

**TABLE OF CONTENTS**

- A. Construction Requirements
- B. Rapid Set Concrete Patching Material – Horizontal Repairs
- C. Dynamic Pile Testing
- D. Hydrophilic Waterstop
- E. Epoxy Urethane Polymer Wearing Surface

 <p>THIS SHEET HAS BEEN              SIGNED, SEALED AND DATED              ELECTRONICALLY</p>	<p><b>MISSOURI HIGHWAYS AND                  TRANSPORTATION COMMISSION</b>                  105 W. CAPITOL AVE.                  JEFFERSON CITY, MO 65102                  Phone 1-888-275-6636</p>
	<p><b>HDR Engineering</b>                  401 South 18<sup>th</sup> St.                  Suite 300                  St. Louis, MO 63103</p> <p>Certificate of Authority: 000856                  Consultant Phone: 314-425-8300</p>
	<p>JOB NUMBER: J6S1718                  ST. LOUIS COUNTY, MO                  DATE PREPARED: 1/31/2020</p>
<p>Date: 3/1/2021</p>	
<p>Only the following items of the Job Special Provisions (Bridge) are authenticated by this seal: A, B, C, D, E</p>	

JOB SPECIAL PROVISIONS (BRIDGE)

---

A. CONSTRUCTION REQUIREMENTS

**1.0 Description.** This provision contains general construction requirements for this project.

**2.0 Construction Requirements.** Plans and the asbestos and lead inspection report for the existing structure(s) and the geotechnical report for the new structure(s) are included in the contract with the bridge electronic deliverables zip file for informational purposes only.

**2.1** In order to assure the least traffic interference, the work shall be scheduled so that a lane or bridge closure is for the absolute minimum amount of time required to complete the work. A lane or bridge shall not be closed until material is available for continuous construction and the contractor is prepared to diligently pursue the work until the closed lane or bridge is opened to traffic.

**2.2** Qualified special mortar shall be a qualified rapid set concrete patching material in accordance with [Sec 704](#). A qualified rapid set concrete patching material will not be permitted for repairing concrete deck (half-soling), deck repair with void tube replacement, full depth repair, modified deck repair and substructure repair (formed) unless a note on the bridge plans specifies that a qualified special mortar may be used.

**2.3** Provisions shall be made to prevent any debris and materials from falling into the streams. Any debris and materials that falls below the bridge outside the limits mentioned previously and if determined necessary by the engineer, the debris shall be removed as approved by the engineer at the contractor's expense.

**2.4** Any damage sustained to the remaining structure as a result of the contractor's operations shall be repaired or the material replaced as approved by the Engineer at the contractor's expense.

**2.5** Provisions shall be made to prevent damage to any existing utilities. Any damage sustained to the utilities as a result of the Contractor's operations shall be the responsibility of the contractor. All costs of repair and disruption of service shall be as determined by the utility owners and as approved by the Engineer.

**2.6** A washer shall be required under head and nut when any reaming is performed for bolt installation.

**3.0 Method of Measurement.** No measurement will be made.

**4.0 Basis of Payment.** Payment for the above described work will be considered completely covered by the contract unit price for other items included in the contract.

B. RAPID SET CONCRETE PATCHING MATERIAL – HORIZONTAL REPAIRS

**1.0 Description.** This specification covers cementitious concrete, polymer-modified concrete and polymer concrete that are suitable for repairing concrete surfaces on bridges or roadways, particularly under fast setting or special conditions. The repairs would involve horizontal

JOB SPECIAL PROVISIONS (BRIDGE)

---

applications. The work shall consist of removing, furnishing, preparing, and placing materials at locations as shown on the plans or as directed by the engineer.

**2.0 Material.** All materials shall be in accordance with MoDOT specifications and as noted herein.

**2.1 Aggregate For Extending Commercial Mixture.** Coarse and fine aggregates shall be in accordance with [Sec 1005](#), except the requirements for gradation and percent passing the No. 200 sieve shall not apply. Coarse aggregate meeting Gradation E requirements shall be used for repairs greater than one inch (25 mm) in depth. Fine aggregate will be allowed for repairs less than one inch (25 mm). Aggregate specified, bagged, labeled and furnished by the rapid set concrete patching material manufacturer may also be used for mortar extension.

**2.2 Material Applications.** The contractor shall select and use the product most suitable for the work and field conditions in accordance with these specifications.

**2.3 Curing.** Rapid set concrete patching material shall be cured until the minimum compressive strength 3200 psi is attained using standard curing specifications, unless otherwise specified by the manufacturer.

**2.4 Qualification and Project Acceptance.**

**2.4.1 Inspection.** All materials shall be subject to inspection and sampling by MoDOT at the source of manufacture, intermediate shipping terminal or destination. MoDOT will be allowed free access to all facilities and records as required to conduct inspection and sampling.

**2.4.2 Qualification.** Prior to use, rapid set concrete patching material shall be qualified. In order to become qualified, a material shall have completed testing through AASHTO's National Transportation Product Evaluation Program (NTPEP). The manufacturer shall contact the AASHTO/NTPEP coordinator to obtain the testing location for the rapid setting concrete patching material.

**2.4.2.1 Requested Information.** The manufacturer shall submit with samples of the materials, a written request to Construction and Materials with the following information:

- (a) Brand name of the product.
- (b) Certification that the material meets this specification.
- (c) NTPEP test results showing compliance with this special provision.
- (d) Specific mixing, handling and curing instructions.
- (e) Application type (i.e., bridge or roadway).

**2.4.2.2 Qualified List.** Upon approval by the engineer, the brand name and manufacturer will be placed on a qualified list of rapid set concrete patching materials. The listing of qualified materials is available from Construction and Materials or on MoDOT's web site. New certified

JOB SPECIAL PROVISIONS (BRIDGE)

---

test results and samples shall be submitted any time the manufacturing process or the material formulation is changed. The material will be subject to removal from the qualified list if there is evidence of unsatisfactory performance or a change in manufacturing process or formulation, or when random sampling and testing of material offered for use indicates nonconformity with any of the requirements herein specified.

**2.4.3 Provisional Approval.** Provisional approval may be granted provided the following requirements have been met:

- (a) New Products Evaluation Form
- (b) Certified test results from an independent laboratory showing compliance with this special provision.
- (c) Documentation prepared by MoDOT covering two years of field performance on MoDOT's system. MoDOT will need to approve the location of the test site. Documentation will contain the placement date, field observations (semi annual), description of field performance and photographs of in-place material.
- (d) During placement the manufacturer's representative shall be present on the project to provide technical expertise.

**2.4.3.1 Disqualification.** If during the two year observation period the repair area(s) fails provisional approval will not be granted. Repair area(s) experiencing any cracking, debonding or spalling will be considered a failure.

**2.4.3.2 Length of Provisional Approval.** Provisional approval will be granted for three years or until NTPEP testing is completed.

**2.5 Certification.** The contractor shall supply a manufacturer's certification to the engineer for each lot of material furnished. The certification shall include the name of the manufacturer, a manufacturer certification statement that the material supplied is the same as that qualified and listing the date of qualification.

**2.6 Acceptance.** Acceptance of the material will be based on the use of a qualified or provisionally approved material, the manufacturer's certification that the material supplied is the same as that approved and upon the results of such tests as may be performed by the engineer.

**3.0 Mixture.** Unless otherwise specified, rapid set concrete patching material shall be approved commercial mixtures meeting [Sections 3.1 – 3.1.3](#) or deck repair cementitious mortar meeting [Section 3.2](#). Rapid set concrete patching materials shall be specifically designed for the application needed.

**3.1 Commercial Mixtures.** Rapid set concrete patching material in its sacked form and mixtures when properly prepared in accordance with the manufacturer's specifications, shall meet the minimum test requirements given in Table 1. Mixtures may be supplied, as required, as a patching mortar or as a patching mortar with aggregate extension. If the material is to be supplied with

JOB SPECIAL PROVISIONS (BRIDGE)

extender aggregate, this shall also pass the required tests in Table 1 using the maximum allowed amount of extender aggregate.

**3.1.1 Mixture Requirements.** Rapid set concrete patching material shall be single packaged dry mix requiring the addition of water or other liquid component just prior to mixing. The material shall be capable of ½ inch (13 mm) to full depth repair and require no bonding agent. The material shall not contain soluble chlorides as an ingredient of manufacture. The material shall be placed in accordance to the manufacturer's recommendations.

<b>Table 1 (English Unit)</b>				
<b>Physical Test Property</b>	<b>Specification</b>	<b>Requirement for cementitious concrete</b>	<b>Requirement for polymer-modified concrete</b>	<b>Requirement for polymer concrete</b>
Bond Strength by Slant Shear <sup>1</sup>	ASTM C882/C928 <sup>3</sup>	min. 1000 psi @ 24hrs. & min. 1500 psi @ 7 days	n/a	min. 1000 psi @ 24hrs. & min. 1500 psi @ 7 days
Linear Coefficient of Thermal Expansion <sup>1, 2</sup> (for bagged mortar only, without extension aggregate)	ASTM C531	n/a	n/a	4 – 8 X 10 <sup>-6</sup> in/in/deg F
Resistance to Rapid Freezing & Thawing <sup>1</sup>	AASHTO T161 or ASTM C666	80% min. using Procedure B <sup>5</sup> (300 Cycles)	80% min. using Procedure B <sup>5</sup> (300 Cycles)	n/a
Compressive Strength <sup>1</sup>	AASHTO T22 or ASTM C39	3200 psi @ 3 hr & 4000 psi @ 7 days	3200 psi @ 3 hr & 4000 psi @ 7 days	n/a
Rapid Chloride Permeability <sup>1</sup>	AASHTO T277 or ASTM C1202	<u>Bridge Decks</u> 1000 coulombs @ 28 days <u>Roadway</u> 2000 coulombs @ 28 days	<u>Bridge Deck</u> 1000 coulombs @ 28 days <u>Roadway</u> 2000 coulombs @ 28 days	<u>Bridge Deck</u> 1000 coulombs @ 28 days <u>Roadway</u> 2000 coulombs @ 28 days
Length Change <sup>1, 4</sup>	AASHTO T 160 or ASTM C157	In water Storage (+0.15) In air storage (-0.15)	In water storage (+0.15) In air storage (-0.15)	n/a
Color		gray	gray	gray

<sup>1</sup>The commercial mix test values can be located in the AASHTO's National Transportation Product Evaluation Program (NTPEP) reports for Laboratory Evaluations of Rapid Set Concrete Patching Materials. Data for provisionally approved materials is located at the Construction and Materials Division.

JOB SPECIAL PROVISIONS (BRIDGE)

<sup>2</sup>Not required for extended mixtures if the mortar passes this requirement.

<sup>3</sup> ASTM C882 shall be performed on non-water based materials. ASTM C928 shall be performed on water-based materials.

<sup>4</sup> As modified by ASTM C928.

<sup>5</sup> Procedure A may be used in lieu of Procedure B

**3.1.2 Construction Requirements.** The manufacturer shall provide with the bagged mixture, specifications for the mixing procedure, amount and kind of liquid to be added, and the amount of aggregate extension allowed, if any. All mixing, handling and curing practices recommended by the manufacturer shall be followed and will be considered a part of these specifications.

**3.1.3 Removal from Qualified List.** All mixtures shall be approved before use. Reoccurring failures of any mixture for any reason will be cause for removal from the qualified list.

**3.2 Deck Repair Concrete.** A qualified rapid set concrete patching material indicated for horizontal use and intended for patching concrete bridge decks may be used when specified on the plans and as approved by the engineer. If this option is selected, the contractor shall provide a trial mix to determine the total cure time needed to achieve a compressive strength of 3200 psi (22 MPa). Compressive specimens shall be prepared in accordance with current MoDOT test methods and cured to simulate actual field conditions. Testing of compressive specimens shall be performed by methods and at facilities acceptable to the engineer. The repaired deck shall not be opened to traffic until at least 4 hours after the last placement of deck repair concrete, the established cure time has elapsed and until such concrete has achieved a compressive strength of 3200 psi (22 MPa). A new trial mix may be required if the engineer determines the field conditions vary substantially from trial mix conditions. The engineer will make field cylinders to verify the 3200 psi (22 MPa) minimum strength.

#### **4.0 Construction Requirements.**

**4.1 Mixing.** Rapid set concrete patching material shall be mixed and finished according to the manufacturer's recommendation.

**4.2 Preparation of Repair Area.** Deteriorated, damaged or defective concrete as shown on the plans, required by the specifications or as directed by the engineer, shall be removed. All exposed reinforcement shall be thoroughly cleaned as shown on the plans, required by the specifications or as directed by the engineer. Unless otherwise specified by the commercial mixture manufacturer, the existing surface shall be damp and all free water shall be removed prior to placement of the required material.

**4.3 Bonding Agent.** A bonding agent may be used if recommended by the rapid set concrete patching material manufacturer.

**5.0 Method of Measurement.** No measurement will be made for rapid set concrete patching material.

**6.0 Basis of Payment.** Rapid set concrete patching material will be paid for at the contract unit price for other items and will be considered full compensation for all labor, equipment and material to complete the described work.

JOB SPECIAL PROVISIONS (BRIDGE)

C. DYNAMIC PILE TESTING

**1.0 General.**

**1.1 Scope of Work.** Scope of work shall include furnishing all labor, equipment and analysis associated with dynamic testing of driven piles as specified in this special provision.

**1.2 Performance and Design Requirements.** Performance and design conditions for dynamic testing of driven piles shall be in accordance with [section 4.0](#) of this special provision.

**1.3 Approved Manufacturers.** For the following hardware and software components, only the listed manufacturer is recognized as providing the level of quality required. If the contractor wants to propose a non-listed manufacturer that is considered to provide an equivalent level of quality, this manufacturer shall be identified and supporting documentation provided. Acceptance of the manufacturer as a substitute will be at the discretion of the engineer.

Component	Product	Manufacturer
Pile Driving Modeling - Wave Equation Software	<u>GRLWEAP</u>	<u>Pile Dynamics, Inc.</u>
Pile Driving Monitoring - Hardware & Software	Pile Driving Analyzer - Model PAK	Pile Dynamics, Inc.
Pile Driving Analysis – Signal Matching Software	<u>CAPWAP</u>	<u>Pile Dynamics, Inc.</u>

**1.4 Test Requirements.** Dynamic pile testing shall be conducted in accordance with the standard test method indicated below.

Standard Test Method	Designation	Conducted By
High-Strain Dynamic Testing of Piles	ASTM D 4945	Contractor

**1.5 Qualifications.** The contractor shall perform dynamic pile testing utilizing the services of an independent dynamic pile testing consultant and qualified personnel. An engineer with a minimum of 3 years dynamic pile testing and analysis experience or who has achieved Basic or better certification under the High-Strain Dynamic Pile Testing Examination and Certification process of the Pile Driving Contractors Association and Foundation QA shall perform pile driving monitoring. An engineer with a minimum of 5 years dynamic pile testing and analysis experience or who has achieved Advanced or better certification under the High-Strain Dynamic Pile Testing Examination and Certification process of the Pile Driving Contractors Association and Foundation QA shall perform pile driving modeling and pile driving analyses.

**2.0 Execution.**

**2.1 Pile Driving Modeling.** The contractor shall perform preconstruction wave equation analyses and prepare a summary report of the results. The wave equation analyses shall be used to assess the ability of all proposed pile driving systems to install piles to the required capacity and the desired penetration depth within allowable driving stresses. The report shall include a drivability graph relating pile capacity, blow count and driving stresses to depth. The report shall include a bearing graph relating the pile capacity to the pile driving resistance. The bearing graph shall indicate blow count versus capacity and stroke. The report shall also contain

JOB SPECIAL PROVISIONS (BRIDGE)

---

a constant capacity analysis or inspectors chart to assist the engineer in determining the required driving resistance at other field observed strokes. The contractor shall perform wave equation analyses in accordance with [section 4.0](#) of this special provision. Acceptability of the wave equation report and the adequacy of analyses will be determined by the engineer.

**2.1.1** Approval by the engineer of the proposed pile driving system will be based upon the wave equation analyses indicating that the proposed system can develop the specified pile capacity at a pile driving rate of 2 to 10 blows per inch at the end of driving, and within allowable driving stresses per *AASHTO LRFD Bridge Construction Specifications*, Section 4.4.1. The contractor shall provide preliminary pile driving criteria based on wave equation analyses and any anticipated capacity changes after driving, set-up or relaxation, subject to revision based upon dynamic pile testing field measurements

**2.1.2** If any changes or modifications are made to the approved pile driving system, additional wave equation analyses in accordance with [section 2.1](#) of this special provision shall be required.

**2.2 High-Strain Dynamic Pile Testing.**

**2.2.1** The contractor shall perform dynamic pile testing at the locations and frequency required in accordance with [section 4.0](#) of this special provision.

**2.2.2** Dynamic pile testing involves monitoring the response of a pile subjected to heavy impact applied by the pile hammer at the pile head. The testing shall provide information on the driving stresses, pile capacity, structural integrity and hammer efficiency.

**2.2.3** The contractor shall engage an independent dynamic pile testing consultant and qualified personnel in accordance with [section 1.5](#) of this special provision. Prior to testing, the engineer will review and approve the proposed independent dynamic pile testing consultant, the experience and qualifications of assigned personnel, details of the method of testing, a list of equipment, and the method of analysis of test results. The contractor shall provide all available details of the subsurface conditions, pile dimensions and properties, and pile driving systems to the independent dynamic pile testing consultant.

**2.2.4** All field testing and measurements shall be made in the presence of the engineer.

**2.3 Field Testing.**

**2.3.1 Equipment.** Dynamic pile testing field measurements shall be carried out using approved equipment, software and recording equipment. The data collected at the end of initial driving shall be analyzed using approved signal matching techniques and software.

**2.3.2 Monitoring during driving.** During pile driving, piles shall be instrumented and monitored with testing equipment satisfying the requirements of [section 1.3](#) of this special provision.

**2.3.2.1** The contractor shall install two sets of strain transducers and accelerometers near the top of each pile to be tested, and shall use a compatible measuring and recording system to record the data during driving.

JOB SPECIAL PROVISIONS (BRIDGE)

---

**2.3.2.2** The equipment required to be attached to the pile shall be appropriately positioned and fixed to the approval of the engineer.

**2.3.2.3** The hammer and all site equipment used shall be capable of delivering an impact force sufficient to mobilize the specified pile capacity indicated in [section 4.0](#) of this special provision without damaging the pile.

**2.3.2.4** The testing equipment shall monitor pile stresses during driving to prevent pile damage and ensure pile integrity and capacity. If the testing equipment indicates overstressing or damage to the pile, the contractor shall immediately discontinue driving and notify the engineer.

**2.3.2.5** If the testing equipment determines that pile stresses during driving exceed acceptable levels, a new pile driving system, modifications to existing system or new pile installation procedures shall be proposed by the contractor. Approval by the engineer of any proposed changes to the pile driving system or pile installation procedures will be based upon the results of additional wave equation analyses in accordance with [section 2.1.2](#) of this special provision.

**2.3.3 Preparation of the Pile Head.** The preparation of the pile head for the application of dynamic test load shall involve, where appropriate, trimming the head, cleaning, and building up the pile using materials that shall, at the time of testing, safely withstand the impact stresses. The impact surface shall be flat and at right angles to the pile axis.

**2.3.4 Dynamic Measurement and Analysis.** Monitoring of pile driving shall begin when pile driving begins. The data shall be recorded and processed immediately in the field by the pile driving monitoring equipment and software. Unless monitoring indicates that additional driving will damage the pile, pile driving and monitoring shall continue until both the specified pile tip elevation and the specified pile capacity are reached. For each pile tested, pile driving analysis using signal matching techniques shall be performed for a selected blow at the end of driving to determine the relative capacities from end bearing and skin friction along the pile.

**2.3.4.1** The engineer may request use of pile driving monitoring equipment and software on additional piles if inconclusive results are obtained or unusual driving conditions are encountered.

**2.3.4.2** Pile bearing capacity and integrity shall be evaluated based on the standard procedure used in practice.

**2.3.4.3** Tabular records of the dynamic pile testing field measurements obtained at the end of initial driving shall be immediately provided to the engineer by the contractor.

**2.3.5 Results.**

**2.3.5.1 Preliminary Reports.** The contractor shall prepare a preliminary report for each pile tested for review by the engineer. Each report shall contain tabular as well as graphical presentation of the dynamic test results versus depth. Each report shall also indicate the pile driving criteria for the additional piles to be installed at the substructure unit of the pile tested. Each preliminary report shall include the following:

- (a) The maximum force applied to the pile head.

JOB SPECIAL PROVISIONS (BRIDGE)

- (b) The maximum pile head velocity.
- (c) The maximum energy imparted to the pile.
- (d) The assumed soil damping factor and wave speed.
- (e) Static capacity estimate.
- (f) The maximum compressive and tensile forces in the pile .
- (g) Pile integrity.
- (h) Blows per inch.
- (i) Stroke.
- (j) Summary results of pile driving analysis from selected blow analyzed using signal matching techniques and software.

**2.3.5.2 Summary Report.** The contractor shall prepare a summary report of all piles tested for review by the engineer. The report shall include the results of hammer performance, pile driving stresses, and pile capacity during initial driving for all piles tested. The report shall also include the following:

- (a) Date of testing and date of pile installation.
- (b) Pile identification number and location.
- (c) All information given in preliminary reports as follows:
  - (1) Length of pile below commencing surface.
  - (2) Total length of pile, including projection above commencing surface at time of test.
  - (3) Length of pile from instrumentation position to tip.
- (d) Hammer type, drop, and other relevant details.
- (e) Blow selected for signal matching analysis.
- (f) Maximum compressive and tensile stresses, stroke, and capacity versus penetration depth.
- (g) Temporary compression.
- (h) Pile integrity and location of damage, if any.

**JOB SPECIAL PROVISIONS (BRIDGE)**

- (i) Force/velocity versus time trace.
- (j) Force/velocity match curve.
- (k) Resistance distribution along the pile.
- (l) Detailed graphical and tabular results from blow analyzed using signal matching techniques and software.

**3.0 Schedule of Contract Submittals.**

<b>Item Number</b>	<b>Submittal Item</b>	<b>Type</b>	<b>Calendar Days</b>	<b>Event/Date</b>	<b>Liquidated Damages Apply</b>
1	Proposed independent dynamic pile testing consultant, and a listing of assigned personnel and their experience and qualifications.	DOCS	45 Before	Start of Pile Driving Monitoring	No
2	Details of the components, method of testing, pile driving equipment and materials to be used, and the results of wave equations analyses.	DOCS	15 Before	Start of Pile Driving Monitoring	No
3	Two copies of each Preliminary Report as defined in section 2.3.5.1 of this special provision	DOCS	3 After	Completion of Each Field Test	No
4	Four copies of the Summary Report as defined in section 2.3.5.2 of this special provision	DOCS	7 After	Completion of All Field Tests	No

**4.0 High-Strain Dynamic Pile Testing Specification.**

<b>Item</b>	<b>Requirement</b>
Wave Equation Analysis	Minimum of 1 and sufficient additional analyses as needed to define performance for all combinations of piles, driving systems and subsurface conditions anticipated.
Dynamic Testing Pile Capacity	Nominal Axial Pile Compressive Resistance or 2.25 times the Design Bearing shown on the plans or as required by engineer
End of Initial Driving Test Frequency	As shown in the contract plans

JOB SPECIAL PROVISIONS (BRIDGE)

Item	Requirement
Pile Driving Analyses using Signal Matching Techniques	For each End of Initial Driving Test

**5.0 Method of Measurement.** Dynamic pile testing will be measured per each.

**6.0 Basis of Payment.** Payment for the above described work, including all material, equipment, tools, labor and any other incidental work necessary to complete this item, will be considered completely covered by the contract unit price for “Dynamic Pile Testing”.

D. HYDROPHILIC WATERSTOP

**1.0 Description.** This work shall consist of fabricating and installing hydrophilic waterstops between the raised sidewalks and roadway surface of Bridge A48441 as shown on the plans.

**2.0 Materials.** Waterstops shall be made of hydrophilic, non-bentonite composition manufactured solely for the purpose of preventing water from traveling through construction joints. Volumetric expansion shall be limited to 3 times maximum.

**3.0 Approved Products.** The following are approved manufacturer products:

- a) Sika (Hydrotite CJ)
- b) Adeka (Ultra Seal USA)
- c) DeNeef (Swellseal WA)
- d) Approved Equal

**4.0 Construction Requirements.** Hydrophilic waterstops shall be installed per manufacturer’s recommendations.

**5.0 Method of Measurement.** No measurement shall be made.

**4.0 Basis of Payment.** Payment for the above described work, including all material, equipment, labor and any other incidental work necessary to complete this item, will be included in the contract unit price for Sidewalk (Bridges) per square foot.

E. EPOXY URETHANE POLYMER WEARING SURFACE

**1.0 Description.** This work shall consist of constructing an epoxy urethane polymer wearing surface on a prepared surface in accordance with this specification, as shown on the plans or as directed by the engineer. Epoxy urethane polymer wearing surface shall be composed of the following components: a healer/sealer prime coat and two courses of epoxy urethane polymer and aggregate.

**1.1 Required Experience.** The contractor shall have experience placing similar epoxy urethane polymer wearing surface systems on at least three structures prior to performing work on this

JOB SPECIAL PROVISIONS (BRIDGE)

project. Written proof of this experience along with project contacts shall be provided to the engineer in writing for approval prior to the preconstruction meeting. Prior to installation of the wearing surface, the contractor shall also provide certification by the material supplier that the contractor is a trained and qualified installer of the selected wearing surface system.

**2.0 Material.** All material shall be in accordance with [Division 1000](#), Material Details, and specifically as follows:

**2.1 Epoxy Urethane Resin.** The infrared spectrum for each component of the epoxy urethane polymer shall essentially match that of the standard infrared spectrum for the particular component as specified in AASHTO T 237, Sections 4 and 5. The epoxide equivalent for Component A shall not exceed 270. The mixed epoxy urethane polymer shall be a two-component (base and hardener), 100% solids, thermosetting, moisture insensitive, flexible, high elongation epoxy urethane resin in accordance with the following physical requirements:

Property	Requirement
Pot life (at 75 F), minutes	15 to 45
Tensile Strength (at 75 F, 7 days), psi, min.	2500
Tensile elongation (at 75 F), percent, min.	30
Water Absorption, percent, max.	1
Compressive Strength (at 3 hr), psi, min.	1000
Compressive Strength (at 24 hr, wet), psi, min.	5000
Rotational Viscosity, (at 75 F, spindle 3, 20 rpm), poise	35 to 70
Thermal Shear (shearing, shrinkage, expansion or scaling)	None
Shore D Hardness (ASTM D 2240) (at 77 F)	60 to 75
Adhesion Strength (at 24 hr), psi, min.	250

**2.1.1 Classes.** Epoxy resin shall be formulated for use at specific temperatures as specified in ASTM C 881. The controlling temperature shall be that of the hardened concrete surface to which the polymer is applied. Where unusual curing rates are desired and upon the approval from the engineer, a class of epoxy resin may be used at a temperature other than that for which the epoxy resin is normally intended.

**2.1.2 Packaging.** Containers shall be identified as "Component A--Contains Epoxy Resin" and "Component B--Contains Hardener" and shall show the type, class and mixing directions. Each container shall be marked with the name of the manufacturer, class, batch, or lot number, date of packaging, date of shelf life expiration, pigmentation (if any), manufacturer, and the quantity contained in pounds and gallons.

**2.2 Prime Coat.** The prepared surface shall receive a healer/sealer prime coat, as specified on the plans or as recommended by the manufacturer, that is compatible with the wearing surface system selected.

**2.3 Aggregate.** Aggregate shall be bauxite, crushed porphyry, aluminum oxide, flint chat or other similarly hard, durable, dry aggregate with less than 0.2 percent moisture. Aggregate shall be in accordance with the following gradation:

Sieve Size	% Passing By Weight
------------	---------------------

JOB SPECIAL PROVISIONS (BRIDGE)

No. 4	100
No. 20	0 – 5
No. 200	0 – 1.0

**2.3.1 Lead Content.** Aggregate produced as a by-product from lead or zinc mining operations shall not have a total lead content greater than 4,500 ppm, as determined by EPA Method 3050A, “Acid Digestion of Sediments, Sludges and Soils”. Suppliers of this aggregate shall provide certification to the engineer for each shipment that the total lead content of the aggregate does not exceed this value and attach a typical test report from the same source no older than 12 months prior to the shipment.

**2.3.2 Aggregate Recommendation.** For each contract, the epoxy urethane polymer supplier shall supply a letter to the engineer specifically recommending the use of a designated aggregate and source, which has been previously approved by Construction and Materials.

**2.3.3 Epoxy Urethane Polymer Performance.** The epoxy urethane polymer system shall not exhibit shearing, shrinkage, expansion or scaling.

**2.3.4 Test Methods.** Tests will be performed in accordance with the following methods:

<b>Test Methods</b>	
Rotational Viscosity	ASTM D 2393 Model LVT Brookfield viscometer
Epoxy Equivalent	MoDOT Test Method TM 73
Filler Content	MoDOT Test Method TM 73
Pot Life	AASHTO T 237
Elongation	ASTM D 638
Tensile Strength	ASTM D 638
Compressive Strength	ASTM C 881
Water Absorption	ASTM D 570
Thermal Shear	MoDOT Test Method TM 72

**2.3.5 Manufacturer and Brand Name Approval.** Prior to approval and use of this material, the manufacturer shall submit to Construction and Materials a certified test report showing specific test results in accordance with all requirements of this specification. The certified test report shall include the manufacturer’s name, brand name of material, lot tested, date of manufacture, ratio of components by volume and system tested. In addition, the manufacturer shall submit to Construction and Materials a sample representing the system for laboratory testing accompanied by a technical data sheet, an MSDS and any special installation instructions relative to the system being submitted. Upon approval of the certified test report and satisfactory results of tests performed on the sample submitted, the brand name and manufacturer will be placed on a qualified list of epoxy resin material for epoxy urethane polymer concrete wearing surface. New certified test results and samples shall be submitted any time the manufacturing process or the material formulation is changed and may be required when random sampling and testing of material offered for use indicates non-conformity with any of the requirements herein specified.

**2.3.6 Product History.** The epoxy urethane polymer shall have a proven record of a minimum of two years on similar bridge decks within the United States. A list including the location, the

JOB SPECIAL PROVISIONS (BRIDGE)

name of the agency involved with the project, and a name and phone number of a contact person with that agency shall be provided for each location used as evidence of satisfactory use.

**2.3.7 Acceptance.** The manufacturer shall furnish certification to the engineer at the destination that the material supplied is in accordance with all requirements specified and stating that the material supplied is the same system and is identically formulated to the material tested for manufacturer and brand name approval. Acceptance will be based on certification and testing.

**3.0 Construction Requirements.**

**3.1 Manufacturer Representation.** The wearing surface manufacturer's representative shall witness the entire testing phase of each field test. The manufacturer's representative shall verify that all operations are performed by acceptable practices.

**3.2 Handling and Storage of Material.** Handling and storage of material shall be in accordance with the manufacturer's written recommendations.

**3.3 Field Test.** Prior to the start of the wearing surface operation, a test area of the complete wearing surface system shall be placed on the bridge deck in a contractor proposed location that is approved by the engineer. When multiple bridges are included in a project, a test area will be required on each bridge. The contractor may utilize one-half of the bridge deck or an area equal to one day's placement operation, whichever is smaller, as a field test. The degree of cleaning used on the test area shall be the minimum used on the remainder of the structure. The surface for the test wearing surface shall be prepared in accordance with the test method prescribed in ACI 503R - Appendix A of the ACI Manual of Concrete Practice to establish an approved cleaning practice. The approved cleaning practice shall remove all potentially detrimental material which may interfere with the bonding or curing of the wearing surface. Concrete shall be sound, with mortar soundly bonded to the coarse aggregate, with clean and open pores to be considered adequate for bond. All areas of asphalt and pavement markings shall be removed. Preparation of the surface shall produce a surface relief equal to International Concrete Repair Institute (ICRI) surface preparation level 6 or 7 or ASTM E 965 pavement macrotexture depth of 0.04 to 0.08 inch.

**3.3.1** Visible moisture on the prepared deck at the time of placing the wearing surface will not be permitted. Moisture in the deck shall be checked by taping a plastic sheet to the deck for a minimum of 2 hours in accordance with ASTM D4263.

**3.3.2** In addition to the above requirements, the cleaning practice shall provide an adhesion strength test result greater than 250 psi or a failure area into the base concrete that is greater than 50 percent of the test area. After the test area has cured for a minimum of 72 hours, adhesion shall be checked in accordance with ACI 503R. A test result will be the average of three tests on a sample area of the test patch. A minimum of three sample areas per test patch shall be tested. Successful test results will be required from each sample area.

**3.3.3** If the test of a sample area fails to meet the above requirements due to a cohesive failure of the substrate concrete, the adhesive strength of the sample area will be considered acceptable.

JOB SPECIAL PROVISIONS (BRIDGE)

---

**3.3.4** Successful completion of the adhesion strength tests will be required before the full-scale wearing surface operation is to begin. All cleaning operations shall equal those used for the adhesion strength test areas in both profile and cleanliness. If changes are made to the established cleaning practice, new adhesion strength testing shall be performed at the contractor's expense.

**3.3.5** Test patches shall be installed with the same material, equipment, personnel, timing, sequence of operations and curing period that will be used for the installation of the wearing surface.

**3.3.6** If the test fails, the contractor shall remove the material represented by the failed test patches and provide another test patch, at the contractor's expense, until satisfactory test results are obtained.

**3.4 Surface Preparation.** Before placement of the wearing surface, the entire deck surface shall be prepared by the cleaning practice established in the field adhesion strength tests in accordance with section 3.3 of this job special provision by shot blast method. Sand blasting will not be permitted. Clean-up and disposal of blast material shall be in accordance with [Sec 202.3.1.3](#).

**3.4.1** If the engineer determines that the weather has changed significantly since the application of the field test patch, the contractor shall verify through adhesion strength tests that the practice is acceptable, at the contractor's expense.

**3.4.2** No traffic of any kind shall be permitted on any portion of the deck which has been shot blasted or on the wearing surface without approval from the engineer. The time between surface preparation and application of the first course shall not exceed 24 hours.

**3.4.3** All patching and cleaning operations shall be inspected and approved prior to placing the wearing surface.

**3.4.4** If the deck or intermediate course is contaminated by foreign material or water after initial cleaning, the contamination and any detrimentally affected wearing surface material shall be removed. Both courses shall be applied prior to opening the area to traffic.

**3.5 Equipment.** The contractor's equipment shall be as recommended by the epoxy urethane manufacturer.

**3.6 Epoxy Mixing.** Mixing of epoxy urethane polymer components shall be in accordance with the manufacturer's recommendations, except that the use of a volumetric mixer will be required. When mineral fillers are specified, the mineral fillers shall be inert and non-settling or readily dispersible. Material showing a permanent increase in viscosity or the settling of pigments that cannot be readily dispersed with a paddle shall be replaced at the contractor's expense. At least 95 percent of the filler shall pass the No. 200 sieve.

**3.7 Application.** Application of epoxy urethane polymer shall be performed by the manufacturer or by a factory trained or licensed applicator with written approval from the manufacturer of the epoxy system.

JOB SPECIAL PROVISIONS (BRIDGE)

**3.7.1** The handling and mixing of epoxy urethane polymer shall be in accordance with the manufacturer's written recommendations. The epoxy urethane polymer shall not be placed when weather or surface conditions are such that the material cannot be properly handled, placed and cured within the specified requirements of traffic control, or when rain is forecast within 24 hours of application.

**3.7.2** The wearing surface shall consist of a two-course application of epoxy urethane polymer and aggregate. A healer/sealer prime coat shall be used as specified on the plans or if recommended by the manufacturer. Each of the two courses shall consist of a layer of epoxy urethane polymer covered with a layer of aggregate in sufficient quantity to completely cover the epoxy urethane polymer. The thickness of each course shall be approximately equal. The total thickness of the wearing surface shall be no less than 1/4 inch.

**3.7.3** The temperature of the bridge deck surface at the time of application shall be less than 90 F and in accordance with the manufacturer's recommendation.

**3.7.4** Dry aggregate shall be applied in such a manner as to cover the epoxy urethane polymer completely within 5 minutes of application. The dry aggregate shall be placed in a manner such that the level of the epoxy urethane polymer is not disturbed.

**3.7.5** The first course shall be swept to remove loose aggregate prior to the second course application. Sweeping shall be performed without removing embedded aggregate. First course applications which do not receive enough aggregate prior to gelling shall be removed and replaced. A second course applied with insufficient aggregate may be left in place, but additional applications shall be placed at the contractor's expense before opening to traffic.

**3.7.6** The thickness of the wearing surface shall be verified to be at least 1/4 inch, measured from the deck surface to the top of the epoxy urethane polymer. The contractor shall provide a minimum 1/2 inch diameter hole at a rate of at least one hole per 100 feet of traffic lane. Hole placement shall be at locations designated by the engineer. Thin areas shall be recoated and reverified at the contractor's expense.

**3.7.7** When additional applications or recoating are required, the engineer may require additional adhesion strength tests by the contractor, at the contractor's expense, in accordance with ACI 503R to verify the contractor's procedure.

**3.7.8** All adhesion strength test areas, thickness test holes or any debonded areas shall be repaired by filling them with wearing surface material before final acceptance.

**3.7.9** The first epoxy urethane polymer course shall be cured at least one hour or until brooming or vacuuming can be performed without tearing or otherwise damaging the surface. No traffic or equipment shall be permitted on the first course surface during the curing period.

**3.7.10** After the curing period, all loose aggregate shall be removed by brooming or vacuuming and the next epoxy urethane polymer course applied as specified in the contract documents.

**3.7.11** The epoxy urethane polymer mixture shall not be permitted to run into drains.

JOB SPECIAL PROVISIONS (BRIDGE)

---

**3.7.12** Unless otherwise specified, the epoxy urethane polymer courses shall be applied over the expansion joints and joint seals of the bridge deck. The expansion joints and joint seals shall be provided with a bond breaker. Prior to opening to traffic, the wearing surface shall be removed over each joint by removal of the bond breaker in accordance with the epoxy urethane polymer manufacturer's recommendations.

**3.7.13** Prior to opening a section to public or construction traffic, the wearing surface shall be allowed to cure in accordance with the manufacturer's recommendations. First course applications shall not be opened to traffic.

**3.7.14** Damaged or debonded areas of an epoxy urethane polymer course shall be removed and repaired prior to acceptance. Repair shall consist of saw-cutting in rectangular sections to the top of the concrete deck surface and replacing the various courses in accordance with this job special provision at the contractor's expense.

**4.0 Method of Measurement.** Final measurement will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. Where required, the area of epoxy urethane polymer wearing surface will be measured to the nearest square yard based on measurement longitudinally from end to end of bridge deck and transversely between roadway face of curbs, excluding the area of any expansion devices. The revision or correction will be computed and added to or deducted from the contract quantity.

**5.0 Basis of Payment.** The accepted quantity of epoxy urethane polymer wearing surface will be paid for at the contract unit price. Payment will be considered full compensation for all labor, equipment and material necessary to complete the described work.