EVALUATION OF PREFORMED NEOPRENE JOINT SEALS

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EVALUATION OF PREFORMED NEOPRENE JOINT SEALS

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Boone and Story County Engineers

8. ABSTRACT

Most pavement contraction joint seals in Iowa, in general, have been performing in less than a satisfactory manner. The effective life of the seals, in maintaining a watertight joint, has been only from two to five years. In search of improvements, research was proposed to evaluate preformed neoprene joint seals. The performance of those seals was to be compared mainly with the hot poured rubberized asphalt sealants and cold applied silicone sealants or other sealants commonly used at the time this research began. Joint designs and methods of sawing were also investigated. All evaluations were done in new portland cement concrete (PCC) pavements. Three projects were initially selected and each included a research section of joint sealing. Some additional sites were later added for evaluation. Several joint sealants were evaluated at each research site. The various sites included high, medium and low levels of traffic. Evaluations were done over a five-year period. Neoprene joint seals provided better performance than hot or cold field formed joints.

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DISCLAIMER

INTRODUCTION

Contraction joints in PCC pavements have commonly been sealed with hot poured bituminous sealants. These sealant materials are comparatively low cost and usually perform well from two to five years. During the 1980s, cold applied silicone sealants were promoted for pavement joints. Even though their material cost was approximately eight times higher, they were promoted to be cost effective because of their projected long effective life of 12 to 15 years.

Applications of the higher quality, high cost silicone sealants in Iowa's primary highways did not prove to have the effective life span as claimed by the producer. Areas of partial or complete silicone sealant failures often occurred within two to five years after installation. The effective silicone sealant life was found to be similar to that of hot poured bituminous sealants.

The history of less than desirable performance of the joint sealants in Iowa brought about the initiation of a research project to study the field performance of various sealants. The study was to investigate various sealants, sealing techniques and joint designs in search of better joint seal performance for the future. To eliminate most possibilities for poor joint seal installation and possible accusations from product representatives to contractors and vice versa, product representatives installed or were involved in the installation of their own respective sealing product.

Three project sites to include research were selected initially. Several additional sites which had short sections of new types or brands of sealants were also observed and evaluated during this research period. The information obtained was used as an extension or support to this primary research project.

OBJECTIVE

The objective of this research was to evaluate the field performance of preformed neoprene joint seals for PCC pavement contraction joints in comparison to the field performance of rubberized asphaltic hot poured sealants, cold applied silicone sealants and other sealants commonly used.

PROJECT LOCATION AND DESCRIPTION

The three paving projects initially selected to include joint seal research consisted of two with low level traffic and one with high level traffic. All of the projects were to be new full depth PCC paving and not resealing projects. The lists of the three project locations and descriptions are as follows:

Boone County

RESEARCH SITE: County road R21, 13 km (8 mi) north of Boone
PROJECT: LFM-3476(5)
PAVEMENT THICKNESS: 180 mm (7 in.) Portland Cement Concrete
DATE OF PAVING: July 12, 1989
DATE OF SEALING: July 20, 1989
CONCRETE SAW: Abrasive
JOINT TYPE: Nondoweled, skewed
ADT: 350, 8% trucks

Dallas County

RESEARCH SITE: I-80, near Milepost 112, eastbound lane
PROJECT: IR-80-3(57)-106--12-25
PAVEMENT THICKNESS: 290 mm (11½ in.) Portland Cement Concrete
DATE OF PAVING: August 24, 1989
DATE OF SEALING: August 30, 1989
CONCRETE SAW: Abrasive
JOINT TYPE: Doweled, skewed
ADT: 22,000, 27% trucks

Story County

RESEARCH SITE: 3.2 km (2 mi) east, 3.2 km (2 mi) south of I-35/US 30 on Cambridge road
PROJECT: FM-85(29)--55-85
PAVEMENT THICKNESS: 190 - 215 mm (7½ - 8½ in.) PCC
DATE OF PAVING: October 10, 1989
DATE OF SEALING: October 13, 1989
CONCRETE SAW: 9.5 mm (3/8 in) abrasive, 9.5 mm (3/8 in) diamond, 6.3 mm (1/4 in) abrasive
JOINT TYPE: Nondoweled, skewed
ADT: 400, 15% trucks

Research joint seal evaluations were also done on several additional sites (see Appendix A).

CONSTRUCTION

The preparation of the pavement contraction joints, i.e, sawing, cleaning and installation of backer rods was done in most cases by the contractor. The joint sealing preparations were normally observed and accepted by the sealant supplier. The research sealants were installed by the factory or sales representative of the specific product.

PRODUCT COSTS

The joint sealants evaluated within this research project were in most cases provided to the project without charges as the sections were small or limited to about 20 joints for each sealant. Estimates are given of product costs so comparisons can be made. The cost of installation must be considered along with the cost of a specific sealing material to get a fair estimate of the overall cost of product installed.

Estimates of costs for sealant materials, per meter (foot) of joint were:

Bituminous, Hot Pour - $0.13/m ($0.04/ft) + backer rod @ $0.08/m ($0.025/ft) = $0.21/m ($0.065/ft)

Silicone, Cold applied - $1.15/m ($0.35/ft) + backer rod @ $0.08/m ($0.025/ft) = $1.23/m ($0.375/ft)

Preformed Neoprene - $1.97/m ($0.60/ft) + adhesive @ $0.16/m ($0.05/ft) = $2.13/m ($0.65/ft)

A more detailed life cycle cost analysis provided by suppliers and contractors, which includes installation costs, is given in Appendix B.

EVALUATIONS

Method of Evaluation (Visual and IA-VAC)

The initial method of determining joint performance was through visual evaluations and probing of the seals and interfaces with a screwdriver. In search of a better method of seal evaluation, IA-VAC was developed. It has been used on some research sites and on a variety of other sites around the state. IA-VAC provides a quick, nondestructive means to evaluate joint seal performance. It applies a low vacuum above a joint that has been wetted with a water/bubble solution. Any seal leakage will be shown by the growth of bubbles. A separate report has been made on the IA-VAC unit (see ref 1).

Evaluations were done on sawing of joints, preparation of joints for sealing, joint sealing operations and sealing materials.

Research sections were limited to new full depth PCC pavement. There were several models or types of concrete saws used throughout the research. No joints were sealed until the concrete was at least 72 hours of age except for Fast Track paving.

Time of Sawing

Observations were made of effects of early sawing, especially when using a Soff-Cut saw. On project IR-35-5(54)133--12-40 in Hamilton County in 1991, Soff-Cut joints were cut from 2½ hours to 4 hours after paving, on a hot summer day. It was noticed that the early sawing caused some of the individual pieces of aggregate to be shoved forward within the concrete paste during the cutting operation. This movement was observed with crushed limestone aggregate. With hard river gravel, the shoving of aggregate would likely be worse.

As a result of early sawing and the corresponding shoving of aggregate, it was expected that an excessive amount of joint spalling would occur, especially after one winter of freeze-thaw cycles. The anticipated excessive spalling was not observed in this case. Excessively early sawing will leave rough, raveled edges with any kind of saw. This often becomes evident when sawing pavement which passes under an overhead bridge. The concrete protected from sunlight by the overhead bridge will not have reached final set and will have raveled sawed joints.

Type of Saw

The majority of joint sawing was done with the conventional saws using abrasive blades. In some cases in this research the new lightweight Soff-Cut saw was used. The smallest saw, which was electric powered, had a mass of 12 kg (26 lbs). Its cut was generally 3.2 mm (1/8 in.) or 6.3 mm (1/4 in.) wide and 22.2 mm (7/8 in.) deep. The later model of Soff-Cut, the G-2000 gasoline engine powered saw using a dry diamond blade, generally cuts 3.2 mm (1/8 in.) to 9.5 mm (3/8 in.) wide by 25 mm (1 in.) to 32 mm (1¼ in.) deep. This saw has a mass of 109 kg (240 lbs). The Soff-Cut saw generally does not create noise or dust problems as conventional saws. This saw can normally be used to saw joints soon after the PCC is hard enough to support the saw operator. This is generally reached from 3 to 4 hours after paving. By the early sawing, the chance of midpanel cracking is minimized. Data from observations of joint cracking is given in Appendix C. Cardinal Industries is another company that makes a small lightweight PCC saw similar to or larger than the Soff-Cut brand.

Other saws observed being used in Iowa were the walk behind models, the three-wheeled riding models and a four-bladed gang saw.

The travel pattern of a heavy saw on new PCC should be such that the wheels of the saw do not pass across a newly sawed joint if possible. A large spall often occurs from the wheel of a saw passing over or turning sharply on a newly sawed joint. For certain models of saws, this problem cannot be avoided and large spalls often occur. The problem of large spalls being created by the wheel of the saw was observed in several projects. The most spalls were created by the three wheel riding model saw.

Type of Saw Blade

Abrasive type PCC saw blades have been the most popular in Iowa for joint sawing operations since the aggregate in Iowa is mostly limestone and not exceptionally hard. As the abrasive blades wear quite rapidly, the depth and width of a cut can gradually change, as the blade wears down. For any field molded sealants such as hot pours or silicones, the slight change in joint dimensions is not a serious problem. However, for preformed compression seals a slight change in joint dimension can become a serious problem. An excessively wide joint may not hold a seal sufficiently tight to keep it in its place. A narrow joint may make seal installation very difficult. Diamond saw blades are normally recommended for use with preformed compression seals. In some cases, diamond blade joint sawing was done with water and in some cases, it was done dry. Diamond blades were used at the research sites for preformed compression seals and abrasive blades were used for the sites with field molded sealants. The preferred sawing method in Iowa is to complete the joint with one pass of the saw rather than making the two step cut. It is believed that the two pass step cut method creates more joint spalls.

Joint Cleaning

Poor quality joint cleaning was considered the cause for failure of many PCC joint seals in Iowa. Cleaning practices were observed carefully to determine if specified methods were being followed and to see if improvements could be made. In many instances, laborers did not produce the quality of work that could have been achieved. It was commonly found that sawed joints were not thoroughly sand cleaned or blown clean before sealing.

Some changes in specifications were made over the past few years to try to improve the performance of joint seals. The new specification called for sand cleaning all joints with the sandblast impacting the joint face at a 30° angle.

Most contractors for mainline paving now use a small trolley to guide and carry their sand cleaning nozzle. The trolley is guided by a wheel running in the sawed joint groove and one or two sand nozzles are directed at a 30° angle toward the joint for control in hitting and cleaning the joint faces.

Joint sealing preparations and practices were stressed in various technical seminars supported by the Iowa Concrete Paving Association (ICPA) and the Iowa DOT. Individual mini seminars were held with some contractors, at the start of their projects, to improve employee understanding of the importance of proper techniques and good work practices.

The struggles and lack of success to get sawed PCC joints sufficiently clean for sealing and to achieve success with long term adhesion thereafter, is what initiated thoughts to go to the use of preformed compression seals. Preformed compression seals are expected to perform well, if properly installed, in joints that are not properly sandblasted or cleaned. They do not rely on bond adhesion, but stay in place due to compression force and friction on the joint face.

Joint Sealing Practices

Backer Rod Installation

A good installation of backer rod begins with unrolling the material off of its spool in a manner such that no twisting of the rod occurs. In some cases, the rod was observed being removed by taking it off of the end of the spool. In those cases, multiple twists developed and the rod diameter was reduced in some places. Sealant, in its liquid state, will often leak past the rod at the twists, as a result of the way the rod was removed from its spool. The end result is that sinkholes are left in the seal or a secondary top-up sealing operation will be necessary to fill the holes.

The wheel used to press the backer rod into the sawed joint should be as wide as possible and smooth. If the wheel is too narrow and has notches at its perimeter, it causes the backer rod to catch on the edge of the joint and then short sections of the rod are sheared off or torn. The torn sections are often left sticking up out of a sealant and do create a path of leakage. Tests done with the Iowa Vacuum Joint Seal Tester (IA-VAC) confirmed the leakage.

The excessive use of an abrasive type sawblade can leave a joint width narrower than specified as a result of blade wear. In those cases, excessive shearing of the backer rod will also occur as it is being forced into a joint which has less than the specified width.

Depth of Seal

Specifications state that seals should be 3 mm (1/8 in.) to 6 mm (1/4 in.) below the surface of the pavement. The most common deviation from this specification is finding seals that are too high and are being hit by traffic tires.

Bubbles in Hot Poured Sealants

In some cases while installing hot poured sealants, bubbles were seen breaking out at the surface of the hot liquid sealant immediately after application. They can be as numerous or severe as having a bubble each 13 mm (1/2 in.). The bubbles could originate from several sources. Minimal evaluations were done to determine the bubble source and results were not conclusive. Additional research is needed on this subject.

Preformed Compression Seals

The ease and success of installation and long term performance of preformed compression seals is heavily dependant upon the quality of the joint sawing operations. Compression seals cannot perform properly in joints with improper widths. Field molded sealants such as hot pours can easily accept variations in joint widths, but that is certainly not true for preformed compression seals.

The lubricant adhesive currently used to install compression seals performs its intended function quite well, however, it is a very difficult product to work with. The product suppliers should apply more efforts in search of a more user-friendly lubricant adhesive.

Equipment cleanup time with currently available lubricant adhesives requires several hours each day when using automated or engine powered equipment for seal installation.

Preformed neoprene compression seals are normally installed by engine powered equipment or by manually pushed (rubber tucker) equipment. In either case, a lubricant adhesive is used to ease seal installation and to help hold the seal in place. The lubricant adhesive is applied automatically with the engine powered equipment. When using the rubber tucker, the lubricant adhesive is applied manually from an independent pressurized container or pump system through a wand with two back to back nozzle outlets. The wand is pulled along the joint applying the lubricant adhesive along both top corners of the joint.

When using the engine powered equipment, there was about 3% of joint seal waste with the transverse joints. There was no seal waste when using the manual equipment.

Installation rates can vary widely. The highest rates observed were with a crew of two people using the (rubber tucker) manual powered equipment to insert the seal and an independent powered pump unit for applying the lubricant adhesive. After a complete spool of preformed neoprene seal was rolled out, the total operations for sealing a transverse joint were done at the rate of 75 to 90 seconds time per joint. That rate would be about 300 m (1,000 lineal ft) of seal in transverse joints or 250 m (800 longitudinal ft) of pavement in one hour. The insertion of the seal only was done in 10 to 15 seconds for a 7.3 m (24 ft) transverse joint. There was no seal waste at the joint ends. The seal used was a 17.5mm

(11/16 in.) wide, 4 compartment, preformed neoprene and it was installed in a 9.5 mm (3/8 in.) wide joint which had a blanking band.

Silicone Sealants

There has been an extensive amount of adhesion failures with silicone sealants in Iowa. Efforts to obtain clean joint faces, before sealing, has not solved the adhesion failure problems. Theories about incompatibilities between silicone sealants and Iowa crushed limestone aggregate, due to molecular charges or Zeta potential, have not been fully confirmed. Joint primers have been proposed to reduce silicone adhesion failures. In spite of all the effort to improve success with silicone sealants, good success has not been achieved. Due to the high failure rate with the high cost product, silicone sealants are currently not recommended for Iowa DOT use.

Hot Pour Sealants

The success or failure of hot pour sealants is thought to depend heavily upon cleaning of joint faces. As a result of efforts toward better cleaning, guided sand cleaning tools are now commonly used and the sand is directed to impact the joint face at a 30° angle. Bubbling of the hot pour sealant in the joint is still commonly seen. Additional investigations are proposed on that problem.

The controls of hot pour melter temperatures were often seen to be somewhat questionable. Temperature gauges were some times broken or giving readings which were considered to be somewhat erroneous.

Types of Sealants Evaluated

The primary objective of the research was to evaluate preformed compression seals compared to silicone and hot pour sealants. There were evaluations of some variations of these sealants as well as some new sealants which recently arrived on the market. Many sealants were evaluated at more than one site. A list of the primary sealants evaluated is as follows:

Preformed	Silicones
D. S. Brown	Dow Corning
Watson Bowman Acme	Crafco
ESCO	CSL
Hydrozo Jeene	
Phoenix	

Hot Pours	Others
W. R. Meadows	Sika - Polyurethane
Crafco	Koch - Polysulfide
Koch	Koch - Spectrum UV
	Clean Seal - Emulsion

Blank Banding

The practice of a blanking band to eliminate tine grooves along a joint and to prevent joint spalling was adopted along with this research. A blanking band was also recommended, especially to help reduce the seal snagging and twisting problems while installing preformed compression seals. That practice continues today for all compression seals installed in Iowa.

Priming Joints for Silicone Sealants

After extensive adhesion problems and poor performance of silicone sealants, it was proposed by the product suppliers to apply a sealant primer to the joint faces of the PCC before installing the sealant. A primer was applied at project IR-35-5(54)-133--12-40 in Hamilton County. Evaluation of this sealant performance will continue on an informal basis beyond the conclusion of this research project. Sealant performance data from this site is given in Appendix D. This data shows there is a major increase in the number of joint spalls from year to year. Joint leakage from spalls far outweigh the leakage from sealant failure. During this test period, the percentage of sealant failures are numerically going down, but only in comparison to the dominating number of new spalls going up. The increasing number of spalls occurring along joints severely clouds the issue of joint sealant failures. The question arises as to whether a concrete spall along a joint seal is to be considered a seal failure or not.

Soff-Cut Sawed Joints Filled With Sealant

A test section consisting of four sets of 12 consecutive joints were installed in Hamilton County in June 1991. The joints were sawed 6.3 mm (1/4 in) wide and 22.2 mm (7/8 in) deep. A hot pour sealant was used for 24 joints. Twelve of these joints had a backer rod and 12 had no backer rod. The same procedure was used for the second 24 joints, but they were sealed with a silicone sealant. No primer was used. Test results show the silicone sealant filled joints are performing very sell so far. See tests results in Appendix F.

Supervisor/Worker Performance

There has been a lot of effort and expense put forth in technology transfer and training of personnel involved in paving and joint sealing operations. The Iowa DOT and ICPA have the subject of joint sealing included specifically or generally in some form of seminar each year. Some mini seminars on joint sealing techniques and problems have been arranged jointly with individual contractors and their front line workers and specific DOT and product supplier personnel as a result of this research. These meetings seemed to be very effective in producing a good understanding and concern in the workers to do a quality job. Some previous observations of poor quality work initiated this need for improvements in communications and training, especially related to the front line workers.

DISCUSSION

This research was initiated as a result of less than satisfactory performance of silicone and hot pour joint sealants. Close observations of preparations for joint sealing soon showed that a variety of operations could be improved to obtain better results. Cleaning of joints was found to be quite poor in some cases. In a search for better performance, preformed compression seals were evaluated and are now accepted for Interstate highway use. The introduction and use of these seals caused some increase in material cost per meter (foot) installed. The new seals required different installation equipment and training of contractor and DOT personnel. This was basically a new application of this product in Iowa.

In the past, the application of silicone sealants was on Interstate highways in transverse and longitudinal joints. After the initiation of the more expensive preformed neoprene compression seal material it was decided that the longitudinal joints would be sealed with the lower cost hot pour sealant material, as those joint movements are negligible and only the transverse joints would receive compression seals. With the change of the Interstate highway sealants to partial hot poured and partial preformed neoprene, from only silicone, there should be a savings in the overall long term cost of sealing the joints (see Appendix B).

The introduction of compression seals led to the need to tighten up on the tolerance in width control of sawed joints. A larger variation was common and somewhat expected when using abrasive blades. Preformed compression seals cannot be installed or perform properly if joint width tolerance is not held tight. For that reason, the use of diamond saw blades was introduced as they can maintain a uniform cut width through a longer blade life. The diamond blade saw was not otherwise required for the soft aggregate in Iowa.

An informal initial laboratory test determined some difference in reaction forces between commonly used brands of compression seals to compress them from 17.5 mm (11/16 in.) wide down to the 9.5 mm (3/8 in.) wide, as installed in joints. The reaction or holding forces which determine the ability of the seals to maintain their position in the joint were found (for 1 m (1 ft.) length) to be:

D. S. Brown - 129 kg/m (87 lb/ft.)
Kirkhill Rubber Co. (ESCO) - 132 kg/m (89 lb/ft.)

As a joint width opening would increase approximately 4 mm (0.15 in.) in the cold of winter, the reaction or holding force would drop down to be:

D. S. Brown - 112 kg/m (75 lb/ft)
Kirkhill Rubber Co. (ESC0) - 68 kg/m (46 lb/ft)

The percentage drop in reaction force was:

D. S. Brown - 13 %
Kirkhill Rubber Co. (ESCO) - 48%

A basic difference between the seals is in their internal compartment design. The D. S. Brown seal has five compartments and the ESCO seal has only four compartments. ESCO seals are easier to install. Material costs are similar. Time will now give the answer concerning the comparison or similarity of long term performance for these two seals now being used in Iowa Interstates.

Both of these products meet the AASHTO M220 requirements and these test results show them to be quite similar. This difference in quality and characteristics between different seals shown by informal tests is not tested by the current method of tests under AASHTO M220 (see Appendix E).

CONCLUSIONS

Joint Preparation

Sand cleaning of joints was often found to be of poor quality, especially at the initial stages of this research project. After discussions and seminars on the subject, including the front line workers, improvements were noticed.

From visual evaluations, the benefits of sand cleaning joints before sealing with compression seals are questionable. As long as roadway conditions are clean and dry, the airblast immediately prior to sealing appears to be sufficient for satisfactory sealing preparation. Additional research should be done to determine if sand cleaning is beneficial, in addition to air cleaning, immediately prior to sealing joints with compression seals.

A positively guided wand and sand cleaning nozzle system is essential to keep the sand directed at the concrete faces of a joint. Handheld nonguided wands generally cannot do a satisfactory job of joint cleaning due to their meandering travel path.

Abrasive type saw blades for PCC joints do not generally maintain width tolerances recommended for preformed compression seals. Diamond blade saws provide better joint width control as required for compression seals.

The most effective and efficient method of preparing and sealing joints is to make a one pass complete saw cut and then clean immediately with air or water, as appropriate. Before sealing, a sandblast and air cleaning should be done. For Interstate PCC highways, transverse joints should be sealed with a compression seal and longitudinal joints with a hot poured sealant.

The control of joint cracking in 290 mm (11½ in) thick Interstate pavement was done successfully by the use of the model 580 Soff-Cut saw leaving a 6.3 mm (1/4 in) wide, 22.2 mm (7/8 in) deep cut in a 48 consecutive joint test section.

The natural cracking of PCC pavement joints initiated by the 22.2 mm (7/8 in) deep Soff-Cut sawed joint was very much delayed compared to joints initiated by the conventional sawed T/3 depth cut. About 70% of the Soff-Cut sawed joints did not crack naturally until heavy construction vehicles drove on the pavement. One hundred percent of the conventionally sawed 9.5 mm (3/8 in) by T/3 joints cracked naturally before any heavy construction vehicles drove on the pavement.

A test section having Soff-Cut sawed joints and filled with sealant is performing well. Of the two sealants, the Dow Corning Silicone 890 SL is performing better than the W. R. Meadows 3405 hot pour.

<u>**Hot Pour Sealant**</u>

Hot pour joint sealants provide a relatively similar performance and life span as silicone sealants even though silicone sealant materials are about 8 times more expensive.

The performance of hot pour sealants varies widely between brands and pavement locations. A good performance in one area does not indicate overall good performance. In one specific five joint test section, the Crafco 231 sealant is performing very well five years after installation. The joints were diamond sawed, waterblasted, sandblasted and air blown.

Silicone Joint Sealants

Five different types of silicone sealants were evaluated. All five failed to perform as proposed and failed at different rates and degrees of failure.

Most silicone sealants applied as recent as five years ago show increasing signs of failure with time. Some silicone sealed projects have already been resealed with a hot pour sealant.

Adhesion failure is the most common failure mode for silicone sealants. Without the bottom support of the step from a step type saw cut, the failed seals fall downward into the joint.

The silicone sealant showing the least failures is Dow Corning Silicone 890-SL. It was installed with a primer in the summer of 1992.

Neoprene Compression Seals

The installation rate of preformed neoprene compression joint seals is somewhat dependant upon the brand of seal being used. The highest rate of installation was observed when installing Kirkhill Rubber Co. (ESCO) 4 compartment seals while using a manually-powered (rubber tucker) installer.

The two most commonly used preformed compression seals pass AASHTO M220 laboratory tests in a similar manner. However, initial informal tests done between those two commonly used seals shows a fairly large difference in reaction forces upon joint opening in the cold of winter.

Preformed neoprene compression seals installed up to five years ago are performing very well, showing no signs of deterioration.

General Findings

Excessive spalling along joints is seen in many paving projects in Iowa. Research should be done with bevelled joints to see if spalling will be reduced.

Bevelled joints appear to allow greater vertical forces to be applied onto the joint seal and tend to shove the seal downward. Phoenix compression seals installed in bevelled joints in a test section in Iowa have all slid down to the stepcut ledge.

Testing the quality of joint sealing contractors work and of the installed seals performance can be done very effectively and efficiently, in a nondestructive manner, with the use of the IA-VAC.

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- Paving Contractors
- Product Suppliers
- Project Inspectors
- County Engineers

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REFERENCES

1. Steffes, Robert F., Innovative Leak Test for Pavement Joint Seals, Progress Report, Iowa Highway Research Board, HR-318, January 1993.

Appendix A
Project Locations and Descriptions

HR-318, "Evaluation of Preformed Neoprene Joint Seals"

Boone County, project LFM-3476(5)

Research Site: County road R-21, 8 mi. N. of Boone

PCC Thickness: 7"

Paved: July 12, 1989

Load Transfer: Nondoweled

Joint Sawing: 3/8" abrasive

Joint Spacing: 15 ft. skewed

Joints Sealed: July 20, 1989

Standard Sealant: Koch 9030 Hot Pour

Contractor: Central Paving Corporation

Station From/To	Sealing Material	No. of Joints	Joint Number
521+10 519+75	Elastomer Neoprene, preformed, 9/16"	10	1 thru 10
519+60 518+21	CSL 315 Silicone, self-leveling	10	11 thru 20
518+06 516+68	Sikaflex 15 LM Polyurethane, tooled	10	21 thru 30
516+53 515+15	Dow Corning 888 Silicone, tooled	10	31 thru 40
515+00 512+10	Koch 9030 Hot Pour	20	41 thru 60
511+95 510+58	Elastomer Neoprene, preformed 9/16"	10	61 thru 70
510+43 509+06	CSL 315 Silicone, self-leveling	10	71 thru 80
508+91 507+55	Sikaflex 15 LM Polyurethane, tooled	10	81 thru 90
507+40 506+04	Dow Corning 888 Silicone, tooled	10	91 thru 100

HR-318, "Evaluation of Preformed Neoprene Joint Seals"

Dallas County, project IR-80-3(57)-106--12-25

Research Site: I-80, near MP 112, EBL

PCC Thickness: 11 1/2"

Paved: August 24, 1989

Load Transfer: Doweled

Joint Sawing: 3/8" abrasive

Joint Spacing: 20 ft. skewed

Joints Sealed: August 30, 1989

Standard Sealant: Dow Corning 888 Silicone, tooled

Contractor: Fred Carlson Company Inc.

Station From/To	Sealing Material	No. of Joints	Joint Number
741+56 746+36	Dow Corning 888 Silicone, self-leveling	26	1 thru 26
743+02 MP 111.99	Construction Joint		
746+56 750+15	Sikaflex 15 LM Polyurethane, tooled	20	27 thru 46
750+35 754+05	CSL 315 Silicone, self-leveling	20	47 thru 66
754+25 758+06	Dow Corning 888 Silicone, self-leveling	20	67 thru 86
758+26 762+26	D. S. Brown Neoprene, preformed, 13/16"	21	87 thru 106
762+46 766+30	W. R. Meadows Sof-Seal, Hi Spec, Hot Pour	20	107 thru 126
766+50 767+46	Dow Corning 888 Silicone, self-leveling	6	127 thru 133
1166+04 1169+81 MP 120	(Blank banding test site) (Dow Corning 888 Tooled)	20	

HR-318, "Evaluation of Preformed Neoprene Joint Seals"

Story County, project FM-85(29)--55-85,
PCC paving 4 miles of Cambridge road

Research Site: 2 miles east - 2 miles south of I-35/US 30 on Cambridge road

PCC Thickness: 7 1/2" - 8 1/2"

Paved: October 10, 1989

Load Transfer: Nondoweled

Joint Sawing: 3/8" abrasive, 3/8" diamond, 1/4" abrasive

Joint Spacing: 15 ft., skewed

Joints Sealed: October 13, 1989

Standard Sealant: Crafco, 231, Hot Pour

Tining: 6" blank banded over joints

Contractor: Fred Carlson Company Inc.

Station From/To	Sealing Material	No. of Joints	Joint Number
1083+18 1088+81	W. R. Meadows, Sof-Seal original formulation, hot pour	40	1 thru 40
1088+95 1091+82	Crafco 231 hot pour	21	41 thru 61
1091+97 1094+74	W. R. Meadows, Sof-Seal original formulation, hot pour	20	62 thru 81
1094+89 1097+71	Sikaflex 15 LM Polyurethane, tooled	20	82 thru 101
1097+86 1100+60	CSL 315 Silicone, self-leveling	20	102 thru 121
1100+75 1102+06	Jeene Technology Corp. Neoprene, preformed, 1/4"	10	122 thru 131
1102+21 1104+99	D. S. Brown Neoprene, preformed 11/16"	20	132 thru 151
1105+14 1107+17	Watson Bowman Neoprene, preformed 11/16"	15	152 thru 166

Station From/To	Sealing Material	No. of Joints	Joint Number
1107+31 1107+89	Crafco 231 hot pour	5	167 thru 171
1108+04 1110+83	Dow Corning 888 Silicone, tooled	20	172 thru 191
1110+98 1113+77	Dow Corning 888 Silicone, self-leveling	20	192 thru 211
1113+92 1116+69	Crafco 231 hot pour	20	212 thru 231

HR-318, "Evaluation of Preformed Neoprene Joint Seals"

Hamilton County, project IR-35-5(54)-133--12-40
Interstate PCC full depth paving

Research Site: I-35, MP 141, northbound lane

PCC Thickness: 11 1/2"

Paved: June 18, 1991

Load Transfer: Doweled

Joint Sawing: Soff-cut 1/4" x 7/8" Tee cut
2 1/2 hrs behind paver

Joint Spacing: 20 ft., skewed

Joints Sealed: June 24, 1991

Standard Sealant: W. R. Meadows Hot Pour 3405 Modified

Contractor: Fred Carlson Company Inc.

Station From/To	Sealing Material	No. of Joints	Joint Number
	SECTION A		
808+25 810+45	W. R. Meadows, hot pour 3405 modified with backer rod	12	1 thru 12
	SECTION B		
810+65 812+87	W. R. Meadows, hot pour 3504 modified with no backer rod	12	13 thru 24
	SECTION C		
813+08 815+29	Dow Corning 890 self leveling silicone with backer rod	12	25 thru 36
	SECTION D		
815+49 817+70	Dow Corning 890 self leveling silicone with no backer rod	12	37 thru 48
	SECTION G (control)		
817+92 819+72	W. R. Meadows, hot pour 3405 modified with backer rod in 3/8" joints abrasive cut T/4	10	49 thru 58

HR-318, "Evaluation of Preformed Neoprene Joint Seals"

Hamilton County project IR-35-5(54)-133--12-40
Interstate PCC full depth paving

Research Site: I-35, MP 141, southbound lane

PCC Thickness: 11 1/2"

Paved: August 19, 1991

Load Transfer: Doweled

Joint Sawing: Section
HS - 3/8" x T/3 abrasive cut
E - 1/4" x T/3 wet diamond cut
F - 1/4" x T/3 wet diamond cut
I - 1/4" x 7/8" Soff-cut
HN 3/8" x T/3 abrasive cut

Joint Spacing: 20′ skewed

Joints Sealed: August 22, 1991

Standard Sealant: W. R. Meadows Hot Pour 3405 Modified

Contractor: Fred Carlson Company Inc.

Station From/To	Sealing Material	No. of Joints	Joint Number
	SECTION HS (CONTROL)		
808+12	W. R. Meadows, hot pour	5	1 thru 5
808+85	3405 modified		
	SECTION E		
809+10	Hydrozo Jeene	21	6 thru 26
813+10	3/8" Preformed Neoprene		
	Epoxy bonded		
	No backer rod		
	SECTION F		
813+30	D. S. Brown 9/16"	24	27 thru 50
817+72	Preformed Neoprene		
	Compression		
	No backer rod		
	SECTION I		
817+92	D. S. Brown 9/16"	5	51 thru 55
818+72	Preformed Neoprene		
	Low profile, compression		
	No backer rod		
	SECTION HN (CONTROL)		
818+92	W. R. Meadows hot pour	5	56 thru 60
819+72	3405 modified		

IOWA DEPARTMENT OF TRANSPORTATION

TO OFFICE: Materials DATE: August 9, 1989

ATTENTION: Jim Grove REF. NO.: 436/HR-544, HR-31

FROM: Robert Steffes

OFFICE: Materials - Research

SUBJECT: Joint Sealing on Cedar Rapids Highway 100 Fast Track II Project F-100-1(11)--20-57 at Northland Avenue, 6-22-89

During a field visit I observed the concrete placement and joint sealing on IA 100 in Cedar Rapids at Northland Avenue. Concrete placement in the intersection was completed at approximately 00:30 AM. The covering blankets were removed from the Fast Track II concrete at approximately 5:00 AM. The primary sawing of the joints was started soon after, with the contractors saw using an abrasive blade, 3/8" wide. The joints were blown clean with compressed air. Some of the slab surfaces were blown clean after the joints were cleaned. This may have put loose debris back into some joints.

Construction Materials Inc. had personnel (Dick Galligan plus 2 assistants) standing by to install D. S. Brown neoprene preformed joint seals in the intersection. They had a diamond blade saw and a D. S. Brown semi-automatic seal installing unit.

The intersection was scheduled to be opened to traffic at 6:00 AM, however, it was only turned over to Construction Materials Inc. personnel at about 6:00 AM. They decided there was no need to use their diamond saw since the cuts already measured 3/8" wide when measuring the width at the surface. A diamond blade saw is normally used with neoprene seals to insure a true cut. After about 15 minutes of making various adjustments on the seal installer they began installing the most northerly longitudinal joint, from east to west. After various difficulties and equipment adjustments and with a major portion of the seal being installed by hand, using a screwdriver, the first joint of 84 ft. length was completed, taking 1 hour time.

The diamond saw was run through some of the remaining joints after the sealing was about half completed, thinking that may reduce the problems. Use of water with this diamond saw was not required.

The sealing of the joints in the intersection, approximately 350 lineal ft., was completed by 9:30 AM, taking 3 1/2 hours time.

The intersection was opened to traffic at 8:00 AM, therefore, the last joints were done under light traffic conditions.

The tining edges were initially blamed for the seal installing difficulties on the longitudinal joint. However, the installation rate and difficulties seemed to be the same when doing transverse joints. Unevenness of the concrete was also blamed for the installation difficulties.

The application of the lubricant/adhesive was done somewhat nonuniformly. The applicator tube had no guides and, therefore, the material was sometimes put more on top of the joint or on one side or the other. This may have contributed to some of the twisting or rolling tendency of the seal. Due to a shortage of material, the type of lubricant/adhesive was changed for the most northerly transverse joint. A fair amount of tension was applied at times by hand to the seal in attempting to get it installed.

Although the roughness of the concrete and the edges from the tining were blamed for the installation difficulties, it did appear as if the seal width was not being compressed sufficiently at the right time for installation into the saw cut. This could have been due to equipment design or adjustment. Also, the seal installing unit was not self centering over the saw cut. The seal tends to guide the installer and when the installer is pushed toward one side or the other it would tend to cause the seal to roll or twist in the saw cut. Due to the installation being done mostly by hand with a screwdriver, the depth of installation varied slightly.

The personnel doing the seal installation worked very hard at their job, yet the rate of installation on this intersection was approximately 100'/hr. Apparently, on other intersections within this project the installation rate was better.

Other points of interest in reference to experimental joint sealants from earlier installations, were noted farther west in the project. The location is near "C" Avenue, exactly below the guy wire from the nearby broadcast tower as the wire passed over IA 100. Around this location is the Dow Corning 888 self-leveling and tooled silicones. There were equipment operational or failure problems while installing the Dow 888 sealants. The hot pour sealant applied in that area and going eastward showed an excessive amount of bubble cavities. In some areas it appears as if the bubbles were somewhat in line and near to the concrete edge. This may indicate that the origin of the bubbles would be from the concrete joint face or from air trapped under the sealant in the two narrow deep "vee" channels running along the intersection line of the joint face and the side of the backer rod.

A brief report on joint sealing on each of the intersections in the IA 100 Fast Track II project is attached, as presented by Construction Materials Inc. through the Iowa DOT Cedar Rapids Construction/Materials Office.

RFS:kmd

Construction Materials Report on
the Sealing Test Areas
F-100-1(11)--20-57
Cedar Valley Corp.

Description of seals used on each intersection.

COUNCIL STREET 80' x 28' B-B

The 5 transverse joints were sealed with 13/16" DS Brown compression seal. The 4 longitudinal joints were sealed with Koch 9030. Intersection opened on time. Between header joints 27+24 to 27+98

DUFFY DRIVE 60' x 26'.5 B-B

The 4 transverse joints were sealed with 13/16" DS Brown compression seal. The 4 longitudinal joints were sealed with Koch 9030. Intersection opened on time. Between header joints 31+49 to 32+18.

PARK LANE 55' x 28' B-B

The 4 transverse joints were sealed with 13/16" DS Brown compression seal. The 4 longitudinal joints were sealed with Koch 9030. Sealed under traffic. Intersection poured after midnight. Between header joints 37+52 to 38+39.

ROCKWELL DRIVE 60' x 28' B-B

The 5 transverse joints were sealed 11/16" Watson Bowman compression seal. The 4 longitudinal joints were sealed with Koch 9030. Original plans called for sealing 3 longitudinal joints with 11/16" Watson Bowman compression seal. This intersection was under penalty, thus they opened it up to traffic. Taking the safer route, we decided to seal just the transverse joints, to avoid the hazards of traffic. Between header joints 52+58 to 53+35.

ROCKWELL ENTRANCE 74' x 28' B-B

Original plans called for this intersection to be sealed in the following fashion. The 5 transverse joints & 3 longitudinal joints were to be sealed with 11/16" Watson Bowman. One longitudinal joint was to be sealed with Koch 9030. Timing more than anything prevented us from abiding by the original plan. All of the joints in this intersection were sealed with Koch 9030. Between header joints 67+61 to 68+46.

C AVENUE 90' x 28' B-B

The 6 transverse joints were sealed with 11/16" DS Brown compression seal. There were 4 longitudinal joints on this intersection. Two of these joints were sealed with 11/16" DS Brown, and the other 2 were sealed with Koch 9030. DuPont filmed different sequences from the pour to sawing and finally the sealing of the joints. Between header joints 81+02 to 81+90.

NORTHLAND AVENUE 100' x 28' B-B

The 6 transverse joints were sealed with 11/16" DS Brown compression seal. There were a total of 4 longitudinal joints on this intersection. Two of these joints were sealed with 11/16" DS Brown, and the other 2 longitudinal joints were sealed with Koch 9030. Sealed partly under traffic. Problems were incurred with the installation. We conveyed to them the roughness of the slab, had a lot to do with ease of installation. Also conveyed how quick Rockwell Drive was sealed. They found this hard to believe. Between header joints 100+13 to 100+97.

K-MART ENTRANCE 90' x 28' B-B

The 6 transverse joints were sealed with 13/16" Watson Bowman. There were 4 longitudinal joints on this intersection. Two of these joints were sealed with 13/16" Watson Bowman, and the other two with Koch 9030. Sealed under traffic. Between header joints 109+52 to 110+58.

TWIXT TOWN 60' x 30'.5 B-B

The 4 transverse joints were sealed with 11/16" Watson Bowman. There were 4 longitudinal joints on this intersection. Two of these joints were sealed with 11/16" Watson Bowman, and the other 2 with Koch 9030. Sealed under traffic. Between header joints 121+25 to 122+26.

All butt joints were Koch 9030.

800' TEST SECTION

The test section was designated between Rockwell Entrance & C Avenue. Original plans called for us to be on the slab and sealing 6 hours after paving. Due to various circumstances that the contractor encountered, we did not get on the slab until 10 hours after the pour.

We utilized 4 different products on this 800' test section. They were Dow 888 Self Leveling Silicone, Dow 888 Silicone, W. R. Meadows Hot Applied Sof-Seal and Koch 9030. Each product was to be applied on a 200' section. The W. R. Meadow Hot Applied Sof-Seal was melted down in a Cimline Model 50 Melter. The material was applied to the joint by hand held pour pots. Due to darkness a portion of the Meadows Sof-Seal was applied under the light of a flashlight. The Koch 9030 was melted down and applied by a Cimline Model 100 Melter/Applicator. The Dow 888 Self Leveling Silicone was to be applied by a Graco Bulldog Series Pump supplied by Dow Corning. Due to a breakdown in the pump, we were only able to seal 2 transverse joints and 1 longitudinal joint. Where we did apply the self-leveling silicone, it seemed to work very nicely.

The Dow 888 Silicone was to be applied by a air powered caulking gun. Once again we incurred equipment breakdowns. We had to apply the Dow 888 Silicone by a manual caulking gun. We then tooled this material to force it against the joint face and also to make sure that the silicone was recessed from the top of the joint. This material was also installed approximately 14 to 16 hours after the pour.

Test strip 70+55 to 78+00

HR-318, "Evaluation of Preformed Neoprene Joint Seals"

Polk County, project IR-80-5(127)143--12-77

Research Site: I-80, near MP 149, EBL

PCC Thickness: 11 1/2"

Paved: June 14, 1990

Load Transfer: Doweled

Joint Sawing: 3/8" diamond, wet

Joint Spacing: 20 ft. skewed

Joints Sealed: June 21, 1990

Standard Sealant: Dow Corning 888 Silicone, tooled

Contractor: Fred Carlson Company Inc.

Station From/To	Sealing Material	No. of Joints	Joint Number
1657+80	Dow Corning Silicone, SL Mix of 888 and 890	1	1
1658+00 1661+40	Dow Corning 890 Silicone Self-Leveling	18	2 thru 19
1661+60	Dow Corning Silicone, SL Mix of 888 and 890	1	20
1661+80 1665+40	Dow Corning 888 Silicone Self-Leveling	19	21 thru 39

HR-318, "Evaluation of Preformed Neoprene Joint Seals"

Story County, project L-F-190--73-85, new paving

Research Site: Riverside Road, west end, Ames, IA

Contractor: Fred Carlson Company Inc.

Load Transfer: Doweled

Joint Spacing: 20 ft. skewed

Joint Sawing: 3/8" abrasive

PCC Thickness: 10"

Standard Sealant: W. R. Meadows 3405 Modified Hot Pour

Station From/To	Sealing Material	No. of Joints	Joint Number
Paved: 7-13-90 (PM)	Sealed 7-14-90 (AM) Transverse 10, Longitudinal 9(x3)		
1+10 2+82	Koch Polysulfide, 9050, SL	10	1 thru 10
	Transverse 5, Longitudinal 5(x3)+1		
2+83 3+90	Koch Spectrum UV, SL, 77, 88	5	11 thru 15
Paved 7-16-90 (AM)	Sealed 7-18-90 (AM) Transverse 12, Longitudinal 11		
23+60 25+85	CleanSeal Systems Inc. CleanSeal, Cold Applied, SL	12	1 thru 12

HR-318, "Evaluation of Preformed Neoprene Joint Seals"

Linn County, project FN-13-1(43)--20-57

Research Site: Northeast of Coggon on IA 13, EBL

PCC Thickness: 10"

Paved: August 29, 1990

Load Transfer: Doweled

Joint Sawing: 3/8" and 3/32"

Joint Spacing: 20 ft.

Joints Sealed: August 30, 1990

Standard Sealant: W. R. Meadows 3405, modified

Contractor: Cedar Valley Corp.

Station From/To	Sealing Material (Koch)	No. of Joints	Joint Number
1542+12 1542+92	Spectrum UV 88 tooled	5	1 thru 5
1543+12 1543+92	Spectrum UV 88 E-40	5	6 thru 10
1544+12 1544+72	Spectrum UV 77 tooled	4	11 thru 14
1544+92 1547+92	9050 SL B#075	16	15 thru 30
1548+12	9050 SL B#075 Day Joint Fastrak	1	31
1548+32 1548+52	9050 SL B#075 Fastrak	2	32 thru 33
1548+72	9050 SL B#075 3/32" joint, Fastrak	1	34
1548+92 1549+12	Spectrum UV 77 E-40, Fastrak	2	35 thru 36
1549+32	9050 SL B#075 3/32" joint, Fastrak	1	37
1549+52 1549+72	Spectrum UV 77 E-40, Fastrak	2	38 thru 39
1549+92	Dow 890 SL 3/32" joint	1	40

Installation of Preformed Neoprene Joint Seals
Story County, US 30, May 1992
F-30-5(80)--20-85

Summary of Various Field Operations

1 - Dowel basket location compared to sawed joint location

- Locations of 16 dowel baskets were recorded before paving between Sta. 1509 and Sta. 1513. Locations of sawed contraction joints were later recorded in the same area. All sawed joints were found to be within 0" to 2.5" off center over the basket except for 1 case which was found (by steel locator) to be 17" off center on one end (Sta. 1512+54). This case could lead to a serious load transfer/joint failure problem.

2 - Orange paint marks at the edge of slab location before paving to mark dowel basket location

- It was noticed that some of the paint marks were up to 3" off of alignment with the centerline of the basket and furthermore, the tail end of the mark was curved. These introduced errors could contribute to some misalignment of the sawed joint over the dowel basket.

3 - String line marking on the soft concrete above the dowel baskets for location of joint sawing

- The string line was often leaving a deep gouge at the edge of the slab. This gouge was sometimes 1/2" wide and 3/4" deep. It would often be close and parallel to the sawed joint and was an unsightly interference to the sealed joint.

4 - Blank banding to prevent tining grooves, to ease joint seal installations and to reduce spalls along the transverse contraction joint

- The blanking band used was a 4" wide metal sheet with thin ropes attached to each end. Due to it being very light and having some bends it was often caught by the wind on windy days and blown out of position. Its use was abandoned on some days.

- It was noticed in some cases the saw cut ran off of the blank band path.

- Dragging a steel bar along the joint to abrade the sharp corners in the nonblank banded section was tried but was later considered not necessary.

5 - The joint sealing operator indicated that the absence of the blank band did not create a significant problem.

- A 6" metal or astro-turf band seen used in other operations seemed to be much more trouble free than the 4" unit used on this project.

6 - Joint spalling

- In some areas there was more spalling along the saw cut edge than in other areas. The spalling is attributed to the somewhat early sawing or softer concrete. Apparently, more spalling occurs with the use of diamond blades when sawing is done early.

7 - Width control of the saw cut

- In some areas control sawing was done with a 1/4" abrasive blade. Final sawing was done with a 3/8" diamond blade. Any resawing misalignment could result in a wide joint. In other areas, the control / final cut was done in one pass.

- The area of a transverse saw cut where saw turnaround occurred is commonly the problem area where the joint is found excessively wide. This area is usually within 5' to 10' from one shoulder and is from 1' to 4' long. Herein lies the one major problem related to preformed neoprene joint sealing

8 - Joint cleaning

- Joint cleaning as per specification seemed to be suitable for preformed neoprene seals. However, the final cleaning with air was at times much too far ahead to be considered "immediately prior" to the sealing operation

9 - Factory/supplier representative supervision

- Representatives were available, as specified

10 - Quality control of neoprene seals (D.S. Brown product)

- No amount of neoprene seals was known to be rejected due to being inferior quality.

- Suppliers previously stated that the seals had 1 ft. marks for use in stretch/tuck measurements. The seal stock on the site had "1 ft." marks each 10 1/2". D.S. Brown reply to this situation was that they recognized this problem, after we brought it to their attention, and they would correct the problem in their plant.

- Stretch tests were done, occasionally, on the project over 25 ft. tape-measured lengths. Some test stretch results were 2-3%.

11 - Installation equipment

- D.S. Brown automatic (prototype) unit was designed to be more user friendly and easier to clean. After minimal operations, it was replaced by a standard unit.

- D.S. Brown automatic (standard) unit initially had lubricant-adhesive pump problems. After several pump repairs and development of experience by the operator, the daily installation footage went from 1000' to 5000' per day. The thick lubricant adhesive led to major machine gumming and cleaning problems, especially in hot weather.

- By diluting the lubricant adhesive by 20 to 40% with Xylene, installation and cleaning problems were reduced.

- The final or maximum installation rate achieved on this project with 1 machine and crew was 8000 linear ft/day.

12 - Seal roll or twist problem

- A roll or twist problem in sealing was usually initiated by a sawing problem such as a sudden step in width change.

13 - Handwork installation of seals

- Normally about 18" of seal on the starting end and 6" on the finishing end had to be tucked into the joint with hand tools.

14 - Longitudinal/transverse seal crossing

- The longitudinal seal was installed first and later cut at each transverse joint.

- In some areas a single cut only was made and in other areas a double cut was made, removing 3/8" of longitudinal seal.

- To prevent openings at the joint crossing, it appears as if the single cut may be preferable.

15 - Seal ends

- The ends of the seals were cut flush with the edges of the slab. The saw cut reservoir below the end of the seal was left open.

- Options to close the reservoir ends were considered but not exercised.

16 - Solutions to saw cut excessive width problems

- Quick-set concrete formed patch to reduce width.

- Resaw total joint wider for wider seal.

- Seal with hot pour or gun-type sealant.

- Accept out of specification, but with monetary recovery.

17 - Joint seal leakage - IA-VAC tests

- IA-VAC tests show some vacuum leakage past neoprene seals against the sawed concrete face when there is no visual evidence to anticipate any leak. The seal usually is not air tight against a clean, dry concrete face when tested with a vacuum differential of 2 psi.

- The amount of vacuum leakage found is somewhat (inversely) proportional to the amount of lubricant adhesive used.

- The source of a vacuum leak in some cases was an exposed void in the concrete behind the seal.

18 - Correction of some non-compliance section of joints and seals

- It has been agreed that the neoprene seals would be removed from approximately 40 non-compliance joints and these joints would be cleaned and sealed with a hot pour sealant.

- Sand cleaning was used to remove the lubricant adhesive from the joints before resealing with hot pour.

- After raising the awareness of sawing inaccuracy problems, improvements became obvious.

- It is estimated that 2/3 of the non-compliance sealed joints were in the first 1/3 of the project.

Summary of PCC Pavement Contraction Joint
Sealing Observations
December 1992

1) Story Co., US 30, 5 miles, WBL Nevada to I-35
F-30-5(80)--20-85 1992

Longitudinal and Transverse

JOINT: 3/8" x T/3 diamond saw cut
SEAL: D. S. Brown 11/16" preformed neoprene
INSTALLER: Automatic, powered machine using lubricant adhesive

PROBLEM: Width control of saw cut
SOLUTION: Extra effort, concern, discussions and supervision

PROBLEM: Lubricant adhesive buildup in installer
SOLUTION: Dilute with solvent by up to 33%

PROBLEM: Installer design and cleanup
SOLUTION: Try new prototype - back to factory

PROBLEM: Excessive width of joints - lack of compression in overwidth cuts.
SOLUTION: Remove ± 40 seals, reclean joints and reseal with hot pour.

RATE: Maximum installation rate reached 7000/8000 ft. of seal/day

PROBLEM: IA-VAC tests show preformed neoprene seals have slight air leakage along concrete/seal interfaces. Initially, the seal is not as air tight as a well installed field molded sealant.
SOLUTION: "We expect" neoprene seals to perform well with many years, much longer than the field molded sealants.

2) Pottawattamie-Harrison Co., I-29, 18 miles, NBL to Missouri Valley IM-29-4(39)56-13-78 1992

Longitudinal

JOINT: 1/4" x T/3 diamond saw cut
SEAL: (3 divisions) 7/16" D. S. Brown preformed neoprene
(1 division) Hot pour

Transverse

JOINT: 3/8" x T/3 diamond saw cut
SEAL: 11/16 x T/3 D. S. Brown Preformed Neoprene

PROBLEM: Two widths of saw cut required changing adjustments on one installation machine or having two dedicated machines.
SOLUTION: Two machines were used.

PROBLEM: Lubricant adhesive
SOLUTION: D. S. Brown tried new experimental product. It did not work at all.

PROBLEM: Width control of saw cut
SOLUTION: Preconstruction training meeting.
Saw cut width was quite well controlled.

OTHER: Phoenix (Germon Co.) installed 30 joints of preformed seal for Iowa DOT on experimental basis near MP 70, NBL on I-29.

The seal is not neoprene, but is EPDM

They made a bevel cut along the top of the joint and used soap water as the lubricant. Seal installation was quick and simple compared to D. S. Brown product.

PROBLEM: Slow rate of preformed neoprene seal installation. Achieved up to 5000 ft./day. (DBE contractor also)
SOLUTION: D. S. Brown tried their new prototype installer. Again, it soon went back to the factory.

PROBLEM: One foot length marks on neoprene seals were spaced at 11 3/8 inches. The marks are used to measure amount of stretch or tuck after installation.
SOLUTION: D. S. Brown was clearly advised on the site of this problem.

PROBLEM: IA-VAC tests show neoprene and EPDM seals are not <u>air</u> tight.

3) Cass - Pottawattamie Co., I-80, 10 miles WBL from US 71, IR-80-1(186)43--12-78 1992

PROBLEM: Silicone sealant was installed since the construction contract was let before the spec for neoprene was in effect. Crafco Road Saver Self Leveling silicone was installed. Initially, IA-VAC tests showed them to be generally air tight except where overfilling had caused failure from tire contacts.

PROBLEM: Excessive overfilling in many areas
SOLUTION: Education, inspection, use less material, (and I would suggest tooling the sealant, even though it is self leveling, to help it make better contact with the joint faces.)

PROBLEM: After 3 months of traffic use, many adhesion failures are occurring and pieces of sealant are coming out or being turned 1/4 turn within the joint.

PROBLEM: The sealant curing process seems questionable.
SOLUTION: Stop using this product and method and get the resealing crews ready.

NOTE: I understand the curing process of the Crafco silicone is an ongoing continuous process and, therefore, the cure is not or never complete.

The Dow Corning curing process is chemically quite different and does cure completely in about 2 weeks.

4) Hamilton Co., I-35, 8 miles, SBL to IA 175
IR-35-5(54)133--12-40 1992

Dow Corning Silicone 890 self leveling sealant was used. A joint primer was also used. IA-VAC tests showed very good air tight results on initial test. No further tests were done to date. So far, there are no indications of failures. Overfilling was not generally observed.

PROBLEM: Where IA-VAC leaks were observed, they were due to spalls. Spalls were noticed specifically in some areas. Spalls seemed to be related to time of joint sawing.

SOLUTION: Spend time to research further this observation.

IOWA DEPARTMENT OF TRANSPORTATION

TO OFFICE: Materials DATE: November 3, 1993

ATTENTION: Vern Marks REF. NO.: 436/HR-318

FROM: Bob Steffes

OFFICE: Materials - Research

SUBJECT: Research Joint Sealant in IA 163, Polk County
RP-163-1(50)--16-77, Westbound Lane

Some discussions were held recently concerning the installation of a short test section of Sika pavement joint seals. The subject was discussed with Jeff Artioli of W. G. Block, Casey Klepper of Sika Corporation, Larry Hill, Des Moines DOT Residency, Jim Grove and yourself. As a result of those discussions, some sealants were installed in Polk County IA 163. The sealants were Sikaflex 15 LM Polyurethane and Sikaflex 1C SL Polyurethane. Safety data sheets have been provided.

The Sikaflex 15 LM was installed in eight joints and the centerline in the WBL from Sta. 985+92 to Sta. 987+32 on October 26, 1993. That concrete was placed on October 21, 1993. The Sikaflex 1C SL was installed in three joints and centerline from Sta. 991+92 to Sta. 992+32 on October 27, 1993. That concrete was placed October 22, 1993. The pavement was quite dry at joint sealing time as there was no rain since paving time. Air temperature at sealing time was around 10°C (50°F).

Joint sawing was done with a dry abrasive blade. Sawing, sand cleaning, air blasting and installation of backer rod was done by the contractor, Cedar Valley Corporation. The sealant was provided and installed by Sika Corp, without cost to the DOT. Evaluation will be done by Materials Research.

The Sikaflex 15 LM has recently been tested in Kansas and Wisconsin and does comply with their specification requirements.

Some of this product was put down in a short test section on I-80 in Dallas County in 1989, and it has performed better than the silicone sealant in the same area.

RS:kmd
cc: L. Hill

Appendix B
Joint Sealing Cost Analysis

LIFE CYCLE COST ANALYSIS
OF PREFORMED NEOPRENE COMPRESSION SEALS

30-Year Life Cycle Cost Analysis
Using Contractor-Provided Cost and Life Data

Preformed Neoprene

Year	Description	Quantity	Unit* Cost	Total	Present** Worth
0	Initial Cost	100,000 LF	$1.69/LF	$169,000	$169,000
18	Replace Seal	100,000 LF	$1.69/LF	$169,000	$ 90,983
30	Reconstruct				

TOTAL PRESENT VALUE $259,983

Silicone Caulk

Year	Description	Quantity	Unit* Cost	Total	Present** Worth
0	Initial Cost	100,000 LF	$1.43/LF	$143,000	$143,000
10	Replace Seal	100,000 LF	$1.43/LF	$143,000	$101,375
20	Replace Seal	100,000 LF	$1.43/LF	$143,000	$ 74,382
30	Reconstruct				

TOTAL PRESENT VALUE $318,757

	Preformed Neoprene	Silicone Caulk
Initial Construction		
Local Funding (15%)	$ 25,350	$ 21,450
Maintenance		
Local Funding (100%)	$ 90,983	$175,757
Total Local Funding over Pavement Life	**$116,333**	**$197,207**

SUMMARY

With the service life and cost data provided, preformed neoprene seals show a significant life cycle cost savings over silicone caulk seals. To the local owner/agency, the choice of joint seal is even more critical because most maintenance is funded solely at the local level. As is demonstrated above, the savings to the local owner/agency is over $80,000 as a result of using preformed neoprene seals.

*Unit cost includes initial material cost and cost of installation.
**Present worth computed at 3.5% annual discount rate.

The above figures were compiled from data submitted by contractors in response to a national survey conducted by The D. S. Brown Company. D. S. Brown is not responsible for the accuracy of the data submitted by the survey respondents.

LIFE CYCLE COST ANALYSIS
OF PREFORMED NEOPRENE COMPRESSION SEALS

30-Year Life Cycle Cost Analysis
Using Contractor-Provided Cost and Life Data

Preformed Neoprene

Year	Description	Quantity	Unit* Cost	Total	Present** Worth
0	Initial Cost	100,000 LF	$1.69/LF	$169,000	$169,000
18	Replace Seal	100,000 LF	$1.69/LF	$169,000	$ 90,983
30	Reconstruct				
				TOTAL PRESENT VALUE	**$259,983**

Hot Pour (Super Seal 777)

Year	Description	Quantity	Unit* Cost	Total	Present** Worth
0	Initial Cost	100,000 LF	$.795/LF	$79,500	$79,500
5	Replace Seal	100,000 LF	$.795/LF	$79,500	$66,937
10	Replace Seal	100,000 LF	$.795/LF	$79,500	$56,359
15	Replace Seal	100,000 LF	$.795/LF	$79,500	$47,453
20	Replace Seal	100,000 LF	$.795/LF	$79,500	$39,954
25	Replace Seal	100,000 LF	$.795/LF	$79,500	$33,640
30	Reconstruct				
				TOTAL PRESENT VALUE	**$323,843**

	Preformed Neoprene	Hot Pour
Initial Construction		
Local Funding (15%)	$ 25,350	$ 11,925
Maintenance		
Local Funding (100%)	$ 90,983	$244,343
Total Local Funding over Pavement Life	**$116,333**	**$256,268**

SUMMARY

With the service life and cost data provided, preformed neoprene seals show a significant life cycle cost savings over Hot Pour.
To the local owner/agency, the choice of joint seal is even more critical because most maintenance is funded solely at the local level.
As is demonstrated above, the savings to the local owner/agency is over $139,935 as a result of using preformed neoprene seals.

*Unit cost includes initial material cost and cost of installation.

**Present worth computed at 3.5% annual discount rate.

The above figures were compiled from data submitted by contractors in response to a national survey conducted by The D. S. Brown Company. D. S. Brown is not responsible for the accuracy of the data submitted by the survey respondents.

Appendix C
Cracking Time of Soff-Cut Sawed Joints

HR-318, "Evaluation of Preformed Neoprene Joint Seals"
Hamilton County, project IR-35-5(54)-133--12-40
Interstate PCC Full Depth Paving
Research Site: I-35, MP 141, northbound lane
June 1991

SECTION A

Section Joint Number	Total Joint Number	Station	Joint Cracks Observed June/July						Joint Crack Width (X 1/32") July 1
			19	20	21	24	1	8	
1	1	808+25		X					2
2	2	808+45			X				1
3	3	808+65			X				2
4	4	808+85					X		1
5	5	809+05					X		1
6	6	809+25					X		1
7	7	809+45		X					4
8	8	809+65					X		1
9	9	809+85					X		1
10	10	810+05					X		1
11	11	810+25	X						4
12	12	810+45					X		1

Notes: Sealant, W. R. Meadows, hot pour 3405 modified.

Backer rod

Backer rod, joints 1 thru 4, 1/4" Cera rod
Joints 5 thru 12, 5/16" Industrial Thermal Polymers (ITP) rod

Joints 4 and 8 have 3' of backer rod removed at quarter point of driving lane.

Longitudinal joint from 1' to 8' N of joint 8 has Cera rod replaced by ITP rod.

(The above three variations were made to determine effect on sealant bubbling.)

SECTION B

Section Joint Number	Total Joint Number	Station	Joint Cracks Observed June/July 19	20	21	24	1	8	Joint Crack Width (X 1/32") July 1
1	13	810+65					X		1
2	14	810+85					X		1
3	15	811+06		X					3
4	16	811+26					X		1
5	17	811+46					X		1
6	18	811+66					X		1
7	19	811+86		X					3
8	20	812+07					X		1
9	21	812+27	X						3
10	22	812+47					X		1
11	23	812+67					X		1
12	24	812+87					X		1

Notes: Sealant, W. R. Meadows, hot pour 3405 modified.

No backer rod.

Joint 20 is at MP 141 marker.

SECTION C

Section Joint Number	Total Joint Number	Station	Joint Cracks Observed June/July 19	20	21	24	1	8	Joint Crack Width (X 1/32") July 1
1	25	813+08					X		1
2	26	813+28		X					4
3	27	813+48					X		1
4	28	813+68					X		2
5	29	813+88					X		2
6	30	814+08						X	1
7	31	814+28							
8	32	814+48			X				3
9	33	814+68					X		1
10	34	814+88					X		1
11	35	815+09					X		1
12	36	815+29		X					4

Notes: Sealant, Dow Corning 890 self leveling silicone

Backer rod

Joints 30 and 31 are below county road D36 bridge.

SECTION D

Section Joint Number	Total Joint Number	Station	Joint Cracks Observed June/July 19	20	21	24	1	8	Joint Crack Width (X 1/32") July 1
1	37	815+49					X		1
2	38	815+69					X		1
3	39	815+89					X		1
4	40	816+10			X				3
5	41	816+30					X		1
6	42	816+50					X		1
7	43	816+70					X		1
8	44	816+90					X		1
9	45	817+10		X					4
10	46	817+30					X		1
11	47	817+50					X		1
12	48	817+70					X		1

Notes: Sealant, Dow Corning 890 self leveling silicone

No backer rod.

Rate of joint sealing wand travel was reduced by approximately 33% when sealing longitudinal joint from Sta. 815+70 to Sta. 816+40 to determine effect on sealant bubbling.

SECTION G

Section Joint Number	Total Joint Number	Station	Joint Cracks Observed June/July 19	20	21	24	1	8	Joint Crack Width (X 1/32") July 1
1	49	817+92			X				2
2	50	818+12			X				1
3	51	818+32		X					2
4	52	818+52			X				1
5	53	818+72			X				1
6	54	818+92			X				1
7	55	819+12			X				1
8	56	819+32			X				1
9	57	819+52		X					1
10	58	819+72			X				1

Notes: Project control

Sealant, W. R. Meadows, hot pour, 3405 modified

Backer rod, Cera rod 1/2"

Abrasive sawed joints 3/8" x T/3

Appendix D
Joint and Sealant Performance (Hamilton County)

IOWA VACUUM JOINT SEAL TESTER (IA–VAC)
TESTS RESULTS
HAMILTON CO.
I–80 SOUTH BOUND LANE

TEST	STATION	LEAKS											
		6/17/92			11/4/93			6/27/94					
			TYPE			TYPE			TYPE			TYPE	
		NO.	SPALL	OTHER	NO.	SPALL	OTHER	NO.	SPALL	OTHER	NO.	SPALL	OTHER
1	761+97	0			5	4	1	4	3	1			
2	761+77	0			0			0					
3	761+57	0			2	2							
4	761+37	0			0			0					
5	761+17	0			4	2	2	1	1				
6	760+97	0			0			1	1				
7	760+77	0			0			4	2	2			
8	760+57	0			1	1		1	1				
9	760+37	0			0			0					
10	760+17	0			2	2		2	2				
11	759+97	0			1	1		1	1				
12	759+77	0			2	2		1	1				
13	759+57	0						1	1				
14	759+37	0			2	2		1					
15	759+17	0			1	1		1	1				
16	758+97	0			1	1		1	1				
17	758+77	0			2	2		2	2				
18	758+57	1		1	3	2	1	3	3				
19	758+37	0			2	2		1	1				
20	758+17	0			1	1		1	1				
21	757+96	0						5	3	2			
22	757+34	2	2					3	2	1			
23	757+14	4	4					3	3				
24	756+94	2	2					3	3				
25	756+74	2	2					3	3				
26	756+54	2	2					4	4				
27	756+34	0						2	2				
28	756+14	0						0					
29	755+94	1	1		3	3		1	1				
30	755+74	2	2		1	1		3	2	1			
31	755+54	0			2	2		4	4				
32	755+34	1	1		3	3		3	3				
33	755+14	0			1	1		1	1				
34	754+94	0			1	1		1	1				
35	754+74	1	1		0			2	2				
36	754+54	1	1		1	1		3	3				
37	754+34	1	1		4	4		3	3				
38	754+14	1	1		1	1		2	2				
39	753+94	2	2		1	1		2	2				
40	753+74	3	3		2	2		2	2				
41	753+54	1	1		5	5		3	3				

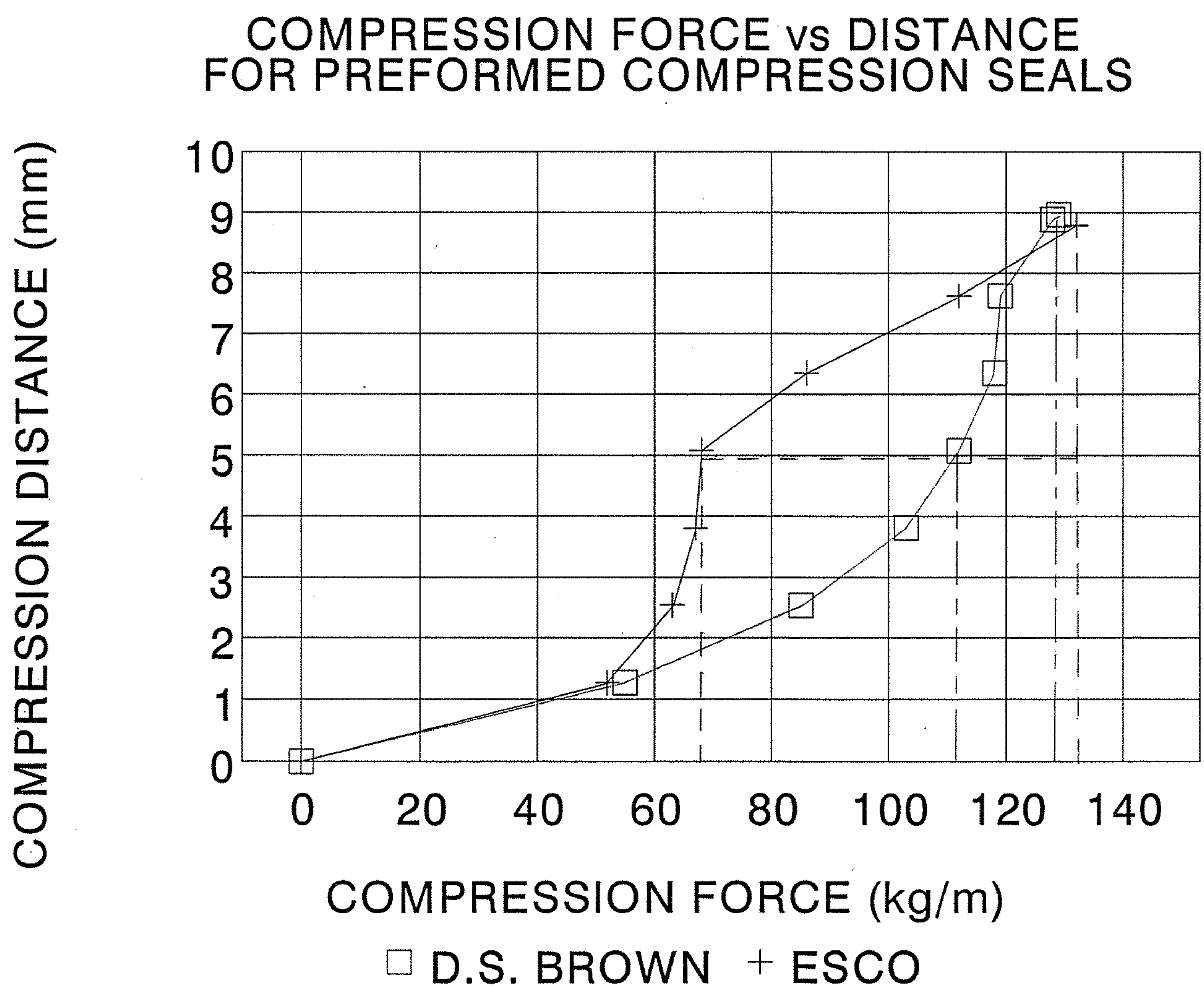
TEST	STATION	LEAKS											
		6/17/92			11/4/93			6/27/94					
			TYPE			TYPE			TYPE			TYPE	
		NO.	SPALL	OTHER	NO.	SPALL	OTHER	NO.	SPALL	OTHER	NO.	SPALL	OTHER
42	716+02	0			4	3	1	3	2	1			
43	715+82	0			3	2	1	1		1			
44	715+62	0			1	1		0					
45	715+42	0			1	1		2	2				
46	715+22	0			2	2		1	1				
47	715+02	0			2	2		3	2	1			
48	714+82	0			0			1		1			
49	714+62	0			2	2		3		3			
50	714+42	0			3	2	1	3	2	1			
51	714+22	0			3	3		2	2				
52	714+02	0			1	1		1	1				
53	713+82	0			3	3		3		3			
54	713+62	0			2	2		2	2				
55	713+42	0			2	2		1	1				
56	713+22	0			3	3		3	1	2			
57	713+02	0			4	3	1	0					
58	712+82	0			5	4	1	1		1			
59	712+62	0			2	2		3	1	2			
60	712+42	0			2	2		3	2	1			
61	712+22	0			4	4		2	2				
62	708+25	0			3	2	1	2	1	1			
63	708+05	0			0			0					
64	707+85	0			1		1	1		1			
65	707+65	0			2		2	0					
66	707+45	0			2	2		2	2				
67	707+25	0			3		3	0					
68	707+05	0			0			1	1				
69	706+85	0			0			0					
70	706+65	0			1			0					
71	706+45	0			1			0					
72	706+25	0			1	1		0					
73	706+05	0			1	1		0					
74	705+85	0			2		2	1	1				
75	705+65	0			1			0					
76	705+45	0			0			1	1				
77	705+25	0			0			2	2				
78	705+05	0			1	1		1	1				
79	704+85	0			0			1	1				
80	704+65	1	1		1	1		0					
81	704+45	0			2		2	4	4				

TEST	STATION	LEAKS											
		6/17/92			11/4/93			6/27/94					
			TYPE			TYPE			TYPE			TYPE	
		NO.	SPALL	OTHER	NO.	SPALL	OTHER	NO.	SPALL	OTHER	NO.	SPALL	OTHER
82	426+12	0			2	2		0					
83	425+92	0			0			0					
84	425+76	0			3	3		3	2	1			
85	425+56	0			1	1		0					
86	425+36	0			2	2		0					
87	425+16	0			3	3		1	1				
88	424+96	0			4	4		2	2				
89	424+76	0			2	2		1	1				
90	424+56	0			1	1		1	1				
91	424+36	0			1	1		2	2				
92	424+16	0			1	1		0					
93	423+96	0			2	2		2	2				
94	423+76	0			3		3	0					
95	423+56	0			3	2	1	1	1				
96	423+36	0			1	1		2	1	1			
97	423+16	0			3		3	3	3				
98	422+96	0			2	1	1	2	2				
99	422+76	0			1		1	0					
100	422+56	0			6	2	4	1	1				
101	422+36	0			0			0					

IOWA VACCUM JOINT SEAL TESTER (IA–VAC)
TEST RESULTS
HAMILTON CO.
I–80 SOUTH BOUND LANE
QUARTER POINT
DOW CORNING SILICONE 890 SL

STA. FROM/TO	760/758	757/752	716/712	708/704	426/422	TOTALS
TOTAL TESTS (48 in)						
1992	21	20	20	20	20	101
1993	19	13	20	20	20	92
1994	20	20	20	20	20	100
1995						
TOTAL NO. OF LEAKS						
1992	1	26	0	1	0	28
1993	29	25	49	22	41	166
1994	31	48	38	16	21	154
1995						
NO. OF LEAKS/TEST						
1992	0.05	1.3	0.0	0.05	0.0	0.28
1993	1.53	1.9	2.45	1.1	2.05	1.81
1994	1.55	2.4	1.9	0.8	1.05	1.54
1995						
SPALL LEAKS, %						
1992	0	100	0	100	0	40
1993	69	48	90	36	68	62
1994	81	96	55	88	90	82
1995						

Appendix E
Reaction Force of Preformed Compression Seals


COMPRESSION FORCE vs DISTANCE
FOR PREFORMED COMPRESSION SEALS
COMPRESSION DISTANCE (mm)
0
1
2
3
4
5
6
7
8
9
10
0
20
40
60
80
100
120
140
COMPRESSION FORCE (kg/m)
D.S. BROWN
ESCO

COMPRESSION FORCE VS DISTANCE
FOR PREFORMED COMPRESSION SEALS

D.S. BROWN			
Compression Force (lb/ft)	Compression Distance (in)	Compression Force (kg/m)	Compression Distance (mm)
0	0.000	0.00	0.00
37	0.050	55.06	1.27
57	0.100	84.83	2.54
69	0.150	102.68	3.81
75	0.200	111.61	5.08
79	0.250	117.56	6.35
80	0.300	119.05	7.62
86	0.350	127.98	8.89
87	0.353	129.47	8.97

ESCO			
Compression Force (lb/ft)	Compression Distance (in)	Compression Force (kg/m)	Compression Distance (mm)
0	0.000	0.00	0.00
35	0.050	52.09	1.27
42	0.100	62.50	2.54
45	0.150	66.97	3.81
46	0.200	68.46	5.08
58	0.250	86.31	6.35
75	0.300	111.61	7.62
89	0.346	132.45	8.79

ARR4-0026
00

PROJECT INFO

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - RUBBER PRODUCTS
LAB LOCATION - AMES

LAB NO....:ARR4-0026 - ARR4-0028

MATERIAL........:NEOPRENE COMPRESSION SEALANT
INTENDED USE....:PC PAVE (CO JOINT)
PRODUCER........:THE D. S. BROWN, CO.
PROJECT NO......:IM-80-8(151)291--13-82 CONTRACT #:43051
COUNTY..........:SCOTT CONTRACTOR:MCCARTHY CO.
BRAND...........:DELASTIC SEAL
SOURCE..........:N. BALTIMORE, OH
UNIT OF MATERIAL:SAMPLED AT JOBSITE;
0994236 - 32 CARTONS; 1094238 - 68 CARTONS;
0894209 - 11 CARTONS; 500 L.F. EA.
SAMPLED BY......:M. HUEBNER SENDER NO.:6DA4-129
DATE SAMPLED: 06/24/94 DATE RECEIVED: 06/28/94 DATE REPORTED: 07/05/94
SUPPLIER: CONTRACTOR'S STEEL

LAB. NO. ARR4-	26	27	28
DUROMETER HARDNESS	57	58	58
MEDIAN TENSILE STR. P.S.I.	2371	2209	2441
MEDIAN ELONG. IN 1" - %	450	425	475
SEAL SIZE - IN.	11/16	11/16	11/16
PROPERTIES AFTER HEAT AGING 70 HRS. @ 212. F.			
CHANGE IN DUROMETER HARDNESS - POINTS	+4	+2	+5
CHANGE IN TENSILE STR. - %	+8.1	+0.14	+2.3
CHANGE IN ELONGATION - %	0	+11.8	0
RECOVERY AFTER 50% DEFLECTION (AVG.)%	93.0	92.3	87.2
WT. CHANGE IN OIL AFTER 70 HRS. - %	37.3	38.2	39.1

COPIES TO:
CENTRAL LAB H. MCCULLOUGH DIST. 6
DAVENPORT RES.

DISPOSITION: RESULTS COMPLY (AASHTO M220)

SIGNED: ORRIS J. LANE, JR.
TESTING ENGINEER

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ARR4-0026
00

PROJECT INFO

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - RUBBER PRODUCTS
LAB LOCATION - AMES

LAB NO....:ARR4-0026 - ARR4-0028

MATERIAL........:NEOPRENE COMPRESSION SEALANT
INTENDED USE....:PC PAVE (CO JOINT)
PRODUCER........:THE D. S. BROWN, CO.
PROJECT NO......:IM-80-8(151)291--13-82 CONTRACT #:43051
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LAB. NO. ARR4-	26	27	28
DUROMETER HARDNESS	57	58	58
MEDIAN TENSILE STR. P.S.I.	2371	2209	2441
MEDIAN ELONG. IN 1" - %	450	425	475
SEAL SIZE - IN.	11/16	11/16	11/16
PROPERTIES AFTER HEAT AGING 70 HRS. @ 212. F.			
CHANGE IN DUROMETER HARDNESS - POINTS	+4	+2	+5
CHANGE IN TENSILE STR. - %	+8.1	+0.14	+2.3
CHANGE IN ELONGATION - %	0	+11.8	0
RECOVERY AFTER 50% DEFLECTION (AVG.)%	93.0	92.3	87.2
WT. CHANGE IN OIL AFTER 70 HRS. - %	37.3	38.2	39.1

COPIES TO:
CENTRAL LAB H. MCCULLOUGH DIST. 6
DAVENPORT RES.

DISPOSITION: RESULTS COMPLY (AASHTO M220)

SIGNED: ORRIS J. LANE, JR.
TESTING ENGINEER

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Appendix F
Test Results of Soff-Cut Sawed Joints Filled With Sealants

IOWA VACUUM JOINT SEAL TESTER (IA-VAC)
TEST RESULTS SUMMARY, 8/8/94
HAMILTON COUNTY, PROJECT NUMBER IR-35-5(54)-133--12-40
I-35 MP-141

NORTHBOUND LANE - SOUTH TO NORTH

SEALANT	TOTAL TESTS	TOTAL LEAKS	SPALL LEAKS	OTHER LEAKS	LEAKS PER TEST	
					INCLUDING SPALLS	EXCLUDING SPALLS
WR MEADOWS WITH BACKER ROD	8	55	16	39	6.9	4.9
WR MEADOWS WITH NO BACKER ROD	8	67	8	59	8.4	7.4
DOW CORNING 890 SL WITH BACKER ROD	8	31	20	11	3.9	1.4
DOW CORNING 890 SL WITH NO BACKER ROD	8	2	2	0	0.3	0.0
WR MEADOWS CONTROL	8	14	8	6	1.8	0.8

SOUTHBOUND LANE - SOUTH TO NORTH

SEALANT	TOTAL TESTS	TOTAL LEAKS	SPALL LEAKS	OTHER LEAKS	LEAKS PER TEST	
					INCLUDING SPALLS	EXCLUDING SPALLS
WR MEADOWS CONTROL	5	21	4	17	4.2	3.4
HYDROZO JEENE WITH NO BACKER ROD	8	26	26	0	3.25	0.0
DS BROWN NEOPRENE WITH NO BACKER ROD	8	2	2	0	0.25	0.0
DS BROWN NEOPRENE LOW PROFILE WITH NO BACKER ROD	5	27	14	13	5.4	2.6
WR MEADOWS CONTROL	5	23	18	5	4.6	1.0