Project Work Plan for

NTPEP Evaluation of Portland Cement Concrete (PCC) Pavement Joint Sealant Material

AASHTO Designation: [JS-14]
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1. SCOPE

1.1 This work plan covers the requirements and testing criteria for the National Transportation Product Evaluation Program (NTPEP) evaluation of Portland Cement Concrete (PCC) Pavement Joint Sealant Material. The National Transportation Product Evaluation Program (NTPEP) serves the member departments of the American Association of State Highway and Transportation Officials (AASHTO).

1.2 The laboratory evaluations consist primarily of ASTM test procedures and the field evaluations are based on procedures described in the Strategic Highway Research Program (SHRP) "Materials and Procedures for the Repair of Joint Seals in Concrete Pavements - Manual of Practice."

1.3 The results of this program may be used for product quality verification by individual member Departments. If used for quality verification, a letter of certification from the joint sealant (JS) manufacturer indicating testing was conducted by NTPEP that supports published values may be required by member Departments.

1.4 This standard practice may involve hazardous materials, operations, and equipment. It does not purport to address all safety problems associated with its use. It is the responsibility of the user of this standard practice to establish the appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. REFERENCED DOCUMENTS

2.1 AASHTO Standards:


2.2 ASTM Standards:

- ASTM D36-12, Test Method for Softening Point of Bitumen (Ring and Ball Apparatus)
- ASTM D395 - 03(2008), Standard Test Methods for Rubber Property—Compression Set
- ASTM D412 - 06a(2013), Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
- ASTM D471 - 12a, Standard Test Method for Rubber Property—Effect of Liquid
- ASTM D2202-00(2010), Test Method for Slump of Sealants
- ASTM D2240 - 05(2010), Standard Test Method for Rubber Property—Durometer Hardness
- ASTM D1985-03(2008), Standard Practice for Preparing Concrete Blocks for Testing Sealants, for Joints and Cracks
- ASTM D3183-10, Practice for rubber- Preparation of Pieces for test Purposes from Products
- ASTM D5329-09, Standard Test Methods for Sealants and Fillers, Hot Applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements
- ASTM D 6690-12, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

2.3 FHWA Standards:

2.4 NTPEP JS/CS Photographic Reference Guide
3. **TERMINOLOGY**

3.1 Standard laboratory conditions are defined as a temperature of 24°C ± 4°C (77°F ± 7°F) and a relative humidity of 50 ± 10%.

4. **PRODUCT REQUIREMENTS**

4.1 The manufacturer will submit an electronic Product Evaluation Form (ePEF) to the NTPEP Manager through Data Mine (http://data.ntpep.org). For each product submitted the manufacturer will be asked to provide product data sheets, installation instructions, technical bulletins, MSDS information, and program payment for each product submitted for testing.

5. **SAMPLING PROTOCOL**

5.1 **Hot Poured Sealants** – Manufacturer shall supply sufficient material to meet requirements of field installation plus two 11.4 kg (25 pound) blocks of sealant material from the same lot or batch for lab testing at time of installation. The sealant product name provided for field and lab evaluation shall be the same as that listed on ePEF. No product name changes are allowed during the course of the evaluation. One of the 11.4 kg (25 pound) blocks will be used to conduct the laboratory evaluation and the second 11.4 kg (25 pound) block of material will be retained for 1 month after the manufacturer has been notified of the laboratory evaluation results for potential verification testing. If application is accomplished by equipment other than the standard caulk gun, manufacturer shall provide specialized equipment to the testing laboratory.

5.2 **Cold Applied, Chemically Curing Sealants** – Manufacturer shall supply sufficient material to meet requirements of field installation plus six-quart size tubes, or equivalent, of sealant material for laboratory evaluation from the same lot or batch number of the material used for the field evaluation. The sealant product name provided for field and lab evaluation shall be the same as that listed on ePEF. No product name changes are allowed during the course of the evaluation. Three of the tubes, or equivalent, will be used to conduct the laboratory evaluation and the remaining, three tubes of material, or equivalent, will be retained for 1 month after the manufacturer has been notified of the laboratory evaluation results for potential verification testing. If application is accomplished by equipment other than the standard caulk gun, manufacturer shall provide specialized equipment to the testing laboratory.

5.3 **Preformed Elastomeric Joint Seal**

Manufacturer shall supply sufficient material to meet requirements of field installation plus 9 linear feet of seal for laboratory evaluation from the same lot or batch number of the material used for the field evaluation. The sealant product name provided for field and lab evaluation shall be the same as that listed on ePEF. No product name changes are allowed during the course of the evaluation.

6. **LABORATORY EVALUATIONS**

6.1 **Hot Poured Sealants**

6.1.1 The laboratory evaluation will consist of testing two samples using the following procedures. The laboratory results that are reported will be the average of the individual tests at each heating condition. The report forms for the hot pour sealants are provided in Figure 1.

6.1.2 **Sample Preparation** - The joint sealant samples shall be prepared in accordance with ASTM D 5167-10 using a sample size of approximately 2,200 grams (4.9 pounds). If the capacity of the sealant melter will not accommodate a 2,200 g sample, the sample will be split into two 1,100-
gram samples and will be melted on both sides of the melter at the same time. The test specimens will be prepared by heating sealant to the manufacturer's maximum heating temperature after which the initial set of test specimens for apparent viscosity, bond to concrete, softening point, resilience, asphalt compatibility, fingerprinting and cone penetration will be prepared. The sealant material remaining in the melter will be kept at the manufacturer's maximum heating temperature for 6 hours ±15 minutes, after which a second set of test specimens for bond to concrete, softening point, resilience, asphalt compatibility, fingerprinting and cone penetration will be prepared.

6.1.3 **Sealant Laboratory Testing** - The sealant shall be evaluated in accordance with ASTM D 6690-12 and the methods described in the following paragraphs:

6.1.3.1 Bond to Concrete - Three non-immersed bond specimens will be prepared and tested in accordance with ASTM D 5329-09, Section 9 and ASTM D 6690-12, Table 1. The blocks will be prepared in accordance with ASTM D 1985-03(2008). Only Type III sealant as defined by D 6690-12 shall be tested for water-immersed bond. Three additional bond specimens will be conditioned and tested per ASTM D 6690-12, Section 7.5 for the water-immersed bond testing. The result of each extension cycle for each specimen will be reported as the amount of adhesion and/or cohesion failure in square centimeters (square inches).

6.1.3.2 Resilience - The resilience specimens will be prepared and in accordance with ASTM D 5329-09, Section 12 and tested at 25°C (77°F). The resilience results will be reported as the percent recovery.

6.1.3.3 Cone Penetration - Two cone penetration specimens will be prepared in accordance with ASTM D 5329-09, Section 6. One cone penetration specimen will be tested in accordance with ASTM D 5329-09, Section 6. The second specimen will be tested in accordance with ASTM D 5329-09, Section 6 with the following exceptions; the specimen will be allowed to cool to standard laboratory conditions for 17 ± 2 hours, the specimen will then be placed in a freezer at -18°C ± 1°C (0°F ± 2°F) for 4 hours ±15 minutes prior to testing. One hour before testing, the penetrometer cone attachment will also be placed in the freezer at -18°C ±1°C (0°F ±2°F). At the end of the 4-hour specimen-conditioning period, remove the test specimen and cone from the freezer, place the cone in the penetrometer and immediately conduct the test. After making the measurement, clean the cone attachment and place the specimen and cone back in the freezer for 10 ± 2 minutes before making two successive measurements for a total of three measurements. The penetration results will be averaged and the average value reported.

6.1.3.4 Asphalt Compatibility - the HMA and joint sealer specimens shall be prepared in accordance with ASTM D 5329-09, Section 14.

6.1.3.5 Apparent Viscosity - Joint sealer specimens shall be prepared in accordance with AASHTO TP 85-10. The viscosity shall be measured at the manufacturer's maximum heating temperature and reading shall be taken at 30 seconds and at 60 RPM.

6.1.3.6 Fingerprinting - Infrared Spectra shall be obtained from a representative sample using an Attenuated Total Reflectance (ATR) attachment.

6.1.3.7 Softening Point – Ring and Ball Softening Point determination will be conducted according to ASTM D 6690 Section 7.3 and D36. Glycerin shall be used for bath fluid.

6.2 **Cold Applied, Chemically Curing Sealants**
6.2.1 The report forms for the cold applied sealants are provided in Figure 2.

6.2.2 **Sealant Laboratory Testing** - All specimens shall be cured at standard laboratory conditions. The sealant shall be evaluated in accordance with ASTM D 5893-10 and the methods described in the following paragraphs.

6.2.2.1 **Tack Free Time** - The tack free time specimens will be prepared and tested in accordance with ASTM C 679-03(2009)e1.

6.2.2.2 **Effects of Heat Aging** - Test specimens will be prepared and tested in accordance with ASTM C792 - 04(2008). The mass loss will be reported as percent mass loss. Any chalking or cracking shall be documented.

6.2.2.3 **Bond to Concrete** - Six test specimens will be prepared and tested in accordance with ASTM D 5893-10, Section 9.6 with the following exceptions. Three non-immersed and three water-immersed of the bond specimens will be tested at -29°C ± 1°C (-20°F ± 2°F) for 5 cycles of 100% extension and recompression. The result of each extension cycle for each specimen will be reported as the amount of adhesion and/or cohesion failure in square centimeters (square inches).

6.2.2.4 **Ultimate Elongation and Tensile Stress at 150% Elongation** - Test specimens will be prepared and tested in accordance with ASTM D 5893-10, Section 9.9. The tensile stress at 150% elongation and the ultimate percent elongation will be reported.

6.2.2.5 **Effects of Accelerated Weathering** - Test specimens will be prepared and tested in accordance with ASTM D5893-10 Section 9.10 using a xenon-arc exposure device. The visual condition of the specimens will be reported.

6.2.2.6 **Slump Test** - Type NS sealants shall be tested in accordance with ASTM D 2202-00.

6.2.2.7 **Fingerprinting** - Fourier Transform Infrared Spectra shall be obtained from a representative sample using an Attenuated Total Reflectance (ATR) attachment. This reference spectrum shall be used for future comparison to verify no change in formulation has been made. Verification samples spectra having a 98% match compared to the reference sample shall be considered the same formulation.

6.2.2.8 **Resilience** - Test specimens will be prepared and tested in accordance with ASTM D 5893-10, Section 9.11.

6.2.2.9 **Hardness** - Test specimens will be prepared and tested in accordance with ASTM D 5893-10, Section 9.7.

**Flow** - Test specimens will be prepared and tested in accordance with ASTM D 5893-10, Section 9.8.

6.3 **Preformed Elastomeric Joint Seal**

6.3.1 **Tensile Strength and Elongation** – Test specimens shall be tested according to ASTM D412.
6.3.2 **Type A Hardness** - Test specimens shall be tested according to ASTM D2628.

6.3.3 **Oven Aging** - Test specimens shall be oven aged according ASTM D573 for 70 hours at 100°C. Test specimens shall be tested for loss of Tensile strength and Elongation and Shore A Hardness points change.

6.3.4 **Oil Swell** – Test specimens shall be tested for weight change according to ASTM D471 with ASTM Oil 3 for 70 hours at 100°C.

6.3.5 **Low-Temperature Stiffening** - Test Specimens shall be tested according to ASTM D2628 - Section 9.2 for Shore A Hardness point change after 7 day conditioning at -10°C

6.3.6 **Low-Temperature Recovery @ -10°C** - Test Specimens shall be tested according to ASTM D2628 - Section 9.2 for % recovery at 50% deflection after conditioning for 72 hours at -10°C.

6.3.7 **Low-Temperature Recovery @ -29°C** - Test Specimens shall be tested according to ASTM D2628 - Section 9.2 for % recovery at 50% deflection after conditioning for 22 hours at -29°C.

6.3.8 **High Temperature Recovery** Test Specimens shall be tested according to ASTM D2628 - Section 9.2 for % recovery at 50% deflection after conditioning for 70 hours at 100°C.

6.3.9 **Compression-Deflection** - Test Specimens shall be tested according to ASTM D2628 - Section 9.3.

### FIELD EVALUATIONS

7.1 **Site Selection for Field Evaluation** – The member department will select a field evaluation site consisting of at least 10 joints for each sealant material evaluated. All sealed joints will be evaluated. Site selection criteria should include pavement age, roadway history and joint spacing. Efforts will be made to host test sites in various climatic regions of the United States. Final site selection will be determined by the NTPEP Joint Sealant Technical Committee.

7.2 **Sealant Installation for Field Evaluation** – The manufacturer will supply all materials for the evaluation of their product. The manufacturer and the test state will mutually agree upon the equipment and labor required to prepare the joints and install the joint sealant material. The manufacturers will either supply all labor and equipment required or the test state will provide a single contractor for all manufacturers at the manufacturers’ expense. Traffic control, installation scheduling, and installation location will be provided by the test state. The manufacturer should have a technical representative present at the installation of the sealant to certify that the material is installed in accordance with their recommended procedures. If the representative believes that the installation is not in accordance with the recommended procedures, they will inform the designated representative of the member department of this fact in writing within one week of the installation of the material. If this occurs, the member department may eliminate that manufacturer’s installation from further evaluation without a refund of fees. If no letter is received within this first week, the installation will be accepted and included in the field evaluation.

Information recorded by the inspectors on each worksheet can be seen in Figure 3A and 3B.
7.2.1 Before installation, GPS or Reference Point stationing of test sections shall be documented, each joint in the test section labeled and each joint photographed. Joints shall be labeled by Test Section and joint number. For example the first joint in the Test Section 4 shall be labeled 4-1.

7.2.2 A pavement condition survey done according to SHRP criteria and a detailed sketch of the joints including the location of each sealant is done. The sketch should include slope of the pavement, joint spacing, joint width and any special condition of the joints.

7.2.3 The joint spacing for each test section shall be reported. Three joints will be pinned with PK nails or pins on each side of the joints for each test section. These pins shall be used to monitor joint movement during the course of the evaluation.

7.2.4 The annual average daily traffic and the closest weather data station will also be reported. The manufacturer will supply with the application for evaluation, performance characteristics such as the amount of joint movement the sealant is capable of withstanding or the sealant working range, the recommended joint preparation and sealant installation procedures, and when the area can be reopened to traffic. These conditions will apply if they do not conflict with the agency’s construction practices.

7.2.5 The joint preparation and sealant installation techniques used during the installation will be recorded. Any deviation from the manufacturer’s recommendations will be noted. Additionally, the manufacturer’s representative will be allowed to provide comments on the joint preparation and sealant installation. If the manufacturer's representative does provide such comments, they will be included with the installation report. Digital photographs are taken of each finished sealed joint. This initial photograph is used for comparison to the photos that are taken at evaluation intervals.

7.3 Field Evaluation Observations

Field evaluation observations are taken each year from the date of installation or at a time in which the sealant is in its greatest extension. The NTPEP evaluation lasts for three years. It is mandatory that no maintenance work be done on the test sections for those three years. Before any reading can be taken, sand and debris has to be removed from the test deck. A gas operated leaf blower is recommended for surface preparation and cleaning. The Individual Joint Field Evaluation Worksheet (Figure 4) is used to track field observation over the course of the 3 yr. evaluation. The NTPEP JS/CS Photographic Reference Guide is used as a guide to rate sealant distresses.

7.3.1 Water Infiltration

Water infiltration will be measured as the percentage of the overall joint length where water can bypass the sealant and enter the joint either through complete adhesion or cohesion failure. Adhesion and cohesion failures will be determined through the SHRP Visual Inspection Method. All joints in the driving lane shall be inspected to determine the percent allowing water infiltration. Any visual cracks, splits or openings in the sealant or between the sealant and PCC shall be examined to determine the depth of the opening. A thin blade spatula may be used to assist in the evaluation. See NTPEP JS/CS Photographic Reference Guide for photo of spatula.
The percentage of joints that allow water infiltration will be determined by the equation:

\[ \%L = \left( \frac{L_f}{L_{tot}} \right) \times 100 \]

Where:
- \( \%L \) = Percent length of the joint allowing water infiltration
- \( L_f \) = Total length of the joint sealant field test section allowing the infiltration of water (inches)
- \( L_{tot} \) = Total length of the joint sealant field test section (inches)

Each joint is then rated into a level of severity. The ratings are as follows:

- No Water Infiltration: \( \%L = 0\% < \%L < 1\% \)
- Low Severity Water Infiltration: \( 1\% < \%L < 10\% \)
- Medium Severity Water Infiltration: \( 10\% < \%L < 30\% \)
- High Severity Water Infiltration: \( \%L > 30\% \)

### 7.3.2 Debris or Stone Retention Severity Rating

- No Debris Retention: No stones or debris are stuck to the top of the sealant or embedded on the surface of the sealant/PCC interface.
- Low Severity: Occasional stones and/or debris are stuck to the top of the sealant, or debris embedded on the surface of the sealant/PCC interface.
- Medium Severity: Stones or debris are stuck to the sealant and some debris is deeply embedded in the sealant or material embedded between the sealant and the joint face but not entering the joint below the sealant.
- High Severity: A large amount of stones and debris are stuck to and deeply embedded in the sealant or filling the joint, or a considerable amount of debris is embedded between the sealant and the joint face and entering the joint below the sealant.

### 7.3.3 Seal Condition Number (SCN)

The water infiltration and stone retention severity ratings are used to calculate a Sealant Condition Number.

"Sealant Condition Number" (SCN) will be assigned to the sealant once a year for three years. Each distress type will be rated as having no distress, low, medium, or high severity distress. The results of the two severity distress ratings will be inserted into the following equation to provide the SCN.

\[ SCN = 1(L) + 2(M) + 3(H) \]

Where:
- \( SCN \) = Sealant Condition Number
- \( L \) = the number of low severity sealant conditions
- \( M \) = the number of medium severity sealant conditions
- \( H \) = the number of high severity sealant conditions
If the sealant material has no defects, then the SCN is defined as 0, the best possible rating. A SCN of 6, the worst possible rating, is obtained when both the debris retention and water infiltration are rated as high severity.

7.3.4 Spalling

Spalling is the length of any jointing, breaking, chipping or fraying of joint edges. The length and severity of spalling shall be measured along each joint. Spalled areas will be not counted as adhesion failure.

7.3.5 Joint Movement

Longitudinal and transverse joint movements shall be measured by installing pins or PK nails on both sides of three transverse joints. A drill should be used to make a pilot hole for the installation of the pins. Pins shall be placed far enough away from the joints so as not to cause further deterioration in the pin installation process. At each evaluation, joint movement shall be measured as the distance between the pins measured by a caliper minus the spacing between the pins at installation.

Vertical movements at the joints or routs shall be measured by the Georgia Faultmeter or a straightedge, wedge and caliper.

Both joint movement measurements shall be an average of nine measurements per test section.

7.3.6 Joint Spacing

The average joint spacing along with the spacing standard deviation shall be reported. This information is acquired from the joint map done prior to installation of products.

7.3.7 Photo Log

Photographs of each joint for each test section per evaluation cycle shall be taken and included in the report.

7.3.8 Annual Average Daily Traffic, Deicing Chemicals Used and Weather Data

Annual average daily traffic in terms of total vehicle and commercial vehicles will be reported.

Tons of salt per lane mile, tons of salt/sand mixture per lane mile and gallons of salt brine per lane miles used will be reported each year. (Figure 6)

Monthly daily high temperature, monthly daily low temperature, number of days per month below freezing and total monthly precipitation shall be reported from the nearest weather station. (Figure 5)
7.3.9 Comments

Additional information such as the pavement condition, environmental conditions, secondary cracking and traffic conditions will also be recorded. Specific items that are to be recorded are provided in Figure 3A.

8. EVALUATION FACILITY REQUIREMENTS

To ensure accuracy and precision in lab testing and field evaluation data collection, the following controls have been instituted in this standard practice.

8.1 Laboratory Testing

8.1.1 The testing lab shall have AMRL or other NTPEP approved laboratory accreditation. All equipment is to be calibrated, verified or checked according to the lab quality system manual and ASTM, AASHTO or lab test methods. The testing lab shall have applicable standards available to technicians testing sealants for the NTPEP program and shall verify that the correct versions of applicable standards are being used per the appropriate NTPEP Joint Sealant work plan.

8.1.2 Technicians conducting sealant testing shall undergo a training program on methods, procedures and practices detailed in this work plan. Training shall be conducted by a technician with a minimum of five years of sealant testing experience. Proficiency of technicians shall be determined using ASTM or DOT sponsored round robin testing program. Training records shall be documented per the lab Quality Systems Manual (QSM). Sealant samples shall be tested according to referenced standards. Replicate tests shall all fall within limits established by the standards precision and bias statement (P&B). If a test fails to meet the P&B, the test will be repeated until the P&B is met.

8.2 Field Evaluation

8.2.1 The field evaluation shall be conducted according to this work plan. The field evaluation team shall consist of state DOT and/or consultants. The technical committee shall conduct a two day training program for new field evaluators.

8.2.2 The average of percent adhesive and cohesive failure for the test site shall be tracked for field evaluators. The coefficient of variation (COV) between the evaluators shall be < 15%. If the COV is greater than 15%, an investigation shall be made to determine causes for this difference. When questions related to how to evaluate sealant distresses occur, the field evaluation team shall meet and come to consensus. This will allow the evaluators to remain consistent in evaluation techniques.

9. EVALUATION RESULTS AND DATA

9.1 Test result data will be compiled and made available to all participating states and testing companies through the AASHTO/NTPEP Data Mine. This report will include data and photos only. No judgment as to a product’s acceptability will be made in this report. End user participants will establish individual criteria for product acceptability.

9.2 The reports issued by the technical committee shall contain the test data generated by the contracted NTPEP laboratory(s). The results of the sealant evaluations will consist of the appropriate laboratory evaluation form and the field evaluation form.
9.3 *Data Mine* – This data base can be accessed through the AASHTO-NTPEP web site link at www.ntpep.org.

Figure 1 – Hot Pour Sealant Laboratory Evaluation
Figure 2—ASTM D 5893 Laboratory Evaluation
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Figure 3A – Field Evaluation Report - Installation Data
Figure 3B – Field Evaluation Report Inspection Report
## CRACK INVENTORY FORM

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<table>
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### WATER INFILTRATION - VISUAL OBSERVATION

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### DEBRIS OR STONE RETENTION

<table>
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<tr>
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<tr>
<td>Low Severity</td>
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<tr>
<td>Medium Severity</td>
<td>Medium Severity</td>
</tr>
<tr>
<td>High Severity</td>
<td>High Severity</td>
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</table>

**Definition:**
- **No Debris Retention:** No stones or debris are stuck to the top of the sealant or embedded on the surface of the sealant / channel interface.
- **Low Severity:** Occasional stones or debris are stuck to the top of the sealant or debris embedded on the surface of the sealant / channel interface.
- **Medium Severity:** Stones or debris are stuck to the sealant and some debris is deeply embedded in the sealant or material embedded between the sealant and the joint face but not entering the joint below the sealant.
- **High Severity:** A large amount of stones or debris is stuck to and deeply embedded in the sealant or filling the joint, or a considerable amount of debris is embedded between the sealant and the joint face and entering the joint below the sealant.

**RATING:**
- No Debris Retention
- Low Severity
- Medium Severity
- High Severity

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**Figure 4- Individual Joint Field Evaluation Worksheet**
10. EVALUATION FREQUENCY

10.1 Following the initial testing, resubmittal testing frequency is at the option of the manufacturer. Product recertification shall occur every three years with laboratory testing only provided there are no changes in the formulation.

Note 1 - Some state DOTs require hot mix asphalt joint sealing and filling materials to undergo resubmittal testing after a specified time.
## 11. TIMELINE

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<th>Timeline (Months)</th>
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<td>Stage 3 Laboratory Testing</td>
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<td>Stage 7 Field Evaluation (2 year)</td>
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<td>Stage 8 Second Report (2 year field data)</td>
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<td>Stage 11 Final Report</td>
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## 12. KEYWORDS

12.1 Joint fillers; joint sealants; Data Mine; NTPEP