coating a minimum of 95 percent of the coarse particles, based on the average of the 3 samples and provided that none of the 3 samples result in fully coating less than 92 percent of the coarse particles, shall be the minimum wet mixing time requirement. A dry mixing time of up to 15 seconds may be required by the Engineer to accomplish the degree of aggregate distribution necessary to obtain complete and uniform coating of the aggregate with asphalt.

211.14—Storage System.

In the event the Contractor elects to use a storage system, the system shall be capable of conveying the mix from the plant to the storage bins and storing the mix without a loss in temperature, segregation or oxidation of the mix. Storage time shall be limited by the ability of the bins to maintain the mix within the quality requirements specified herein with a maximum time limit not to exceed 10 days. Material may be stored in bins for no more than 24 hours without an approved heating system.

The conveyor system may be a continuous or skip bucket type. Continuous type conveyors shall be enclosed so that the mix temperature is maintained.

The storage bins shall be designed in such a manner as to prevent segregation of the mix during discharge from the conveyor into the bins and shall be equipped with discharge gates that will not cause segregation of the mix while loading the mix into the trucks.

Approval for the use of storage bins may be withdrawn by the Engineer in the event there is an excessive amount of heat loss, segregation or oxidation of the mix.

211.15—Initial Production.

At the start of production of a mix not previously used on a state roadway, the Contractor shall be placed on limited production at an approved site (may be project site) so the Engineer can examine the mixing plant process control, placement procedures, surface appearance, compaction patterns and correlation of the nuclear density device. The material placed will be at the specified application rate and shall be paid for at the contract unit price for the specified mix type. The Engineer will determine the disposition of material that was not successfully produced and/or placed due to negligence in planning, production or placement by the Contractor.

SECTION 212—JOINT MATERIALS

212.01—Description.

These specifications cover resilient products made from various materials that are designed to accommodate the movement of rigid structures, such as component

parts of hydraulic cement concrete, and seal the joint from intrusion of water or incompressibles.

212.02—Detail Requirements.

(a) **Hot-poured joint sealer** shall be heated in accordance with the manufacturer's recommendations.

1. **Asphalt sealer** shall conform to the requirements of FS SS-S-1401 or AASHTO M173, with the following modifications:

   a. The temperature of the air bath during the bond test shall be –20 ±3 degrees F.

   b. Asphalt sealer shall have a ductility of at least 40 centimeters at 77 degrees F when tested in accordance with the requirements of AASHTO T51.

   c. Material shall not have a flow of more than 1.0 centimeter.

   d. Hot-poured asphalt joint sealer shall be used only for longitudinal joints or crack sealing in concrete pavements.

2. **Elastomeric joint sealer** shall conform to the requirements of ASTM D3406 and shall be used only for longitudinal joints.

(b) **Silicone Sealants** shall be furnished in a one or two part formulation. The sealant shall be compatible with the surface to which it is applied. Acid cure sealants are not acceptable for use on hydraulic cement concrete. Bond breakers shall be chemically inert and resistant to petroleum products, solvents, and primers.

Silicone sealants will be identified in the following manner:

- **Class A:** A low modulus non-sag silicone for use in sealing horizontal and vertical joints in hydraulic concrete pavements and structures. Tooling is required.

- **Class B:** A very low modulus self-leveling silicone used to seal horizontal joints in hydraulic cement concrete pavements and structures. Tooling is not normally required.

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

- **Class D:** An ultra low modulus self-leveling rapid curing two-part silicone used to seal expansion joints on bridge decks. It can also be used to seal joints subject to dynamic movements where rapid curing is necessary. Tooling is not normally required.

Silicone sealants shall conform to the following physical requirements:

Properties	Test Method	Sealant Class A	Sealant Class B	Sealant Class C	Sealant Class D
Tensile Stress at 150% Strain (Max. PSI) (Note 1)	ASTM C1135	45	40	15	25
Durometer Hardness, Shore (0° and 77° ± 3°F) (Note 1)	ASTM D-2240	"A" 10–25	"00" 40–80	"00" 20–80	"00" 40–80
Bond to Concrete Mortar (Min. PSI) (Note 1) (Note 3)	VTM-90	50	40	35	35
Tack Free Time (Skin-over) (Max. Minutes) (Note 2)	VTM-90 (Note 4)	180	180	180	30
Extrusion Rate (Min. Grams/Minute)	VTM-90	75	90	100	200
Non-volatile (Min.%)	VTM-90	90	90	90	90
Specific Gravity	ASTM D-792 (Method A)	1.1–1.5	1.1–1.5	1.1–1.5	1.2–1.5
Shelf Life (from date of shipment)		6 Months	6 Months	6 Months	6 Months
Movement Capability & Adhesion (Note 1)	VTM-90	No adhesive or cohesive failure after 10 cycles at 0°F			
Ozone and U. V. Resistance (Note 1)	ASTM C-793-75	No chalking, cracking, or bond loss after 5,000 hours			

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

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

Note 3: Class C silicone shall also attain its bond strength requirement to asphalt concrete.

Note 4: 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.

Bond breakers shall be chemically inert and resistant to petroleum products, solvents, and primers. The bond breaker shall 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 Class A silicone only and is suitable for roadway and structure 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 sealants and is suitable for use in roadway and structure joints.

Backer rods shall conform to 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 sealants, but is suitable for structure joints only.

Bond breaking tapes shall be no less than .005-inch thick.

The manufacturer of the joint sealant shall furnish certified test results on each lot of sealant furnished to a project. The certified test results must include all test results except the Bond To Concrete Mortar and Shore Durometer Hardness at 0 degrees F.

Only those silicone sealants which appear on the latest approved products listing published by the Department's Materials Division will be permitted for use.

Silicone sealants submitted for initial approval and conforming to the material requirements of this specification will not be approved until field evaluations are made. The material shall be installed in roadway or bridge joints and shall go through two winters without failure before being approved. After approval, material will be placed on the Department's approved products list.

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

(c) **Preformed expansion joint filler** shall conform to the requirements of AASHTO M213.

(d) **Expanded rubber joint filler** shall conform to the requirements of ASTM D1056.

(e) **Preformed neoprene (polychloroprene) seals** shall conform to the requirements of ASTM D1056, Grade 2B3. (Modification requires that material be manufactured from neoprene.)

(f) **PVC and PE joint fillers** shall conform to the requirements of ASTM D1667. Grades VE-43 BL to VE-45 BL shall be furnished. Adhesives for use with this material shall be as recommended by the manufacturer.

(g) **Sponge rubber joint filler** shall conform to the requirements of AASHTO M153, Type I. When used in conjunction with bridge bearings, the load required to compress the test specimen to 50 percent of its thickness before the test shall be not more than 100 pounds per square inch.

(h) **Gaskets for pipe** shall conform to the following: Rubber gaskets for ductile iron pipe and fittings shall conform to the requirements of AWWA C111; for concrete sewer pipe shall conform to the requirements of ASTM C443; and for other pipe shall conform to the requirements of AASHTO M198, Type A, and Section 237.

Preformed plastic gaskets shall conform to the requirements of AASHTO M198, Type B.

(i) **Preformed elastomeric joint sealer** shall be a vulcanized elastomeric compound in which noncrystallizing neoprene is used as the sole polymer. Sealer shall be resilient and resistant to heat, oil, and ozone.

The seal shall conform to the following as evidenced by samples cut from the finished product:

Property	Test Procedures	Physical Requirements
Tensile strength	ASTM D412	2000 psi min.
Elongation at break	ASTM D412	250% min.
Hardness (durometer, Shore A)	ASTM D2240	55 ± 5
Oven aging (70 hrs/ 212°F)		
Tensile strength (change)	ASTM D573	–30% max.
Elongation (change)		–40% max.
Hardness (points change)		+10% max.
Ozone resistance (20% strain, 100 pphm in air, 300 hr/ 104°F) (wipe with solvent to remove surface contamination)	ASTM D1149	No Cracks
High temperature recovery (72 hr/212°F under 50% deflection)	VTM-3	85% (no web adhesion or cracks)
Low temperature recovery (72 hr/14°F under 50% deflection)	VTM-3	87%
Low temperature recovery (22 hr/-20°F under 50% deflection)	VTM-3	82%

When tested at a temperature of 70 ± 5 degrees F, the seal shall also conform to the following:

Use	Deflection Based on Nominal Width (%)	Pressure (psi)
Pavement	20	Min. 3
	50	Max. 15
Structure	20	Min. 4
	50	Max. 40

After aging at 212 degrees F for 70 hours at 50 percent deflection, the seal shall conform to the following:

Use	Deflection Based on Nominal Width (%)	Pressure (psi)
Pavement	20	Min. 1.0
	50	Max. 15
Structure	20	Min. 1.5
	50	Max. 40

Lubricant adhesive shall be a one component polyurethane compound with an aromatic hydrocarbon solvent and shall conform to the physical properties of ASTM D4070.

Lubricant for pavement seals shall conform to the requirements of ASTM D2835.

(j) **Elastomeric Expansion Dam and Tooth Expansion Joint** – The elastomeric sheet gland material shall be virgin ethylene propylene diene monomer (EPDM) or virgin polychloroprene. The elastomeric material shall have the following physical properties:

Property	Test Procedures	Physical Requirements
Tensile Strength	ASTM D412	1500 psi min.
Elongation at Break	ASTM D412	175% min.
Low Temperature Brittleness	ASTM D746	Not brittle at –40° F
Oil Deterioration (no requirement for EPDM material) Volume increase after 70 hrs. immersion in ASTM Oil No. 3 at 212°F	ASTM D471	120% max.
Ozone Resistance–Exposure to 100 pphm ozone in air for 70 hrs, at 100°F under 20% strain	ASTM D1149	No Cracks
Hardness, Durometer A	ASTM D2240	50–60

The elastomeric strip seal gland material shall be preformed non-reinforced, polychloroprene and shall have the following properties.

Property	Test Procedures	Physical Requirements
Tensile Strength	ASTM D412	2000 psi min.
Elongation at Break	ASTM D412	250% min.
Hardness, Durometer A, points	ASTM D2240 (Modified)[A,C]	60 ± 5
Oven aging, 70 hrs at 212°F (100°C)	ASTM D573	
Tensile strength, loss,		20% max.
Elongation, loss		20% max.
Hardness, Durometer A, points	ASTM D2240 (Modified)[A,C]	0 to +10
Oil swell, ASTM oil 3, 70 hrs at 212°F (100°C) Weight change	ASTM D471	45% max.
Ozone resistance 20% strain, 300 pphm in air, 70 hrs at 104°F (40°C)	ASTM D1149 (Modified)[B]	No Cracks
Low temperature stiffening 7 days at 14°F(10°C) Hardness, Durometer A, points change	ASTM D2240 (Modified)[A,C]	0 to +15
Compression set, 70 hrs at 212°F (100°C)	ASTM D395 Method B (Modified)[A]	40% max.

[A]The term "modified" in the table relates to the specimen preparation. The use of the strip seal as the specimen source requires that more plies than specified in either of the modified test procedures be used. Such specimen modification shall be agreed upon by the purchaser and producer or supplier prior to testing.

[B]Test in accordance with Procedure A of D518 and ozone concentration is expressed in pphm.

[C] The hardness test shall be made with the durometer in a durometer stand as recommended in Method D2240.

Steel portion of expansion dam shall conform to the requirements of ASTM A709 Grade 36.

Deformed reinforcing steel bars shall conform to the requirements of ASTM A615, Grade 60.

Lubricant adhesive shall be a one-part moisture curing polyurethane compound conforming to the requirements of ASTM D4070.

Fabric reinforcement shall be nonwicking woven polyester material.

Bolts, nuts and washers shall conform to the requirements of ASTM A276, Type 304 Stainless Steel.

Flathead screws shall conform to the requirements of ASTM F 738, Type 304 Stainless Steel.

Stud anchors shall conform to the requirements of Section 226.02(d).

Special conditions such as doglegs, tees and crosses in the elastomeric strip seal gland shall be shop fabricated in a mold under heat and pressure.

(k) **Pressure relief joint material** shall conform to the requirements of ASTM D3204.

(l) **Waterstops** shall conform to the following:

1. **Metal:** Sheet copper shall conform to the requirements of Section 230.

2. **Nonmetallic waterstops:** Nonmetallic waterstops shall be manufactured from neoprene or PVC. Manufacturer's shop splices shall be fully vulcanized.

a. **Neoprene waterstops** shall be manufactured from a vulcanized elastomeric compound containing neoprene as the sole elastomer and shall conform to the following:

Property	Test Procedures	Physical Requirements
Tensile strength	ASTM D412	Min. 2,000 psi
Elongation at break	ASTM D412	Min. 300%
Ozone resistance (20% strain, 100 hrs at 100 ± 2°F	ASTM D1149 (except 100 ± 20 pphm)	No cracks
Oil swell (ASTM No. 3 oil, 70 hrs at 212°F, volume change)	ASTM D471	Max. 80%

After accelerated aging in accordance with the requirements of ASTM D573 for 70 hours at 212 degrees F, the elastomer shall not show a change in tensile strength of more than 15 percent or a change in the elongation at break of more than 40 percent.

b. **PVC waterstops** shall be manufactured from PVC conforming to U.S. Corps of Engineers Specification CRD-C 572 and shall conform to the ozone resistance as required for neoprene waterstops. A certificate certifying compliance with the performance requirements specified under paragraph 6 of CRD-C 572 shall be furnished with the test sample supplied.

(m) **Traffic loop sealant material** shall be an epoxy-resin system, a polyester system, or rubberized asphalt designed specifically to conform to the physical properties for sealing traffic loop pavement cuts. The system shall bond to either hydraulic cement concrete or asphalt concrete, be unaffected by environmental conditions, and have a dielectric strength

sufficient to allow the traffic loop to operate as intended. The viscosity of the mixture shall be such that the mixture is easily pourable into the saw slot and sufficiently flowable to encase the electrical wiring.

1. **The epoxy-resin system** shall be a two-component material conforming to the following based on the epoxy without sand, except for the cure time requirement:

Property	Test Procedures	Physical Requirements
Pot life at 77°F	ASTM C881, Para. 11.2	Min. 12 minutes
Initial cure time at 77°F		Max. 60 minutes
Hardness, Shore D	ASTM D2240	25–65
Elongation	ASTM D638	Min. 50%
Water absorption (24 hr)	ASTM D570	Max. 0.5%
3% NaCl absorption (24 hr)	ASTM D570	Max. 0.5%
ASTM No. 3 oil absorption (24 hr)	ASTM D570	Max. 0.1%
Gasoline absorption (24 hr)	ASTM D570	Max. 1.0%

The sand used in the epoxy-resin system shall conform to the following grading requirements:

Sieve No.	% Passing
16	100
30	95 ± 5
100	Max. 10
200	Max. 3

2. **The polyester system** shall be a two-component material conforming to the following:

Property	Test Procedures	Physical Requirements
Pot life at 77°F	ASTM C881, Para. 11.2	Min. 12 minutes
Initial cure time at 77°F		Max. 45 minutes
Hardness, Shore D	ASTM D2240	25–65
Elongation	ASTM D638	Min. 15%
Water absorption (24 hr)	ASTM D570	Max. 0.2%
3% NaCl absorption (24 hr)	ASTM D570	Max. 0.2%
ASTM No. 3 oil absorption (24 hr)	ASTM D570	Max. 0.02%
Gasoline absorption (24 hr)	ASTM D570	Max. 0.8%

3. **Rubberized asphalt** (two-component) shall conform to the following:

Property	Test Procedures	Physical Requirements
Pot life at 77°F		Min. 25 minutes
Initial cure time at 77°F		Max. 60 minutes
Hardness, Shore A	ASTM D2240	Max. 20
Flow at 140°F (5 hr)	ASTM D1851	No flow
Bond at 0°F (3 cycles)	ASTM D1851	Min. 50% of original width
Water absorption (72 hr)		Max. 0.1%
ASTM No. 3 oil absorption (24 hr)		Max. 0.1%

SECTION 213—DAMP-PROOFING AND WATERPROOFING MATERIALS

213.01—Description.

These specifications cover materials, generally asphalt based, that are intended to prevent or delay the passage of water, usually through a section of hydraulic cement concrete.

213.02—Detail Requirements.

(a) **Asphalt** shall conform to the requirements of ASTM D312, Type II. Where vertical or near vertical surfaces are encountered, asphalt shall conform to the requirements of ASTM D312, Type IV. Primer shall conform to the requirements of AASHTO M116.

(b) **Fabric** shall conform to the requirements of AASHTO M117. When cotton fabric is used, it shall be saturated with asphalt. Glass fiber shall conform to the requirements of ASTM D1668.

(c) **Joint sealers** for horizontal joints shall be an asphalt cement, viscosity grade AC-40, conforming to the requirements of Section 210. Sealers for vertical joints shall have fiber added, 20 percent by weight. Fiber and asphalt shall be mixed by the manufacturer to ensure a uniform mixture.

(d) **Membrane** shall conform to ASTM D6153.