EVALUATION OF JOINT SEALANT MATERIALS

Final Report

By

RICHARD W. KINCHEN
PAVEMENT RESEARCH ENGINEER

WILLIAM H. TEMPLE
ASSISTANT RESEARCH ENGINEER

W. T. BURT III
ASSISTANT MATERIALS ENGINEER
(COORDINATOR)

DAVID G. AZAR
ASSISTANT MATERIALS ENGINEER
(CHEMICAL UNIT HEAD)

Research Report No. 105

Research Project No. 69-2G
Louisiana HPR 1 (14)

Conducted By
LOUISIANA DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT, OFFICE OF HIGHWAYS
Research and Development Section
In Cooperation with
U. S. Department of Transportation
FEDERAL HIGHWAY ADMINISTRATION

MAY 1977

TABLE OF CONTENTS

LIST OF FIGURES

IMPLEMENTATION STATEMENT

The results of this project are perhaps best presented in the form of the proposed 1977 joint specifications in Appendix E and the current qualified products lists for joint sealants and lubricant adhesives in Appendix F of this report. The specifications are presented for completeness, as they are the promulgation of expertise developed since the State's first portland cement concrete pavement was constructed approximately 50 years ago. However, laboratory and field results, stimulation of thought, and nationwide exchange of information resulting from this study are very much in evidence in the mentioned appended documents.

This study formally introduced preformed elastomeric compression sealants (neoprenes) to the State of Louisiana. The study promoted great strides in regard to installation procedures and materials testing of not only preformed compression joint sealants but also of pourable materials.

Last but not least, the Department's Training Unit developed a training course and an inspector's field manual documenting certain information on pavement and bridge joint construction gathered in this research study.

SYNOPSIS

Joints perform an important role in relieving shrinkage stresses caused by seasonal changes in the volume of concrete comprising pavements and bridge decks. Joints allow the concrete pavements and bridge decks to move, and thus absorb the translation of thermally-induced stresses to strains. Joints are planned breaks and, as such, prevent or at least minimize uncontrolled cracking at the concrete surface. Possessing the ability to design breaks into their concrete facilities, highway engineers have for many years been faced with the problem of sealing joints so as to prevent the intrusion of debris and water.

In May, 1968, the Department's Research and Development Section initiated a project to evaluate joint sealants being marketed for use on roads and bridges. In the study, representatives of 31 companies installed 46 products primarily on one road and one bridge for evaluation. Thus, at first the project was primarily materials oriented; however, during the course of the study various aspects of design, construction and maintenance of joints were also investigated.

It is concluded that joints in concrete pavements and bridge decks are more effective (sometimes effective only) when adequately sealed. A joint sealant system should reject incompressibles or at least absorb the impact upon the joint of those incompressibles which d so intrude. The sealant system design should facilitate the cleaning action of rain and/or traffic in removal of undesirable material. A sealant system should prevent the passage of water through bridge deck joints and limit its passage through pavement joints. The sealant should be stable, remain non-sticky, and retain sufficient performance properties to function in a typical roadway environment at surface temperatures (in Louisiana) from 0° F. (-17.8° C.) to 160° F. (71.1° C.). The sealant system should not create any harmful effects such as spalling, roughness, and noise. The sealant system should be effective for at least five years. Small failures eventually will occur but should not propagate.

Research engineers observed that on the experimental pavements and bridge deck the neoprene compression seal performed best (although not perfectly) in sealing joints subjected to movement. Three pourable polymeric sealants performed effectively in the field experiments; however, these three products were the exception rather than the rule for the group of pourable polymeric sealants evaluated. The asphalt-based sealants demonstrated complete inadequacy to seal joints that experience movement.

Based on limited laboratory-determined materials' properties test data, most of the products evaluated met the Department's quality assurance criteria. Hence, there was only slight correlation between laboratory-determined materials' properties and the field life of a joint sealant. Perhaps the beggest disappointment was the pourable polymeric sealants which as a group exhibited excellent physical characteristics in the laboratory but performed poorly in the field.

Adequate joint design for concrete pavements and bridge decks must consider movements which the joints will experience. More specifically, proper joint design will be tempered with an awareness of construction tolerances and restraints, a knowledge of in-service joint movements, and an understanding of sealants' limitations.

Louisiana's concrete pavements and bridge decks contain a river-deposited siliceous type of aggregate (chert) so hard as to preclude economical routine sawing of hardened slabs. The best approach to forming the joint reservoirs in such concrete appears to be to install a joint-forming device (removable or permanent) in the plastic mix. Following joint formation and preparation, application of lubricant-adhesive to the neoprene compression seal can facilitate its installation. More important, the investigators conclude that lubricant-adhesives enhance the performance of neoprene compression seals by the bond of sealant to concrete.

The investigators did not develop a simple yet effective method of cleaning and resealing transverse joints. However, they did conclude that, difficult as it may be, it is worthwhile to periodically clean and reseal transverse pressure relief and contraction joints on concrete pavements immediately adjacent to bridge structures. This action would be to minimize the thermally-induced forces which pavements with clogged joints accumulate and malevolently direct towards structures.

It is recommended that the neoprene compression seal continue to be specified for transverse joints in concrete pavements and bridge decks. The two pourable polymeric sealants which performed well on the experimental pavements should be allowed as alternates in situations such as split-slab construction where neoprene compression seal installation would be awkward. The asphalt-based sealants should not be used to seal joints subject to movement.

The Department should continue its laboratory quality assurance testing of joint sealants accepted for use. However, field evaluations of at least one-year duration should continue to be required of joint sealants prior to their qualification for use.

The Department's pavement design efforts should be directed toward the control of water being introduced at the longitudinal shoulder joint. This volume of water far exceeds that entering at the transverse joints. Longitudinal joint sealing, full-roadway-width asphalt-treated drainage layers, or a system of longitudinal and transverse drainage trenches within the shoulder could be considered for this purpose.

It is recommended that the State's existing joint maintenance policy be revised to direct attention to the upkeep of transverse expansion and, as resources permit, transverse contraction joints in pavements immediately adjacent to bridge structures. This action is intended to minimize pavement thrust damage to bridge structures.

INTRODUCTION

"For want of a nail, the shoe was lost;
For want of the shoe, the horse was lost;
For want of the horse, the rider was lost;
For want of the rider, the battle was lost;
For want of the battle, the Kingdom was lost;
And all for the want of a horseshoe nail."

And such is the destiny of conventional concrete pavements (and bridge decks) where too little emphasis is placed on design, materials, construction and maintenance of joints. If highway engineers consider joints as only an accessory to a pavement, they will discover that the greatest portion of their concrete maintenance is joint maintenance (1).*

Joints are indeed an important part of concrete pavement. They reduce shrinkage stresses caused by seasonal changes in the volume of concrete. Joints allow the pavement to move--that is, to expand in summer and contract in winter. In addition, they serve as the method of ending each day's construction operation. Joints are planned breaks in the pavement and, as such, they prevent unplanned and uncontrolled cracking of the pavement surface.

Of course, these planned breaks in concrete pavements provide paths by which moisture and debris can enter a pavement system and undermine its strength. Joint sealing then must be effectively accomplished, lest the cure for uncontrolled cracking be as destructive as the disease itself.

*Underlined numbers in parentheses refer to numbered entries in the section of this report entitled "References."

The word "seal" is a key one on a discussion of joints. It is <u>not</u> interchangeable with the word "fill." The authors feel that the synonymy of these two words has caused many problems on rigid pavements in the State of Louisiana in past years.

Improperly sealed joints in bridge decks allow water to permeate to supporting members and cause aesthetic and structural damage (Figures 1 and 2). The intrusion of incompressibles can be perhaps more damaging (Figure 3 in conjunction with Figure 4).

Improperly sealed joints in pavements permit the entrance of incompressible debris which can cause localized spalling or cumulative pavement thrust damage (Figures 5 and 6). Water can enter an improperly sealed joint and cause erosion of a granular sub-base material.

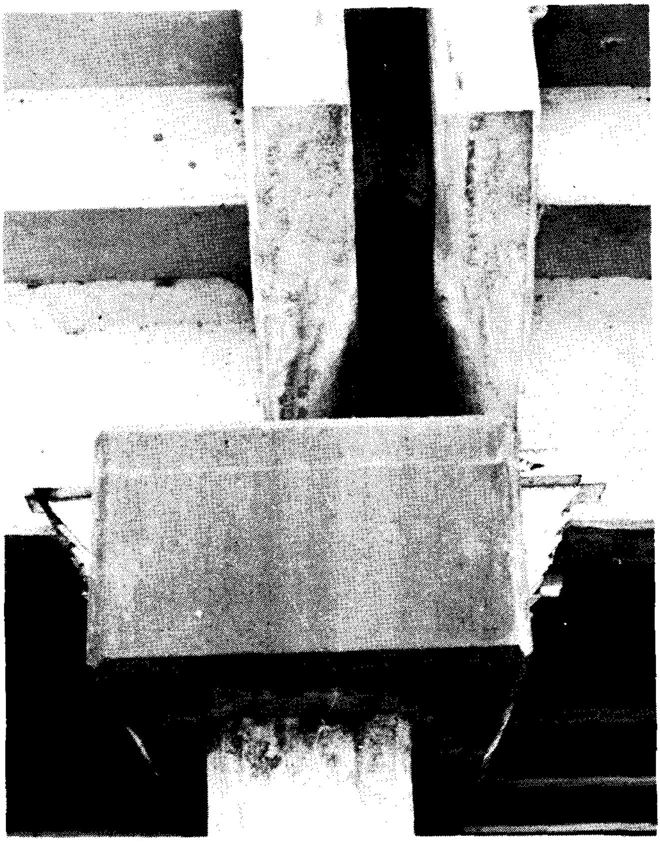
In May, 1968, the Department's Research and Development Section responded to problems such as those mentioned above by initiating a research project to evaluate joint sealants being marketed for use on roads and bridges. The project at first was primarily materials oriented; however, during the course of the study various aspects of design, construction, and maintenance of joints were also investigated. This report presents the results of the research study.

Aesthetically Displeasing Wall at Overpass
FIGURE 1

Steel Corrosion Due to Unsealed Joint
FIGURE 2

Locked Expansion Joint

FIGURE 3

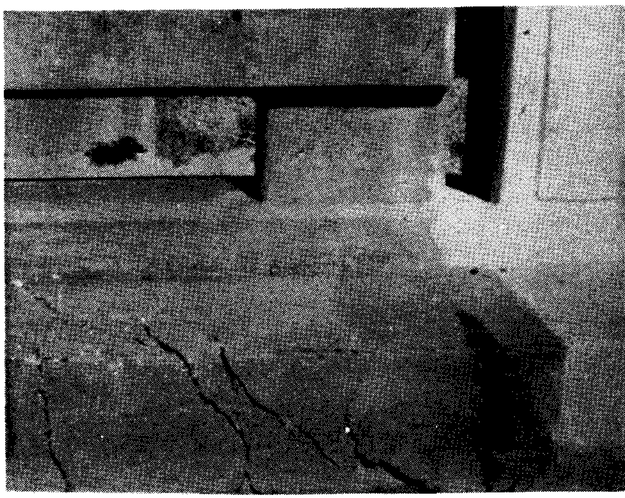


Bridge Being Pushed Off Cap

FIGURE 4

Pavement Spall

FIGURE 5



Crushing Due to Pavement Thrust

FIGURE 6

SCOPE

In this study, research personnel of the Department evaluated the performance of available joint sealants installed by suppliers primarily on one bridge deck and on one road. Materials and research technicians concurrently determined the pertinent materials properties of these joint sealants in the laboratory. The researchers analyzed their results with emphasis in the following areas:

1. Design of joints.
2. Selection of best materials available for joint sealing.
3. Construction and installation procedures for joints.
4. Maintenance of joints.
5. Comparison of materials' properties with field performance.
6. Development of test procedures and specifications.

SCOPE

In this study, research personnel of the Department evaluated the performance of available joint sealants installed by suppliers primarily on one bridge deck and on one road. Materials and research technicians concurrently determined the pertinent materials properties of these joint sealants in the laboratory. The researchers analyzed their results with emphasis in the following areas:

1. Design of joints.
2. Selection of best materials available for joint sealing.
3. Construction and installation procedures for joints.
4. Maintenance of joints.
5. Comparison of materials' properties with field performance.
6. Development of test procedures and specifications.

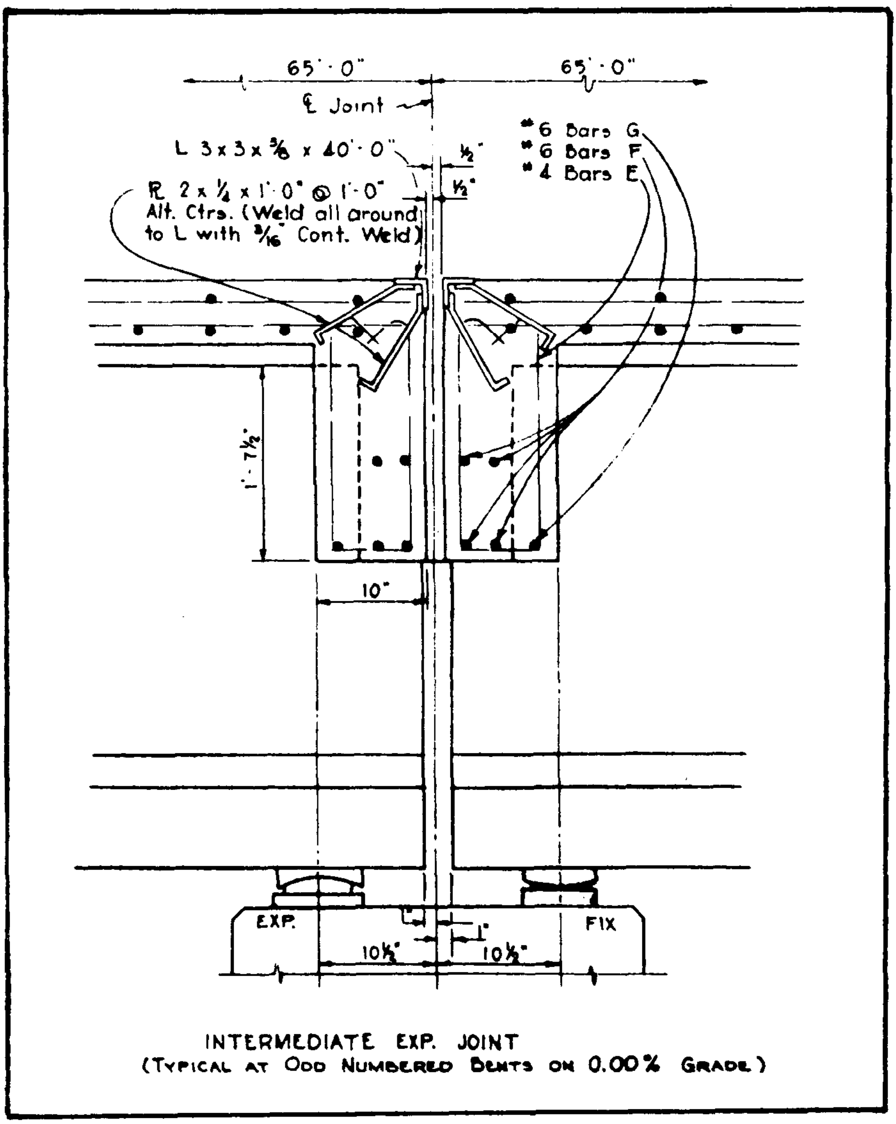
METHOD OF PROCEDURE

Bridge Installations

The research investigators contacted thirty suppliers of joint sealants and invited them to participate in the study. The suppliers were asked to provide material for field and laboratory purposes, to recommend specifications, construction procedures, and controls, and to actually install their sealant(s) in three or more joints per product on an existing bridge for evaluation by the Department. Eight suppliers accepted the offer and installed thirteen products on a total of fifty-six joints. Maintenance forces of the Department sandblasted the joint faces and provided traffic control.

Research personnel selected the eastbound bridge (northerly directed at this point) of the Interstate Route 10 twin bridges across Lake Pontchartrain (New Orleans area) for this phase of the research project. This five and one-half mile (8.8 km-)-long bridge has one-inch (2.5-cm) armored joints, with concrete joint faces at the curb and sidewalk. Figure 7 relates the design of the armored portion of the joint. Only two of the three lanes were sealed because of traffic control problems; however, as mentioned, the sealants were extended through the concrete curb and sidewalk on one side so that the adhesion of the material to both concrete and steel could be evaluated. The bridge was built in 1963 with prefabricated deck units.

Researchers installed simple scribe gauges at each joint to record the maximum and the minimum joint openings. Two strips of painted wood, each glued to an adjacent slab, and a screw extending from one piece of wood to the other comprised the joint scribe gauge. Relative movement between the two slabs was recorded as a scratch mark inscribed into one of the strips by the point of the screw.



Typical Bridge Expansion Joint, Experimental Project

FIGURE 7

Members of the Research and Development Section conducted performance reviews initially at three-month intervals and later at six-month intervals. The scribe gauges were read and the joint sealants were examined in these reviews. Each sealant's performance record from the date of installation has been documented by color slides and black-and-white photographs.

Most of the installations on this I-10 bridge were accomplished during the summer of 1968. As the joint sealant market expanded, the researchers later observed the installation and performance of additional sealants on bridges at other locations in the state.

Roadway Installations

Investigators on this research project invited forty companies which supply joint sealants to participate in the roadway phase of the study. The suppliers were asked to provide material for laboratory and field evaluation, to recommend specifications, construction procedures, and controls, and to actually install their sealant(s) in five or more joints per product on a new portland cement concrete pavement. Twenty-three companies accepted the invitation and installed thirty-three products on a total of one hundred forty-eight joints. The transverse contraction joints formed by the paving contractor were cleaned and sandblasted prior to sealing by Louisiana Department of Highways personnel to the satisfaction of the materials suppliers.

Research engineers selected a segment of Interstate Route 12 east of Baton Rouge for this phase of the research project. Plans for the project specified 58.5-foot (17.8-m) slab lengths and 3/8 inch-(1.0 cm) wide contraction joint widths. Researchers altered the joint widths to 5/8 inch (1.6 cm) in the test area so as to limit percent movement of the joint to 60%, as a theoretical movement of 3/8 inch (1.0 cm) was calculated. The joints were formed in the plastic concrete by means of an insert material, and the insert material was later sawed from the hardened concrete to the required width and depth.

Research project personnel conducted performance reviews initially at three-month and later at six-month intervals of time. They attempted to measure joint widths by means of scribe gauges installed therein; however, an inferior glue rendered many of these scribes inoperative. Each joint sealant was examined carefully. Each sealant's performance record has been documented by color slides and black-and-white photographs.

The suppliers installed most of their products on Interstate Route 12 during the summer and fall of 1969. As new products were marketed, research personnel observed the installation and performance of various additional joint sealants on roads at other locations in the state.

For both the bridge and the roadway phases of this study, the installed materials were evaluated in the field for their ability to adhere to the joint walls, to resist penetration of foreign materials, to resist splitting (cohesion failure), to resist wear, and, in general, to keep the joints sealed. Failure was considered complete when fifteen percent of the length of a given joint was ineffectively sealed.

Laboratory Test Program

The researchers feel that the physical requirements of a joint sealant in the field can basically be grouped under the following four headings:

1. Installation requirements
2. Durability and the ability to reject foreign materials or resist the effects of foreign materials
3. Ability to resist effects of movement
4. Ability to properly seal (adhesion)

These four performance criteria are considered sufficient to cover the major performance requirements for a good sealant as far as necessary laboratory testing is also concerned.

A review was conducted of the available tests adopted as standard by American Society for Testing and Materials, as referred to in federal specifications, as devised by other states, and as developed by the individual joint material suppliers. The tests could be grouped under the four headings of the previous paragraph according to the following descriptive terms:

1. Installation Requirements - Application life, tack free time, change in weight and volume, flow, self-leveling, viscosity and mixing.
2. Durability - Hardness, tensile strength loss, elongation loss, hardness change, oil swell, ozone resistance, low temperature hardness, resistance to weathering, and resistance to ultraviolet light.
3. Movement - Tensile strength, compression set, elongation at break, permanent set at break, low temperature recovery, high temperature recovery, tear strength, cycling rate (temperature controlled, number, distance), and resilience.
4. Seal - Adhesion, cohesion, distortion, penetration, bond to concrete, bond to steel, and peel strength.

Samples of the joint sealants installed on roads and bridges in this study were tested in the laboratory for characterization with respect to the proposed four areas of requirement. Test procedures are delineated in Appendix C to this report. Field performance was compared with materials' properties in search of a correlation which could form the basis for acceptance or rejection of joint sealant materials (Appendix D).

DISCUSSION OF RESULTS

Field Evaluation

Pavement Seals

Table 1 in Appendix A provides a description of the test sealants and installation procedures. Table 2 in Appendix A lists these sealants. Pavement seals from four suppliers are still performing satisfactorily six years after installation on the I-12 test section. Included in this performing group are three neoprene compression seals--Acme "S-545", D. S. Brown "A-1250", and D. S. Brown "E-1250", as well as two pourable sealants--"Superseal 444" (a polyvinyl chloride) and "Edoco 3200" (a polyurethane).

Amont the sealants which have failed, asphalt-based materials had an average seal life (A.S.L.) of two months, polysulfide materials 11 months, polyurethane materials 14 months, and liquid neoprene 16 months.

Preparation of joints prior to sealing is essential to insure adequate bond between the sealants and the concrete joint faces. The best results are obtained when joints are sandblasted and blown clean. Additionally, most cold-poured (polyurethane and polysulfide) sealants require that a primer be applied to the joint faces prior to application of the sealant. One polyurethane sealant (PRC 3105), which performed well on the metal bridge joints (A.S.L.= 93+ months), did not adhere to the concrete roadway joints beyond 31 months. Another polyurethane sealant (Sikaflex T-68) had an average seal life in the bridge joints four times longer than the same material installed in the concrete roadway joints. It is possible, therefore, that although some joint primers are effective on metal "armored" bridge joints, they do not provide a good bond to concrete surfaces.

Attempts at measuring pavement joint movement with wooden scribes were unsuccessful due to problems encountered in maintaining a good bond of the scribes to the concrete. However, estimates from joint width measurements taken during several field inspections indicate an average joint movement of approximately 40% of the 3/8-inch (0.95 cm) theoretical value.

Bridge Seals

Table 4 of Appendix B provides a description of the test sealants and installation procedures. The bridge seals are listed in Table 5 in Appendix B. Seals from three suppliers are still performing satisfactorily eight years after installation on the I-10 bridge over Lake Pontchartrain. Included in this group are four neoprene seals--Acme "S-800" (2" and 1 1/4"), D. S. Brown "CV-2000", D. S. Brown "B-1625", and D. S. Brown "H-1625", as well as one pourable sealant--PRC "3105".

Another D. S. Brown seal, the "B-2500", was installed two years later and is still performing satisfactorily after six years of service.

In the pourable sealant category polyurethanes had an average seal life of 21 months while polysulfides lasted only 12 months.

Laboratory Evaluation

Pavement Seals

Due to the limited laboratory facilities available for testing joint sealants during the first three years of the study, no original test data is available for preformed compression seals installed in transverse pavement joints. Some initial materials' properties were determined for the pourable sealants, however, and this data is presented in Table 3.

The Department's Standard Specifications for Roads and Bridges, October, 1971, presents test value requirements for two types of pourable joint sealants--asphaltic types and polyurethane polymers. These values are presented in Table 3 for reference. The document of specifications is currently being rewritten, and the revised version will specify a third type of pourable joint sealant--polyvinyl chloride extended coal tar compounds. (See Appendix E for proposed revised joint sealant specifications.)

Although the data in Table 3 is not complete for many of the sealants evaluated, enough tests were run to determine that a sealant can pass most laboratory tests and still fail prematurely in the field. Tests such as artificial weathering (Weather-Ometer), shrinkage, ozone resistance, and the various hardness and penetration tests can serve to reveal materials with inferior physical properties. These tests do not, however, have the capability of simulating actual joint movement as does the Bostik Environmental Cycling Chamber. The Bostik tester subjects joint sealant samples to a series of cyclic movements (65% elongation, 35% compression) with accompanying temperature variations of 0° F. to 160° F. (-18° C. to 71° C.). The failure criteria used in this test are adhesion, cohesion, or distortion failures for greater than or equal to 15% of the two-inch (5.1-cm) sample length. Although only six of the samples were tested in the Bostik device, a satisfactory correlation seems to exist between acceptable and unacceptable materials as determined by actual service life. A more detailed comparison of materials' properties with field performance is included in a later section.

Bridge Seals

Tests on pourable sealants used in bridge joints led to observations similar to those for pavements in regard to comparing laboratory-determined materials' properties to the life of a sealant actually installed in the field. Most of these laboratory tests serve to detect inferior physical properties, but materials with acceptable properties may or may not be durable enough to withstand joint movement. Materials' properties for four of the pourable sealants installed in the bridge joints may be found in Table 6. The sealants are listed in order of their field performance.

Preformed compression seals are also listed in Table 6 in order of their field performance. The first three seals in this list, which have performed well beyond five years of service, have met all the indicated specifications. Continuing down the list, as the seals meet fewer and fewer of the materials' specifications, the service life was found to decrease accordingly.

Samples of preformed compression seals were removed from the I-10 bridge two and one-half years and five years after installation. The field aged seals were tested in the laboratory as indicated in Table 7. Although these samples would not be expected to meet the indicated criteria for new compression seals, trends similar to those found in Table 6 may be observed.

Design

Pavements

At the inception of this study, Louisiana had two basic types of pavement design. High traffic count facilities were 10 inches (25.4 cm) thick, reinforced, with 58 1/2 feet (17.8 m) between joints. This was the type used for the evaluation. The theoretical joint movement was 3/8 inch (1.0 cm). Lower traffic count roads were eight or nine inches (20.3 or 22.9 cm) thick, unreinforced, with 20 feet (6.1 m) between joints. The theoretical joint movement was 1/8 inch (0.3 cm). For both designs the joints were 3/8 inch (1.0 cm) wide and 2 1/2 inches deep (6.4 cm).

In evaluating pavement performance across the state, several reoccurring distress patterns were noted to be associated with the 58 1/2-foot (17.8-m) reinforced slabs. These signs of distress were:

(1) Pavement growth - all of the pavements "grew," that is, developed pavement thrust very quickly.

(2) Spalling - after approximately eight to ten years of service, major joint spalling was prevalent.

(3) Uncontrolled cracking - midpoint and third-point cracking commonly occurred between joints.

Because of these problems, this type design is no longer used. Though the thickness may vary according to projected usage, the slab lengths are 20 feet (6.1 m) long and unreinforced. The design width for the transverse contraction (dummy) joint is 7/16 inch (1.1 cm). Figure 8 shows the Department's Standard Plan R-CP-108 and relates current transverse contraction joint design.

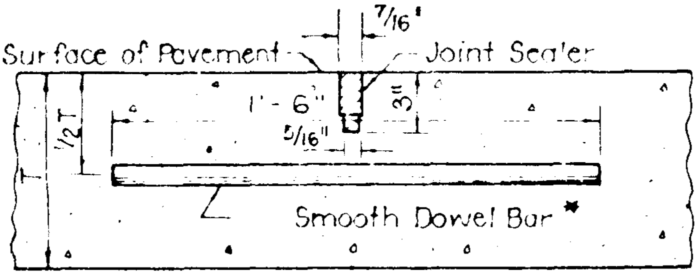
Even though the early Present Serviceability Indices* may be relatively less than those for the longer slab lengths because of the increased joints, it is felt that the Present Serviceability Indices over the total design life will be improved and that the problems of growth, spalling, and cracking will be less frequent.

Bridges

On the Lake Pontchartrain Bridge where the installation took place, an expansion joint was placed after several fixed joints. Through the years some of the expansion joints have apparently become locked, and the movement due to expansion and contraction has been transferred through the fixed joints to the next expansion joints. Consequently, some expansion joints moved less than expected, whereas others moved much more than expected, as indicated in Appendix B, Table 5.

---

*Note: Present Serviceability Index is an AASHO Road Test-developed concept for rating a pavement's performance based upon slope variance and certain signs of distress.



SECTION OF TRANSVERSE CONTRACTION JOINT

Joints Are to be Placed 20' Apart on All Pavement Thicknesses

Current Transverse Contraction Joint Design

FIGURE 8

The Department's Bridge Design Section has been interested in determining actual versus theoretical movement on various types of bridges since the beginning of the study. Accordingly, wooden scribes have been placed on the Lake Pontchartrain Bridge as well as eight other bridges around the state to record minimum and maximum joint openings. The movements on these eight bridges are reported in Table 8 in Appendix B. The actual average joint widths, reflecting as-built widths and subsequent movements, slightly exceeded the design width in most cases. Actual average movement compared quite well with the predicted movement on seven of these eight bridges.

An important design feature associated with joint movement is the pressure-relief mechanism at bridge approach slabs. At one time the joint design called for one 4-inch (10.2-cm) relief joint with a bolster block for load transfer. A more recent design has reduced this configuration to a 2-inch (5.1-cm) wide relief joint over a bolster block at the approach slab followed by two 1-inch (2.5-cm) expansion joints spaced at 20-foot (6.1-m) intervals in the pavement. It is felt that this design could provide a smoother ride, particularly if faulting were experienced.

The principal investigators are currently field-evaluating a design concept involving watertight bridge joint pressure relief systems. Proposed non-proprietary specifications for such systems are presented in Appendix E under Sections 805.13 (d) and 1005.04, "Steel Reinforced Elastomeric Joint Seals."

The mentioned proposed specifications describe these bridge joint systems as units of elastomer and bonded metal components so arranged as to provide for the expansion and contraction joint movements. The metal components bridging the joint gap shall be of sufficient strength to carry wheel loads across the joint. The expansion joints shall seal the deck surface, gutters, and curbs to prevent moisture and other contaminants from reaching the pier and abutment caps and shall provide adequate anchorage to the bridge deck.

The researchers are evaluating two types of bridge joint systems for watertightness and pressure relief capabilities, the Transflex Joint and the Acme Modular Joint. The Acme Modular Joint has been installed as an experimental feature on one high-rise structure in the state. This system has exhibited some loss of stability in regard to deflection under traffic loads. It is experiencing a rocking motion upon impact, with a subsequent increase in noise level. The Modular Joint has not exhibited signs of leakage to date, although watertightness of this joint system is difficult to verify on high-rise structures spanning bodies of water.

The Transflex Expansion Joint System has been placed on overpass and elevated ramp structures in the state. It has performed with varying degrees of success. Some have exhibited problems with watertightness, vertical displacement of one side with respect to the other, and deterioration of pourable sealant in the gap between the neoprene and the metal end dam.

Federal Highway Administration's National Experimental and Evaluation Program (N.E.E.P.) No. 11 - Development of Watertight Bridge Deck Joint Seals is evaluating joint sealant systems such as the above.

Materials

Louisiana's latest proposed revisions to its joint sealant materials' specifications are included in Appendix E. The specifications are the culmination of laboratory and field tests on many types of sealants through the years.

The most effective joint sealant for pavement and bridge joints was found to be the neoprene compression seals. Also, where the bridge seals were correctly installed, a "high solids" (75 percent solids) lubricant-adhesive aided the seals' performance significantly. Bridge seals which were installed with a "low solids" (25 percent solids) adhesive or with the aid of soap and water as a lubricant did not adhere when joint openings reached a maximum. Poor performance due to the use of the "low solids" lubricant-adhesive was not as prevalent for the pavement seals, however.

Three pourable sealants were also found to be acceptable when adequately prepared and applied to joints which had been sandblasted and primed (for those materials requiring primers). These sealants included two polyurethane materials and one polyvinyl chloride material, (Tables 2 and 5). Currently these materials are restricted to applications where compression seals are difficult or impossible to install, such as in split-slab construction or where joints are not of a uniform width.

Other types of pourable sealants such as polysulfides and asphalt-based materials were found to be unacceptable from laboratory tests and from observations of field performance.

All of the five general types of materials used to seal four-inch pressure-relief joints are still performing satisfactorily, as indicated in Table 9. Two pourable sealants, which did not seal beyond 21 months in the 5/8-inch (1.6-cm) pavement-contraction joints, continue to protect the four-inch (10.2-cm) joints from materials intrusion. Both of these sealants, a two-component polysulfide and a two-component polyurethane, failed in cohesion in the pavement joints where they were subjected to tension as well as compression. Asphalt-based materials have had a long history of early deterioration as expansion-joint sealants in Louisiana. Currently the preformed polyethylene and preformed urethane foam seals are considered to be the most practical materials in terms of cost and time required for installation. [One early attempt to seal a 4-inch (10.2-cm) pressure-relief joint with the preformed material failed when the joint unexpectedly opened and the seal floated out. Since that time the seals have been installed with a lubricant-adhesive or have been placed prior to concrete being poured around them. One very promising new seal, "Flex-Lock", a preformed urethane foam, has the added design feature of reducing the possibility of a seal floating out by creating added side wall pressure at the bottom of the joint.] One and two-inch (2.5 and 5.0-cm) pressure relief joint seal sizes are currently required for new construction, although four-inch (10.2-cm) joints continue to be used for maintenance purposes.

Construction

Louisiana's revised proposed specifications for the construction and sealing of joints in P.C.C. pavements are included in Appendix E. These specifications are the result of extensive experimentation with various construction techniques and new construction materials.

Louisiana's pavements are constructed with an extremely hard chert gravel. This aggregate precludes the sawing of joints because of its hardness. Therefore, the typical longitudinal and transverse joint formation has been with fiberboard inserts later sawed out with abrasive or diamond blades. This type of joint formation has several problems associated with it: (1) the tendency for a joint to taper with depth, (2) variation in joint widths according to how well the saw follows the insert, (3) increased joint edge spalling or raveling, (4) insufficient depth removal of insert because of blade wear, and (5) insufficient removal of insert fibers from joint wall faces because the faces were not cleaned well. The remains of a sawed 5/16 inch (0.79 cm)-wide fiberboard is depicted in Figure 8, previously presented.

Several corrective measures have subsequently been developed concerning joint formation when using the sawed insert method, as follows:

1. The insert itself should be asphalt free, since the blade friction heats the asphaltic material thereby depositing a thin asphaltic film along the joint walls which is difficult to remove.

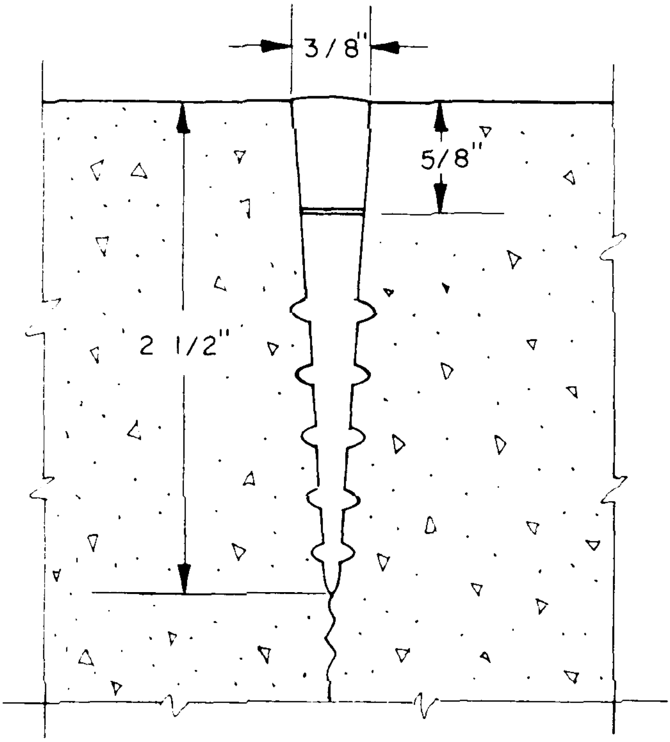
2. The insert should be removed in one saw pass since additional saw passages create increased joint width variations. Reducing the slab length has reduced the preformed compression seal size thereby reducing the necessary removal depth of the insert.

3. Some allowance must be tolerated in joint width variations. An overall width variation of 1/8 inch (0.32 cm) is allowed as the seal itself is capable of accommodating an average variation of 3/16 inch (0.48 cm). This variation was considered in developing the Department's current 7/16 inch (1.11 cm)-wide joint with the 13/16 inch (2.06 cm) compression seal for the 20-foot (6.1 m) slab-length pavements.

4. The concrete pavement should be allowed sufficient curing time prior to removal of the insert (a minimum of five curing days). This produces more immediate but less ultimate minor spalling. The spalling that does occur can be corrected prior to installation of the joint sealant.

5. Sandblasting the joint sidewalls is required for complete removal of the insert's fibers from the sidewalls.

Several other types of inserts have been experimentally installed in an effort to find a suitable alternate to sawing. One insert which consists of a 20-mil-by-three-inch (0.05-by-7.6-cm) plastic strip has been used to form the longitudinal pavement joint by inserting the strip into fresh concrete. The strip, which is fed into the concrete from a roll as part of the paving train, has been only partially successful in forcing the pavement to crack at the desired location. Another (much thicker) insert which was successful at creating the desired longitudinal plane of weakness is "Zip-Per Strip" by Kold-Seal Corporation. This insert, illustrated in Figure 9, has a removable cap which creates a sealable joint upon removal. The cap was not removed in the experimental installation, however, as this measure was not considered necessary for the



"Zip-per Strip" Joint Insert

FIGURE 9

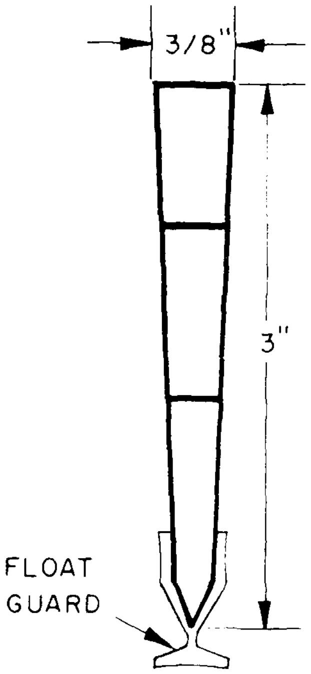
longitudinal joint. The larger thickness, approximately 0.3 inch (0.76 cm), of this product may be an important factor in preventing the random longitudinal cracking experienced with the thinner plastic strips.

One of the earliest experimental alternates to fiberboard insertion in transverse contraction joints was the metallic insert. These hollow inserts were made of a soft metal which could be crimped down after the concrete hardened to create a sealable joint cavity. Since the asphaltic joint material used at that time did not repel incompressibles, the shallow joint cavity created by the insert promoted joint edge spalling. Volume changes caused by corrosion of the metal inserts also contributed to the joint spalling problem.

The next product to be tried for transverse joint formation was a removable metal insert. These retractable inserts proved difficult to remove without damaging the concrete if they were slightly deformed prior to or during installation.

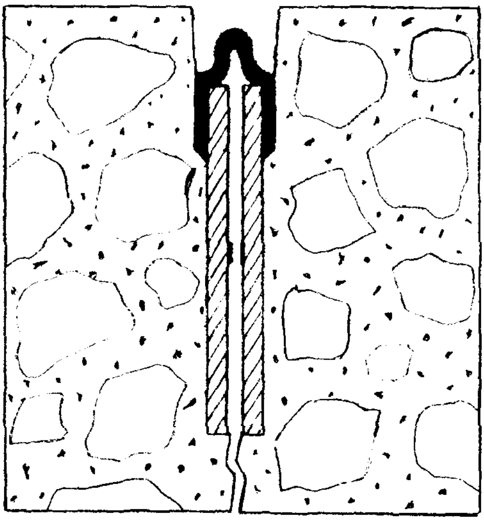
A resilient, yet rigid, insert was found in a plastic version of the removable insert. The plastic inserts could be easily cut when odd lengths were required, they did not require the use of a bond breaker as did the metal inserts, and they were generally reuseable. Some problems have arisen, however, as finishing devices in the paving train occasionally cause the inserts to float up out of position. A float guard which has recently been added to the bottom of the plastic insert seems to have solved the floating problem--at least on one project. The plastic insert with float guard is depicted in Figure 10.

Another permanent insert, "Sealinsert" by the R. J. Company, was also used to form transverse joints as illustrated in Figure 11. This insert seal was designed to remain in the pavement, thereby eliminating all sawing and sealing operations. The concept seemed very promising, but the inserts proved difficult to install correctly with



Plastic Insert with Float Guard

FIGURE 10



SEALED JOINT

"Sealinsert", Experimental Trial

FIGURE 11

regard to alignment and adequate vibration of the concrete around them. The "Sealinserts" experienced bond problems and seemed to increase joint edge spalling. Modifications which have been suggested include assurances of quality neoprene, extension of the depth of neoprene to provide better bond to the concrete, and a removable cap which will form a joint with more rounded edges to help minimize spalling.

Maintenance

Damage to pavement slabs and adjacent structures can be directly related to improperly sealed pavement joints where incompressible debris restricts joint movements. Problems resulting from this condition may be frequently encountered on some of Louisiana's older portland cement concrete pavements in the form of crushed pavement joints and joint "blow-ups." It is acknowledged that initial construction of joints and subsequent maintenance cannot create a watertight joint which would waterproof the supporting pavement layers. Any maintenance applications are directed toward eliminating or minimizing the detrimental effects of incompressibles' entrapment and resulting pavement growth. An equally serious result of pavement growth occurs where bridge structures which succumb to pavement thrust are shoved nearer to the edge of their supports.

Experimentally, many methods of cleaning pavement joints for re-sealing have been employed in an effort to arrive at an economically justifiable solution to the problem. The greatest difficulty seems to be encountered in removal of old asphalt-based materials which have failed as sealants. All of the asphalt adhering to the concrete must be removed if the joints are to be resealed with a pourable sealant. Possibly less cleaning would be required if preformed compression seals were installed; however, these preformed seals are inappropriate where joints are not of a uniform width, and the cost of the seals is prohibitive where a large number of joints require resealing.

Some of the experimental cleaning techniques included plowing out as much material as possible and then (1) sandblasting, or (2) heating with a torch and sandblasting, or (3) using a water jet, or (4) freezing with liquid nitrogen and then sandblasting. The most effective results have been obtained where the old joint material is plowed out and the joints are sandblasted and blown clean. Although this procedure will successfully remove the old asphalt, it is considered too expensive for implementation on a large scale.

As stated earlier, when pavement thrust is not relieved, considerable damage to bridge members, such as crushing and shoving, may occur. One proposed method of protecting these bridges involves the confinement of pavement thrust by redirecting it away from the bridges. If the pavement could be anchored next to a structure, the structure would not be damaged and the pavement damage, immediately noticeable, could be immediately corrected. It has been theorized that keeping the joints free of incompressibles 1,000 feet to 2,000 feet (305 m to 610 m) adjacent to the structures would provide sufficient pavement weight and friction to resist pavement growth and creep.

In September, 1969, a study was initiated to observe pavement thrust adjacent to four bridges on I-10 west of Sulphur, Louisiana. This project contains transverse joints on a 58.5-foot (17.8-m) spacing and consists of 10 inches (25.4 cm) of portland cement concrete, 1 inch (2.5 cm) of sand asphalt, and 6 inches (15.0 cm) of soil cement. In three of the test sections transverse contraction joints were completely cleaned of asphalt and debris and resealed with neoprene compression seals for varying distances back from the bridges--500, 1,000 and 1,500 feet (175, 305, and 480 m). In the control section transverse joints were not cleaned and resealed. Pressure-relief joints were rewidened adjacent to all of the bridges and resealed to relieve any existing pressure from the pavement slabs. Closure of relief joints and reference-point movements were measured periodically over a five-year period. The initial and final measurements are represented in Table 10.

Measurements of relief joint closure indicated no pavement thrust in the section cleaned and resealed for 1,500 feet (480 m). The 1,000-foot (305-m) section exhibited 0.3 inches (0.76 cm) of joint closure. The 500-foot (175-m) section and the control section experienced 0.6 and 0.5 inch (1.5 and 1.3 cm) of closure, respectively. These measurements indicate success in anchoring pavement in the 1,500-foot (480-m) section, and less success as fewer joints were resealed. Similarly, the reference point data indicates the almost complete absence of movement in the 1,500-foot (480-m) section and the greatest degree of reference point movement in the control section as seen in Table 10. The fact that the magnitude of this movement data is small compared to movement in other locations in Louisiana can be explained by the almost complete absence of incompressible materials lodged in the transverse joints. This section of I-10 has few major intersections and is not exposed to the large amount of traffic debris found in other areas.

It was concluded that pavement thrust near bridges can be effectively controlled by cleaning and resealing transverse contraction joints and thus anchoring the pavement in these areas. The best results were obtained by cleaning and resealing 1,500 feet (480 m) adjacent to the structures.

Comparison of Materials' Properties with Field Performance

Table 3 and Tables 6 and 7 in the appendices present materials' properties for pavement and bridge joint sealants evaluated in this study. Considering the many materials' properties evaluated, only slight correlation with field performance can be reported.

Even under ideal conditions, good correlation between laboratory-determined materials' properties and field service could not have been assured. Time lags between field installation, sample acquisition, laboratory equipment mobilization, and technician training further decreased the chances for the sought correlations.

Pavements

The investigators did observe a trend between life in the Bostik Environmental Cycling Chamber and life on the highway for pourable sealants.

As described in Appendix C, the Bostik device subjects a 1/2-inch-by-2-inch-by-2-inch (1.3-cm-by-5.1-cm-by-5.1-cm) test specimen to alternate cycles of heating while in compression and cooling while undergoing elongation. This environment simulates seasonal joint movement in the field.

The trend is shown in Figure 12 of Appendix D. Sealant life in the field increases as sealant life in the Bostik device increases. The graph reflects limited available test data as shown in Table 3. However, the trend and the technical appeal of the Bostik test merit attention and further research. The investigators plan to employ the Bostik test in the future to screen new pourable sealants for field potential. An unofficial and tentative requirement of forty Bostik cycles will be applied as a measure of satisfactory laboratory performance.

Bridges

The investigators observed a trend between the wall pressure exerted by a new sample of preformed joint sealant compressed to 80% of its nominal width <u>and</u> its life in an armored joint on a bridge deck.

The trend is shown in Figure 13 of Appendix D and reflects data reported in Table 7. As initial compressive pressure increases, so does life in the field. Superimposed on Figure 13 is the 1971

Department specification requirement of three pounds per square inch (20.7 Pa) minimum compressive pressure now in effect. Also superimposed is the more stringent, proposed 1977 Department specification requirement of four pounds per square inch (27.6 Pa) minimum compressive pressure. The new requirement is a quality control measure to ensure inclusion of an adequate amount of elastomer in the sealant. Highly responsive inter-webs could have effected conformance to the three pounds per square inch (20.7 Pa) criteria, and deprived the Department of assurance of a durable product.

Figure 14 of Appendix D relates the worth of continued wall pressure in relation to field life of preformed joint sealants. In most cases those sealants which exhibited the greatest wall pressures after 0, 2.5, and 5 years of field service enjoyed the longest lives.

CONCLUSIONS

1. The neoprene compression seal performed best in the transverse contraction joints and the transverse expansion joints of the experimental pavements and bridge, respectively. Three of the pourable polymeric sealants performed effectively in the field experiments; however, these three products were the exception rather than the rule for the pourable polymeric sealants. (The three sealants include one polyvinyl chloride-coal tar extended sealant and two polyurethane sealants.) The asphalt-based sealants demonstrated complete inadequacy to seal joints that experience movement.

2. Based on limited laboratory-determined materials' properties test data, most of the sealants evaluated met the Department's quality assurance criteria in force at the time of testing. The most rigorous test imposed on the pourable sealants was that in the Bostik Environmental Cycling Chamber as described in Appendix C. The Weather-Ometer also is a very effective screening device and can be used to eliminate inferior sealants.

3. The bulk of the pourable polymeric sealants performed very well in the laboratory but quite poorly in the field. Improper mixing and application proved to be a problem for the pourable polymeric sealants.

4. There was only slight correlation between laboratory-determined materials' properties and the life of a joint sealant in the field. Most of the laboratory tests conducted in relation to this study served to reveal materials with inferior physical properties but did not accurately forecast field performance.

5. Lubricant adhesives enhance the performance of neoprene compression seals in transverse joints of bridges and pavements. A high-solids lubricant adhesive is deemed necessary for neoprene seals in bridge joints, and a low solids lubricant adhesive appears adequate for neoprene seals in pavement joints.

6. Louisiana's concrete pavements contain a river-deposited siliceous type of aggregate (chert) so hard as to preclude routine sawing of hardened slabs. The best approach to forming the joint reservoirs in such concrete appears to be to install a joint forming device (removable or permanent) in the plastic mix.

7. Adequate joint design for concrete pavements and bridge decks must consider movements which the joints will experience. The designer must consider construction tolerances and limitations, in-service movements, and sealants' limitations if he is to believe that his design will be translated into an effective joint system.

8. Periodic cleaning and resealing of transverse contraction and expansion joints on concrete pavements is a necessary and cost-effective measure to prevent pavement thrust damage to the structures. The timely concentration of manpower required to conduct such a maintenance program indicates that it might best be done by contract rather than by Department forces. Most joint cleaning problems have been associated with joints which contained failed asphalt-based sealants. As neoprene compression seals begin to fail some definite plans should be made for resealing these joints. It is felt that other than the problems encountered in traffic control the cleaning problem will be minimal at joints originally sealed with neoprene compression seals.

9. The following passage describes properties desired of a sealant system:

A joint sealant system should reject incompressibles or at least absorb the impact upon the joint of those incompressibles which do so intrude. The sealant system design should facilitate the cleaning action of rain and/or traffic in removal of undesirable material. A sealant system should prevent the passage of water through bridge deck joints and limit its passage through pavement joints. The sealant should be stable, remain non-sticky, and retain sufficient performance properties to function in a typical roadway environment at surface temperatures (in Louisiana) from 0° F. (-17.8° C.) to 160° F. (71.1° C.). The sealant system should not create any harmful effects such as spalling, roughness, and noise. The sealant system should be effective for at least five years. Small failures eventually will occur but should not propagate.

RECOMMENDATIONS

1. Neoprene compression seals represent the best solution to sealing transverse contraction joints in pavements and armored transverse expansion joints in bridge decks. Consequently, neoprene compression seals should continue to be specified for these joints.

2. The two polymeric pourable sealants (one polyvinyl chloride and one polyurethane sealant) which performed well on the experimental pavements should be allowed as alternates in situations where neoprene compression seal installation would be awkward. Liquid-poured sealants are well-suited for pavements characterized by split-slab construction or non-uniform joint widths.

3. The asphalt-based joint sealants are ineffective in sealing a joint exhibiting movement, and these materials should not be used for this purpose.

4. Laboratory testing serves the purpose of assuring quality of joint sealants which the Department has accepted for use. However, field evaluations should continue to be required of joint sealants prior to their qualification for use.

5. The Department's pavement design efforts should be directed toward the control of water being introduced at the longitudinal shoulder joint. This volume of water far exceeds that entering at the transverse joints. Longitudinal joint sealing, full roadway-width, asphalt-treated drainage layers, or a system of longitudinal and transverse drainage trenches within the shoulder could be considered for this purpose.

6. It is recommended that a joint maintenance policy be formulated directing attention to the upkeep of transverse expansion and, as resources permit, transverse contraction joints in pavements and bridges. This action is intended to minimize the thermally-induced forces which pavements accumulate and direct towards structures.

REFERENCES

1. Copas, Thomas L., Irick, Paul E., and Pennock, Herbert A., Design, Construction, and Maintenance of PCC Pavement Joints, National Cooperative Highway Research Program Synthesis No. 19 (Washington: Highway Research Board, 1973), 40 pp.

2. Thornton, J. B., Rigid Pavement Joints and Sealants Study, Georgia Department of Transportation Research Report No. 6903 (Office of Materials and Research, 1975), 144 pp.

3. Cook, John P., and Lewis, Russell M., Evaluation of Pavement Joint and Crack Sealing Materials and Practices, National Cooperative Highway Research Program Report No. 38 (Washington: Highway Research Board, 1967), 40 pp.

4. Williaman, Dennis L., Investigation of Use of Preformed, Compressed Neoprene Seals in Joints of Concrete Bridge Decks, Kentucky Department of Highways Research Report (Lexington: Division of Research, 1968), 77 pp.

5. Watson, Stewart C., "Reconstruction and Effective Resealing of Joints on Existing Bridges and Structures," for presentation to the Committee on Maintenance of Structures, Highway Research Board, January 1970.

6. Henry, Robert L., Final Report on a Study of Control of Pavement Movements Adjacent to Structures, (University of Mississippi, School of Engineering, 1968), 137 pp.

7. Gordinier, D. C., and Chamberlin, William P., Pressure Relief Joints for Rigid Pavements, Interim Report on Research Project 245 (Albany: Engineering Research and Development Bureau, New York State Department of Transportation Agency, Division of Highways, 1970), 12 pp.

8. Giordano, J. J., and Pachuta, J. M., Concrete Pavement Joints, A Special Report Delivered at the Symposium Elastoplastics in Commercial and Governmental Application; American Hotel, New York, June 3, 1968 (Thiokol Chemical Co., 1968), 39 pp.

9. Spellman, D. L., California Pavement Faulting Study, Interim Report on Research Project No. 635167 (Sacramento: State of California Transportation Agency, Division of Highways, 1970), 67 pp.

10. Hiss, J. G., Jr., and Brewster, David R., The Influence of Joint Widths and Spacings on Pavement Riding Qualities, Report on a Special Study under Physical Research Project 926 (Albany: Bureau of Physical Research, New York State Department of Transportation, 1968), 17 pp.

11. McCarty, William M., Brewster, David R., and Hiss, J. G. Fred, Jr., Sealers for Longitudinal Joints, Final Report on Research Project 39-1 (Albany: Engineering Research and Development Bureau, New York State Department of Transportation, 1971), 31 pp.

12. Tons, Egons, "A Theoretical Approach to Design of a Road Joint Seal," Concrete Pavement: Subbase and Joint Construction, Highway Research Board Bulletin 229 (National Academy of Sciences, National Research Council, Publication 689), pp. 20-53.

13. Committee on Sealants and Fillers for Joints and Cracks in Pavements, HRB, Joint Sealing, A Glossary: Highway Research Board Special Report 112, 30 pp.

14. Burt, W. T., Azar, David G., Myers, John C., Evaluation of Joint Sealant Materials (Interim Report No. 1), Research Report No. 62, (Louisiana Department of Highways, 1972), 86 pp.

15. State of Louisiana, Department of Highways, Standard Specifications for Roads and Bridges October 1971, 715 pp.

APPENDIX A

PAVEMENT SEALS FIELD AND LABORATORY DATA

TABLE 1

PAVEMENT SEALS FIELD INSTALLATION INFORMATION

I. Acme

S-545

1. A neoprene compression seal.

2. The joints were sawed and sandblasted. The seal was installed by hand using a high solids (75%) glue lubricant, E. P. Prima-Lub (No. 1009). The seal was installed at least 1/4 inch below the top of the joint.

II. American Metaseal

A. Meta-Seal 355

1. A black two part polysulfide.

2. The joints were sawed, sandblasted and primed with S.P.I.D. The two components were drill mixed and hand poured onto a closed cell polyethylene backup material that controlled the depth of 1/2 inch at 1/4 inch below the top of the joint.

B. Meta-Seal 220

1. A black two component polyurethane.

2. The joints were sawed, sandblasted and primed with SP 30. The two components were drill mixed and hand poured onto a closed cell polyethylene backup material that controlled the thickness to 1/2 inch at 1/4 inch below the top of the joint.

III. ByWater

ByWater Road Seal

1. A two part polysulfide.

2. The joint was sawed, sandblasted and primed with Byco seal primer. The two components were mixed and poured by hand onto a closed cell polyethylene foam backup material that controlled the depth to 1/2 inch at 1/4 inch below the top of the joint.

TABLE 1 (CONTINUED)

PAVEMENT SEALS FIELD INSTALLATION INFORMATION

IV. Continental Products

J.C. 26

1. A two part polyurethane.

2. The joints were sawed, sandblasted and primed. The two components were hand mixed and applied with a caulking gun onto a closed cell polyethylene backup material that controlled the thickness to 1/2 inch at 1/4 inch below the top of the joint.

V. D. S. Brown

A and E 1250

1. Both are neoprene compression seals.

2. The joints were sawed and air blasted. The seals were installed and the glue was placed with a machine. The depth of installation was controlled by the machine at 1/4 inch below the surface. A low solids (25%) glue was used.

VI. DuPont

Imron

1. A black one part polyurethane with a 24 hour curing time.

2. The joint was sawed, sandblasted, air blasted and primed with V.M. 5881. The material was in cartridges and was placed by using a hand caulking gun. The backup material was a closed cell polyethylene that controlled the depth to 1/2 inch at 1/4 inch below the top of the joint.

VII. Edoco

Code 3200

1. A two component polyurethane with a curing time of two hours.

2. The joints were sawed, sandblasted and primed with Edoco 3203 primer. The two components were hand mixed and applied onto a closed cell polyethylene foam backup material that controlled the thickness of 1/2 inch at 1/4 inch below the top of the joint.

TABLE 1 (CONTINUED)

PAVEMENT SEALS FIELD INSTALLATION INFORMATION

VIII. Essex

A. Beta Seal 260

1. A two part polyurethane with a 3-4 hour cure.

2. The joints were sawed, sandblasted and primed with primer 435.6. The two materials were drill mixed and applied with a caulking gun onto a closed cell polyethylene backup material that controlled the depth of 1/2 inch at 1/4 inch below the joint surface.

B. Beta Seal 250

1. A two part coal tar extended polyurethane with a 2-3 hour curing time.

2. The joints were sawed, sandblasted and primed with primer 435.6. The two components were drill-mixed and applied with a caulking gun onto a closed cell polyethylene backup material that controlled the depth of 1/2 inch at 1/4 inch below the surface of the joint.

IX. Gulf States Asphalt

A. 621 X Soft

1. A catalytically blown asphalt.

2. The joints were sawed and sandblasted. The material was heated in a kettle and applied by hand at 425° F.

B. 622 Y Medium

1. A catalytically blown asphalt.

2. The joints were sawed and sandblasted. The material was heated in a kettle and applied by hand at 425° F.

X. Lion Oil Company

Nokorode D 200

1. A black two component polyurethane.

2. The joints were sawed and blown clean. The two components were mixed and poured onto a cotton rope backup material. A spatula was pulled through to eliminate air bubbles.

TABLE 1 (CONTINUED)

PAVEMENT SEALS FIELD INSTALLATION INFORMATION

XI. Products Research Chemical Corporation, Inc.

P.R.C. 3105

1. A black two component polyurethane with a 6 minute curing time.

2. The joints were sawed, sandblasted and primed with primer number 14. The two components were machine mixed and applied over a closed cell polyethylene backup rod that controlled the depth of the seal to 1/2 inch at 1/8 inch below the top of the joint.

XII. Roadways International Company

Kractite II

1. A one component cold poured asphalt emulsion with latex rubber, mineral filler and other additives.

2. The joints were sawed and blown clean. The one component was hand mixed and applied with an applicator onto a 1/2 inch minicell backup material.

XIII. Sandell

Polytite

1. A polyurethane impregnated foam.

2. The joints were sawed and sandblasted and the material was installed by hand after being compressed by being stepped on.

XIV. Sika Chemical

A. T-68

1. A black two component modified polyurethane with a 3 hour curing time.

2. The joints were sawed, sandblasted, and primed with Colma-Sol Clear. The two components were hand mixed and poured onto a closed cell polyethylene foam backup material that controlled the depth to 1/2 inch flush with the surface of the joint.

TABLE 1 (CONTINUED)

PAVEMENT SEALS FIELD INSTALLATION INFORMATION

B. Sikaflex 1-A

1. A one component polyurethane sealant.

2. The joints were sawed, brushed and blown clean. A minicell backup material was placed by roller. The sealant was applied from a tube, using a caulking gun. A moist rubber spatula was then used to smooth the material.

C. Colma SL

1. A two component polysulfide system.

2. The joints were sawed and blown clean. A minicell backup material was placed by hand to a depth of 3/4 inch. The joints were brushed clean before applying primer. The material was machine mixed for five minutes and poured from a bucket to approximately 1/4 inch below the top of the joint.

XV. Slip-Pruf Service Corporation

Kractite

1. A two part polyurethane.

2. The original joints were sawed, sandblasted and primed with Kractite Primer. The two components were hand mixed and applied with a caulking gun onto a closed cell polyethylene foam backup material. The later joints were sawed, sandblasted and not primed. The two components were drill mixed and applied with a caulking gun onto the backup material.

XVI. Sonneborn

Sonolastic Paving Joint Sealant

1. A two part polyurethane.

2. The joints were sawed, sandblasted and primed with 733 primer. The two components were hand mixed and poured onto a closed cell polyethylene foam backup material that controlled the depth to 1/2 inch beginning at the surface of the joint.

TABLE 1 (CONTINUED)

PAVEMENT SEALS FIELD INSTALLATION INFORMATION

XVII. Superior Products

Superseal 444

1. A polyvinyl chloride, coal tar extended polymer.

2. The joints were sawed and sandblasted. The material was heated in a kettle at 275° F. and poured by hose onto a rope backup material to within 1/4 inch from the top of the joint.

XVIII. Tee Juana

Tee Juana

1. Asphalt and mineral filler.

2. The joints were sawed and sandblasted. The material was heated in a kettle and poured using hand pouring pots. The joint was filled.

XIX. Thiokol

701

1. A two component extended coal tar polysulfide.

2. The joints were sawed and sandblasted. The two components were machine mixed and applied with pump and nozzle onto a closed cell polyethylene backup to within 1/4 inch from the top of the joint.

XX. U. S. Rubber Reclaiming

Flow-Mix

1. Asphalt and 20 percent reclaimed rubber.

2. The joint was sawed and sandblasted. Ground rubber was used as a backup and controlled the depth of 1/2 inch at 1/4 inch below the top of the joint. The materials were heated and mixed in a kettle with an agitator and poured by hand.

TABLE 1 (CONTINUED)

PAVEMENT SEALS FIELD INSTALLATION INFORMATION

XXI. W. R. Grace

A. Daraseal U

1. A black two component polyurethane with a 2-4 hour curing time.

2. The joint was sawed, sandblasted and primed with Daraseal U-2C. The two components were mixed with a drill and hand poured over a closed cell polyethylene backup rod creating a depth of 1/2 inch. The joint was filled to the top.

B. 2350 Improved Paraplastic

1. A rubberized asphalt poured at 400° F.

2. The joint was sawed, sandblasted and a cane fiber backup material was used. The material was heated in a double boiler kettle and poured by hand to the top of the joint.

C. Bondtite

1. A black two component polysulfide with a 2-4 hour curing time.

2. The joint was sawed and sandblasted. No primer was used. The two components were mixed and poured by hand onto a closed cell polyethylene backup rod to control the depth to 1/2 inch at 1/4 inch below the top of the joint.

D. Type II

1. Neoprene Compression Seal.

2. The joint was sawed and sandblasted. A low solids (24%) glue lubricant was used in conjunction with a rolling disc to seat the neoprene at 1/4 inch below the top of the joint.

E. 416 M Developmental Paraplastic

1. A rubberized asphalt.

2. The joints were sawed and sandblasted. The material was heated in a kettle to 400° F. and poured by hand onto a celotex backup rod that controlled a depth of 1/2 inch.

TABLE 1 (CONTINUED)

PAVEMENT SEALS FIELD INSTALLATION INFORMATION

XXII. W. R. Meadows

Gardox

1. A two component liquid neoprene.

2. The joints were sawed, sandblasted and airblasted. No primer was used. The two components were hand mixed and poured onto a closed cell polyethylene backup material that controlled the depth to 1/2 inch at 1/4 inch from the top of the joint.

XXIII. Witco Chemical

Witmer 520

1. A two component polyurethane.

2. The joints were sawed and blown clean. A minicell backup material was placed by a roller to a depth of 3/4 inch. The two component material was hand mixed and poured from a spout to 1/4 inch below the top of the joint.

TABLE 2

SUMMARY OF PAVEMENT SEALS PERFORMANCE INFORMATION

Company Name	Product Name	Material	Number of Joints	Time Distress First Noticed (Months)	Average Seal Life[1] (Months)	Distress Noted	Remarks[1]
Acme	S-545	Neoprene	5	--	76 Months[2]	Adhesion	Four seals still performing
D. S. Brown	E-1250	Neoprene	5	62 Months	75 Months[2]	Adhesion	Three seals still performing
D. S. Brown	A-1250	Neoprene	5	62 Months	75 Months[2]	Adhesion	Three seals still performing
Superior Products	Superseal 444	Polyvinyl With Fillers	5	41 Months	75 Months[2]	Adhesion	Three seals still performing
			100		27 Months[2]	--	All seals still performing
			50		11 Months[2]	--	All seals still performing
Edoco	3200	Two Part Polyurethane	3	--	73 Months[2]	--	All seals still performing
W. R. Grace	1 1/4"	Neoprene	5	30 Months	44 Months	Adhesion	All seals have failed
Acme	11/16"	Neoprene	16	--	38 Months[2]	--	All seals still performing
D. S. Brown	11/16"	Neoprene	16	--	38 Months[2]	--	All seals still performing
Products Research Corporation, Inc.	PRC 3105	Two Part Polyurethane	41	1 Month	31 Months	Adhesion	All seals have failed
W. R. Grace	11/16"	Neoprene	6	26 Months	26 Months	Recovery Failures	All seals have failed
W. R. Grace	Daraseal U	Two Part Polyurethane	5	1 Month	22 Months	Adhesion	All seals have failed
American Metaseal	Meta-Seal 220	Two Part Polyurethane	5	6 Months	21 Months	Cohesion	All seals have failed

[1]A sealant is considered failed when fifteen percent or more of the joint is no longer sealed.

[2]Sealant still performing satisfactorily as of last inspection.

continued

TABLE 2 (CONTINUED)

SUMMARY OF PAVEMENT SEALS PERFORMANCE INFORMATION

Company Name	Product Name	Material	Number of Joints	Time Distress First Noticed (Months)	Average Seal Life[1] (Months)	Distress Noted	Remarks[1]
W. R. Grace	Bondtite	Two Part Polysulfide	5	12 Months	16 Months	Adhesion, Cohesion	All seals have failed
Sonneborn	Sonolastic	Two Part Polyurethane	3	11 Months	16 Months	Adhesion	All seals have failed
W. R. Meadows	Gardox	Liquid Neoprene	4	3 Months	16 Months	Adhesion	All seals have failed
Sika	Colma SL	Two Component Polysulfide	3	14 Months	14 Months	Adhesion	All seals have failed
Witco Chemical	Witmer 520	Two Part Polyurethane	5	12 Months	14 Months	Adhesion	All seals have failed
Lion Oil Co.	D-200 Nokorode	Two Part Polyurethane	6	9 Months	14 Months	Adhesion	All seals have failed
Sika	Sikaflex 1-A	One Part Polyurethane	5	4 Months	14 Months	Adhesion	All seals have failed
Thiokol	701	Two Part Polysulfide	5	3 Months	14 Months	Adhesion	All seals have failed
Slip-Pruf Service	Kractite	Two Part Polyurethane	4	8 Months	11 Months	Cohesion	All seals have failed

[1]A sealant is considered failed when fifteen percent or more of the joint is no longer sealed.

continued

TABLE 2 (CONTINUED)

SUMMARY OF PAVEMENT SEALS PERFORMANCE INFORMATION

Company Name	Product Name	Material	Number of Joints	Time Distress First Noticed (Months)	Average Seal Life[1] (Months)	Distress Noted	Remarks[1]
Essex	Beta Seal 260	Two Part Polyurethane	4	10 Months	10 Months	Adhesion	All seals have failed
Essex	Beta Seal 250	Coal Tar Extended Polyurethane	2	10 Months	10 Months	Adhesion	All seals have failed
American Metaseal	Meta-Seal 355	Two Part Polysulfide	5	6 Months	9 Months	Cohesion	All seals have failed
Dupont	Imron	One Part Polyurethane	2	3 Months	7 Months	Adhesion, Cohesion	All seals have failed
Sika	T-68	Two Part Polyurethane	5	5 Months	5 Months	Adhesion	All seals have failed
Bywater	Bywater Road Seal	Two Part Polysulfide	2	5 Months	5 Months	Adhesion	All seals have failed
Roadways International Co.	Kractite II	Asphalt Emulsion	9	4 Months	4 Months	Excessive Shrinkage	All seals have failed
Continental	J. L. 26	Two Part Polyurethane	5	3 Months	3 Months	Adhesion, Cohesion	All seals have failed
W. R. Grace	Paroplastic	Rubberized Asphalt	5	1 Month	3 Months	Adhesion	All seals have failed

[1]A sealant is considered failed when fifteen percent or more of the joint is no longer sealed.

continued

TABLE 2 (CONTINUED)

SUMMARY OF PAVEMENT SEALS PERFORMANCE INFORMATION

Company Name	Product Name	Material	Number of Joints	Time Distress First Noticed (Months)	Average Seal Life[1] (Months)	Distress Noted	Remarks[1]
U. S. Rubber Reclaiming	Flo-Mix	Asphalt and Reclaimed Rubber	5	0	0	Attracts Incompressibles	All seals have failed
Sandell	Polytite	Polyurethane Impregnated Foam	4	0	0	Attracts Incompressibles	All seals have failed
Tee Juana Asphalt Co.	Tee Juana	Asphalt with Mineral Filler	6	0	0	Attracts Incompressibles	All seals have failed

[1]A sealant is considered failed when fifteen percent or more of the joint is no longer sealed.

TABLE 3

PAVEMENT SEALS MATERIALS' PROPERTIES

POURABLE SEALANTS[1]

Product Name	Bostic Test	% Recovery 38°F	% Recovery 122°F	Ductility 77°F	Ductility 39°F	Shrinkage	Weather-ometer	Hardness Penn. 77°F	Hardness Penn. 39°F	Tack Free Time	Ozone Resistance	Flow 200°F,5Hr.	Hardness Shore, A	Bond 0°F
1971 LDH Spec. Polyurethane	Cycles 40 min.	--	--	--	--	None	Hours 600 min.	--	--	Hours 72 max.	Pass	--	5-30	--
Super Seal 444[2]	(64) Pass							119				0		Pass
Edoco (3200)[3]	(75) Pass													
PRC 3105[3]		97	75	10	17	None	650 Good	12	15	24	Pass			
Daraseal U[3] (W. R. Grace)		99	89			Slight	650 Fair	25	27	24	Pass			
Bondtite[4] (W. R. Grace)		88	44	11	16	Nil	50 Fail	2	3	24	Pass			
Sonolastic[3] (Sonneborn)		99	92	48	48	None	150 Fail	18	25	48	Pass			
Lion D-200[3] (Lion Oil)	(16) Fail			22				75				0	3	Pass
Witmer 520[3] (Witco Chem.)	(21) Fail			6				34				0	15	Pass
Colma (SL)[4] (Sika)	(12) Fail			23				41				2	14	Pass
Beta Seal 260[3] (Essex)		90	80	53	52	None	150 Fail	5	5	48	Pass			
By Water Road Seal[4] (By Water)		85	55	6	7	Nil	650 Fair	7	8	48	Pass			
Kracktite[3] (Slipproof)		76	54	20	20	None	650 Good	17	20	24	Pass			
Kracktite[5] (Roadways International)	(0) Fail													

[1]All samples represent material reordered three years after date of installation.

[2]*Polyvinyl chloride.* [3]*Polyurethane.* [4]*Polysulfide.* [5]*Asphaltic emulsion.*

APPENDIX B

BRIDGE SEALS FIELD AND LABORATORY DATA

TABLE 4

BRIDGE SEALS FIELD INSTALLATION INFORMATION

I. Acme

Regular shape

1. Neoprene compression seal.

2. The joint faces were sandblasted to a white metal finish and primed. The neoprene was installed using prima-lub glue lubricant to within 1/4 inch of the top of the joint.

3. The prima-lub used as a glue lubricant is a high solids (74%) polyurethane base glue.

II. D. S. Brown

A. B Series

1. Neoprene compression seal.

2. The joint was not sandblasted. Supporting lugs were welded to the joint faces.

3. A lubricant-adhesive containing 24 percent solids was used.

B. CV Series

1. Neoprene compression seal.

2. The joint was not sandblasted. Supporting lugs were welded to the joint faces.

3. A lubricant-adhesive containing 24 percent solids was used.

C. H Series

1. Neoprene compression seal.

2. Joint was not sandblasted. Supporting lugs were welded to the joint face.

3. A lubricant-adhesive containing 24 percent solids was used.

TABLE 4 (CONTINUED)

BRIDGE SEALS FIELD INSTALLATION INFORMATION

D. K Series

1. Neoprene compression seal.

2. Some joints were sandblasted to a white metal finish. One joint had lugs welded to the joint faces.

3. Delasti bond glue was used in some joints. Other seals were installed with soap and water only.

III. Dow Corning

Terraseal 100

1. A one component polyurethane with a time of six to eight hours for curing.

2. The joint faces were sandblasted to a white metal finish and were primed with Primer G. The polyurethane came in cartridge form and was placed by hand using a caulking gun. Round closed cell polyethylene backup rods were used to control thickness to 1/2 inch at 1/4 inch below the top of the joint.

IV. Products Research Chemical Corporation

P.R.C. 3105

1. A black two part component polyurethane with a 3 to 6 minute curing time.

2. The joint faces were sandblasted to a white metal finish and primed with primer numbers 14 for concrete and 15 for steel. The two components were mixed and placed using a machine. A closed cell polyethylene foam backup rod was used to control thickness to 1/2 inch at 1/4 inch below the surface of the joint.

V. Sika

A. T-68

1. A two component black polyurethane with a three hour curing time.

2. The joint faces were sandblasted to a white metal finish and primed. The two components were mixed

with a drill and hand poured on top of a closed cell polyethylene backup rod placed at a depth in the joint to give a 1/2 inch thickness to the seal at 1/4 inch below the top of the joint.

B. Colma Seal

1. A two component black polysulfide with a four hour curing time.

2. The joint faces were sandblasted to a white metal finish and primed. The two components were mixed with a drill and poured by hand. The backup rod of closed cell polyethylene was glued in place to give the seal a depth of 1/2 inch at 1/4 inch below the top of the joint.

VI. Slip-Pruf Service

Kractite

1. A white two component polyurethane.

2. The two components were drill mixed and applied with a caulking gun. The joint was sandblasted to a white metal finish and not primed. Bead board styrene was used to control thickness to 1/2 inch at 1/8 inch from the top of the joint.

VII. Thiokol

BD-3

1. A black two component polysulfide with a six minute curing time.

2. The joint faces were sandblasted to a white metal finish and primed with TPR 410 and the components were mixed and installed with a machine. A closed cell polyethylene was placed to give a sealant depth of 1/2 inch at 1/4 inch below the top of the joint.

VIII. W. R. Grace

A. Type II

1. Neoprene compression seal

TABLE 4 (CONTINUED)

BRIDGE SEALS FIELD INSTALLATION INFORMATION

2. The joint faces were sandblasted to a white finish and the neoprene was installed using a glue lubricant.

3. The glue lubricant used meets the Michigan Specifications of July, 1968.

B. Bondtite

1. A black two component polysulfide with a curing time of 2-4 hours.

2. The joint faces were sandblasted to a white metal finish and were not primed. The two components were mixed and poured by hand onto a closed cell polyethylene backup rod which was placed to maintain a thickness of 1/2 inch at 1/4 inch below the top of the joint.

TABLE 5

SUMMARY OF BRIDGE SEALS PERFORMANCE INFORMATION

Company Name	Product Name	Material	Number of Joints	Date Installed	Time Distress First Noticed (Months)	Distress Noted	Average[1] Seal Life (Months)	Average Initial Joint Width(In.)	Average Minimum Joint Width(In.)	Average Maximum Joint Width(In.)
Acme	S-800 (2")	Neoprene	4	7-68 8-68	52	Adhesion, Cohesion	93[2]	1.19	0.98	1.77
Acme	S-800 (2")	Neoprene	1	4-72	28	Small Split	48[2]	--	--	--
Acme	S-800 (1 1/4")	Neoprene	1	8-68	59	Surface Cracking	92[2]	--	0.35	0.68
Products Research Corporation, Inc.	PRC 3105	Two Part Polyurethane	4	7-68	62	Adhesion, Cohesion	93[2]	1.32	1.17	1.71
D. S. Brown	CV-2000	Neoprene	1	10-68	0		90[2]	1.19	0.94	1.61
D. S. Brown	B-1625	Neoprene	1	10-68	57	Cohesion	90[2,4]	1.00	0.95	1.55
D. S. Brown	H-1625	Neoprene	1	10-68	31	Slight Intrusion	90[2,4]	0.90	0.78	1.10
D. S. Brown	B-2500	Neoprene	1	5-70	12	Slight Separation	71[2]	1.30	0.59	1.45
D. S. Brown	B-2000	Neoprene	2	10-68 5-70	12	Adhesion, Intrusion	66[3]	1.26	1.02	1.73
D. S. Brown	K-2000	Neoprene	1	10-68	4	Intrusion	39[4]	1.05	0.95	1.41
D. S. Brown	K-3000	Neoprene	6	5-70	9	Intrusion	24[3]	1.31	1.12	1.75
D. S. Brown	H-2000	Neoprene	3	4-72	6	Slight Separation	22[3]	--	--	--

[1]A sealant is considered failed when fifteen percent or more of the joint is no longer sealed.

[2]All sealants in this line item performing satisfactorily as of April 8, 1976, the date of the last inspection.

[3]One of the sealants in this line item performing satisfactorily as of April 8, 1976, the date of the last inspection.

[4]One joint sealant of this type not included because joint opening exceeded uncompressed seal width.

continued

TABLE 5 (CONTINUED)

SUMMARY OF BRIDGE SEALS PERFORMANCE INFORMATION

Company Name	Product Name	Material	Number of Joints	Date Installed	Time Distress First Noticed (Months)	Distress Noted	Average[1] Seal Life (Months)	Average Initial Joint Width(In.)	Average Minimum Joint Width(In.)	Average Maximum Joint Width(In.)
Sika	T-68	Two Part Polyurethane	3	4-71	26	Adhesion, Cohesion	36	1.18	0.50	1.40
Sika	T-68	Two Part Polyurethane	3	4-69	4	Adhesion, Cohesion	13	1.23	0.96	1.76
Sika	T-68	Two Part Polyurethane	4	8-68	2	Adhesion, Cohesion	9	1.37	1.14	1.94
W. R. Grace	Type II (1 5/8")	Neoprene	2	7-68	6	Excessive Joint Opening	48[5]	1.15	0.98	1.78
W. R. Grace	Type II (2")	Neoprene	1	7-68	6	Excessive Joint Opening	34[5]	1.39	1.06	2.04
Dow Corning	Terraseal 100	One Part Polyurethane	3	7-68	7	Adhesion	24	1.37	1.20	2.01
Slip-Pruf Service	Kractite	Two Part Polyurethane	2	1-70	11	Adhesion, Cohesion	23	1.56	1.38	2.10
W. R. Grace	Bondtite	Two Part Polysulfide	3	6-68	11	Cohesion	21	1.30	1.05	1.65

[1]A sealant is considered failed when fifteen percent or more of the joint is no longer sealed.

[5]Sealants failed because joint opening exceeded uncompressed seal width.

continued

TABLE 5 (CONTINUED)

SUMMARY OF BRIDGE SEALS PERFORMANCE INFORMATION

Company Name	Product Name	Material	Number of Joints	Date Installed	Time Distress First Noticed (Months)	Distress Noted	Average[1] Seal Life (Months)	Average Initial Joint Width(In.)	Average Minimum Joint Width(In.)	Average Maximum Joint Width(In.)
Thiokol	BD-3	Two Part Polysulfide	6	10-68	1	Cohesion	14	1.25	1.07	1.91
Thiokol	BD-3	Two Part Polysulfide	5	7-68	1	Adhesion	11	1.26	1.07	1.77
Sika	Colma FC	Two Part Polysulfide	4	7-68	1	Adhesion, Bubbles	3	1.12	0.95	1.38

[1]A sealant is considered failed when fifteen percent or more of the joint is no longer sealed.

TABLE 6

BRIDGE SEALS MATERIALS' PROPERTIES

POURABLE SEALANTS

Product Name	% Recovery 38°F	% Recovery 122°F	Ductility 77°F	Ductility 39°F	Shrinkage	Weatherometer	Hardness Penetration 77°F	Hardness Penetration 39°F	Tack Free Time	Ozone Resistance
1971 LDH Specs. (Polyurethane)	--	--	--	--	None	Hours 600 min.	--	--	Hours 72 max.	Pass
PRC 3105[3]	97	75	10	17	None	650 Good	12	15	24	Pass
Kracktite[3] (Slip Proof)	76	54	20	20	None	650 Good	17	20	24	Pass
Bondtite[4] (W. R. Grace)	88	44	11	16	Nil	50[2] Poor	2	3	24	Pass
Colma F. C.[4] (Sika)	63	55	--	--	None	--	10	15	--	Pass

[1]All samples represent material reordered three years after installation.

[2]Failure relative to specifications.

[3]Polyurethane.

[4]Polysulfide (not specified in 1971).

continued

TABLE 6 (CONTINUED)

BRIDGE SEALS MATERIALS' PROPERTIES

PREFORMED COMPRESSION SEALANTS[1]

Product Name	Tensile Strength (P.S.I.)	Tensile Strength Heat Aged % Loss	Elongation At Break	Elongation At Break Heat Aged % Loss	Hardness Type A Durometer	Heat Aged Points Change In Hardness	Ozone Resistance	Weight Change In Oil	Recovery 50% Defl.	Compressive Pressure @ % Nominal Width, P.S.I. 80%	50%
1971 LDH Specifications	2000 min.	(%) 20 max.	(%) 250 min.	(%) 20 max.	55 ± 5	0 to ± 10	No Cracks	(%) 45 max.	(%) 85 min.	P.S.I. 3 min.	P.S.I.
Acme (S-800) (2")	2026	0	330	9	60	+ 7	No Cracks	35	90	6	16
Acme (S-800) (1 1/4")	2284	0	330	6	58	+ 9	No Cracks	39	85	3	5
D. S. Brown B-2000	2293	0	300	0	59	+ 6	No Cracks	35	93	5	8
D. S. Brown K-2000	2420	4	275	9	63[2]	+ 4	No Cracks	35	90	2[2]	9
D. S. Brown K-3000	2330	0	250	16	62[2]	+ 5	No Cracks	34	84[2]	1[2]	3

[1]All samples represent material reordered three years after installation.

[2]Failure relative to specifications.

TABLE 7

BRIDGE SEALS FIELD AGED[1] PHYSICAL PROPERTIES

Company Name	Product Name[2]	Seal Size	Compression Set (In.)	Tensile Strength P.S.I.	Heat Aged % Loss	Elongation At Break (%)	Heat Aged % Loss	Recovery 50% Defl.	Compressive Pressure @ 80% Nominal Width, P.S.I.		
1971 LDH Specifications for New Preformed Compression Seal			--	2000 min.	30 max.	250 min.	30 max.	(%) 85 min.	3 min.		
									Initial	@ 2.5 years	@ 5 years
Acme	S-800	2"	0.234	1959	0	300	13	58	3.0	1.2	1
Acme	S-800	1 1/4"	0.186	--	--	--	--	51	3.0	0.9	0
D. S. Brown	CV-2000	2"	0.108	2076	0	240	4	85	9.0	7.2	4
D. S. Brown	B-1625	1 5/8"	0.091	2333	0	290	7	56	5.6	3.3	2
D. S. Brown	H-1625	1 5/8"	0.198	2271	3	280	11	70	4.5	1.6	1
D. S. Brown	B-2000	2"	0.226	1407	0	250	4	79	6.4	6.5	2
D. S. Brown	K-2000	2"	0.466	1926	0	220	5	63	1.2	0.7	0
D. S. Brown	H-2000	2"	0.085	2660	3	290	9	81	--	2[3]	--
W. R. Grace	Type II	1.625"	0.343	1539	0	220	14	47	3.0	1.3	0
W. R. Grace	Type II	2"	0.530	1644	0	230	17	49	1.5	1.2	0

[1]Sampled 60 months after installation.

[2]Products are listed in order of decreasing service life.

[3]Sampled 15 months after installation.

TABLE 8

BRIDGE JOINT MOVEMENT DATA

Name of Bridge	State Project No. Route	Bridge Type	Designed Joint Opening (In.)	Actual Average Joint Width (In.)	Total Movement (In.) Theo.	Total Movement (In.) Actual Ave.
Perkins Road Overpass	450-10-06 I-10	Steel girders and concrete slabs	1.25	1.68	0.42	0.37
Evangeline St. Overpass	450-33-45 I-110	Prestressed concrete girders 66' 6" and 72' 6"	1.25	1.60	0.32	0.43
Hollywood St. Overpass	450-33-45 I-110	Prestressed concrete girders	1.25	1.48	0.32	0.42
Calcasieu River	3-30-03 I-10	Steel girders and concrete slabs	1.00 2.00	1.22 2.01	0.44 1.08	0.31 0.85
Atchafalaya Floodway	913-214 4814-3 U.S. 190	41' concrete slab and girders	1.00	1.06	0.19	0.32
Bonnet Carre Spillway	450-14-07 I-10	65' precast prestressed concrete girders	1.25	0.73	0.66	0.75
Moss Bluff	24-1-16 24-2 U.S. 171	65' precast prestressed concrete girders	1.25	1.34	0.98	0.47
Breaux Bridge	450-06-07 I-10	Precast prestressed girders	1.25	1.21	0.31	0.37

TABLE 9

SUMMARY OF FOUR-INCH PRESSURE RELIEF JOINT MATERIALS PERFORMANCE INFORMATION

Company	Product	Material	Average Seal Life (Months)[1]	Remarks
Edoco	Accordian Joint Seal	Neoprene	74	Installed with a lubricant-adhesive
W. R. Meadows	Foam-In Place	Urethane Foam	74	
W. R. Meadows	Sealtight	Preformed Polyethylene	57	Installed with a lubricant-adhesive
American Meta Seal	Meta-Seal 355	Two Component Polysulfide	57	Primed with SP 30
American Meta Seal	Meta-Seal 220	Two Component Polyurethane	57	Primed with SP 30
D. S. Brown	K-5000	Neoprene	56	Installed with a lubricant-adhesive
Midwest Manufacturing Corporation	Flex-Lok (519/63)	Preformed Urethane Foam	24	Installed with a lubricant-adhesive (Adhesilube 7239)

[1]All seals still performing satisfactorily as of last inspection.

TABLE 10
PAVEMENT GROWTH INVESTIGATION RESULTS
INTERSTATE ROUTE 10

		Initial	Final	Relief Joint Closure	Reference Point Movement	Direction of Movement	Distance From Approach Slab
Wing Gully Bridge (500 Foot Section)	Reference D	5.2	5.0		0.2	Toward Bridge	468 Feet
	Reference C	7.1	7.0		0.1	Toward Bridge	351 Feet
	Reference B	8.3	8.2		0.1	Toward Bridge	234 Feet
	Reference A	8.2	7.9		0.3	Toward Bridge	Approach Slab
	Relief Joint	4.2	3.6	0.6			
Choupique Bayou Bridge (1000 Foot Section)	Reference D	4.5	4.6		0.1	Away From Bridge	936 Feet
	Reference C	9.3	9.4		0.1	Away From Bridge	702 Feet
	Reference B	8.9	9.7		0.8	Away From Bridge	468 Feet
	Reference A	8.8	8.5		0.3	Toward Bridge	Approach Slab
	Relief Joint	4.3	4.0	0.3			
Choupique Bayou Bridge (1500 Foot Section)	Reference D	5.0	5.2		0.2	Away From Bridge	1521 Feet
	Reference C	7.7	7.7		0.0		1170 Feet
	Reference B	6.7	6.7		0.0		761 Feet
	Reference A	10.1	10.1		0.0		Approach Slab
	Relief Joint	2.5	2.5	0.0			
Control Section							
Coon Gully Bridge (1500 Foot Section)	Reference D	3.9	4.2		0.3	Away From Bridge	1521 Feet
	Reference C	9.3	8.8		0.5	Toward Bridge	1170 Feet
	Reference B	6.8	6.2		0.6	Toward Bridge	761 Feet
	Reference A	7.5	6.7		0.8	Toward Bridge	Approach Slab
	Relief Joint	3.6	3.1	0.5			

NOTE: All measurements are in inches.

APPENDIX C

LABORATORY TEST PROCEDURES

TABLE 11

STANDARD TEST PROCEDURES

Pourable Sealants

ASTM D113-44	Test for Ductility of Bituminous Materials
ASTM D5-73	Test for Penetration of Bituminous Materials
AASHTO-T187	Test for Concrete Joint Sealers
ASTM D1149-64	Test for Accelerated Ozone Cracking of Vulcanized Rubber
Federal Specifications TT-S-00227E	"Sealing Compressed, Elastomeric Type, Multi-Component" (COM-NBS), Nov. 4, 1969.
Federal Specifications TT-S-00230B	"Sealing Compressed, Elastomeric Type, Single Component" (COM-NBS), May 5, 1967.
LDH-TR609	Bostik Mastic Tester
LDH-TR611	Weather-ometer Exposure
LDH-TR613	Shrinkage Test

Preformed Compression Seals

ASTM D2628	Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements (Table 1) With the following exceptions: 1. In the test for ozone resistance, strain determination may, by option of the Department, be determined by the Bent Loop Test method. 2. Compression seals shall also be tested for force deflection as determined by LDH Designation TR612 "Compression-Deflection of Preformed Compression Joint Seals."
ASTM D395-67	"Compression Set of Vulcanized Rubber"

METHOD OF TEST FOR
THE BOSTIK MASTIC TESTER
LDH DESIGNATION TR609-76
(PROPOSED)

Scope

1. This method of test is intended to determine the ability of pourable joint sealants (used to seal concrete pavement joints) to withstand simulated joint movements which are synchronized to simulated environmental temperature changes.

Apparatus

2. (a) A Bostik Mastik Tester equipped with an environmental cycling chamber.

   (b) Components for sample molds as follows:

   Concrete blocks 2.0 by 2.0 by 1.0 inches (5.1 by 5.1 by 2.5 cm), wooden spacers 2.0 by 0.75 by 0.50 inches (5.1 by 1.9 by 1.3 cm), petroleum jelly or silicone grease.

Preparation

3. (a) Brush concrete blocks until free from loose particles and blow clean with air hose. Lightly coat one side of each of two wooden blocks, 0.5 by 2 inches (1.3 by 5.1 cm) sides, with petroleum jelly to break the bond with the sealant. Sample molds will consist of two concrete blocks spaced 0.5 inches (1.3 cm) apart by two wooden spacers such that a seal 0.5 by 0.5 by 2 inches (1.3 by 1.3 by 5.1 cm) can be poured. Care must be taken to prevent <u>any</u> smearing of the petroleum jelly on to the concrete blocks. After the wooden spacers have been correctly positioned, wrap masking tape around the concrete block molds to hold the spacers in position. Extend the tape across the bottom of the mold to further contain the joint sealant.

(b) Mix the joint material according to the manufacturer's directions. If the material requires a primer, this must be applied to the concrete prior to assembling the molds and according to the manufacturer's directions. Pour the mixed material into the molds. (Try to avoid pouring material along the side of the molds before it has filled the bottom as this can cause air to become trapped.) Allow the sealant to cure for seven days at room temperature.

Procedure

4. (a) The movement arm of the Bostik tester and the plexiglass temperature program of the environmental cycling chamber will be synchronized such that an eight hour testing cycle is developed. A cycle will consist of gradually cooling and elongating the sealant to an ultimate elongation of 65 percent (0.83 inch, 2.11 cm) at 0° F. (-18° C.), then gradually heating and compressing the sealant to an ultimate compression of 35 percent (0.18 inch, 0.46 cm) at 160° F. (71° C.). The selection lever on the Bostik tester will be set on a time delay setting of 30 minutes to provide 16 incremental open and closure movements of 0.064 inch (0.16 cm) in each cycle.

(b) After the devices have been synchronized and have completed at least three cycles correctly, fix the samples securely into their holders, when the movement arm is at the zero setting; that is, when there is no extension or retraction of the holders beyond the 0.5 inch (1.3 cm) setting. At this point the cycle counter is zeroed and the test begins.

(c) Samples will be inspected for adhesion, cohesion, or roping (distortion) failures once a day when the extension arm has completely retracted (65 percent elongation, 0° F., -18° C.). The condition of the sample will be recorded along with the appropriate number of cycles.

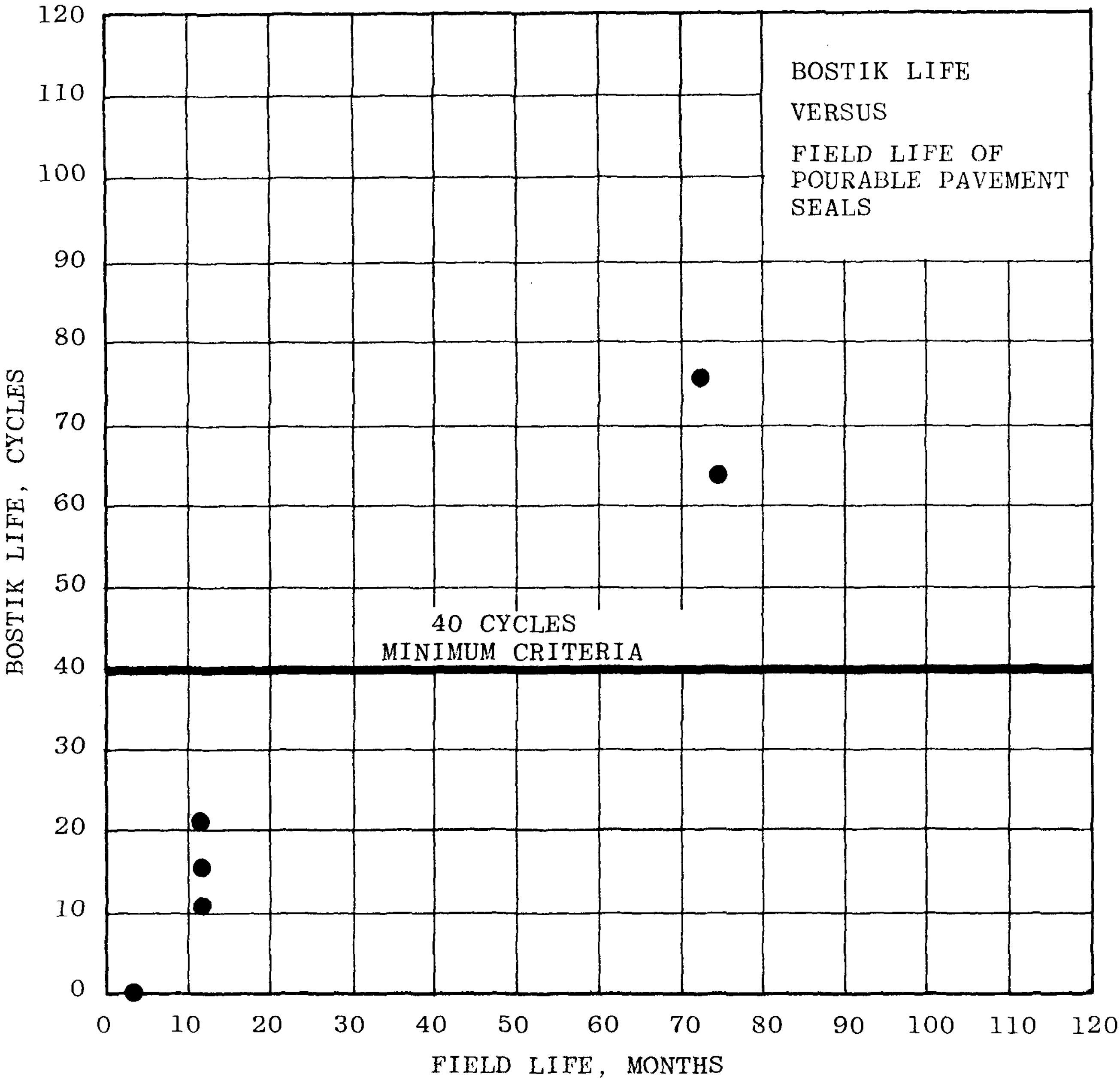
Report

5. (a) A sample will be considered to have failed when 15 percent or greater of the 2-inch (5.1-cm) length has failed in adhesion, cohesion, or roping.

   (b) Testing shall be conducted on at least two separate batches of the joint sealant obtained from separate containers with a minimum of six samples per batch for a total of twelve samples.

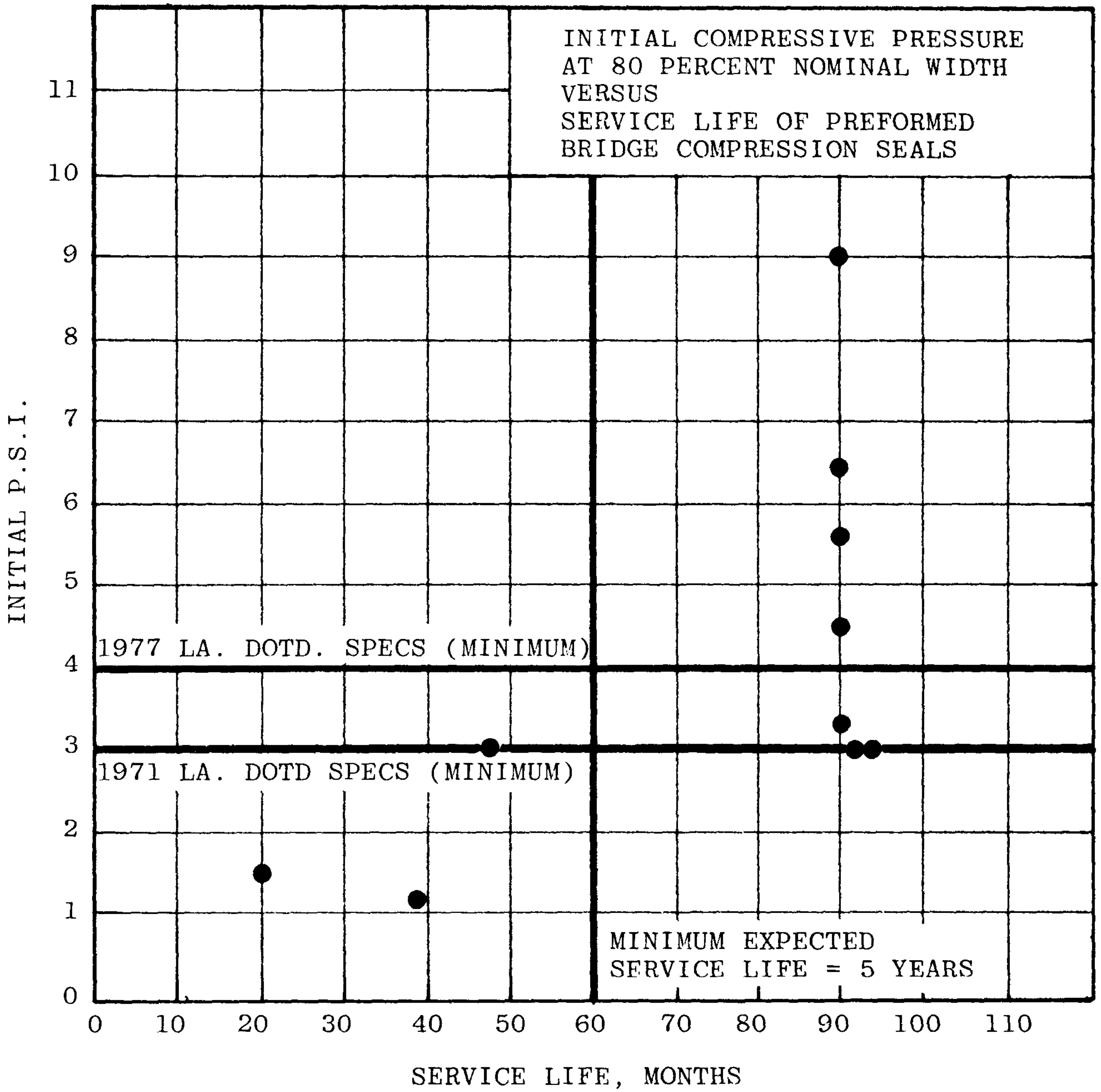
APPENDIX D

CORRELATION OF FIELD AND LABORATORY DATA



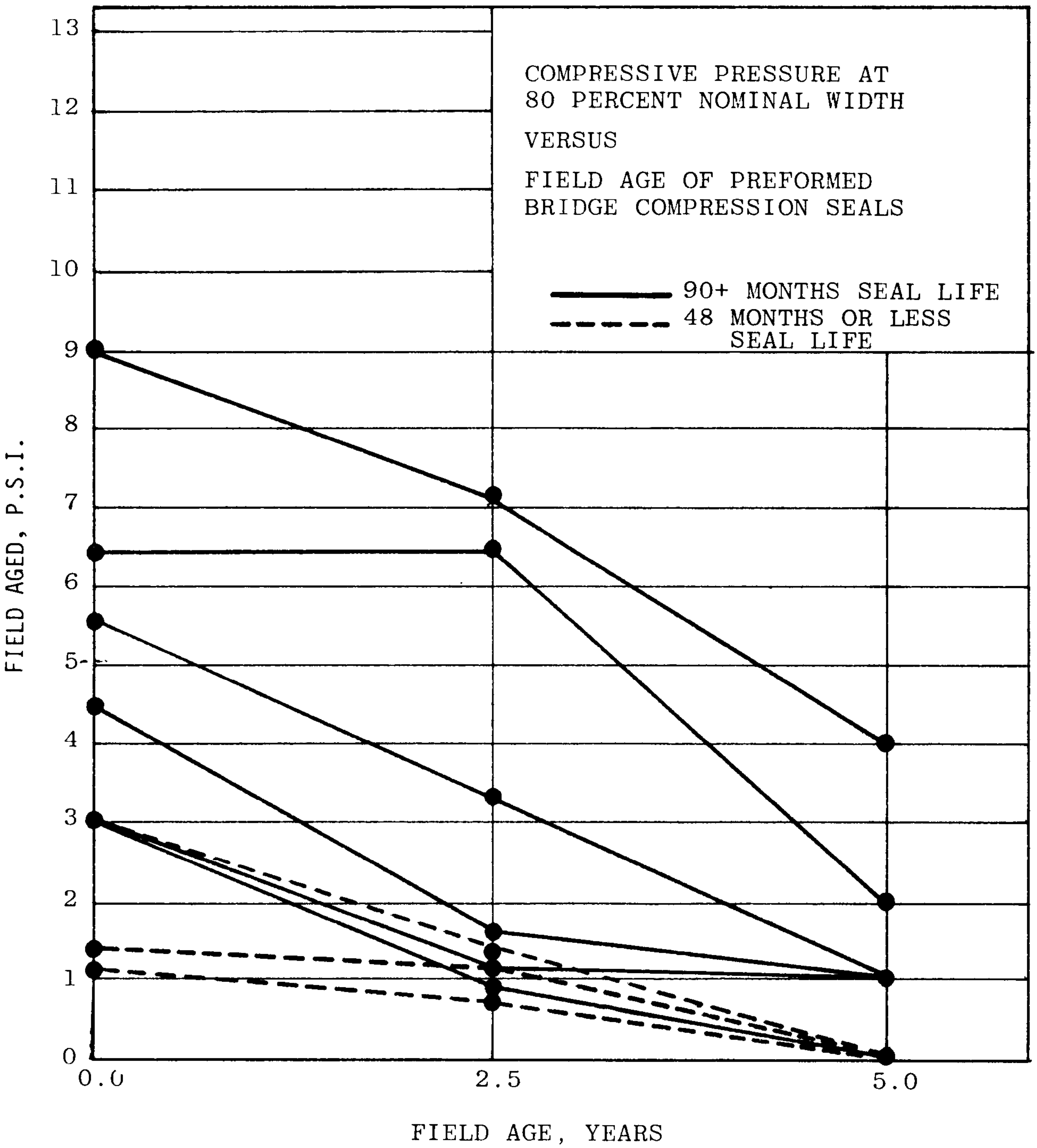
Bostik Life Versus Field Life
of Pourable Pavement Seals

FIGURE 12



Initial Compressive Pressure at Eighty Percent Nominal Width Versus Service Life of Preformed Bridge Compression Seals

FIGURE 13



Compressive Pressure at Eighty Percent Nominal Width
Versus Field Age of Preformed Bridge Compression Seals

FIGURE 14

APPENDIX E

PROPOSED LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT, OFFICE OF HIGHWAYS REVISED (1977) SPECIFICATIONS FOR JOINTS IN PAVEMENTS AND STRUCTURES

JOINT MATERIALS FOR PAVEMENTS AND STRUCTURES

Subsection	1005.01	Joint Fillers
Subsection	1005.02	Poured Joint Sealers
Subsection	1005.03	Preformed Elastomeric Compression Joint Seal
Subsection	1005.04	Steel Reinforced Elastomeric Joint Seals
Subsection	1005.05	Joint Materials for Approach Slabs
Subsection	1005.06	Waterstops

CONSTRUCTION REQUIREMENTS FOR JOINTS

Subsection	601.10	Joints (in Rigid Pavements)
Subsection	601.15	Sealing Joints (in Rigid Pavements)
Subsection	805.13	Expansion and Fixed Joints and Bearings (in Structural Concrete)

SECTION 1005

JOINT MATERIALS FOR PAVEMENTS AND STRUCTURES

1005.01 JOINT FILLERS. These preformed fillers shall be used in joints when specified in accordance with the plans and project specifications. Unless otherwise specified, the contractor may use any of these approved preformed fillers for its intended use. Other preformed fillers may be approved by the Department and specified in the plans or project specifications.

In the absence of detailed material specifications, the contractor shall furnish certificates of analysis of materials proposed for use together with their specification requirements and recommended uses.

(a) Preformed Expansion Joint Fillers for Concrete Paving and Structures:

(1) Nonextruding and resilient bituminous types: Fillers shall consist of preformed strips which have been formed from cane or other suitable fibers of a cellular nature securely bound together and uniformly saturated with a suitable bituminous binder, or strips which have been formed from clean granulated cork particles securely bound together by a suitable bituminous binder and encased between two layers of felt.

The type shall be as specified and shall conform to AASHTO Designation: M 213.

(2) Nonextruding and Resilient Nonbituminous Types: Fillers shall consist of preformed expansion joint fillers of the following types:

Type I	Sponge Rubber
Type II	Cork
Type III	Self-expanding Cork

The type shall be as specified and shall conform to AASHTO Designation: M 153.

(3) Bituminous type: Bituminous preformed expansion joint filler shall consist of bituminous (asphalt or tar) mastic composition, formed and encased between two layers of bituminous impregnated felt. The preformed filler shall conform to ASTM Designation: D 994.

(b) Wood Fillers:

The boards shall be sound heart redwood, northern white pine, western hemlock or white fir. All species other than redwood shall be treated with preservatives. Occasional small sound knots and medium surface checks will be permitted provided the board is free of any defects that will impair its usefulness for the purpose intended. No board of a length less than 6 feet may be used and the separate pieces shall be held securely to form a straight line.

The preservative treatment for wood other than redwood shall be ammonical copper arsenate or chromated copper arsenate conforming to AWPA P5 with a minimum retention of 0.4 lb./cu. ft.

The dimensions shall be as specified and a tolerance of +1/16 inch thickness, +1/8 inch depth and ±1/4 inch length will be permitted.

The load required to compress the material in an oven-dry condition to 50 percent of its original thickness shall not exceed 1800 lbs. per square inch.

(c) Preformed Nonbituminous Cellular Filler (For Sawed Joints):

This filler shall consist of preformed strips which have been formed from cane or other suitable fibers of a cellular nature, or laminated fiberboard built up to plan thickness. The material forming these strips shall be securely bound together with a suitable nonbituminous binder and formed to the plan dimensions.

The preformed strips shall meet the following:

(1) Water absorption: When tested in accordance with AASHTO Designation: T 42, the sample shall not absorb more than 15 percent by volume in 4 hours.

(2) Permissible variation in dimensions: The preformed filler shall not vary from the thickness specified by more than ± 1/16 inch.

(d) Preformed Polyvinylchloride Joint Filler:

This filler shall be an approved, extruded insert material (with or without removable cap as required) composed of polyvinylchloride of the required depth and thickness. It shall possess sufficient rigidity to enable it to form a straight joint.

(e) Preformed Closed Cell Polyethylene Joint Filler:

This material is primarily used in pavements and structure joints whose slabs are tied together with steel thus exhibiting minimal thermal movement. It is also used in pressure relief joints for concrete pavement approaches and bridge approach slabs as shown on the plans. The dimensional requirements shall be as specified on the plans.

The joint filler shall be formed by the expansion of polyethylene base resin, extruded as a multicellular, closed cell, homogeneous section of foamed polyethylene. This material shall be used with an adhesive as recommended by the manufacturer. The Materials Section shall maintain a qualified products list of joint fillers and adhesives to be used with each. The Department may require a filler to prove its performance through field installation and evaluation prior to placement upon the qualified products list. The joint filler shall meet the following requirements:

Property	Test Method	Limit
Density, pcf	ASTM D 1564	2.0 - 3.0
Water Absorption, % by volume, max.	ASTM C 272 (Note 1)	1.0
Compression, psi	ASTM D 1056	
@ 20% deflection, min.		3.0
@ 80% deflection, max.		125.0
Extrusion @ 80% deflection inches per inch width, max.	ASTM D 545	0.03

Note 1: The requirements that materials which trap water in flutes shall be dipped in absolute alcohol shall be omitted. Instead, the joint filler shall be dried quickly by blotting with absorbent paper.

(f) Cellular Polystyrene Joint Filler:

This material shall conform to ASTM Designation D 2125-62T with the following specific requirements:

Density shall be 2 pounds per cubic foot (± 0.2) and shall be an extruded type of homogeneous foam with a maximum of 30 psi compressive strength.

1005.02 POURED JOINT SEALERS. These joint sealers shall be used in sealing joints when specified in accordance with the plans and project specifications. If not specified, the contractor may use any of these approved sealants for its intended use. Other sealants may be approved by the Department and specified in the plans or project specifications.

(a) PVC Extended Coal Tar. This material shall be an approved single component polymer type elastomeric compound meeting the following physical requirements.

Property	Test Method	Requirements
Penetration	AASHTO T-187	130 max.
Flow	AASHTO T-187 (Note 1)	None
Bond	AASHTO T-187	1/4" separation max.
Resilience,%	DOTD - TR 623	60 min.
Ball Penetration		5 - 20
Artificial Weathering	DOTD - TR 623	Pass

Note 1: The test for flow shall be conducted according to AASHTO T-187 with the following exceptions: The sample shall be placed in an oven maintained at 65.6°C ± 1.1°C (150°F ± 2°F) for 24 hours.

Back-up material and elastomeric primers shall be approved products on the Qualified Products List. Once a product is approved for joint sealing, the requirements shall continue to be met for every lot produced.

(b) Polyurethane Polymers (Liquid Poured). This joint sealer shall be a one or two component, pourable or extrudable material. It shall set up as a solid rubberlike material able to withstand both tension and compression. This sealer shall not flow at temperatures below 160°F.

The joints shall be backed with joint fillers of a type specified by the manufacturer to obtain the correct depth of sealant. This backing material must not adhere to the sealant material.

The primer-adhesive shall be as recommended by the sealant manufacturer for the proper joint interface.

Primers, back-up materials and elastomeric polymers shall be approved products on the Qualified Products List. Once a product including corresponding primer and back-up material is approved for a joint sealer, these requirements shall continue to be met for every lot produced.

Each container of material shall be properly marked as to material, identity, batch number and manufactured date. Three copies of certificates of compliance and analysis shall be furnished for each project and batch.

Shelf life shall be specified by the manufacturer, and the expiration date shall be clearly shown on the container. All joint sealing compounds shall have passed all qualification tests which include actual field installation and evaluation. All material furnished shall be equal in composition to the original sample which has been tested and approved as a qualified product. Any deviation in composition or performance of the product shall result in it being removed from the Qualified Products List.

In addition, for verification purposes the material shall meet the following requirements:

Property	Limits	Test Methods
Tack Free Time, Hrs.	72 (Max.)	Federal Spec. TT-S-00227E
Hardness, Shore A		Federal Spec. TT-S-00227E
After Heat Aging	20-50	
Standard Condition	5-30	
Weatherometer, 600 hrs. (min.)	Pass	DOTD-TR 611
Ozone	Pass	ASTM D 1149
Weight Loss, %	10 (Max.)	Federal Spec. TT-S-00227E
Infrared Charts		DOTD-TR 610
Activator	Pass	
Base Resin	Pass	

(c) Asphaltic Types.

(1) Asphalt with Mineral Filler: Asphalt mineral filler shall be homogeneous and shall be composed of asphalt and mineral filler. The asphalt shall be free from impurities. The asphalt mineral filler shall conform to the following requirements:

	Test Method	Min.	Max.
Softening Pt. °F	AASHTO T-53	125	145
Penetration at 32°F, 200g, 1 min.	AASHTO T-49	14	--
Penetration at 77°F, 100g, 5 sec.	AASHTO T-49	50	70
Ductility at 77°F, cm	AASHTO T-51	15	--
Asphalt Solubility,%	AASHTO T-44	45	55
Mineral Filler,%	AASHTO T-44	45	55
Water, %	AASHTO T-55	--	2

(2) Hot Poured Elastic Type: Hot poured elastic type sealer is intended for sealing joints in concrete pavements, bridges and other structures and shall conform to AASHTO Designation: M 173, except that the pour point test will be performed only as deemed necessary.

1005.03 PREFORMED ELASTOMERIC COMPRESSION JOINT SEAL. The joint seal shall be an approved preformed, elastomeric polychloroprene joint seal which shall be compatible with concrete and steel and shall be resistant to abrasion, oxidation, oils, gasoline, salt and other substances that may be spilled on or applied to the surface.

The Materials Section maintains a qualified products list of compression seals. The Department may require a seal to prove its performance through field installation and evaluation prior to placement upon the Qualified Products List. All material furnished shall be equal in composition, shape and physical characteristics to the original sample which has been tested and approved as a qualified product.

When the seal size is not stated on the plans, the size shall be selected as a seal with a nominal width that is double the joint's theoretical width at maximum closure.

Unless otherwise noted, the width of the joint seal to be used shall be determined on the basis of temperature range, between 20°F and 120°F for structural steel, and between 30°F and 100°F for structural concrete.

The uncompressed depth of the seal shall be approximately equal to or greater than the uncompressed width of the seal. The actual width of the seal shall not be less than the nominal width of the seal.

Each lot of joint sealer submitted for Department approval shall demonstrate that it possesses the inherent capabilities necessary for satisfactory field installation. This property shall be judged by actual installation, and the sealer shall not exhibit any twisting, rolling, misalignment of the opposite top edges, tendencies to trap incompressibles or any other qualities which shall be deemed detrimental to the sealer's proper installation and performance.

The seal will be tested for compression-deflection in accordance with DOTD Designation: TR 612.

(a) Pavement Use - The material shall conform to ASTM Designation: D 2628 with the following exceptions:

(1) The test for Ozone resistance may, at the option of the Department, be determined by the Bent Loop test method.

(2) The seal shall exert a minimum pressure of 3.0 pounds per square inch at 80% of nominal width and a maximum of 25.0 pounds per square inch at 50% of nominal width.

The lubricant-adhesive shall conform to ASTM Designation: D 2835.

(b) Bridge Use - The seal shall conform to 1005.03 (a) with the following exceptions:

(1) The seal shall exert a minimum pressure of 4.0 pounds per square inch at 80% of nominal width.

(2) Lubricant Adhesive - The material shall be compatible with concrete, steel and polychloroprene and must be of a character that is recommended by the sealant manufacturer. The material shall not necessarily be from the same base polymer as the seal; however, each type of lubricant adhesive shall demonstrate by actual test installation that it possesses the inherent capabilities necessary for satisfactory performance. The lubricant-adhesive shall provide adequate lubrication for insertion of the seal into the joint, and shall bond the seal to the joint faces throughout repeated cycles of expansion and contraction, effectively sealing the joint against infiltration or moisture.

It shall exhibit a viscosity of 16,000 to 450,000 centipoises and a minimum shear ratio of 2.5. It shall have a minimum lubricating life of two hours at 100°F, and shall cure within 48 hours without sagging.

No material shall be used which has skinned over or which has settled in the container to the extent that it cannot be easily dispersed by hand stirring to form a smooth uniform product.

The material shall be uniform, homogeneous, contain no lumps or agglomerates, and there shall be no settlement in the container. The minimum percent solids is 65 percent and shall be determined by oven drying at 230°F ± 5°F for 3 hours.

All material furnished shall be equal in composition to the original sample which has been tested and approved for the Qualified Products List. The manufacturer shall provide a certificate of compliance for each lot produced for each project.

The lubricant adhesive shall be delivered in containers plainly marked with the manufacturer's name or trademark, lot number, date of manufacture and storage stability.

1005.04 STEEL REINFORCED ELASTOMERIC JOINT SEALS. This material shall consist of integrally molded units of elastomer and bonded metal components so arranged as to provide for the expansion and contraction joint movements. The metal components bridging the joint gap shall be of sufficient strength to carry wheel loads across the joint. The total system with components shall be as approved on the Qualified Products List.

The expansion joints shall seal the deck surface, gutters and curbs to prevent moisture and other contaminants from descending onto the pier and abutment caps and shall have provision for adequate anchoring of the joint assembly to the bridge deck. The gutter and vertical curb face shall be one piece. There shall be no appreciable change in the deck surface with the bridge expansion and contraction movements. All the expansion and contraction movements of the bridge deck shall be taken entirely by deformation of the elastomer.

The elastomer portion of the elastomeric compound for expansion joints shall be 100% virgin chloroprene and shall have the following physical properties:

Property	ASTM Test	Requirement
Tensile Strength, min., psi	D-412	1800
Elongation at break, min., %	D-412	400
Hardness, Type A Duro, points	D-2240	45 ± 5
Compression Set		
22 hours at 158° F, max., %	D-395	20
Low Temperature, brittleness @ -40° F	D-746 Procedure B	No failure
Ozone Resistance Exposure to 100 pphm ozone for 70 hours @ 104° F sample under 20% strain or Bent Loop	D-1149	No cracks
Oil Deterioration ASTM Oil No. 3 for 70 hours @ 212° F, Vol. Change, max., %	D-471	120

The dimensions of the elastomeric portion of the joint shall be correct to - 0 inch + 1/4 inch in width and length, and from - 0 inch + 1/8 inch in thickness of the exterior dimensions required on the plans measured at 70° F.

The sealant for sealing joints between the expansion joint units, along the edge of the expansion joint, and the bolts and plugs shall be as listed on the Qualified Products List. It shall be capable of bonding to concrete, steel and elastomer. When cured the sealant shall possess excellent abrasion resistance and shall resist attack by salt, oil and road chemicals.

The internal steel plates shall conform to ASTM Designation: A 570, Grade D, or A 36. The plates will be bonded to the rubber during the vulcanization process. They shall not be exposed to the atmosphere.

The supplier shall furnish the Materials Section a certificate of compliance for the steel used, and a certificate of analysis for the elastomer used in this system.

1005.05 JOINT MATERIALS FOR APPROACH SLABS.

(a) Preformed Closed Cell Polyethylene Joint Filler - This material shall conform to Subsection 1005.01 (e).

Lubricant-adhesive shall be used and applied according to the manufacturer's instructions.

(b) Preformed Urethane Foam Joint Filler - This material shall be made with a semi-open, flexible polyurethane foam which is molded to such cross-sectional shape that it can be easily installed in the pavement joint with parallel sides and which will be sufficiently self-locking to prevent the material from floating out of the joint. The joint filler shall have the following cross-sectional dimensions: top width, 4 7/8 to 5 1/8 inches; overall depth 7 1/4 to 8 1/4 inches.

The properties of the urethane foam when determined on skinfree specimens shall meet the following requirements.

Property	Requirements	Test Method
1. Density, pcf	7 to 11	ASTM D 1564
2. Comp. Strength, psi		ASTM D 1564
25% Deflection	3 to 7	
65% Deflection	8 to 16	
3. Recovery, % of original, minimum	95	65% deflection, calculated after 1 min. of relaxation from deflection return.

Property	Requirements	Test Method
4. Tensile Strength, psi, min.	25	ASTM D 1564
5. Water Absorption, % Vol. max. one inch thick specimen	30	AASHTO T-42

6. Chemical Resistance - Immerse a specimen approximately 0.5 cubic inch in volume in a 50% by volume mixture of mineral spirits and linseed oil for 24 hours. Remove and visually examine the specimen for evidence of deterioration.

A lubricant adhesive, recommended by the manufacturer for the intended use, shall be provided with the joint filler, and liberally used according to his instructions.

(c) Preformed Elastomeric Compression Joint Seal - This material shall conform to Subsection 1005.03 (b).

1005.06 WATERSTOPS. Waterstops shall be of the type and dimension shown on the plans and conform to the following requirements:

(a) Copper waterstops shall conform to ASTM Designation: B 370, soft temper.

(b) Polyvinylchloride waterstops shall conform to Corps of Engineers Specification CRD-C 572.

(c) Rubber waterstops shall conform to Corps of Engineers Specification CRD-C 513.

Details of installation and splicing, when not shown on the plans, shall be submitted to the Materials Engineer for approval. Copper and rubber waterstops shall be sampled in accordance with the Department's Materials Sampling manual. When polyvinylchloride waterstops are used, the contractor shall submit a certificate of analysis indicating conformance to all requirements of the specification.

CONSTRUCTION REQUIREMENTS FOR JOINTS

601.10 JOINTS. Joints shall be constructed of the type and dimensions and at the location as shown on the plans or project specifications.

(a) Longitudinal Joint: The longitudinal joint shall not interrupt the continuity of any transverse joint. Deformed steel tie bars of specified length, size, spacing and material shall be placed perpendicular to longitudinal joints. They shall be placed by approved mechanical equipment or rigidly secured by chairs or other approved supports to prevent displacement. Tie bars shall not be coated with asphalt or other material or enclosed in tubes or sleeves. When adjacent lanes of pavement are constructed separately, steel side forms or other approved types shall be used. Tie bars may be bent at right angles against the form of the first lane constructed and straightened into final position before the concrete of the adjacent lane is placed or, in lieu of bent tie bars, approved 2-piece connectors may be used. Tie bars which break or show evidence of fracture upon straightening shall be replaced when directed by the engineer by drilling 1-inch holes to a depth of 12 inches and pressure grouting the holes before insertion of the tie bars.

(1) The groove for the longitudinal joint shall be formed by using a "T" iron, cutting wheel or other device that will insure a groove that is true in both vertical and horizontal alignment. All grooves shall be cut to the minimum depth shown on the plans and in such manner that the surface of freshly placed concrete will not be depressed or otherwise disturbed. Retempering of concrete adjacent to joints will not be permitted.

Strips of preformed joint filler material of the dimensions shown on the plans shall be inserted in the groove. After insertion, the top edge of the strip shall be flush with the surface or slightly below. In no case shall the distance between the top of the insert and the surface of the concrete exceed 1/8". The joint shall then be aligned and the surface of the pavement floated and checked with a 10-foot straightedge. These fillers shall conform to subsection 1005.01 (a) (1); (a) (2) Type I or III; or (e), and no sealer is required. Filler in accordance with Subsection 1005.01 (c) may be used if a sealer in accordance with Subsection 1005.02 (a), (b) or (c) 2, is used.

(2) A flexible joint forming device of the type or types shown on the plans may be used. Such joints shall be formed in accordance with plan details and the recommendation of the manufacturer. When the contractor desires to use a joint forming device not shown on the plans, the device and the method of installation must be approved in writing by the engineer. These joint forming devices shall conform to Subsection 1005.01 (d).

(b) Transverse Expansion Joints: The expansion joint filler shall be one of the following types:

(1) Fillers requiring sealing. When wood filler conforming to Subsection 1005.01 (b), cellular polystyrene conforming to Subsection 1005.01 (f), or preformed nonbituminous cellular filler (for sawed joints) conforming to Subsection 1005.01 (c) is used to form the joint, they shall be sealed in accordance with the plans. When wood filler is used, it shall be immersed in water for a period of not less than 24 hours before installation in the pavement. The boards shall be kept thoroughly wet until installed. The sealer shall be one of the following materials:

(a) Preformed elastomeric compression seal conforming to Subsection 1005.03.

(b) PVC extended hot poured elastic joint sealer conforming to Subsection 1005.02 (a).

(c) Polyurethane sealant conforming to Subsection 1005.02 (b).

(2) Fillers not requiring sealing shall conform to Subsection 1005.01 (a) 2, Type I or III, or 1005.01 (e).

The expansion joint filler shall be continuous from form to form and shaped to the subgrade. Preformed joint fillers shall be furnished in lengths equal to the pavement width or equal to the width of one lane. Damaged or repaired joint fillers shall not be used unless approved by the engineer.

The expansion joint filler shall be held in a vertical position. An expansion installing bar or other device shall be used if required to secure preformed expansion joint filler at proper grade and alignment during placing, vibrating and finishing of concrete. Care shall be taken to prevent any deformation of the vertical sides of the filler. Finished joints shall not deviate more than 1/4 inch in the horizontal alignment from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. No plugs of concrete shall be permitted anywhere within the expansion space.

(c) Transverse Contraction Joints (Dummy Joints): Transverse contraction joints shall consist of planes of weakness created in cross section of pavement and shall be constructed by one of the following methods:

(1) Install a nonbituminous preformed filler board in a groove in the pavement formed as outlined under (a) (1) above and then sawed to the dimensions specified on the plans with one pass of the saw.

(2) Install an approved removable joint forming device to form a joint to a width slightly less than the required width and to the required depth. The joint shall then be sawed to proper width and depth with one pass of the saw.

(3) Install an approved removable joint device to form a joint to the required width and depth. This device shall be vibrated and remain in place for a minimum of 72 hours before removal. These devices may be reused providing they are cleaned of foreign materials and are undamaged in removal. They shall be reused only with prior approval of the engineer.

Unless otherwise specified, the joints shall include load transfer devices.

(d) Transverse Construction Joints: Transverse construction joints shall be constructed when there is an interruption of more than 30 minutes in the concreting operations. No transverse joint shall be constructed within 10 feet of an expansion joint, construction joint or plane of weakness. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet long, the excess concrete back to the preceding joint shall be removed and disposed of as directed. Hand vibrators shall be used to ensure proper consolidation of the concrete adjacent to the construction joint.

(e) Load Transfer Devices: Load transfer devices, either dowel assemblies or cantilever type assemblies, shall conform to Subsection 1009.04. Dowels may be held in positions parallel to the surface and centerline by a metal device that is left in the pavement.

Dowels shall be smooth, free of burrs, projections and deformations which may prevent pavement slippage. Dowels shall be coated with one coat of an approved paint and thoroughly coated with an approved lubricant to prevent the concrete from bonding to the dowel. In lieu of painted and lubricated dowels, plastic coated dowel bars in accordance with Subsection 1009.04 may be used. An approved sleeve, conforming to Subsection 1009.04 (a), shall be furnished with each dowel bar used in expansion joints. The sleeve shall fit the dowel bar tightly and the closed end shall be watertight.

Cantilever type assemblies shall be in accordance with the type shown on the plans or approved equal.

Load transfer devices may be placed by an approved mechanical device provided satisfactory positioning and alignment is attained.

Load transfer devices for construction joints shall be the dowel assembly type.

(f) Where the plans provide that concrete pavement be overlaid with asphaltic concrete pavement, the sawing of longitudinal and transverse joints as hereinbefore specified will not be required.

601.15 SEALING JOINTS.

(a) General Requirements: The engineer shall inspect and approve each joint for proper width, depth, alignment and preparation for sealing before sealing is allowed. Sealing of joints will not be required when new portland cement concrete is to be overlaid with asphaltic concrete.

The pavement may be opened to traffic prior to sealing provided the joint forming device or insert has not been removed or sawed. When the insert is removed or sawed the pavement may be opened to traffic provided the joints are protected during the interval between sawing and sealing. Protection of the joints shall be accomplished by placement of a backup material immediately after sawing or removal of insert. The elastomeric polymers (poured sealers) require that the concrete be at least 28 days old prior to sealing joints.

The joint shall be thoroughly cleaned immediately prior to sealing. Poured sealers require that joint faces be sandblasted immediately prior to sealing. Sandblasting is not required for preformed elastomeric compression seal except when the joint insert is sawed.

The sealant shall be placed as soon as possible after the required curing of the concrete. Traffic shall not be permitted while sealing and until after the sealant is cured. When a liquid poured sealant in accordance with Subsection 1005.02 is used, the pavement shall be closed to all traffic for sealing for a minimum of one day. When elastomeric compression seal is used, the pavement may be opened to traffic immediately following completion of sealing.

Joints shall be reasonably free of spalls, fractures, breaks or voids. Areas requiring repairs shall be chipped back to sound concrete and repaired with an approved non-shrinking patching system in accordance with the manufacturer's recommendations.

Joint sealants shall be installed in accordance with the manufacturer's recommendations. The sealant shall be installed to a depth of 1/4 inch (± 1/8 inch) below the pavement surface or in accordance with the plans. The sealants used shall conform to the following:

(1) Longitudinal joints - as specified in Subsection 601.10.

(2) Transverse expansion joints - as specified in Subsection 601.10.

(3) Transverse contraction and construction joints - shall be sealed with preformed compression joint seal in accordance with Subsection 1005.03, unless otherwise noted on the plans.

(b) Additional Requirements: The following additional requirements apply to the installation of elastomeric polymers and preformed compression seals conforming to Subsections 1005.02 and 1005.03.

(1) Hot Poured Sealants:

(a) Joint Preparation: The joints shall be either formed or cut in accordance with Subsection 601.10. Removal of joint forming devices or sawing operation shall not commence until immediately before cleaning and application of the sealant material. All joints shall be thoroughly cleaned by commercial type sandblasters capable of effectively removing all concrete curing membrane, laitance and other foreign matter from the joint. The sandblasting operation shall continue until the joint exhibits a uniform etched surface. Upon completion of sandblasting, the joint and adjacent areas shall be cleaned of all dust and sand.

(b) Application and Equipment: The sealant shall not be installed until the joint has been inspected and approved. A backing material shall be placed as shown on the plans and shall be non-adhesive to the concrete or the sealant material. The material shall be upholstery roving cord. The joint sealant shall be applied uniformly solid from bottom to top in accordance with details shown on the plans. The joint shall be filled without formation of entrapped air or voids. The air temperature at the time of installation shall be 60° F or above.

Poured sealers conforming to Subsections 1005.02 (a) and 1005.02(c) (2) shall be installed in accordance with the following requirements. A mobile, heated, double walled, agitator type kettle with suitable oil medium in the outer space for heat transfer capable of maintaining a temperature range of the sealant material of 240° F to 280° F will be required. The kettles shall have easy access to facilitate cleaning and shall be thoroughly cleaned of any foreign substances or previously used compounds and shall be flushed daily with flushing oil. This equipment shall be provided with automatic continuous temperature recording chart for constant kettle temperature surveillance. A direct connecting pressure type extruding device with nozzles shaped for insertion into the joint to be filled shall be provided. The application equipment shall be designed so that the sealant material may be recirculated in the inner kettle when not in use and shall be capable of filling the joint with sealant material free of voids or entrapped air. The applicator shall be approved by the engineer and shall be maintained in satisfactory working condition.

(2) Polyurethane Polymers, Subsection 1005.02 (b): Care shall be taken that the material's shelf life is not exceeded and that application is accomplished at a temperature of 70° F or above.

(3) Preformed Elastomeric Compression Seals, Subsection 1005.03: Dilution of the lubricant adhesive is discouraged; however, a maximum of 10 percent dilution with a material recommended by the manufacturer will be allowed when application is by pump and the viscosity is such that the lubricant adhesive will not flow through a pump. The lubricant adhesive shall be applied just prior to installation of the seal and shall be sufficient to completely cover the seal's sidewalls.

The sealer shall be machine installed on all projects requiring 10,000 feet or more sealing. Stretching of the compression seal shall not exceed 5 percent. Prior to beginning installation, a length of sealer equal to the width of the pavement shall be cut and installed so that the stretching may be measured for the method of installation used. Random checks for stretching shall then be made throughout the project as deemed necessary by the engineer. If the lubricant adhesive has chemically set and maximum stretch limits are exceeded, the seal shall be removed and cleaned, the joint recleaned and reinstallation made.

Field splicing will not be allowed unless otherwise noted on the plans.

The sizes of compression seals to be used are as follows:

Joint Width	Seal Width
5/8"	1 1/4"
7/16"	13/16"
3/8"*	11/16"

*This joint width and the corresponding seal width will be allowed only when an approved removable joint forming device capable of accurately forming the 3/8" joint width is used and no sawing is permitted.

805.13 EXPANSION AND FIXED JOINTS AND BEARINGS. All joints shall be constructed in accordance with the details shown on the plans, specifications and the following requirements.

(a) Open Joints. Open joints shall be placed in the locations shown on the plans and shall be constructed by the insertion and subsequent removal of a wood strip, metal plate or other approved material. The insertion and removal of the template shall be accomplished without chipping or breaking the corners of the concrete. Reinforcement shall not extend across an open joint unless so specified on the plans.

(b) Filled Joints. All joints to be sealed with poured or preformed compression seals shall be formed and constructed similar to open joints. When prefabricated types are specified, the filler shall be in correct position when concrete on one side of the joint is placed. When the form is removed, the concrete on the other side shall be placed. Adequate water stops of metal, rubber or plastic shall be carefully placed as shown on the plans.

(c) Joint Seals (Nonreinforced). Nonreinforced seals used for bridges are of 2 general types: liquid poured and preformed. Both types shall effectively prevent water leakage and the intrusion of incompressible materials.

Unless otherwise required, the joints are to be sealed full width, including curbs and sidewalks.

(1) Liquid Poured: The joint seal shall conform to Subsection 1005.02 (b). The joints shall be thoroughly cleaned, using whatever equipment is necessary. Before application of the poured joint seal the joint faces must be sandblasted unless otherwise specified. The joints shall be thoroughly cleaned and dry at the time of installation. The joint seal shall be installed in accordance with the manufacturer's recommendations. Care shall be taken that the material's shelf life is not exceeded and that application is accomplished at 70° F or above. Application shall be done by a machine with a powered mixing device with an accurate method of proportioning and mixing the 2 separate components.

Primers, if required, shall be applied as directed by the manufacturer; however, it shall be applied the same day as the installation and shall be tack free prior to installation of the joint seal.

Joints shall be backed with a closed cell polyethylene foam joint filler to obtain the correct depth of seal. The filler may be cast into the joint or compressed into the joint such that it adheres tightly to the sides of the joint providing a stable backing for the poured joint seal. This backing material must not adhere to the seal material and must be of a character recommended by the seal manufacturer.

(2) Preformed Elastomeric Compression Joint Seal (Mechanical Type): The joint seal and lubricant-adhesive materials shall conform to Subsection 1005.03. The joints shall be thoroughly cleaned and free of loose rust using whatever equipment is necessary. Where armored joints are welded for alignment for construction purposes, the weld spots shall be ground smooth prior to seal placement. In all cases the joints shall be smooth faced and thoroughly clean and dry at the time of installation. The joint seal shall be installed in accordance with the manufacturer's recommendations.

The lubricant-adhesive shall be applied just prior to installation and shall be sufficient to completely cover the seal's sidewalls. The installation shall be done in a manner that least disturbs the lubricant-adhesive on the joint walls. Dilution of the lubricant-adhesive will not be allowed.

Stretching of the seal should be minimal. When installation procedures appear to cause stretching, random checks shall be made. The frequency and thoroughness of the checks shall be as directed by the engineer as he deems necessary in accordance with the adequacy of the installation. The maximum allowable stretch of the compression seal is 5 percent. When the maximum stretch limits are exceeded, and the lubricant-adhesive has chemically set, the seal shall be completely removed and cleaned, the joint recleaned and reinstallation made.

One manufacturer's shop splice per 48 foot length shall be allowed provided field performance and laboratory tests indicate satisfactory performance. Field splicing shall not be allowed unless specifically noted on the plans to accommodate severe angles in the seal due to planned alignment.

(d) Steel Reinforced Elastomeric Joint Seals. Steel reinforced elastomeric joint seals and sealants shall conform to Subsection 1005.04 and shall be approved products on the Qualified Products List maintained by the Department's Materials Section or products that are approved for the Qualified Products List prior to use. The contractor shall also submit a manufacturer's certification stating that the seal and sealants meet the specified requirements.

Prior to installation, the contractor shall advise the engineer of the intended method of construction, anchorage system and method of setting system according to temperature.

A recess shall be constructed with adjustable forms set to proper dimensions for the temperature at the time of pouring. Forms shall not be released less than two hours after pouring concrete in the form-out. All edges shall be tooled. The maximum misalignment from parallel with the slab surface will be 1/16".

Projections on the sides and bottom of the depression shall be ground flush. All depressions, voids, honeycombs and air bubbles shall be filled with an approved rapid setting patching material.

The joints shall be installed as shown on the plans and in accordance with the manufacturer's recommendations.

Prior to installation, the concrete or metal surface on which the seal is to be set will be sandblasted and shall be dry; shall be free from dirt, grease, oil or other contaminants; shall be level; and shall be sound with no broken or spalled concrete. No joint shall be placed until the engineer has inspected and approved the seat conditions. Immediately prior to installation, all neoprene surfaces to be in contact with sealant shall be buffed or wire brushed to provide a bonding surface, and shall be cleaned with toluene or mineral spirits.

The sealant must be thoroughly mixed before applying and shall be placed for one section at a time. The sealant shall be in a layer at least 1/4" thick on the bottom of the form-out and extend from the bottom corner of the form-out to 1 1/2" past the anchor. The joint must be placed within 30 minutes after the sealant is mixed. The joint shall be positioned over the anchor bolts and the nuts securely tightened. All loose or long anchor bolts shall be corrected in a manner approved by the engineer. Prior to filling the space in the bolt wells, the engineer's inspection of the anchor bolts and tightening of the nuts will be required. All joints between units, around connecting bolts, and cavity plugs shall be carefully sealed with sealant in a neat workmanlike manner.

The finished joint shall present a smooth, neat appearance with no protruding bolts or rough joints. Excess sealant shall be removed before it becomes hard. Upon completion of an entire joint, the contractor shall grind any uneven end butt connections flush. Any openings between butt ends not showing mastic to the top shall be cleaned and filled with mastic . The ends of the joint at the curb faces shall be caulked with mastic.

When the bridge deck is to be waterproofed and surfaced, the installation of the joint shall be completed prior to placement of waterproofing and surfacing.

(e) Premolded Expansion Joint Filler:

(1) Nonextruding and Resilient Types: Nonextruding and resilient types shall conform to Subsection 1005.01.

(2) Asphaltic Types: Asphaltic types shall conform to Subsections 1005.01 (a) (1) or 1005.01 (a) (3).

(3) Nonasphaltic Types: Nonasphaltic types shall conform to Subsection 1005.01 (a) (2) or 1005.01 (c).

(f) Steel Joints. The plates, angles or other structural shapes shall be accurately fabricated to conform to the section of the concrete floor. The fabrication and painting shall conform to the specifications covering those items. When specified, the materials shall be galvanized in lieu of painting. Care shall be taken to insure that the surface in the finished plane is true and free of warping. Positive methods shall be employed in placing the joints to keep them in correct position during the placing of the concrete. The opening at expansion joints shall be designated on the plans at the prescribed temperature and care shall be taken to avoid impairment of the required clearance.

Temporary restraints placed in joints will be removed as early as practical after the casting of adjacent pours where they are able to resist the contraction of the adjacent concrete.

(g) Water Stops: Adequate water stops of metal, rubber or plastic shall be placed as shown on the plans. Where movement at the joint is provided for, the water stops shall be of a type permitting such movement without injury. They shall be spliced, welded or soldered to form continuous watertight joints.

(h) Bearing Devices. Bearing plates, rockers and other expansion devices shall be constructed according to details shown on the plans. The masonry surfaces on which bearings are to be set shall be finished to insure a true and uniform bearing at the grade and elevation shown on the plans. Bronze or copper-alloy plates shall conform to Subsection 1013.07. Structural steel and painting shall conform to the specifications for those items. When specified, the material shall be galvanized in lieu of painting. The rockers or other expansion devices shall be accurately set considering temperature and deflection at the time of erection.

(i) Elastomeric Bridge Bearing Pads: Elastomeric bearing pads shall conform to these specifications and Subsection 1017.14. These bearings may be either plain (consisting of elastomer only) or laminated (consisting of layers of elastomer interspersed with nonelastic laminates) as shown on the plans. Bearings shall be specified on the plans by hardness (durometer), size and configuration and, in the case of laminated bearings, by the thickness of individual layers of elastomer and the size and position of special connection members, if any, required to be vulcanized with the bearing.

APPENDIX F

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT, OFFICE OF HIGHWAYS, QUALIFIED PRODUCTS LISTS FOR JOINT SEALANTS AND LUBRICANT ADHESIVES FOR PAVEMENTS AND BRIDGES

Louisiana Department of Highways

Qualified Products List 5

POLYURETHANE POURED JOINT SEALERS

SOURCE	MATERIAL
1. Edoco Technical Products, Inc. 22039 South Westward Avenue Long Beach, California 90810	(A) Polyurethane Sealer 1. Edoco U-Seal Code # 3200-hand mixed 2. Edoco U-Seal Code # 3201-machine grade (B) Primer 1. Edoco U-Seal Code # 3203 (C) Backing Material 1. Polyethylene Rod 2. Sized Polyethylene Sheets 3. Polyethylene or Polyurethane Foam
2. Specialty Products Dist. Company (Products Research & Chem. Corp.) 5440 San Fernando Road Glendale, California 91203	(A) Polyurethane Sealer 1. Rubber Calk Sealant 3105 (B) Primer 1. For Masonry Surfaces: PRC Primer # 24 2. For Steel Surfaces: PRC Primer # 7 (C) Backing Material 1. Polyethylene Rod (such as PRC/Minicel backer rod or approved equal) 2. Sized Polyethylene Sheets 3. Polyethylene or Polyurethane Foam

REFERENCE:

LDH Standard Specifications, Subsection 905.01 (b)

NOTE:

All material, regardless of prior approval, shall be sampled in accordance with the Materials Sampling Manual and tested for conformance to the original specification. Any deviation in performance from the original sample submitted may result in disqualification of the product from the qualified products list.

No information contained in this list is to be used for promotional purposes.

State of Louisiana
Department of Transportation and Development
Office of Highways

Qualified Products List 6

PREFORMED ELASTOMERIC COMPRESSION JOINT SEALS

SOURCE	MODEL NUMBER
1. Acme Highway Products Corp. * 33 Chandler Street Buffalo, New York 14207	(A) PAVEMENT USE Series M: Models M-062, M-081, M-100 (B) BRIDGE USE Series J: Models J-125, J-162, J-175, J-200, J-225, J-250, J-300, J-350, J-400, J-500, J-600
2. D. S. Brown Company * P. O. Box 158 North Baltimore, Ohio 45872	(A) PAVEMENT USE E Series (Except nominal widths 1 1/4", 1 5/8", 2"); H Series: Model H-1250 (B) BRIDGE USE B Series; CV Series; H Series: Models H-1626, H-1750, H-2001, H-2503, H-3000, H-3500, H-4000
3. W. R. Grace & Company 6051 West 65th Street Chicago, Illinois 60638	(A) PAVEMENT USE Model "Y" Series (B) BRIDGE USE Model "X" Series
4. Watson-Bowman Assoc., Inc. * 1280 Niagara Street Buffalo, New York 14213	(A) PAVEMENT USE Model WB-4 (B) BRIDGE USE W A Series; W D Series (Except WD-200L) (Serrated edge is acceptable)

* The following seals of the listed nominal widths are acceptable for use in pressure relief joints only: Acme A-125 (1 1/4"); D. S. Brown E-1250 (1 1/4") and E-2500 (2 1/2"); Watson-Bowman WC-1 (1 1/4").

NOTE:

All seals, regardless of prior approval, shall be sampled in accordance with the Materials Sampling Manual and tested for conformance to the original specification. Any deviation in performance from the original sample submitted may result in removal of the product from the qualified products list.

No information contained in this list is to be used for promotional purposes.

LOUISIANA DEPARTMENT OF HIGHWAYS
APPROVED SOURCES OF LUBRICANT-ADHESIVES FOR USE IN CONJUNCTION WITH BRIDGE SEALS: (MINIMUM OF 65% SOLIDS CONTENT)

QUALIFIED PRODUCTS LIST 8

SOURCE	MATERIAL
1. Acme Highway Products Corp. 33 Chandler Street Buffalo, New York 14207	EP Prima-Lub
2. D. S. Brown Company P. O. Box 158 North Baltimore, Ohio 45872	Delastibond No. 1520
3. Robson Corporation P. O. Box 67 Oxford, Maryland 21654	Bon-Lastic

NOTE

All material, regardless of prior approval, shall be sampled in accordance with the Materials Sampling Manual and tested for conformance to the original specification. Any deviation in performance from the original sample submitted may result in disqualification of the product from the qualified products list.

Louisiana Department of Highways

Qualified Products List 18

PREFORMED CLOSED CELL POLYETHYLENE JOINT FILLER

SOURCE	LUBRICANT - ADHESIVE	MATERIAL
1. W. R. Grace & Company 6051 West 65th Street Chicago, Illinois	EC-1300 Cement (Code No. 5318-3M)	No. 5401 Closed Cell Plastic Foam Filler
2. W. R. Meadows, Inc. 2 Kimball Street Elgin, Illinois 60120	Sealtight Pressure Relief Joint Lubricant and Adhesive	Sealtight Pressure Relief Preformed Polyethylene Joint

NOTE 1:

No information contained in this list is to be used for promotional purposes.

NOTE 2:

All material, regardless of prior approval, shall be sampled in accordance with the Materials Sampling Manual and tested for conformance to the original specification. Any deviation in performance from the original sample submitted may result in disqualification of the product from the qualified products list.