1 Cutting tips are sufficiently sharp to minimize spalling and cracking.
   - 2.2 Router operators wear appropriate safety attire: hard hat, reflective vest, long-sleeved shirt, long pants, steel-toed boots, safety glasses, and hearing protection.
   - 2.3 Guards and safety mechanisms on equipment work properly.
   - 2.4 The router follows cracks without difficulty.
   - 2.5 Asphalt concrete pavement gives routs free of spalling.
   - 2.6 Rout dimensions are checked with a die every 30 minutes.

3. Material Preparation
   - 3.1 Melter operator wears appropriate safety attire: hard hat, reflective vest, long-sleeved shirt, long pants, gloves, steel-toed boots, and safety glasses.
   - 3.2 Before the workday began, the melter was empty and no material was reheated.
   - 3.3 The heating oil in the melter jacket is not fuming and its level is adequate.
   - 3.4 The melter’s temperature gauge was calibrated in the last 6 months.
   - 3.5 If the temperature gauge was not calibrated, then
     a) the sealant temperature is measured with a hand-held thermometer every 30 minutes;
     b) the reading of the melter temperature gauge is the same as that for a hand-held thermometer.
   - 3.6 Throughout the day, the sealant was never heated above the manufacturer’s recommended pouring temperature.
   - 3.7 The material safety data sheet (MSDS) for the product to be applied is available on-site.
4. Cleaning of AC and Routs

- 4.1 Operators of cleaning equipment wear appropriate safety attire: hard hats, reflective vests, long-sleeved shirts, long pants, gloves, steel-toed boots, safety glasses, and hearing protection.
- 4.2 Dirt and debris are removed from the pavement surface with a power sweeper or vacuum cleaner.
- 4.3 The compressor for high-pressure air provides at least 700 kPa of pressure.
- 4.4 The oil and moisture filters on the compressor work properly. (Check by directing the airflow at the side of a tire.)
- 4.5 If in use, the temperature of the hot-air lance (HAL) is below 500°C (tip is not coloured), and the tip is 5 cm to 10 cm from the crack or rout. Confirm that the rout and pavement surface are not discoloured from overheating with the HAL and that its use immediately precedes the sealing operation (i.e., within 2 metres).
- 4.6 Crack/rout cleanliness is checked every 30 minutes. (Use 1 m of duct tape to check for dirt, dust, or grit.)
- 4.7 The rout/crack is dry. There is no moisture or condensation visible along the crack sidewalls or edges, both before and after the cleaning/heating treatment.

5. Sealant Application

- 5.1 The hot-pour sealant is poured at the manufacturer’s recommended pouring temperature and, preferably, at the lowest recommended temperature.
- 5.2 The sealant recirculates in the hose when the installation train is idle.
- 5.3 The crack or rout is bridged rather than flush-filled.
- 5.4 There is sufficient sealant to allow for a 5 to 10 mm band or bridge on either side of the sealant, when applicable.
- 5.5 Bubbles due to moisture are absent from the sealant after application.

6. Overbanding of Sealant (if not applicable go to section 7)

- 6.1 The overband is about 5 to 10 mm on either side of the crack or rout.
- 6.2 The overband is formed during sealant application, or immediately after.
- 6.3 Excess sealant is removed before it hardens.

7. Sealant Protection

- 7.1 At intersections, the hot-poured sealant surface is covered with wood shavings. Emulsions are not covered.
- 7.2 Traffic is rerouted until sealant has set. Always applies to emulsions.
D.3 INSPECTION CHECKLIST FOR CONSTRUCTION
Appendix D

Inspection Checklists for Construction

This appendix contains inspection checklists for the various operational steps in a sealing or filling operation. These checklists were developed for use by inspectors or supervisors to maximize workmanship in the field, giving crack treatment the best chance possible to perform well.

D.1 Crack Cutting

1. Cutting tips or blades are sufficiently sharp to minimize spalling and cracking.

2. Operator is wearing appropriate safety attire.

3. All guards and safety mechanisms on equipment are functioning properly.

4. Cutting equipment follows cracks so that the percentage of missed cracks is minimized (less than 5 percent missed cracks).

5. AC surface is not so cold as to inhibit cutting operations and cause excessive spalling or cracking.

6. AC surface mixture is not so coarse as to inhibit cutting operations and cause excessive spalling or cracking.

7. Cut reservoir dimensions are satisfactory and uniform, especially for bond-breaker application so that appropriate backer rod depth can be achieved.
D.2 Crack Cleaning and Drying

1. Oil and moisture filters on air compressor functioning properly. Periodic check for oil and moisture made by placing white towel over nozzle during operation.

2. Operator is wearing appropriate safety attire.

3. Dirt and debris are adequately blown from crack channel and surrounding pavement area to well off edge of roadway.

4. At least one pass on each side of crack channel is made with cleaning equipment.

5. When cleaning and drying with hot compressed air, intended bonding surfaces are darkened but not burned.

6. Cleaning operation is maintained just ahead of sealing or filling operation in order to retain crack cleanliness.

7. Hot airblasting operation is conducted immediately ahead of hot-applied sealant or filler installation so that the potential for moisture condensation is minimized and crack surface warmth is maximized (5 minutes or 50 m maximum).

8. Check periodically for crack cleanliness by running finger along crack sidewalls and examining for dirt, dust, or oxidized asphalt grit.

9. Check periodically for crack moisture visually and by feeling crack sidewalls.
10. Consistently check cracks for loosened fragments, and remove by hand those that will come free.

11. Blasting operations (sand or air) always proceeding away from and are directed away from passing traffic.

12. Airblasting and hot airblasting nozzles are held no more than 50 mm away from crack channel during first pass.

13. Sandblasting nozzle is directed against crack sidewalls and maintained 100 to 150 mm away.

D.3 Material Preparation and Installation

D.3.1 Backer Rod Installation

1. Backer rod placed to specified depth.

2. Wide crack segments filled with additional or larger backer rod.

3. Backer rod sufficiently compressed in reservoir so that the weight of uncured sealant does not force it down into the reservoir.

4. Surface of backer rod not damaged, twisted, or excessively stretched during installation.
D.3.2 Sealant or Filler Preparation and Installation

1. A double-boiler, agitator-type kettle with oil heat transfer is used for hot-applied, rubber-modified asphalt materials.

2. Kettle with full-sweep agitation and 50-mm recirculating pump used for fiberized asphalt applications.

3. Operator is wearing appropriate safety attire.

4. Melting vat kept at least one-third full of material to reduce chance of burning material or introducing air into pumping system.

5. Systematic check of material temperature in vat by both kettle temperature gauge and thermometer probe.

6. Recirculate material during idle periods.

7. Pump functions efficiently (no loss of power causing surges of material extrusion).

8. Crack channel filled with material from bottom up.

9. Crack channel filled with material to specified level in recessed configurations.

10. Sufficient amount of material is dispensed to form design configuration, but not so much as to oversupply squeegee.
11. Material is reapplied to crack segments that initially received too little material or experienced settling of material.

12. Material installation operations follow immediately behind cleaning and drying operation to retain crack cleanliness and, if hot airblasting, the potential for moisture condensation in the crack is minimized and crack warmth is maximized.

13. No bubbling due to moisture in crack channel after installing hot-applied materials.

14. Spilled material removed from the pavement surface.

15. Melter vat and application equipment thoroughly cleaned of contaminant materials.

D.4 Material Finishing/Shaping

1. Squeegee size and shape appropriate for planned material placement configuration.

2. Rubber inserts on squeegee cut to desired dimension for creating overband (periodically checking for cut-out wear).

3. Material buildup on squeegee being removed with propane torch.

4. Squeegee operated immediately after material application or strike-off delayed to allow overly runny material to cool in order to prevent slumping of band.
5. Band-aid squeegee consistently centered over crack.

6. Hot-applied material is cooling sufficiently to prevent tracking given the type of traffic control setup and ambient conditions.

7. Bond checked by peeling "cooled" hot-applied sealant from crack channel (check for moisture and dirt).

8. No bubbling due to moisture in crack channel after installation of hot-applied materials.

D.5 Material Blotting

1. Sufficient amount of sand applied to fully cover emulsion material.

2. Toilet paper, dust, or powder applied to fully cover hot-applied rubber-modified asphalts.

Source: FHWA Report No. FHWA-RD-99-147
Materials and Procedures for Sealing and filling Cracks in Asphalt-Surfaced Pavements
Manual of Practice
Created by: Federal Highway Administration
U.S. Department of Transportation
Strategic Highway Research Program - National Research Council
Appendix E  Specifications

E.1  ALBERT ASPHALT PAVEMENT CRACK SEALING SPECIFICATION
E.2  MANITOBA STANDARD PRACTICE FOR APPROVAL OF JOINT AND CRACK SEALANT FOR ASPHALT PAVEMENTS
E.3  SASKATCHEWAN MINISTRY OF HIGHWAYS AND INFRASTRUCTURE – 4215 – SPECIFICATION FOR RUBBER ASPHALT CRACK SEALING
E.4  ONTARIO PROVINCIAL STANDARD SPECIFICATION – CONSTRUCTION SPECIFICATION FOR ROUTING AND SEALING CRACKS IN HOT MIX ASPHALT PAVEMENT
E.5  CITY OF COLUMBUS PUBLIC SERVICE DEPARTMENT TRANSPORTATION DIVISION – SUPPLEMENTAL SPECIFICATION 1540 ASPHALT REJUVENATING AGENT, MAY 26, 2006
E.1 ALBERT ASPHALT PAVEMENT CRACK SEALING
SPECIFICATION
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<th>3.31</th>
<th>TABLE OF CONTENTS</th>
</tr>
</thead>
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</table>
3.31 ASPHALT PAVEMENT CRACK SEALING

3.31.1 GENERAL

The purpose of crack sealing is to prolong the life of existing pavements by preventing moisture from penetrating the roadway structure, and by preventing the spalling of material from the edges of the cracks.

The Work shall consist of sealing cracks with crack sealant between the limits shown on the plans or as directed by the Consultant.

3.31.2 MATERIALS

The Contractor shall supply all materials necessary for the Work including the crack sealant.

The Contractor shall choose the crack sealant to be used from the following list of approved products:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>SPECIFICATION CONFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Pour</td>
<td><strong>EC-101</strong> Cold Pour Rubber Filled Bituminous Emulsified Pavement Crack Sealant</td>
</tr>
<tr>
<td>M&amp;M Asphalt</td>
<td></td>
</tr>
<tr>
<td>Ace Asphalt &amp; Maintenance Ltd.</td>
<td></td>
</tr>
<tr>
<td>McAsphalt Industries Limited</td>
<td></td>
</tr>
<tr>
<td>Pounder Emulsions Limited</td>
<td></td>
</tr>
<tr>
<td>Elsro Construction Products</td>
<td></td>
</tr>
<tr>
<td>Hot Pour</td>
<td><strong>HC-200</strong> Hot Pour Bituminous Pavement Crack Sealant</td>
</tr>
<tr>
<td>Husky Oil Marketing Company</td>
<td></td>
</tr>
<tr>
<td>Elsro Construction Products</td>
<td></td>
</tr>
</tbody>
</table>

The Contractor shall provide the Consultant with the following information 5 days prior to commencing the Work:

- Name and mailing address of crack sealant supplier and manufacturer
- Name of crack sealant product to be supplied
- Written confirmation from the manufacturer that the crack sealant to be supplied meets all specified requirements along with test results that demonstrate that the product meets all specified requirements.

The Contractor shall verify that all crack sealant delivered and used in the Work is the type and grade ordered.

The Contractor shall supply the Consultant with the manufacturer's quality control test results (as identified in Table 3.31.2) for each batch of crack sealant. These test results shall be supplied at the time of delivery of each batch of crack sealant to the Work.

17 APRIL 2000
Table 3.31.2

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>QUALITY CONTROL TESTING REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLD POUR</td>
<td>a) Uniformity</td>
</tr>
<tr>
<td></td>
<td>b) Viscosity</td>
</tr>
<tr>
<td></td>
<td>c) Solids Content</td>
</tr>
<tr>
<td></td>
<td>d) Rate of Curing (24 hour)</td>
</tr>
<tr>
<td></td>
<td>EC-101</td>
</tr>
<tr>
<td></td>
<td>ASTM D562</td>
</tr>
<tr>
<td></td>
<td>ASTM D244</td>
</tr>
<tr>
<td></td>
<td>EC-101</td>
</tr>
<tr>
<td>HOT POUR</td>
<td>a) Softening Point</td>
</tr>
<tr>
<td></td>
<td>b) Penetration @ 25°C</td>
</tr>
<tr>
<td></td>
<td>c) Viscosity</td>
</tr>
<tr>
<td></td>
<td>ASTM D36</td>
</tr>
<tr>
<td></td>
<td>ASTM D5</td>
</tr>
<tr>
<td></td>
<td>ASTM D2170</td>
</tr>
</tbody>
</table>

When necessary, the Contractor shall supply one of the following blotting agents:

- screened sand with a maximum topsize of 2 mm
- cement
- flyash

The use of other products shall be subject to the approval of the Department

3.31.3 EQUIPMENT

The Contractor shall supply all equipment necessary for completion of the Work including but not limited to the melting kettle (Hot Pour only), crack sealing equipment and all related equipment such as fork lifts, hoists, and transport vehicles.

The melting kettle shall consist of a double jacketed oil bath kettle with continuous agitation equipment to prevent localized heating. The kettle must be equipped with two thermometers to show the temperature of the crack sealant and the temperature of the heat transfer oil.

Application equipment must be capable of regulating the application of crack sealant directly to the road.

3.31.4 CRACK SEALING

All Work shall be performed during daylight hours only. No Work shall be performed if the visibility is less than 700 metres. No Work shall be performed during rain or snow or when the pavement surface or cracks are wet. The maximum work area shall be 3 km in length.

Crack sealant shall not be applied when the atmospheric temperature at the construction site is below 0° Celsius.

All cracks within the entire width of the pavement surface, which are 5 mm and greater in width shall be sealed.

Prior to the application of crack sealant, the Contractor shall ensure that the road surface adjacent to the cracks is clean.

Hotpour crack sealant shall be heated to the temperature specified by the manufacturer. Overheating will not be permitted.
Crack sealant shall be applied within the manufacturer’s specified temperature range.

Crack sealant shall be applied so that the crack is flush filled immediately following application and a thin overband of sealant extends approximately 25 mm beyond the edges of the crack.

Excess crack sealant shall be removed from the pavement surface immediately following application. Removal shall involve the use of a squeegee, starting from the centerline and proceeding to the shoulder.

Traffic shall be kept off sealed cracks until the crack sealant will not track under the action of traffic. At locations such as intersections where this is not practical, the Contractor shall prevent tracking by applying a blotting agent to the crack sealant.

Fuel, asphalt and any other spills shall be cleaned up to the satisfaction of the Consultant at the Contractor’s expense.

Work that does not meet the foregoing requirements shall be repaired or reconstructed to the satisfaction of the Consultant and at the Contractor’s expense.

3.31.5 ACCEPTANCE SAMPLING AND TESTING

3.31.5.1 Acceptance Sampling and Testing of Crack Sealant

All crack sealant supplied shall be subject to inspection, sampling and testing by the Department and the Contractor shall cooperate in the inspection and sampling process. The Contractor shall obtain two representative samples of crack sealant material in accordance with ATT-42 for each Lot of production.

A Lot is defined as a day’s production of at least 5 km of roadway. If a day’s production is less than 5 km, it shall be added to the production of subsequent days until a minimum of 5 km is obtained for the Lot. If the last day’s production is less than 5 km, it shall be added to the previous Lot.

The Department will determine the frequency of testing of sealant. Cold Pour materials that do not conform to the specification limits shall result in a unit price adjustment for each km of roadway in the Lot in accordance with Table 3.31.6.

3.31.5.2 Appeal of Acceptance Test Results and Appeal Testing

The following procedures will apply for an appeal:

(i) Appeals will only be considered if the Contractor can demonstrate to the satisfaction of the Consultant that there is sufficient cause to support the appeal.

(ii) Acceptance test results for any penalized Lot may be appealed only once.

(iii) The Contractor shall serve notice of an appeal to the Consultant, in writing, within 24 hours of receipt of the test results.

(iv) For an appeal of the materials characteristics testing, the Consultant will conduct a retest on the duplicate material sample for the Lot.

(vii) The results of the original measurements will be averaged with the results of the new tests and the new averages shall form the basis for payment.

17 APRIL 2000
3.3.6 MEASUREMENT AND PAYMENT

Measurement will be made of the length of roadway, in kilometres, on which crack sealing has been performed.

A roadway will include all travel lanes, shoulders, acceleration and deceleration lanes, truck turnouts and intersections. A divided or twinned highway will be considered two separate roadways.

Payment will be made at the unit price bid per kilometre for "Crack Sealing" subject to the unit price adjustments specified herein. This payment will be full compensation for cleaning the road surface adjacent to the cracks, supplying and applying the crack sealant, quality control, traffic accommodation and signing.

The following unit price adjustments apply only to EC-101 or other approved cold pour materials and do not relieve the Contractor of the requirements to complete the Work in accordance with these specifications.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Unit Price Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solids (%)</td>
<td></td>
</tr>
<tr>
<td>≥ 59</td>
<td>No Adjustment</td>
</tr>
<tr>
<td>58.9 to 54.0</td>
<td>5 %</td>
</tr>
<tr>
<td>53.9 to 49.0</td>
<td>10 %</td>
</tr>
<tr>
<td>&lt; 49</td>
<td>15 %</td>
</tr>
</tbody>
</table>

The unit price applicable to each Lot quantity of "Crack Sealing" shall be as follows:

\[ L_k = B_P - (B_P \times A_F) \]

Where

- \( L_k \) is the Lot Unit Price per kilometre;
- \( B_P \) is the Contract Bid Price per kilometre; and
- \( A_F \) is the Adjustment Factor for the Crack Sealant.
E.2 MANITOBA STANDARD PRACTICE FOR APPROVAL OF JOINT AND CRACK SEALANT FOR ASPHALT PAVEMENTS
STANDARD PRACTICE FOR APPROVAL OF JOINT AND CRACK SEALANT FOR ASPHALT PAVEMENTS

Materials Engineering Branch
MEB8-10
April 2004
1.0 Scope

This standard practice governs the process for evaluating the performance of hot-applied and cold-applied joint and crack sealant based on satisfactory laboratory testing and field performance. Sealants that meet both laboratory and field requirements will be added to the Department's list of approved products and Suppliers.

2.0 Sealant Approval Process

Suppliers and their product must be pre-approved and placed on the Department’s Products Standards List in to provide sealant to the Department. To qualify for pre-approval, suppliers must submit sealant for laboratory testing and provide material to conduct a minimum of one year acceptable field performance. All material submitted for testing must be accompanied by materials specification sheet, a Materials Safety Data Sheet (MSDS) and a proposal that meets the requirements of Section 5 of the attached Standard Practice for New Product Approval. Lab testing and field evaluation will be performed by the Department and/or an approved designated test lab.

3.0 Material Specifications

3.1 Hot-Applied Sealant

Hot-applied sealant must be a single component material that meets the low modulus ASTM D6690 specification for Type IV sealant. The Department’s specification for hot-applied sealant is as follows:

<table>
<thead>
<tr>
<th>Physical Requirement</th>
<th>Test Method</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cone Penetration @ 25°C, dmm</td>
<td>ASTM D5329</td>
<td>110 min - 150 max</td>
</tr>
<tr>
<td>Flow @ 25°C, mm</td>
<td>ASTM D5329</td>
<td>3 mm max</td>
</tr>
<tr>
<td>Bond @ -29°C, 12.7 mm specimen, 200% extension</td>
<td>ASTM D5329</td>
<td>Pass 3 cycles</td>
</tr>
<tr>
<td>Resilience @ 25°C</td>
<td>ASTM D5329</td>
<td>60% min</td>
</tr>
<tr>
<td>Asphalt Compatibility</td>
<td>ASTM D5329</td>
<td>Pass all requirements</td>
</tr>
<tr>
<td>Cone Penetration at -17.8°C, dmm</td>
<td>ASTM D5329</td>
<td>&gt; 40</td>
</tr>
<tr>
<td>Extended heating @ pouring temperature, 6 hours</td>
<td>Pass all requirements</td>
<td></td>
</tr>
</tbody>
</table>

The hot-applied sealant shall not be self-levelling, and should not flow or track at high pavement temperatures.
3.2 Cold-Applied Sealant

Cold-applied sealants must meet the following performance requirements:
- will perform below -29°C
- not self levelling
- will not track from traffic at high temperatures

Cold-applied sealants will be evaluated in the field using the same failure rates at the hot-applied sealants.

4.0 Field Performance Evaluation and Requirements

In addition to laboratory tests, all sealants will be evaluated for performance under field conditions. As part of the approval process, two failure modes will be evaluated; bond failure and tensile failure.

1. Bond Failure is where the sealant material has lost its bond with the vertical faces of the routed cross-section but does not include where the face of the rout sidewall has pulled away from the pavement. Before evaluating this failure, it will be visually verified that the routed cross-section is as specified and that both vertical faces of the filled cross-section were freshly cut by the router.

2. Tensile Failure occurs when the material is adequately bonded to the vertical faces of the routed cross-section but the sealant itself tears apart under the tensile strain as the crack opens. Failure occurs when the tearing has progressed completely through the sealant. The tension cracks in the sealant should not be just surface cracks (where weathering tends to crack a dry skin) but should progress right through the material.

The failure type for performance is based on the total length of transverse cracks only, since longitudinal cracks are not subject to the same level of strain.

<table>
<thead>
<tr>
<th>Failure Type</th>
<th>% of Total Transverse Length</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>After 1 Winter</td>
</tr>
<tr>
<td>Loss of Bond one face</td>
<td></td>
</tr>
<tr>
<td>Loss of Bond 2 faces</td>
<td></td>
</tr>
<tr>
<td>Complete loss of bond</td>
<td></td>
</tr>
<tr>
<td>Tensile Stress Failure in Sealant</td>
<td></td>
</tr>
<tr>
<td>Total Allowable Failures (combined length)</td>
<td>7%</td>
</tr>
</tbody>
</table>
5.0 Pavement Selection and Test Section Location

The test section will be evaluated a minimum of two years, with conditional approval after year 1 based on failure below 7%. The pavements selected for applying the sealant will be a four lane, divided highway approximately 2-5 years old. For each crack sealant, the test section will be approximately 500-meter long and include the travelling and passing lanes. All longitudinal and transverse cracks will be rout and sealed in each section.

6.0 Sealant Application

Application of the crack sealant will be performed by the Department according to Department procedures. The cracks will be routed and cleaned with a hot air lance. Rout configuration will be 3:1 for the application of the sealant, as shown in Figure 1. The routed crack shall be overfilled and squeegeed to provide a film of sealant on both sides 10 mm or less.

![Figure 1: Rout Configuration](image-url)
The following factors relating to field application will be recorded:

- Date and time
- Air Temperature
- Pavement Temperature
- Sealant Temperature
- Total length of transverse cracks sealed
- Total length of longitudinal cracks sealed
- Comments regarding the ease of sealant application

7.0 Field Performance Evaluation

A field performance evaluation will be conducted between January and late March of each year. The following information will be collected for evaluation:

- Length of longitudinal cracks sealed
- Length of transverse cracks sealed
- Length of bond loss on one side
- Length of bond loss on 2 sides
- Length of tensile failure

A report of the results will be prepared by the Department and will be provided to the sealant suppliers by May of each evaluation year.

8.0 Contacts

For further information on the evaluation process, please contact:

Operational Services Branch
Phone: (204) 945-3896
Fax: (204) 945-3841
Carl Wiebe, P.Eng
Tim Klassen, C.E.T.

Materials Engineering Branch
Phone: (204) 945-8982
Fax: (204) 945-2229
Leonnie Kavanagh, P.Eng
Tara Liske, E.I.T.

9.0 References


Recommended:

L. Kavanagh, P. Eng.
Surfacing Engineer.
Materials Engineering Branch

Approved

R. A. Van Cauwenberghe, P. Eng.
Director
Materials Engineering Branch
E.3 SASKATCHEWAN MINISTRY OF HIGHWAYS AND INFRASTRUCTURE – 4215 – SPECIFICATION FOR RUBBER ASPHALT CRACK SEALING
4215-1 DESCRIPTION:

1.01 The work shall consist of hot poured rubber asphalt sealant placed in prepared transverse and longitudinal cracks at locations shown on the plans or designated by the Engineer.

1.02 The following definitions shall apply to this specification:

(a) Acceptance limit

The maximum or minimum value for a test result above or below which the sublot or lot shall be rejected.

(b) Acceptance testing

The testing performed by the Engineer to determine compliance with the specification requirements, limits and tolerances for the quality of materials and workmanship supplied.

(c) Lot

1 day's production.

(d) Sublot

1 500 m of crack. Where 1 day's production is less than 1 500 m, the work produced shall be included in the next day's lot. At the end of a control section, or at the end of the day, sections 750 m and greater shall be defined as a sublot and sections less than 750 m shall be incorporated into the previous sublot.

(e) Surface defects

Surface defects shall include but shall not be limited to the following:

(i) Extensive overbanding of sealant (> 10 mm 1 side).
(ii) Excessive debris or moisture in the rout.
(iii) Charring of the asphalt in the crack.
(iv) Obvious contamination of sealant.
(v) Routed cracks not filled.
(vi) Lack of bond to sides of rout.

4215-2 MATERIALS

2.01 The Contractor shall select and pay for all materials including but not limited to the rubber asphalt sealant.

2.02 The Contractor shall select the rubber asphalt sealant from the products listed in the Special Provisions.

4215-3 CONSTRUCTION

General

3.01 The Contractor shall rubber asphalt crack seal the entire road width, including shoulders. Railway crossings shall be rubber asphalt crack sealed to the edge of the planking. Bridges shall be rubber asphalt crack sealed to the edge of the abutment slabs.

3.02 The Contractor shall not rubber asphalt crack seal the following unless directed by the Engineer:
(a) severely fatigue-blocked areas.
(b) centreline cracks except on curves.
(c) cracks less than 2 mm in width.
(d) cracks in excess of 25 mm in width.

3.03 The Contractor shall construct the rubber asphalt crack seal as shown on the plan(s).

Routing

3.04 Routing shall be carried out by pavement routing equipment capable of following and cutting the cracks to the required dimensions. Each crack shall be routed to a width of 30 mm or greater and shall have both sides routed. All cracks shall be routed to a minimum depth of 15 mm.

Sealant Preparation

3.05 The rubber asphalt sealant shall be heated in a kettle of indirect heating, double boiler type. The kettle shall be equipped with:

(a) Thermometric controls which automatically control the product temperature.
(b) A built-in agitator capable of automatic operation.
(c) Monitoring thermometers for the heat transfer oil and the sealing compound which are readable by Department personnel from the road surface.

3.06 The compound shall be melted slowly with constant agitation. The manufacturer's maximum safe heating temperature shall not be exceeded.

Cleaning And Treating The Routed Crack

3.07 Immediately prior to pouring the hot rubber asphalt sealant, the routed crack shall be cleaned of all loose material and treated with hot compressed air until the pavement in the routed crack is dry and darkened but not charred.

Placing Rubber Asphalt Sealant

3.08 Application of rubber asphalt sealant to routed cracks shall be by hose and wand at or above the manufacturer's recommended pour temperature. Manufacturer's minimum pour temperatures for the approved products shall be designated in the Special Provisions.

3.09 The Engineer may allow sealant temperatures lower than the manufacturer's recommended pour temperature if high ambient air temperatures and steep rout gradients cause the sealant to flow in the routed crack.

3.10 When filling routed cracks, the tip of the wand shall be placed close to the bottom of the routed crack to ensure uniform application.

3.11 The routed cracks shall be filled with sealant such that upon cooling the sealant has a cross-section as shown on the plan(s).

3.12 Contamination of the rubber asphalt seal by debris from the Contractor's routing operations shall be repaired by the Contractor to the satisfaction of the Engineer.

4215-4 SAMPLING AND TESTING

4.01 The failure of the Engineer to provide test results within the time provided in this specification shall not relieve the Contractor of his obligation to remedy any defect, but the Department shall be obligated to reimburse the Contractor for any additional costs incurred by the Contractor to remedy the defect if the additional costs are attributable to the delay in receiving results.
Acceptance Testing

4.02 Within this specification, certain requirements, limits and tolerances are specified regarding the quality of materials and workmanship to be supplied. Compliance with these requirements where so specified, shall be judged by testing as described in this section. These tests cannot be disputed on the grounds of statistical theory or a specified or implied Contractor's risk.

4.03 Sampling and acceptance testing for rubber asphalt sealant shall be in accordance with the following:

(a) A random sample of virgin rubber asphalt sealant shall be selected from each lot. Testing frequency shall be determined by the Engineer but shall not be less than every third sample. The Contractor shall be notified of the results within 7 calendar days from when the sample was taken.

(b) If the sample tested does not meet the acceptance limits stated in Table 1, the samples taken before and after the sample tested may also be tested. Pay factors for a lot shall be based on results of tests on that lot. A lot not tested shall be given a pay factor of 1. The Contractor shall be notified of these results within 7 calendar days of testing the new samples.

(c) Rubber asphalt crack sealant shall be tested in accordance with ASTM D 3405 and ASTM D 3407

(d) The maximum temperature of the heated sealant shall be the manufacturer's maximum safe heating temperature specified for the product used. One temperature reading shall be taken at the kettle for each sublot. The timing of the temperature reading shall be at the discretion of the Engineer. The average temperature for the lot shall be used to determine sealant pay factors as indicated in Table 1.

4.04 Sampling and acceptance testing for length of cracks missed and rout cross section shall be in accordance with the following:

(a) Twenty 1 m samples shall be located randomly in the routed crack in each sublot.

(b) Each 1 m sample shall be assessed for the following:

(i) Length of crack missed entirely such that neither side of the crack is routed:

The segments of missed crack are measured in millimetres accumulated and recorded for the sample.

(ii) Length of crack routed on one side only:

The segments of crack routed on one side only are measured in millimetres and accumulated for the sample.

(iii) Width of rout:

The clear width is measured at the 8 mm depth from the surface. Segments of measured width in each range are measured in millimetres and accumulated for the sample. Rout width is measured in millimetres and grouped into the following ranges:

\[ W > 25 \]
\[ 25 \geq W \geq 15 \]
\[ W < 15 \]

(iv) Depth of rout
The depth of rout is measured by a template equal to the top width of the rout but not greater than 30 mm. Segments of measured depth in each range are measured in millimetres and accumulated for the sample. Rout depth is measured in millimetres and grouped into the following ranges:

\[
\begin{align*}
D & > 13 \\
13 & \geq D \geq 10 \\
D & < 10
\end{align*}
\]

4.05 Sampling and acceptance testing for depth of routed crack filled shall be in accordance with the following:

(a) A minimum of 5 - 1 m sites shall be located randomly in each sublot.
(b) Each 1 m sample shall be assessed for the depth of underfilling. The depth of underfilling is measured from the top of the routed crack.
(c) The depth of crack underfilled for the sample is measured in millimetres and is grouped into the following ranges:

\[
\begin{align*}
\text{Depth underfilled} & \leq 5 \text{ mm} \\
\text{Depth underfilled} & > 5 \text{ mm}
\end{align*}
\]

(d) Measurements of depth of routed cracks filled shall be taken on the following working day.

4.06 Areas of surface defects shall be excluded from random sampling. Each crack shall be inspected for surface defects.

4.07 The Engineer shall provide test results within 2 working days.

4.08 The results for the acceptance testing for the following 4 properties shall be used to accept or reject the sublot and/or lot:

(a) Rubber asphalt sealant material.
(b) Percent of length of cracks missed entirely.
(c) Rout cross section.
(d) Depth of routed crack filled.

4.09 The results for the acceptance testing for the following 4 properties shall be used to establish the extent of pay factors as defined in Tables 1, 2 and 3:

(a) Rubber asphalt sealant material.
(b) Percent of length of cracks missed entirely.
(c) Rout cross section.
(d) Depth of routed crack filled.

**Appeal of Acceptance Test Results and Appeal Testing**

4.10 Appeal of acceptance test results for rubber asphalt sealant shall be in accordance with the following:

(a) Within 2 days of receipt of the acceptance test results for a lot the Contractor may appeal the test results and request a verification test.

(b) The verification test shall be carried out on comparison of split samples obtained from the virgin sealant. The average of the original test and the verification test shall be used for acceptance and pay factors determination for the lot.

4.11 Appeal of acceptance test results for rout cross section shall be in accordance with the following:

February 1995
(a) Within 2 days of receipt of the acceptance test results for a sublot/lot the Contractor may appeal the test results and request a verification test.

(b) For sublot retesting, the 5 highest and the 5 lowest results of the original samples shall be rejected and replaced by retest results taken from alternate samples in the sublot. The new sublot average shall be used for acceptance and pay factors determination for the lot.

(c) For lot retesting, each sublot shall be retested as specified in 4.10 (b). The new lot averages shall be used for acceptance and pay factors determination for the lot.

4.12 Appeal of acceptance test results for the depth of routed crack filled shall be in accordance with the following:

(a) Within 2 days of receipt of the acceptance test results for a sublot/lot the Contractor may appeal the test results and request a verification test.

(b) The verification test shall be carried out on the same sample as the original acceptance test. The average of the original test and the verification test shall be used for acceptance and pay factors determination for the lot.

4.13 For all appeal testing, the Contractor shall prepare the retest sample by removing the sealant and cleaning the sample to an acceptable condition for remeasuring; provide an acceptable backfill for the sealant and provide all necessary traffic accommodation as described in Specification 8400 For Traffic Accommodation And Safety.

4.14 If the verification testing does result in a decrease of the pay factors, all testing costs incurred during the appeal procedure shall be paid by the Contractor. The rate for Department testing shall be as designated in the Special Provisions.

4.15 If the appeal testing results in the lot being accepted at full payment, then the Contractor shall be reimbursed for all direct retesting costs incurred for sealant removal and restoration, sample preparation and traffic accommodation. The Department shall not accept any claims for any other expenses that the Contractor may have encountered.

4.16 The new retesting results shall be binding on the Contractor and the Department.

**4215-5 END PRODUCT ACCEPTANCE OR REJECTION**

**End Product Acceptance**

5.01 Acceptance of a lot at full payment shall occur if it contains no surface defects and if:

(a) The rubber asphalt sealant in the lot meets the Acceptance Limits At Full Payment requirements for each property outlined in Table 1.

(b) The rout cross section of each sublot meets the following requirements:
   (i) both sides of the crack are routed;
   (ii) the rout width exceeds 25 mm; and
   (iii) the rout depth exceeds 13 mm.

(c) The rout underfilling of each sublot does not exceed 5 mm.

(d) All repairs have been completed and accepted by the Engineer.

5.02 Acceptance of a lot at reduced payment shall occur if it contains no surface defects and if:

(a) The rubber asphalt sealant in the lot meets the Acceptance Limits At Reduced Payment requirements for each property outlined in Table 1.

(b) The rout cross section of each sublot does not meet the requirements of 5.01 (b).
(c) The rout underfill of each sublot does not meet the requirements of 5.01 (c)

(d) All repairs have been completed and accepted by the Engineer.

**End product rejection**

5.03 The sublot and/or lot shall be rejected as unacceptable work if:

(a) There are any surface defects.

(b) The rubber asphalt sealant in the lot meets the Reject Limits for any property outlined in Table 1.

**Repairs:**

5.04 Defective work which has been rejected due to surface defects or due to the rubber asphalt sealant being within the reject limits for any property outlined in Table 1; shall be promptly repaired, removed, replaced or remedied in a manner that is acceptable to the Engineer.

5.05 The Contractor shall not be required to repair, replace or remedy other lots of work which does not meet the specified acceptance limits.

**4215-6 MEASUREMENT:**

6.01 Rubber asphalt crack sealing shall be measured in metres.

**4215-7 PAYMENT:**

7.01 Payment for Rubber Asphalt Crack Sealing shall be at the contract unit price per metre less the pay factors for rubber asphalt sealant, rout cross section and depth of routed crack filled.

7.02 The unit price per lot of Rubber Asphalt Crack Sealing shall be calculated as follows:

\[
\text{Lot unit price per metre} = P \times (1 - P_{mc}) \times (\text{Contract Unit Price per metre}) \text{ where:}
\]

\[
P = P_M (0.85 \times P_R + 0.15 \times P_F)
\]

\[
P_M = \text{Pay Factors for the Rubber Asphalt Sealant as per Table 1}
\]

\[
P_{mc} = \% \text{ of cracks missed entirely less 5}\%
\]

\[
P_R = \text{Pay Factors for the rout cross section as per Table 2}
\]

\[
P_F = \text{Pay Factors for depth of routed crack filled as per Table 3}
\]

7.03 The contract unit price shall be full compensation for completing the work except for those activities for which specific provision for payment is made in this section.

7.04 If any sublot has been rejected payment shall not be made for the lot until the rejected sublot has been remedied.

7.05 All remedial work shall be performed at the Contractor’s expense.
### TABLE 1
LOT PAY FACTORS FOR RUBBER ASPHALT SEALANT (P<sub>M</sub>)

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>Acceptance Limits At Full Payment</th>
<th>Acceptance Limits At Reduced Payment</th>
<th>Reject Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration at 25°C, dmm</td>
<td>≤ 90</td>
<td>&gt; 90 - 100</td>
<td>&gt; 100</td>
</tr>
<tr>
<td>Flow, mm</td>
<td>≤ 3</td>
<td>&gt; 3 - 5</td>
<td>&gt; 5</td>
</tr>
<tr>
<td>Resilience at 25°C</td>
<td>≥ 60 %</td>
<td>≥ 55% - &lt; 60 %</td>
<td>&lt; 55</td>
</tr>
<tr>
<td>Temperature at the kettle °C</td>
<td>MMSHT +5 °C</td>
<td>MMSHT + 25 °C</td>
<td>&gt; MMSHT + 25 °C</td>
</tr>
<tr>
<td>Pay Factors (P&lt;sub&gt;M&lt;/sub&gt;)</td>
<td>1.0</td>
<td>0.80</td>
<td>0.0</td>
</tr>
</tbody>
</table>

where: MMSHT is the Manufacturer’s Maximum Safe Heating Temperature.

### TABLE 2
SUBLOT PAY FACTORS FOR ROUT CROSS SECTION (P<sub>R</sub>)

<table>
<thead>
<tr>
<th>Lot Average Measurements</th>
<th>Weighting</th>
<th>Weighted Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) % of length that is routed one side only</td>
<td>Multiplied by 0.15</td>
<td></td>
</tr>
<tr>
<td>(b) Rout width (W) mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) % of length that W &gt; 25</td>
<td>Multiplied by 0.00</td>
<td></td>
</tr>
<tr>
<td>(ii) % 25 &gt; W &gt; 15</td>
<td>Multiplied by 0.25</td>
<td></td>
</tr>
<tr>
<td>(iii) % W &lt; 15</td>
<td>Multiplied by 1.00</td>
<td></td>
</tr>
<tr>
<td>(c) Rout depth (D) mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) % of depth that D &gt; 13</td>
<td>Multiplied by 0.00</td>
<td></td>
</tr>
<tr>
<td>(ii) % 13 &gt; D &gt; 10</td>
<td>Multiplied by 0.20</td>
<td></td>
</tr>
<tr>
<td>(iii) % D &lt; 10</td>
<td>Multiplied by 1.00</td>
<td></td>
</tr>
<tr>
<td>Total Weighted Deviation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The lot pay factors for rout cross section (P&lt;sub&gt;R&lt;/sub&gt;) is:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P&lt;sub&gt;R&lt;/sub&gt; = 1 - Total Weighted Deviation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 3
SUBLOT PAY FACTORS FOR DEPTH OF ROUTED CRACK FILLED (P<sub>F</sub>)

<table>
<thead>
<tr>
<th>Lot Average Measurement</th>
<th>Weighting</th>
<th>Weighted Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of length that cracks are underfilled, mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Underfilling ≤ 5</td>
<td>Multiplied by 0.00</td>
<td></td>
</tr>
<tr>
<td>(b) Underfilling &gt; 5</td>
<td>Multiplied by 1.00</td>
<td></td>
</tr>
<tr>
<td>Total Weighted Deviation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The lot pay factors for depth of routed crack filled (P&lt;sub&gt;F&lt;/sub&gt;) is:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P&lt;sub&gt;F&lt;/sub&gt; = 1 - Total Weighted Deviation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
E.4 ONTARIO PROVINCIAL STANDARD SPECIFICATION – CONSTRUCTION SPECIFICATION FOR ROUTING AND SEALING CRACKS IN HOT MIX ASPHALT PAVEMENT
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341.10 BASIS OF PAYMENT

341.10.01 Routing and Sealing Cracks in Hot Mix Asphalt Pavement - Item
341.01    SCOPE

This specification covers the work of routing and cleaning cracks up to 20 mm wide in hot mix asphalt pavements and then sealing with hot poured rubberized asphalt sealant compound.

341.02    REFERENCES

This specification refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Material:
OPSS 1212 Hot-Poured Rubberized Asphalt Joint Sealing Compound

341.05    MATERIALS

341.05.01 Crack Sealant

Crack sealant shall be hot poured rubberized asphalt sealant conforming to OPSS 1212.

341.06    EQUIPMENT

341.06.01 Router

The router shall be a mechanical router capable of following meandering cracks, keeping the rout centreline within 8 mm of the centre of the crack, and providing a rout width of 40 mm to 50 mm and a depth of 6 mm to 8 mm. Such capability shall be demonstrated to the Contract Administrator prior to its use.

341.06.02 Heating Kettle

The heating kettle for joint sealant compound shall be a double boiler oil heat transfer type, with built in agitator and equipped with thermometers to measure the temperature of both heat transfer oil and the sealing compound.

The heating kettle shall have automatic thermometric controls which will prevent overheating of the sealant.

341.06.03 Compressed Air Lance

The hot compressed air lance shall have a discharge air temperature greater than 1000°C and an air velocity greater than 1000 metres per second.

341.07    CONSTRUCTION

The work of routing and sealing cracks in hot mix asphalt pavement shall include preparation of the crack sealant, routing and cleaning the cracks, and the placing of the crack sealant compound. Debris shall be managed as specified in the Contract.

341.07.01 Crack Routing

Cracks up to 20 mm in width shall be routed to the dimensions as specified in the Contract.
341.07.02  Sealant Preparation

The sealant compound shall be melted slowly with constant agitation until it is in a lump-free, free-flowing state, within the temperature range recommended by the manufacturer for application. Heating above the manufacturer's recommended range for application is not permitted.

341.07.03  Crack Cleaning

Immediately prior to pouring the sealant compound, the routed cracks shall be cleaned and dried using a hot compressed air lance. The routed grooves shall be treated with hot compressed air until the pavement in the groove is darkened.

341.07.04  Placing Sealant

The sealant compound shall be placed within two minutes of the hot lance treatment by a manual pouring cone, or hose and wand fitted with proper size tip from a low pressure pump connected to the heating kettle.

The tip of the cone or wand shall be placed to the bottom of the crack to ensure uniform application.

The routed cracks are to be filled with sealant compound so that upon cooling, the sealant compound is flush with the adjacent pavement surface.

If after the initial placement, the material subsides below the pavement surface, then additional material shall be applied prior to sealant dusting.

On surfaces to be overlaid with hot mix, cracks shall be filled such that the top of the sealant is 4 mm to 6 mm below existing asphalt pavement surface.

Sealant compound damaged by construction traffic or the Contractor's operation shall be replaced by the Contractor at the Contractors expense.

341.07.05  Sealant Dusting

When traffic is to be maintained during crack sealing, the surface shall be dusted with Portland cement, to eliminate the adhesiveness prior to allowing traffic on the treated areas.

341.08  QUALITY ASSURANCE

During the process of placing the joint sealant compound, the Contract Administrator may require that samples be taken from the heating kettle for testing purposes.

341.09  MEASUREMENT FOR PAYMENT

341.09.01  Routing and Sealing Cracks in Hot Mix Asphalt Pavement

Measurement for payment shall be measured in linear metres along the routed and sealed crack. Measurement shall be made using a metering wheel.
341.10 BASIS OF PAYMENT

341.10.01 Routing and Sealing Cracks in Hot Mix Asphalt Pavement - Item

Payment at the Contract price for the above item shall be full compensation for all labour, equipment and material required to do the work. No additional payment shall be made for overruns in sealant compound quantity.
CITY OF COLUMBUS
PUBLIC SERVICE DEPARTMENT
TRANSPORTATION DIVISION

SUPPLEMENTAL SPECIFICATION 1540
ASPHALT REJUVENATING AGENT

May 26, 2006

1540.1 Description
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1540.12 Basis of Payment
ASPHALT REJUVENATING AGENT

1540.01 Description

This work shall consist of furnishing all labor, material, and equipment necessary to perform all operations for the application of an asphalt rejuvenating agent to asphalt concrete surface courses. The rejuvenation of surface courses shall be by spray application of a cationic rejuvenating agent composed of petroleum oils and resins emulsified with water. All work shall be in accordance with the specifications, the applicable drawings, and subject to the terms and conditions of this contract.

1540.02 Material Specifications

The asphalt rejuvenating agent shall be an emulsion composed of a petroleum resin oil base uniformly emulsified with water. Each bidder must submit with their bid a certified statement from the asphalt rejuvenator manufacturer showing that the asphalt rejuvenating emulsion conforms to the required physical and chemical requirements.

<table>
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<th>Tests</th>
<th>SPECIFICATIONS</th>
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<th>Requirements</th>
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<tr>
<td>Tests on Emulsion:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity @ 25°C, SFS</td>
<td></td>
<td>D-244</td>
<td>T-59</td>
</tr>
<tr>
<td>Residue, % W&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td>D-244(mod.)</td>
<td>T-59(mod.)</td>
</tr>
<tr>
<td>Miscibility Test&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td>D-244(mod.)</td>
<td>T-59(mod.)</td>
</tr>
<tr>
<td>Sieve Test, %W&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
<td>D-244(mod.)</td>
<td>T-59(mod.)</td>
</tr>
<tr>
<td>Particle Charge Test</td>
<td></td>
<td>D-244</td>
<td>T-59</td>
</tr>
<tr>
<td>Percent Light Transmittance&lt;sup&gt;4&lt;/sup&gt;</td>
<td>GB</td>
<td>GB</td>
<td>-</td>
</tr>
</tbody>
</table>

Tests on Residue from Distillation:

<table>
<thead>
<tr>
<th></th>
<th>SPECIFICATIONS</th>
<th>TEST METHOD</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash Point, COC, °C</td>
<td></td>
<td>D-92</td>
<td>T-48</td>
</tr>
<tr>
<td>Viscosity @ 60°C, cst</td>
<td></td>
<td>D-445</td>
<td>-</td>
</tr>
<tr>
<td>Asphaltenes, %w</td>
<td></td>
<td>D-2006-70</td>
<td>-</td>
</tr>
<tr>
<td>Maltene Dist. Ratio</td>
<td></td>
<td>D-2006-70</td>
<td>-</td>
</tr>
</tbody>
</table>

\[
\frac{PC + A_1}{S + A_2}
\]

PC/S Ratio<sup>5</sup>  
D-2006-70  -  0.5  - Saturated

Hydrocarbons, S<sup>5</sup>  
D-2006-70  -  21  28

<sup>1</sup> ASTM D-244 Modified Evaporation Test for percent of residue is made by heating 50 gram sample to 149°C (300°F) until foaming ceases, then cool immediately and calculate results.
2 Test procedure identical with ASTM D-244-60 except that .02 Normal Calcium Chloride solution shall be used in place of distilled water.
3 Test procedure identical with with ASTM D-244 except that distilled water shall be used in place of two percent sodium oleate solution.
4 Test procedure is attached.
5 Chemical composition by ASTM Method D-2006-70:
   PC = Polar Compounds,  \( A_1 = \) First Acidaffins
   \( A_2 = \) Second Acidaffins,  \( S = \) Saturated Hydrocarbons

1540.03 Material Performance

The rejuvenating agent shall have a record of at least five years of satisfactory service as an asphalt rejuvenating agent and in-depth sealer. Satisfactory service shall be based on the penetration value of the asphalt binder as follows. The viscosity shall be reduced by a minimum of 45 percent and the penetration value shall be increased by a minimum of 25 percent. Testing shall be performed on extracted asphalt cement from a pavement to a depth of three eighths inch (\( 3/8'' \)). In addition, the pavement shall be in-depth sealed to the intrusion of air and water.

The bidder must submit with their bid the manufacturer’s certification that the material proposed for use is in compliance with the specification requirements. The bidder must submit with their bid, previous use documentation and test data conclusively demonstrating that; the rejuvenating agent has been used successfully for a period of five years by government agencies such as cities, counties, etc.; and that the asphalt rejuvenating agent has been proven to perform, as heretofore required, through field testing by government agencies as to the required change in the asphalt binder viscosity and penetration number. Testing data shall be submitted indicating such product performance on a sufficient number of projects, each being tested for a minimum period of three years to insure reasonable longevity of the treatment, as well as product consistency.

1540.04 Applicator Experience

The asphalt rejuvenating agent shall be applied by an experienced applicator of such material. The bidder shall have a minimum of three years experience in applying the product proposed for use. They must submit with their bid a list of five projects on which they applied said rejuvenator. They shall indicate the project dates, number of square yards treated in each, and the name and phone number of the representative in charge of each project.

A project superintendent knowledgeable and experienced in application of the asphalt rejuvenating must be in control of each day’s work. The bidder shall submit a written experience outline of the project superintendent.

The contractor responsible for applying the asphalt rejuvenating agent shall maintain a current, written Storm Water Pollution Prevention Plan (SWPPP) that complies with all
relevant Ohio Environmental Protection Agency (OEPA) regulatory requirements. Prior to the commencement of application operations, the contractor shall conduct SWPPP training of all personnel actually applying the asphalt rejuvenating agent. At all times, the contractor shall ensure that a current copy of their SWPPP is present on-site, wherever the asphalt rejuvenating agent is being applied.

1540.05 Handling of Asphalt Rejuvenating Agent

Contents in tank cars or storage tanks shall be circulated at least forty-five minutes before withdrawing any material for application. When loading the distributor, the asphalt rejuvenating agent concentrate shall be loaded first and then the required amount of water shall be added. The water shall be added into the distributor with enough force to cause agitation and thorough mixing of the two materials. To prevent foaming, the discharge end of the water hose or pipe shall be kept below the surface of the material in the distributor which shall be used as a spreader. The distributor truck will be cleaned of all its asphalt materials, and washed out to the extent that no discoloration of the emulsion may be perceptible. Cleanliness of the spreading equipment shall be subject to the approval and satisfaction of the Engineer.

1540.06 Resident Notification

The Contractor shall distribute by hand, a typed notice to all residents and businesses on the street to be treated. The notice will be delivered no more than 24 hours prior to the treatment of the road. The notice will have a local phone number that the residents may call to ask questions. The notice shall be of the door hanger type which secures to the door handle of each dwelling. Unsecured notices will not be allowed. The contractor shall also place the notice on the windshield of any parked cars on the street. Hand distribution of this notice will be considered incidental to the contract.

1540.07 Application Equipment

The distributor for spreading the emulsion shall be self-propelled, and shall have pneumatic tires. The distributor shall be designed and equipped to distribute the asphalt rejuvenating agent uniformly on variable widths of surface at readily determined and controlled rates from 0.05 to 0.5 gallons per square yard of surface, and with an allowable variation from any specified rate not to exceed 5 percent of the specified rate.

Distributor equipment shall include full circulation spray bars, pump tachometer, volume measuring device and a hand hose attachment suitable for application of the emulsion manually to cover areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the emulsion within the tank.

A check of distributor equipment as well as application rate accuracy and uniformity of distribution shall be made when directed by the Engineer.
The truck used for sanding shall be equipped with a spreader that allows the sand to be uniformly distributed onto the pavement. The spreader shall be able to apply 1/2 pound to 3 pounds of sand per square yard in a single pass. The spreader shall be adjustable so as not to broadcast sand onto driveways or treelawns.

The sand to be used shall be free flowing, without any leaves, dirt stones, etc. Any wet sand shall be rejected from the job site.

Any equipment which is not maintained in full working order, or is proven inadequate to obtain the results prescribed, shall be repaired or replaced at the direction of the Engineer.

1540.08 Application of Rejuvenating Agent

The temperature of the asphalt rejuvenating emulsion, at the time of application shall be as recommended by the manufacturer. The asphalt rejuvenating agent shall be applied only when the existing surface to be treated is thoroughly dry. Additionally, application of the asphalt rejuvenating agent shall be prohibited when weather forecasts indicate a chance of a rain event in the work area, which would produce in excess of 0.10 inches of rain within four hours of the application of the asphalt rejuvenating agent. The contractor shall perform follow-up inspections of stormwater inlets, culverts, and drainage ditches (in accordance with the contractor’s SWPPP) in the vicinity of the asphalt rejuvenating agent application operations, whenever a precipitation event, in excess of 0.10 inches of rain, occurs during a two day period following application of the asphalt rejuvenating agent. The asphalt rejuvenating agent shall not be applied when the ambient temperature is below 40°F.

The asphalt rejuvenating agent shall be applied by a distributor truck at the temperature recommended by the manufacturer and at the pressure required for the proper distribution. The emulsion shall be applied so that uniform distribution is obtained at all points of the areas to be treated. Distribution shall be commenced with a running start to insure full rate of spread over the entire area to be treated. Areas inadvertently missed shall receive additional treatment as may be required by hand sprayer application.

Application of asphalt rejuvenating agent shall be on one-half width of the pavement at a time. When the second half of the surface is treated, the distributor nozzle nearest the center of the road shall overlap the previous application by at least one-half the width of the nozzle spray. In any event the centerline construction joint of the pavement shall be treated in both application passes of the distributor truck.

Before spreading, the asphalt rejuvenating agent shall be blended with water at the rate of two(2) parts rejuvenating agent to one(1) part water, by volume or as specified by the manufacturer. The combined mixture of asphalt rejuvenating agent and water shall be spread at the rate of 0.05 to 0.10 gallons per square yard, or as approved by the Engineer.
Where more than one application is to be made, succeeding applications shall be made as soon as penetration of the preceding application has been completed and approval is granted for additional applications by the Engineer.

Grades or super elevations of surfaces that may cause excessive runoff, in the opinion of the Engineer, shall have the required amounts applied in two or more applications as directed.

After the street has been treated, the area within one foot of the curb line on both sides of the road shall receive additional treatment of the asphalt rejuvenating emulsion. Said treatment shall be uniformly applied by a method acceptable by the Engineer.

The Contractor shall furnish a quality inspection report showing the source, manufacturer, and the date shipped, for each load of asphalt rejuvenating agent. When directed by the Engineer, the Contractor shall take representative samples of material for testing.

1540.09 Street Sweeping

The Contractor shall be responsible for sweeping and cleaning of the streets prior to, and after treatment.

Prior to treatment, the street will be cleaned of all standing water, dirt, leaves, foreign materials, etc. This work shall be accomplished by handbrooming, power blowing or other approved methods. If, in the opinion of the Engineer, the hand cleaning is not sufficient then a self-propelled street sweeper shall be used.

All sand used during the treatment must be removed no later than 48 hours after treatment of the street. This shall be accomplished by a combination of hand and mechanical sweeping. All turnouts, cul-de-sacs, etc. must be cleaned of any material to the satisfaction of the Engineer. Street sweeping will be included in the price bid per square yard for asphalt rejuvenating agent.

If, after sand is swept and in the opinion of the Engineer, a hazardous condition exists on the roadway, the contractor must apply additional sand and sweep same no later than 24 hours following reaplication. No additional compensation will be allowed for reapplications and removal of sand.

1540.10 Traffic Control

The Contractor shall schedule his operations and carry out the work in a manner to cause the least disturbance and/or interference with the normal flow of traffic over the areas to be treated. Treated portions of the pavement surfaces shall be kept closed and free from traffic until penetration, in the opinion of the Engineer, has become complete and the area is suitable for traffic.
When, in the opinion of the Engineer, traffic must be maintained at all times on a particular street, then the Contractor shall apply asphalt rejuvenating agent to one lane at a time. Traffic shall be maintained in the untreated lane until traffic may be switched to the completed lane.

The contractor shall be responsible for all traffic control and signing required to permit safe travel. The contractor shall notify the police and fire departments as to the streets that are to be treated each day.

If, in the opinion of the Engineer, proper signing is not being used, the Contractor shall stop all operations until safe signing and barricading is achieved.

1540.11 Method of Measurement

Asphalt rejuvenating agent will be measured by the square yard as provided for in the Contract Documents. The accepted quantities, measured as provided for above, will be paid for at the contract unit price for asphalt rejuvenating agent.

1540.12 Basis of Payment

Asphalt rejuvenating agent shall be paid for per square yard for furnishing all materials, equipment, labor and incidentals necessary to complete the work as specified.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
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<tbody>
<tr>
<td>1540</td>
<td>Asphalt Rejuvenating Agent</td>
<td>Square Yard</td>
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