JOINT SEALANT MATERIALS FOR CONCRETE PAVEMENT REPAIRS

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(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

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INTRODUCTION, PURPOSE, & SCOPE

The information gathering for this report was begun by talking with Ken McGhee of the Council staff and John Bassett and Tom Neal of the Materials Division. All three have had wide experience with joint sealant materials, but each of them has his own perspective because of his different job duties. Their comments are summarized below. It was assumed that these comments were valid and consequently they provided the "base" from which this work was slanted:

- There are three classes of joint sealant materials: preformed neoprene (used only in new construction), silicones, and "all others."
- VDOT uses only silicones and hot-poured materials in repair work. No cold-poured materials are used.
- In new construction, only preformed neoprene or silicones are used.
- A majority of repair work is conducted on pavements with a 61.5-ft joint spacing.
- VDOT specs would be improved if extensibility, weatherability, and workmanship were included.
- Although joints only make up approximately 5 percent of the cost of new pavement, they constitute 95 percent of the maintenance cost of pavements.

Conversations were also held with pavement engineers from several states, the FHWA, PCA, and the American Concrete Pavement Association; also, a number of published articles were reviewed. The general consensus is well stated in the American Concrete Institute's (ACI) 1990 *Guide to Sealing Joints in Concrete Structures*[1] (which includes concrete pavements), which states in its concluding remarks that "the cost of providing well-sealed joints by using the *best available sealants*, carefully installed in joints of the correct type, size and location, is usually only a small fraction of the total cost of a concrete structure."

This report *lightly* covers material properties, costs, and the experience with silicones on I-81 over the past few years. Appendix A is a copy of the AASHTO-AGR-ARTBA *Joint and Crack Resealing*, Chapter 3, "Guide Procedures for Concrete Pavement 4R Operations," which provides an excellent overview of the resealing of joints and cracks in existing portland cement concrete pavements. Appendix B is a copy of the Georgia Department of Transportation's most recent specifications dealing with silicone joint sealants. The Georgia specification for silicone joint material is frequently cited as a model for this material.

PROPERTIES

Three types of sealants are recommended by the Transportation Research Board (TRB) for contraction joints.[2]

1. Hot-poured elastomeric types that meet ASTM D3406. This material is covered by VDOT Specifications 213.01(6).
2. Low modulus silicone sealant that meets specifications similar to those of the Georgia Department of Transportation (see Appendix A for a copy of this specification).
3. Preformed polychloroprene elastomeric seals that meet ASTM D2628.

These are the same three materials permitted for use by VDOT, but the preformed materials are limited to use on new construction since joints seldom have the precise dimensions after years of usage to properly accommodate the preformed materials. Neither TRB nor VDOT recognize the two-component polysulfide cold-poured sealants as viable materials for maintenance work. VDOT's position on the use of these materials is based on the work performed by Noble[3] in which he studied joint sealant materials that were used on the ramps of interchanges and at a rest area on I-64 near Charlottesville.

Pavement joints are generally open in the winter and more nearly closed in the summer. Principally because of subgrade friction on the bottom of the pavement slab, the opening and closing of joints with temperature changes is jerky and nonuniform. Also, all joints are not free to move uniformly, the principal reason being the intrusion of incompressible materials in some of the joints. If traffic loadings and the lack of protection from weather are included, it is logical to assume that the stress and strain placed on joint sealants in concrete pavement applications are probably more severe than in almost any other application.

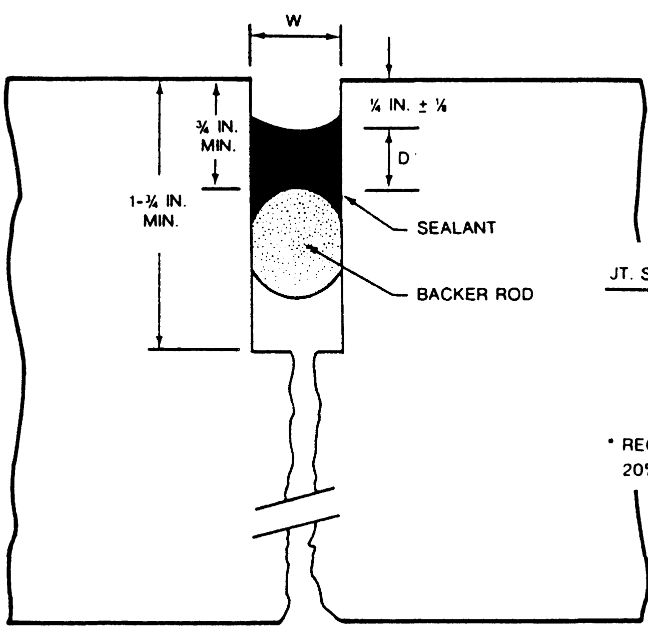
In a discussion of work by Tons[4] (which resulted in a graphical method for determining slab expansion), McGhee and Elroy[5] show that with slabs approximately 60 ft in length undergoing annual atmospheric temperature changes of 100°F (say 100°F to 0°F), a joint of 3/8-in width undergoes an expansion of approximately 85 percent. Since hot-poured sealants (asphaltic, rubber-asphalt, coal tar, or rubber tar compounds) have an extension-compression range of only ±5 percent,[6] there is little likelihood that hot-poured sealants will perform satisfactorily in joints between 61.5-ft slabs. A relatively new material of this class (a poly-vinyl chloride) is reported to have an extension-compression range of ±25 percent,[6] but that still would be inadequate for the 61.5-ft slabs.

A 1986 report produced by the U.S. Department of Transportation[6] states that in recent years, a warranty of 5 to 10 years has become available on proper installations of hot-poured joint sealants when used with 15-ft joint spacings. This report also states that a low modulus silicone sealant was available in 1986 that had an extension recovery of 100 percent and a compression recovery of approximately 50 percent. It is reasonable to assume that silicones of equal or better extension-compression recoveries are available today and that they would more likely accommodate the joint movements present in our concrete pavements than would the hot-poured materials, everything else being equal.

All joint sealants are solids at ambient temperatures; they alter their shape but not their volume as the joint opens and closes.[7] Because the extensibility and compression characteristics of hot-poured sealants and silicones differ, the "shape factor" has a critical effect on a sealant's ability to accommodate the movements within the pavement joint. The shape factor is described as the depth-to-width proportion (D/W) of the material as placed in the joint.

Studies have shown that for hot-poured sealants, the closer the ratio of D/W is to 1, the lower the stresses and strains and the better the subsequent performance of the sealer.[2] Recommended depths and widths for hot-poured sealants for various slab lengths are shown in Figure 1.

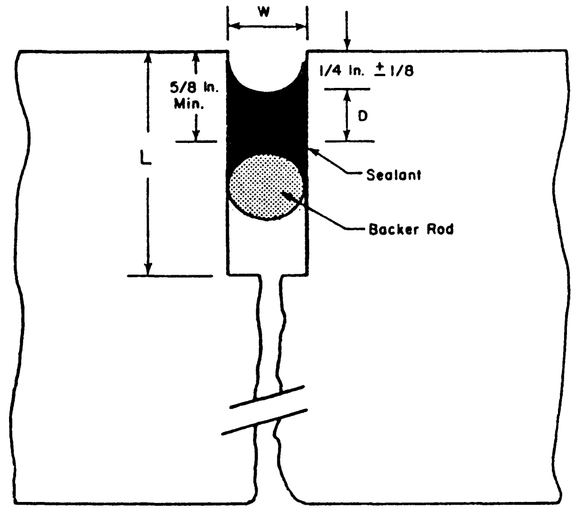
For low modulus silicones, the shape factors that seem to perform the best are those with ratios that are approximately 1 to 2. Figure 2 presents the sealant dimensions most desirable for the silicones.



JT. SPACING (FT.)	D (INS.)	FREEZE AREA W (INS.)	NON-FREEZE AREA W (INS.)
≤ 20	½ - 1	½	⅜
21 - 40	½ - 1	¾	½
41 - 60	½ - 1	1	¾
61 - 100	*	*	*

* REQUIRED JOINT WIDTH EXCEEDS 1 IN. TO MAINTAIN STRAIN BELOW 20% IN SEALANT.

Figure 1. Recommended hot-poured sealant configurations.
Source: *Joint Repair Methods for Portland Cement Concrete Pavements*



Jt. Spacing (Ft.)	D (Ins.)	L (Ins.)	Freeze Area W (Ins.)	Non-Freeze Areas W (Ins.)
≤ 20	1/4	1-1/4	1/4	1/4
21-40	1/4	1-1/2	1/2	3/8
41-60	3/8	1-3/4	5/8	1/2
61-80	1/2	2	3/4	5/8
81-100	1/2	2-1/2	1	3/4

Figure 2. Recommended silicone sealant configurations.
Source: *Joint Repair Methods for Portland Cement Concrete Pavements*

The field performance of sealants depends on the sealants' elastomeric rubber properties and on their ability to maintain these properties over a long period of time. One way to measure a sealant's rubber properties is to measure its change in modulus as a result of changes in temperature and as a result of exposure to accelerated weathering. The modulus is defined as the amount of stress required to produce a given strain. The specimen is pulled until it reaches a certain elongation, and the modulus is read in psi or KPa.[8] Because joint sealants may also have to withstand shear stresses as a result of slab curling or voids beneath the slab resulting from traffic loads, subjecting specimens to shear cycles and hours of accelerated weathering will provide an indication of a sealants ability to withstand these types of stresses. The shear test discussed herein subjects test specimens to positive and negative deflections of 1/8 in at 144 rpm. The 1/8-in deflections are twice that of pavement slabs in the field. The 144-rpm speed simulated the rate of deflection caused by a truck traveling 55 mph across 30-ft slabs.

Using the tests mentioned above, i.e., temperature measurements, accelerated weathering, and shear cycles, the DOW Corning Corporation[8] tested a low-modulus silicone, a two-component organic polymer, a polyurethane, and a polysulfide. Three of these materials are described by ACI[1] as chemically cured thermosetting sealants. They have different expansion-compression ranges: silicones, +100/-50 percent; polyurethane, ±25 percent; and polysulfides, ±25 percent. The two-component organic polymer could not be identified nor classified under the ACI guide. The ACI guide goes on to say, "Silicone sealants remain more flexible over a wider temperature range than other field-molded liquid sealants. If substrate conditions are clean and otherwise suitable, then thermosetting, chemically curing sealants can withstand greater movements than other field-molded sealants and generally have a much greater service life."[1] (These other field-molded sealants include the hot-poured types, which are classified as thermo-plastic; their joint sealant properties are generally considered to be inferior to the thermosetting chemically cured sealants).

Results of the tests performed by DOW indicate that

- The low-modulus silicone had a much smaller change in modulus over a range of temperatures than the other three materials (see Figure 3). When a sealer stiffens and loses flexibility with decreasing temperatures, i.e., a modulus increase, more stress is placed on the sealant internally and on the bond line.
- The low-modulus silicone had practically no change in modulus after 500 hours of accelerated weathering (ASTM G53-77), whereas the moduli of the three other materials showed changes (see Figure 4).
- The low-modulus silicone, as opposed to the other three materials, showed practically no effect of accelerated weathering on its ability to withstand cyclic shear testing (see Figure 5).

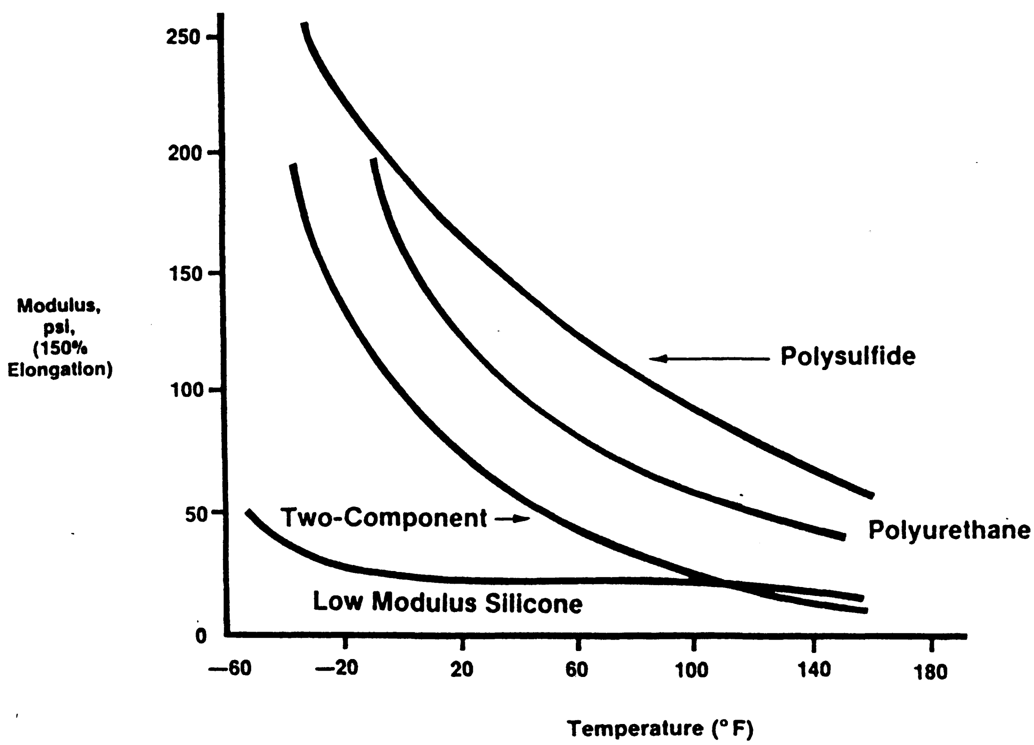


Figure 3. Effect of temperature on initial elastomeric properties.

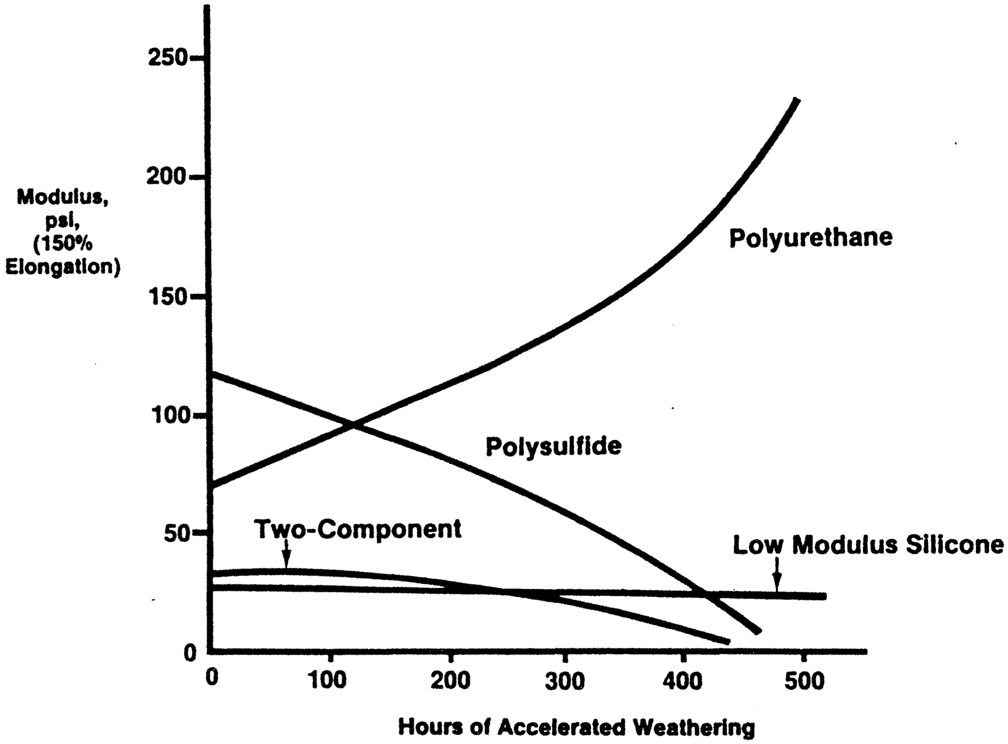
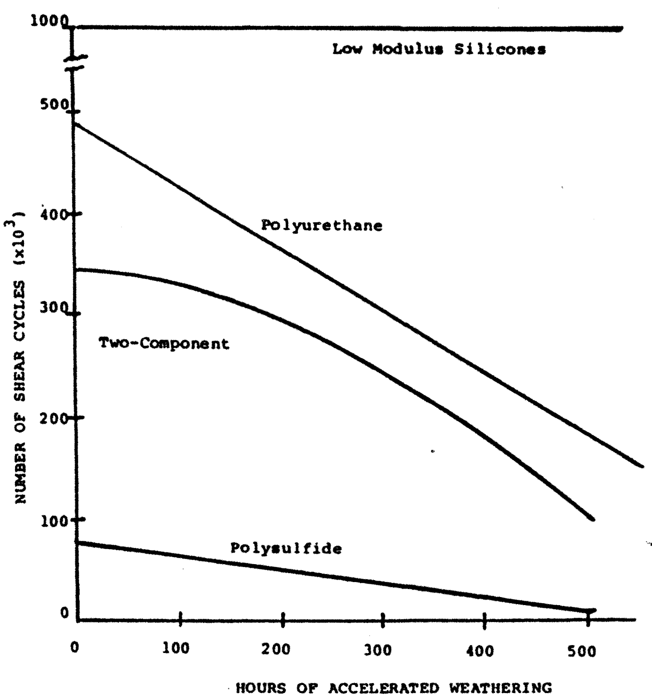


Figure 4. Effects of accelerated weathering on elastomeric properties.



're 5. Effects of accelerated weathering on shear cycles.

The advantages of using silicone joint sealant materials include the following:[9]

1. Their properties are virtually unchanged over a wide temperature range.
2. They are available as one component.
3. They are available with very low moduli; therefore, adhesion is relatively unaffected in cold weather.
4. They do not shrink on curing; therefore, no tension is induced in the material during curing.
5. They are virtually inert; therefore, they have good weathering characteristics.
6. A perfect joint is not required because they can seal a small spalled area, whereas preformed sealants cannot accommodate these small imperfections.

COSTS

When the cost of joint preparation, traffic control, user delay, etc. is considered, the cost of a good sealant over that of sealants of lesser quality is well worth the added expense since the cost of sealant material, per se, is a minor expense in the overall cost of joint repairs. This is particularly true where heavy traffic is prevalent.

Costs for hot-poured and silicone materials can be estimated from the bid prices shown in Tables 1 through 4, which give cost data from 15 bid proposals for the period from April 1987 through February 1990. The cost figures applied to the hot-poured and silicone joint sealant materials taken from the Department's bid proposal for concrete pavement repairs also include the cost of cleaning and resealing the joints. Data for both longitudinal and transverse joints are included. Lineal feet of joint work ranged from a low of 200 ft to a high of 137,500 ft. The cost of hot-poured material ranged from $0.40/ft to $5.00/ft (Tables 1 and 2); the weighted average was $0.86/ft. For the silicones, the figures were $1.23/ft to $5.00/ft; the weighted average was $1.74/ft. It can be concluded that the cost of cleaning and resealing joints when silicones are used is approximately twice the cost of using hot-poured materials (1.74/0.86 = 2.02).

The costs of all of the items associated with concrete pavement repair work, such as mobilization, grout subsealing, patching, traffic control, etc. ranged from 0.8 to 13.0 percent of the total job cost for hot-poured materials, with the average being 4.3 percent. For the silicones, the range was from 0.6 to 7.2 percent, with the average being 3.2 percent. It is evident that with respect to the total cost of repairing jointed concrete pavements with either hot-poured or silicone materials, the cost of reworking the joints is relatively small.

The data shown in Tables 1 through 4 indicate that resealing pavement joints initially with silicones costs about twice that of using hot-poured materials. Disregarding all the other expenses that would be associated with redoing a repair job (including the public's irritation with additional traffic delays), the silicone would only need to perform satisfactorily twice as long as the hot-poured material to be equally cost-effective. VDOT's experience and that of others cited in the literature supports the view that, everything else being equal, silicones should outlast hot-poured materials by a greater margin than 2 to 1.

I-81 EXPERIENCE

In the CPR project on I-81 in Botetourt County, which took place several years ago, the original silicone-filled joints failed almost immediately. The failure was the result of a loss of adhesion under moist conditions between the material and the dolomite aggregate. The Wisconsin DOT had under similar circumstances experienced the same poor results; consequently, the silicone manufacturer recommended the use of a primer prior to the placement of the silicone in future work. This procedure was instituted on subsequent I-81 work, and no further adhesion problems were experienced with the silicones at the time this report was being prepared.

On the same I-81 project, rubberized asphalt joint sealant material meeting ASTM D-3405 was used in some of the transverse joints, but it was reported that it was not flexible enough to accommodate the joint movement of 61.5-ft slabs.* However, this material may be appropriate for use in pavements with slabs having joint spacing of 15 to 20 ft.

A nitrile rubber (synthetic rubber) material was also used on this job as a joint sealant material. It is a self-leveling material that cures by the evaporation of solvents. Thus, there is a volume reduction of material in the joint when the solvent has evaporated. Tears developed in this material, which left openings for incompressible material to enter.

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*During 9/10/90 telephone conversation with Bob Long, formerly a Research Scientift with the Research Council specializing in Concrete Pavement work, he stated that his overall feeling about joint sealant materials as a result of this project and others is that the silicones are the best material available for filling joints spaced at 61.5 ft because the other materials lack the properties to accommodate the movements of joints at these spacings. However, the joints must be cleaned well and kept clean until the silicones are placed, otherwise the full advantage over the other materials will not be realized. His feeling is that if the paving contractor elects to handle the joint work when silicones are called for rather than contract it out to a specialist, then the results will often be poor. The hot- poured materials appear to require less joint preparation than silicones, and this is one point in their favor.

CONCLUSIONS

From conversations with specialists and from the information gleaned from the literature, it appears that the following conclusions are warranted.

1. When concrete pavements with transverse joint spacings of 20 ft or more are to be repaired, it is cost-effective to have the joints filled with a silicone rather than a hot-poured material. It would also be prudent to fill longitudinal joints between lanes and concrete shoulders with silicones or silicone-like materials.

2. If a silicone is to be used, it is important that the placement be done properly and not left to persons familiar only with the application of hot-poured materials.

3. Where small joint movements are anticipated, such as transverse joints spaced at less than 20 ft or longitudinal joints, hot-poured materials (in particular, rubberized asphalts) conforming to Section 213.01(a) may be an adequate and economical first choice over the more expensive silicone materials. These materials (not silicones) should be used in repairing longitudinal edge joints between concrete pavements and asphalt shoulders to avoid potential material incompatibility problems.

4. Where repaired concrete pavements are to be immediately overlaid, the hot-poured materials may be an adequate choice since they would be protected from ultra-violet degradation, severe weather conditions, and the intrusion of incompressible materials. They also may be an economical choice when the anticipated service life of the pavement is expected to be relatively short.

Table 1

Hot-Poured Joint Sealants—Longitudinal (Cleaning and Resealing)

Bid Date	Lineal Feet (a)	Weight (b) = (a) ÷ Total (a)	$/ft (c)	Weighted $/ft (d) = (b) x (c)	Joint Cost (e) = (a) x (c)	Total Job Cost (f)	Percent of Total Job Cost (g) = (e) ÷ (f)
2/21/90	6,400	0.018	1.10	0.020	7,000	881,000	0.8
2/21/90	37,500	0.390	0.50	0.195	68,800	565,000	12.2
5/23/89	61,600	0.175	1.50	0.262	92,400	2,254,000	4.1
3/21/89	5,900	0.017	1.45	0.025	8,600	97,000	8.8
7/26/88	40,000	0.113	1.00	0.113	40,000	789,000	5.1
5/31/88	26,900	0.076	0.40	0.030	10,800	563,000	1.9
4/19/88	12,900	0.037	1.00	0.037	12,900	630,000	2.0
2/23/88	36,600	0.104	0.50	0.052	18,300	1,285,000	1.4
5/27/87	24,200	0.069	1.50	0.103	36,300	1,018,000	3.6
4/28/87	300	0.001	5.00	0.005	1,500	135,200	1.1
Totals	352,300	1.000		0.84			

Table 2

Hot-Poured Joint Sealants—Transverse (Cleaning and Resealing)

Bid Date	Lineal Feet (a)	Weight (b) = (a) ÷ Total (a)	$/ft (c)	Weighted $/ft (d) = (b) x (c)	Joint Cost (e) = (a) x (c)	Total Job Cost (f)	Percent of Total Job Cost (g) = (e) ÷ (f)
2/21/90	8,500	.034	1.15	.039	9,800	881,000	1.1
2/21/90	110,500	.441	0.50	.220	55,200	565,000	9.8
5/23/89	53,000	.211	1.50	.216	79,500	2,254,000	3.5
3/21/89	8,700	.035	1.45	.051	12,600	97,000	13.0
7/26/88	20,000	.080	1.25	.100	25,000	789,000	3.2
5/31/88	28,700	.114	0.80	.091	23,000	563,000	4.1
4/19/88	8,300	.033	1.00	.033	8,300	630,000	1.3
2/23/88	13,200	.053	0.75	.040	9,900	1,285,000	0.8
Totals	250,900	1.000		0.89			

The cost of hot-poured material ranged from $0.40/ft to $5.00/ft (Tables 1 and 2), the weighted average being $0.86/ft:

352,300 L. ft	(58%)	x 0.84 $/ft	=	$0.49 $/ft
250,900 "	(42%)	x 0.89 "	=	0.37 "
603,200	100%			$0.86 $/ft

Table 3

Silicone Joint Sealants—Longitudinal (Cleaning and Resealing)

Bid Date	Lineal Feet (a)	Weight (b) = (a) ÷ Total (a)	$/ft (c)	Weighted $/ft (d) = (b) x (c)	Joint Cost (e) = (a) x (c)	Total Job Cost (f)	Percent of Total Job Cost (g) = (e) ÷ (f)
2/21/90	400	.002	4.00	.008	1,600	146,000	1.1
5/23/89	21,000	.112	1.50	.168	31,500	437,000	7.2
3/21/89	60,000	.319	1.50	.478	90,000	1,892,000	4.8
5/27/87	79,500	.423	1.23	.520	97,800	2,919,000	3.3
5/27/87	27,000	.144	1.50	.216	40,500	1,606,000	2.5
Totals	187,900	1.000		1.39			

Table 4

Silicone Joint Sealants—Transverse (Cleaning and Resealing)

Bid Date	Lineal Feet (a)	Weight (b) = (a) + Total (a)	$/ft (c)	Weighted $/ft (d) = (b) x (c)	Joint Cost (e) = (a) x (c)	Total Job Cost (f)	Percent of Total Job Cost (g) = (e) + (f)
2/21/90	200	.003	5.00	.015	1,000	146,000	0.7
5/23/89	9,600	.147	2.50	.367	24,000	437,000	5.5
3/21/89	3,900	.060	3.00	.180	11,700	1,892,000	0.6
5/27/87	30,600	.469	2.92	1.369	89,400	2,919,000	3.1
5/27/87	21,000	.321	2.50	0.802	52,500	1,606,000	3.3
Totals	65,300	1.000		2.73			

For the silicones, the figures were $1.23/ft to $5.00/ft, with the weighted average being $1.74/ft:

187,900 L. ft	(74%)	x 1.39 $/ft	=	$1.03 $/ft
65,300 "	(26%)	x 2.73 $/ft	=	$0.71 $/ft
253,200	100%%			$1.74 $/ft

REFERENCES

1. American Concrete Institute. 1990. *Guide to Sealing Joints in Concrete Structures*, ACI 504R-90. Detroit, Michigan.

2. Transportation Research Board. 1985. *Joint Repair Methods for Portland Cement Concrete Pavements*. NCHRP Report No. 281, Washington, D.C.

3. Noble, D. F. 1987. *Field Evaluation of Three Joint Sealants: Final Report*, VTRC Report No. 87-R18. Charlottesville, Virginia: Virginia Transportation Research Council.

4. Tons, Egons. 1958. *Materials and Geometry in Joint Seals*. Joint Highway Research Project, Purdue University, Lafayette, Indiana.

5. McGhee, K. H. and Elroy, B. B. 1971. *Study of Sealing Practices for Rigid Pavement Joints*. VHTRC Report No. 70-R53. Charlottesville, Virginia: Virginia Highway Research Council.

6. U.S. Department of Transportation. 1986. *Improved Rigid Pavement Joints*, Publication No. FHWA/RD-86/040. Turner-Fairbank Highway Research Center, McLean, Virginia.

7. Schutz, R. J. 1962. Shape Factor in Joint Design. *Journal of American Society of Civil Engineers* (Reprint: October 1962).

8. Speels, S. and Klosowski, J. M. 1985. *Laboratory and Field Tests Can Predict Long-Term Field Performance on Joint Sealants.* In *Third International Conference on Concrete Pavement Design and Rehabilitation Proceedings*, 587-593. Purdue University, West Lafayette, Indiana.

9. Thornton, J. B. 1977. *Investigation into the Performance of Rigid Pavement Joints and Sealants.* In *International Conference on Concrete Pavement Design Proceedings*, 435-446, Purdue University, West Lafayette, Indiana.

APPENDIX A

Guide Procedures for Concrete Pavement 4 R Operations

AASHTO-AGC-ARTBA
Joint Committee

GUIDE PROCEDURES FOR CONCRETE PAVEMENT 4R OPERATIONS

1985

Subcommittee on
New Highway Materials

Task Force 23

GUIDE PROCEDURES

3 JOINT AND CRACK RESEALING

3.01 DESCRIPTION

This specification covers the resealing of joints and cracks in existing portland cement concrete pavements.

The joint or crack shall be prepared by removing the old sealant or joint insert and refacing and cleaning the joint. Repairs meeting the requirements of Section 4 shall be completed prior to this operation. Installation of separating or blocking medium (if required) and installation of new sealant shall be in accordance with this specification in order to produce the proper shape factor in the joint sealant.

3.02 RESEALING OF JOINTS - LIQUID SEALANTS

3.02.1 MATERIALS

All sealant materials and separating and blocking medium shall be certified or tested and approved by the engineer before being incorporated into the work. When requested by the contracting agency, the contractor shall furnish a complete written statement of the origin, composition and manufacture of any or all materials that are to be used in the work. Where installation procedures or any part thereof are required to be in accordance with recommendations of the manufacturer of sealing compounds, the contractor shall submit catalogue data and copies of recommendations prior to installation of the materials.

The following Specifications cover the various types of liquid sealant material available.

ASTM D 1190	Concrete Joint Sealer, Hot Poured, Elastic Type
ASTM D 1850	Sealing Compound, Cold Application, Roadmix liquified, Type 1, for Joints in Concrete.
ASTM D 3405	Sealing Compound, Hot Applied
ASTM D 3406	Joint Sealant, Hot Poured, Elastomeric type
ASTM D 3581	Sealing Compound, Hot Applied
MINNESOTA D.O.T. 3720	Hot Pour Low-Modulus Sealant

3.02.2 EQUIPMENT

Proper sealing equipment must be used for the specific material listed in accordance with the manufacturers recommendations. The equipment for hot applied sealing compounds shall be a melting kettle of a double boiler, indirect heating type, using oil as a heat-transfer medium. The kettle shall have an effective mechanically operated agitator and shall be equipped with a positive thermostatic temperature control which shall be checked for calibration before commencing. Manufacturer's recommendations for application temperature shall be followed. Overheating shall not be permitted. The hoses and applicator wand shall be insulated.

3.02.3 CONSTRUCTION

Removal of existing joint sealant or insert, refacing of joints and cleaning, shape factor dimensions, blocking medium and sealant installation shall be in accordance with these specifications.

3.02.3.1 JOINT INSERT REMOVAL - Inserts shall be removed from all joints and the joints shall be sawed to provide a clean vertical face. The width and depth of the saw cuts shall be sufficient to insure removal of all the insert and to provide a finished joint of the correct joint shape dimensions for the sealant material specified for the resealing operation.

3.02.3.2 EXISTING SEALANT REMOVAL - Any in-place sealant shall be cut loose from each joint face independently using a vertical cutting edge tool. Alternatively, a power driven concrete saw with diamond or abrasive blades may be used. After cutting the existing sealant free from both joint faces, the sealant shall be removed to the depth required to accommodate any separating and/or depth blocking medium used, and to provide the specified depth for the new sealant material to be installed.

3.02.3.3 REFACING OF JOINTS - Joints shall be refaced using a power driven concrete saw with diamond or abrasive blades to remove all old sealant from the joint faces to expose new clean concrete and, if required, to cut the joint to the width and depth necessary to provide for an effective shape factor in the joint sealant.

3.02.3.4 CLEANING PRIOR TO RESEALING - Following the refacing operation, the joint faces and opening shall be thoroughly cleaned using a high-pressure water jet followed by an oil-free air jet to remove all cuttings or debris remaining on the faces or in the joint opening. The newly exposed joint faces shall then be cleaned by water blast or sandblasting. A multiple-pass technique shall be used until the surfaces are free of any traces of old sealant and free of sawcutting fines that might prevent bonding. For final cleaning immediately prior to installation of the blocking medium, the joints shall be blown clean with oil-free compressed air and left completely free of sand and water. Cleaning joints shall follow the reccommendations of the manufacturer of the joint seal being used.

3.02.3.5 SEPARATING AND BLOCKING MEDIUM - The lower portion of the joint groove shall be plugged or sealed off at a uniform depth with a backer rod to prevent entrance of the sealant below the specified depth. The size of the backer rod required will depend on the joint width. The backer rod shall be compatible with the sealant (see sealant manufacturer's recommendations). The product shall be clean, free of scale or foreign matter, oil or moisture and shall be nonabsorbing. The proper size for different joint widths are listed below:

Joint Width	Blocking Media Dia.
5/16 in. (.8 cm.)	3/8 in. (.96 cm.)
3/8 in. (.96 cm.)	1/2 in. (1.28 cm.)
1/2 in. (1.28 cm.)	5/8 in. (1.6 cm.)
5/8 in. (1.6 cm.)	3/4 in. (1.92 cm.)
3/4 in. (1.92 cm.)	1 in. (2.54 cm.)
1 in. (2.54 cm.)	1 1/4 in. (3.18 cm.)
1 1/4 in. (3.18 cm.)	1 1/2 in. (3.8 cm.)
1 1/2 in. (3.8 cm.)	2 in. (5.08 cm.)

The backer rod shall not be stretched during insertion in the joint. When the existing sealant has been removed to the required depth and the bottom of the joint opening to be resealed is formed by previously installed sealant material (such as in an expansion joint), a nonreactive adhesive-backed tape shall be inserted in lieu of the backer rod. The tape shall be 1/8 inch wider than the nominal width of the joints.

3.02.3.6 LIMITS OF JOINT PREPARATION - The work required for the removal of existing joint sealant, widening and/or deepening of the joint openings, if required, refacing of joint faces, and sandblasting of the joint faces should proceed at reasonable production rates determined by the contractor. The final stages of joint preparation which includes air pressure cleaning of joints, and placement of separating and/or blocking medium if required, shall be limited to only that lineal footage of joint that can be resealed during a day's production.

3.02.3.7 INSTALLATION OF SEALANTS - Sealant compound shall not be placed unless the joint is dry, clean and free of dust. The face of the joint shall be surface dry and the atmospheric and pavement temperature shall both be at least 50° F. at the time of application of the sealant. Installation of the sealant shall be such that the in-place sealant shall be well bonded to the concrete and free of voids or entrapped air. The joints shall be sealed in a neat and workmanlike manner, so that upon completion of the work, the surface of the sealant material shall be 1/4 ± 1/8 in. below the adjacent pavement surface. The contractor shall "spot up" or refill all low joints before final acceptance. Any excess material on the surface of the pavement shall be removed and the pavement surface shall be left in a clean condition. Unless otherwise specified, the period of cure shall be in accordance with the manufacturer's recommendations. Vehicular or heavy equipment traffic shall not be permitted on the pavement in the area of the joints during the curing period.

3.02.4 TRAFFIC CONTROL

The contractor shall supply all temporary signing, cones and other traffic control devices as required and approved by the engineer. Unless otherwise specified, the contractor shall prepare and submit in advance a written traffic control program in accordance with the recommendations in Part VI of the "Manual of Uniform Traffic Control Devices," current edition, for review and approval by the engineer.

3.02.5 METHOD OF MEASUREMENT

Resealing of joints - liquid sealant shall be measured to the nearest lineal foot or meter of seal installed.

3.02.6 BASIS OF PAYMENT

The accepted quantities measured will be paid for at the contract unit price for:

Resealing Transverse Joints-Liquid Sealant	Lin. Ft. (Lin. M.)
Resealing Longitudinal Joints-Liquid Sealant	Lin. Ft. (Lin. M.)

Traffic control will be paid for as a separate bid item or a lump sum for the duration of the project and shall include procurement, placement and maintenance of all barricades, cones, flashing lights, signs, flagmen, or other requirements as stipulated by Section 3.02.4 "Traffic Control."

3.03 RESEALING JOINTS - NEOPRENE COMPRESSION SEAL

3.03.1 MATERIALS

All seals and lubricant materials for joint repair of portland cement concrete pavement shall be inspected, tested and approved by the contracting agency before being incorporated into the work. Any work in which untested and unaccepted materials are used without approval or written permission of the contracting agency shall be performed at the contractor's risk. When requested by the agency, the contractor shall furnish a complete written statement of the origin, composition and manufacture of any or all materials that are to be used in the work.

The following specifications apply to the preformed compression seal:

ASTM D 2628	Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 2835	Lubricant for Installation of Preformed Compression Seals for Concrete
AASHTO M 220	Preformed Elastomeric Compression Seals for Concrete

Compression seal dimensions must be determined in conjunction with the joint spacing dimensions and expected range of annual joint movement. Typical seal widths and joint dimensions are shown below.

Joint Spacing	Minimum Width & Maximum Joint Depth	Typical Seal Width
lineal ft.		
15 & 20	1/4 in. x 1/1/2 in.	7/16 in.
25	5/16 in. x 1/1/2 in.	5/8 in.
30	3/8 in. x 2 in.	11/16 in.
40	1/2 in. x 2 in.	1 in.
over 40	5/8 in. x 2 1/4 in.	1 1/4 in.

Tolerances on all joint widths shall be plus or minus 1/16 inch.

3.03.2 EQUIPMENT

The seal shall be installed by a machine or other method suitable for the intended purpose. The machine shall be capable of installing the material in a compressed state without cutting, twisting, distorting or damaging the seal. The machine shall be capable of installing the seal with not more than 5 percent stretching of the seal.

3.03.3 CONSTRUCTION

Removal of existing sealant or inserts, refacing of joints, cleaning and installation of seals with the aid of a lubricant shall be in accordance with these specifications.

3.03.3.1 JOINT INSERT REMOVAL - Inserts shall be removed from all joints and the joints shall be sawed to provide a clean vertical face. The width and depth of the saw cuts shall be sufficient to insure removal of all the insert and to provide a finished joint to the dimensions necessary for the size neoprene specified.

3.03.3.2 EXISTING SEALANT REMOVAL - Any in-place sealant shall be cut loose from each joint face using a vertical cutting edge tool. Alternatively, a power-driven concrete saw with diamond or abrasive blades can be used. After cutting free the existing sealant from both joint faces, the sealant shall be removed to the depth required to accommodate the neoprene compression seal.

3.03.3.3 REFACING OF JOINTS - The joint faces shall be recut using a power-driven concrete saw with diamond or abrasive blades to remove all old sealant from the joint faces to expose new clean concrete and, if necessary, to widen the joint to the proper width and depth required for the neoprene compression seal.

3.03.3.4 REPAIR OF JOINTS - Joint walls must be inspected and repaired if necessary to ensure intimate contact between the compressic seal and the concrete across the full width of the pavement. If spalling occurs during joint preparation which would be detrimental to the seal, the joint should be repaired in accordance with Section 4.01, "Partial Depth Patching."

3.03.6 BASIS OF PAYMENT

The accepted quantities measured will be paid for at the contract unit price for:

Resealing Transverse Joints-Neoprene Compression Seals	Lin. Ft. (Lin. M)
Resealing Longitudinal Joints-Neoprene Compression Seals	Lin. Ft. (Lin. M.)

Traffic control will be paid for as a separate bid item or a lump sum for the duration of the project and shall include procurement, placement and maintenance of all barricades, cones, flashing lights, signs, flagmen, or other requirements as stipulated by Section 3.03.4 "Traffic Control."

3.03.3.5 CLEANING PRIOR TO RE-SEALING - Following the refacing and repair operations, the joint shall be thoroughly cleaned using a high pressure water jet and/or oil-free air jet to remove all cuttings or debris remaining on the face or in the joint opening. The contact faces shall be thoroughly cleaned by sandblasting to remove any sawing residue or other materials which would prevent a satisfactory bond between the seal and the concrete. When the surfaces are thoroughly clean and dry, and before the joint sealer is placed, compressed air shall be used to blow out the joint and remove all traces of dust.

3.03.3.6 INSTALLATION OF COMPRESSION SEAL - The neoprene compression seal shall be installed in the upright position free from twisting, distortion or stretching. The face of the joint shall be surface dry and the atmospheric and pavement temperatures shall be above 30° F. at the time of installation of the joint seal. A coating of lubricant (ASTM D-2835) shall be applied to the joint reservoir walls or to the preformed compression sealant material or both. The compression seal shall be installed to a depth of 1/4 inch, plus or minus 1/16 inch below the concrete surface. For beveled joints, the seal shall be installed to a depth of 3/16 inch, plus or minus 1/16 inch below the bottom edge of the bevel. No transverse joint having a length of 24 feet or less shall contain any splice of the preformed compression joint seal. Transverse joints having a length over 24 feet shall not have more than one splice of the joint seal. Unless otherwise specified, the period of cure for the newly placed sealant material shall be in accordance with the manufacturer's recommendations.

3.03.4 TRAFFIC CONTROL

The contractor shall supply all temporary signs, cones and other traffic control devices as required and approved by the contracting agency. Unless otherwise specified, the contractor shall prepare and submit in advance a written traffic control program in accordance with the recommendations in Part VI of the "Manual of Uniform Traffic Control Devices," current edition, for review and approval by the contracting agency. Vehicular or heavy equipment traffic shall not be permitted on the pavement in the area of the joints during the curing period.

3.03.5 METHOD OF MEASUREMENT

Resealing of joints with neoprene compression seals shall be measured to the nearest lineal foot or meter of seal installed.

3.04 RESEALING JOINTS - SILICONE SEALANT

3.04.1 MATERIALS

All sealant materials, separating and blocking medium shall be inspected, tested and approved by the contracting agency before being incorporated into the work. Any work in which untested and unaccepted materials are used without approval or written permission of the contracting agency shall be performed at the contractor's risk. Where requested by the contracting agency, the contractor shall furnish a complete written statement of the original composition and manufacture of any or all materials that are to be used in the work. Where the installation procedures or any part thereof are required to be in accordance with recommendations of the manufacturer of sealing compounds, the contractor shall submit catalog data and copies of recommendations before installation of the material is commenced.

The sealant material shall comply with the following Federal or Agency Specifications:

TT-S-001543A	One-component silicone sealant (Class A)
Georgia DOT 833.06	Low Modulus Silicone

3.04.2 EQUIPMENT

The sealant material shall be installed by an approved mechanica device suitable for the purpose intended. When the seal is appl mechanically, a nozzle shall be shaped to fit inside the joint to introduce the sealant between the joint faces.

3.04.3 CONSTRUCTION

Removal of existing joint sealant or insert, refacing of joints and cleaning; shape factor, blocking medium and sealant installation shall be in accordance with these specifications.

3.04.3.1 <u>INSERT REMOVAL</u> - Inserts shall be removed from all joints and the joints shall be sawed to provide a clean vertical face. The width and depth of the saw cuts shall be such as to insure removal of all the insert and to provide a finished joint of the dimensions necessary for the sealant material selected for the resealing operation.

3.04.3.2 REMOVAL OF EXISTING SEALANT - Any in-place sealant shall be cut loose from each joint face independently using a vertical cutting edge tool. Alternatively, a power driven concrete saw with diamond or abrasive blades can be utilized. After cutting free the existing sealant from both joint faces, the sealant shall be removed from both joint faces to the depth required to accommodate any separating and/or depth blocking medium used, and to maintain the specified depth for the new sealant material to be installed.

3.04.3.3 REFACING OF JOINTS - Joints shall be refaced using a power driven concrete saw with diamond and/or abrasive blades to remove all old sealant from the joint faces, to expose new clean concrete and, if required, to widen the joint to the width and depth necessary to provide for an effective shape factor.

3.04.3.4 SHAPE FACTOR - Climatic conditions should be considered when this type of material is to be specified. Actual width and depth of joints will depend on the original construction and existing field conditions. The joint reservoir shape shall be such that the sealant material is a minimum of 1/4 inch thick, but not greater than 1/2 inch thick for joints up to 1 inch wide. Thickness of sealant in joints over 1 inch wide shall be limited to 1/2 inch. A width to depth ratio of 2:1 is ideal and shall be maintained for joints less than 1 inch wide.

3.04.3.5 CLEANING PRIOR TO SEALING - Following the refacing operation, the joint faces and opening shall be thoroughly cleaned using a high-pressure water jet followed by an air jet (oil-free) to remove all cuttings or debris remaining on the faces or in the joint opening. The newly exposed joint faces shall then be cleaned by sandblasting. A multiplepass technique shall be used, until the surfaces are free of any traces of old sealant and sawcutting fines that might prevent bonding. For final cleaning immediately prior to installation of the blocking medium, the joints shall be blown with oil-free compressed air and left completely free of sand and water. Cleaning of the joint shall follow the recommendations of the manufacturer of the joint seal being used.

3.04.3.6 SEPARATING AND BLOCKING MEDIUM - The lower portion of the joint groove or opening shall be plugged or sealed off at a uniform depth with a backer rod to prevent entrance of the sealant below the depth specified. It shall be compatible with the sealant, clean and free of scale, foreign matter, oil or moisture and shall be nonabsorbing.

The size of blocking medium required shall depend on the width of the joints after proper preparation as shown below:

Joint Width	Blocking Media Dia.
5/16 in. (.8 cm.)	3/8 in. (.96 cm.)
3/8 in. (.96 cm.)	1/2 in. (1.28 cm.)
1/2 in. (1.28 cm.)	5/8 in. (1.6 cm.)
5/8 in. (1.6 cm.)	3/4 in. (1.92 cm.)
3/4 in. (1.92 cm.)	1 in. (2.54 cm.)
1 in. (2.54 cm.)	1 1/4 in. (3.18 cm.)
1 1/4 in. (3.18 cm.)	1 1/2 in. (3.8 cm.)
1 1/2 in. (3.8 cm.)	2 in. (5.08 cm.)

3.04.3.7 LIMITS OF JOINT PREPARATION - The work required for the removal of existing joint sealant, widening and/or deepening of the joint openings if required, refacing of joint faces, and sandblasting of the joint faces may proceed at any production rate determined by the contractor. The final stages of joint preparation which includes air pressure cleaning of joints, and placement of separating and/or blocking medium if required, shall be limited to that lineal footage of joint that can be resealed during a day's production.

3.04.3.8 PRIMING - Some silicone highway sealants require priming of the joint before installation. The priming procedure should always follow the manufacturer's instructions for proper application rate and proper time of cure before the sealant is applied. In most cases the primer cure time, will change as the temperature and relative humidity changes.

3.04.3.9 INSTALLATION OF THE SEALANT - Installation of the sealant shall be such that the in-place sealant will adhere to the concrete and be free of voids. The joints shall be sealed in a neat and workmanlike manner. It is recommended that upon completion of the work, the surface of the sealant material shall be 1/4 inch ± 1/8 inch below the pavement surface. The contractor shall "spot up" or refill all low joints before final acceptance. Any excess material on the surface of the pavement shall be removed and the pavement surface shall be left in a clean condition.

If the silicone sealant material is not self-leveling, the sealant material shall be tooled in a manner which causes it to wet the joint surfaces.

Climatic conditions should be considered when this type of material is to be specified. Silicone sealant cures by reacting with atmospheric moisture, but the rate of cure is temperature dependent. At a temperature of 75°F. (24°C.) and 50 percent relative humidity, the sealant will cure to a tack-free surface in one hour and reach its ultimate properties in seven to fourteen days. At a temperature of 40°F. (4°C.), the tack-free time will be about two to three hours. If sealing is done at low temperature or if faulting and deflections are severe, longer cure time should be allowed. Re-opening of the roadway is generally permitted within an hour, but where large deflections occur or in areas of low humidity, a 3 to 4 hour cur time is recommended before opening the road to traffic.

3.04.4 TRAFFIC CONTROL

The contractor shall supply all temporary signs, cones and other traffic control devices are required and approved by the contracting agency. Unless otherwise specified, the contractor shall prepare and submit in advance a written traffic control program in accordance with the recommendations in Part VI of the "Manual of Uniform Traffic Control Devices," current edition, for review and approval by the contracting agency.

3.04.5 METHOD OF MEASUREMENT

Resealing of joints-silicone sealant shall be measured to the nearest lineal foot or meter of seal installed.

3.04.6 BASIS OF PAYMENT

The accepted quantities measured will be paid for at the contract unit price for:

Resealing Transverse Joints-Silicone Sealant-Lin. Ft. (Lin. M)

Resealing Longitudinal Joints-Silicone Sealant-Lin. Ft. (Lin. M.)

Traffic control will be paid for as a separate bid item or at a lump sum for the duration of the project and shall include procurement, placement and maintenance of all barricades, cones, flashing lights, signs, flagmen, or other requirements as stipulated by Section 3.04.4 "Traffic Control."

3.05 RESEALING OF CRACKS

3.05.1 MATERIALS

All materials shall be in accordance with Section 3.02.1 or 3.04.1 of this specification.

3.05.2 EQUIPMENT

All sealing equipment shall be in accordance with Section 3.02.2 or 3.04.2 of this specification. A concrete saw with a pivotal small-diameter blade which will follow the crack shall be used to provide a joint reservoir.

3.05.3 CONSTRUCTION

Removal of any existing joint sealant, construction of proper shape factor, cleaning, blocking medium (if necessary) and sealant installation shall be in accordance with the specifications. Low severity or hairline cracks with no spalling may not be sealed.

3.05.3.1 EXISTING SEALANT REMOVAL - The old sealant, if any, shall be removed from the crack in a manner similar to that specified in Section 3.02.3.2 of this specification.

3.05.3.2 REFACING OF CRACKS - Refacing cracks shall be accomplished using a special power-driven concrete saw with small-diameter diamond and/or abrasive blades to remove all old sealant from the crack faces and expose new clean concrete. If required, the crack shall be widened to the width and depth necessary to produce an effective shape factor.

Where crack widths vary and crack faces are ravelled and somewhat irregular, a minimum crack reservoir depth of approximately 3/4 inch shall be maintained.

3.05.3.3 CLEANING OF CRACKS - This operation shall be the same as that outlined for joints in Section 3.02.3.5 of this specification.

3.05.3.4 REPAIR OF SPALLS - Cracks with major spalling shall be repaired in accordance with Section 4.

3.05.3.5 BLOCKING MEDIUM - The lower portion of the crack shall be plugged or sealed at a uniform depth to prevent entrance of the sealant below the depth specified. For materials defined in Section 3.02.1 the material used to seal the lower portion of the crack shall be readily compressible, nonshrinkable, nonreactive with the sealing compound, and nonabsorptive. Materials such as upholstery cord, rope, neoprene foam rubber or polyethylene foam rod are satisfactory. They shall not be stretched during insertion in the crack. The width of the filler shall be slightly larger than the width of the crack. For sealants defined in Section X03.04.1 nonwater absorbing closed cell foam rod is satisfactory.

3.05.3.6 INSTALLATION OF SEALANT - This work shall be done in accordance with Section 3.02.3 of this specification. Vehicular or heavy equipment traffic shall not be permitted on the pavement in the area of the resealed cracks during the curing period.

3.05.4 TRAFFIC CONTROL

The contractor shall supply all temporary signing, cones and other traffic control devices as approved by the contracting agency. Unless otherwise specified, the contractor shall prepare and submit in advance a written traffic control program in accordance with the recommendations in Part VI of the "Manual of Uniform Traffic Control Devices," current edition, for review and approval of the contracting agency.

3.05.5 METHOD OF MEASUREMENT

Resealing of joints - sealant shall be measured by the length to the nearest foot or meter.

3.05.6 BASIS OF PAYMENT

The accepted quantities measured will be paid for at the contract unit price for:

Resealing Cracks-Liquid Sealant	Lin. Ft. (Lin. M.)
Resealing Cracks-Silicone Sealant	Lin. Ft. (Lin. M.)

Traffic control will be paid for as a separate bid item or at a lump sum for the duration of the project and shall include procurement, placement and maintenance of all barricades, cones, flashers, signs, flagmen, or other requirements as stipulated by Section 3.05.4 "Traffic Control."

APPENDIX B

Georgia Department of Transportation

Supplemental Specification for Joint

Fillers and Sealers

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

SUPPLEMENTAL SPECIFICATION

Modification of Standard Specifications

SECTION 833 - JOINT FILLERS AND SEALERS

DELETE 833.06 and substitute the following:

833.06 SILICONE SEALANTS AND BOND BREAKERS:
Silicone sealant shall be furnished in a one part silicone formulation. The sealant shall be compatible with the surface to which it is applied. Acid cure sealants are not acceptable for use on Portland cement concrete. Bond breakers shall be chemically inert and resistant to oils, gasoline, solvents, and primer if one is required. Preparation and installation of silicone and bond breakers shall be in accordance with Section 442 or 461 whichever is applicable.

A. SILICONE: Silicones shall be identified in the following manner:

Type A - A low modulus non-sag silicone for use in sealing horizontal and vertical joints in Portland cement concrete pavements and bridges. Tooling is required.

Type B - A very low modulus self-leveling silicone used to seal horizontal joints in Portland cement concrete pavements and bridges. Tooling is not normally required.

Type C - An ultra low modulus self-leveling silicone used to seal horizontal joints in Portland cement concrete pavements and bridges. It can also be used to seal the joints between Portland cement concrete pavement and asphaltic concrete shoulders. Tooling is not normally required.

1. Physical Requirements:

TYPE SILICONE	A	B	C
Tensile Stress at 150% Strain (Max. PSI) (Note 1)	45	40	15
Durometer Hardness, Shore (0° and 77±3°F) (Note 1)	"A" 10-25	"00" 40-80	"00" 20-80
Bond to Concrete Mortar (Min. PSI) (Note 1) (Note 3)	50	40	35
Tack Free Time (Skin-over) (Max. Minutes) (Note 2)	90	90	90
Extrusion Rate (Min. Grams/Minute)	75	90	100
Non-volatile (Min. %)	90	90	90
Specific Gravity	1.1 - 1.5	1.1 - 1.5	1.1 - 1.5
Shelf Life (from date of shipment)	6 Months	6 Months	6 Months
Movement Capability & Adhesion (Note 1)	No adhesive or cohesive failure after 10 cycles at 0°F		
Ozone and U.V. Resistance (Note 1)	No chalking, cracking, or bond loss after 5,000 hours		

Note 1: The cure time for these specimens shall be 21 days for Type A and 28 days for Types B and C. Specimens shall be cured at 77°±3°F and 50±5% relative humidity.

Note 2: At conditions of 77°±3°F and 50±5% relative humidity.

Note 3: Type C silicone must also meet its bond strength requirement to asphalt concrete.

2. Test Methods:

Tensile Stress	ASTM D-412 (Die "C")
Durometer Hardness	ASTM D-2240
Bond to Concrete Mortar	GDT-106
Tack Free Time (Skin-over)	GDT-106 (Note)
Extrusion Rate	GDT-106
Non-volatile	GDT-106
Specific Gravity	ASTM D-792 (Method A)
Movement Capability & Adhesion	GDT-106
Ozone and U.V. Resistance	ASTM C-793-75

Note: In cases of dispute, ASTM D-2377 shall be used as a referee test. The exposure period under Section 7, Procedure, shall be the Tack Free Time requirement of this specification.

B. BOND BREAKERS: Silicone sealants must be installed over a bond breaker to prevent the sealant from bonding to the bottom of the joint. Bond breakers shall be chemically inert and resistant to oils, gasoline, solvents, and primer if one is required. The bond breaker must not stain or adhere to the sealant. Bond breakers shall be either a backer rod or tape identified and used in accordance with the following:

1. Backer Rods:

Type L - A closed-cell expanded polyethylene foam backer rod. This backer rod may be used with Type A silicone only and is suitable for roadway and bridge joints.

Type M - A closed-cell polyolefin foam backer rod which has a closed-cell skin over an open-cell core. This backer rod may be used with all three types of silicone and is suitable for use in roadway and bridge joints.

Test Requirements: Both types of backer rod shall meet the following requirements:

Density (ASTM D-1622)	2.0 lbs/Ft^3 Minimum
Tensile Strength (ASTM D-1623)	25 PSI Minimum
Water Absorption (ASTM C-509)	0.5% by Volume Maximum

2. Bond Breaking Tapes:

Type N - Bond breaking tape shall be made from extruded polyethylene and shall have a pressure sensitive adhesive on one side. Bond breaking tapes may be used with all three types of silicone but is suitable for bridge joints only.

Test Requirements: Bond breaking tapes shall meet the following requirements:

Thickness	.005" Minimum

C. CERTIFICATION: The manufacturer of the joint sealant shall furnish certified test results on each lot of sealant furnished to a project. All of the test requirements of this specification shall be certified to except the Bond To Concrete Mortar and Shore Durometer Hardness at 0°F.

D. ACCEPTANCE: Silicone sealants submitted for initial approval and meeting the material requirements of this specification cannot be accepted until field evaluations are made.

The manufacturer must furnish at no cost to the Department a minimum of 30 gallons of the material. The material will be installed by the Department in roadway and/or bridge joints and must go through two winters without failure before being accepted.

Even though a sealant or bond breaker has been evaluated and approved, failure to perform adequately in actual use shall be just cause for rejection.