



# INDIANA DEPARTMENT OF TRANSPORTATION

100 North Senate Avenue  
Room N925 - CM  
Indianapolis, Indiana 46204

PHONE: (317) 232-5456  
FAX: (317) 232-5551

**Michael R. Pence, Governor**  
**Brandye L. Hendrickson,**  
**Commissioner**

# APPROVED MINUTES

## May 19, 2016 Standards Committee Meeting

MEMORANDUM

June 24, 2016

TO: Standards Committee

FROM: Scott Trammell, Secretary

RE: Minutes from the May 19, 2016 Standards Committee Meeting

The Standards Committee meeting was called to order by Mr. Miller at 09:00 a.m. on May 19, 2016 in the N955 Bay Window Conference Room. The meeting was adjourned at 10:26 a.m.

Mark Miller, Chairman, Construction Management Director  
Bob Cales, Director, Contract Administration Division  
Joseph Bruno\*, Traffic Engineering Division  
Elizabeth Phillips, Bridge Standards and Policy Supervisor  
Greg Pankow, State Construction Engineer  
Michael Koch, Fort Wayne District Area Engineer  
Rob Goldner, Manager, Construction Technical Support  
Peter Yao, Road Services  
Matthew Beeson, Materials Engineer, Materials Management

\*Proxy for Dave Boruff

Also in attendance were the following:

Scott Trammell, INDOT	Michael Prather, INDOT
Tom Duncan, FHWA	Jason Wielinski, Heritage Research
Lana Podorvanova, INDOT	Melinda Schwer, INDOT
Steve Fisher, INDOT	Dudley Bonte, APAI
Joel Salinas, INDOT	Dimas Prasetya, FHWA
Andrew Pangallo, INDOT	

The following items were listed for consideration:

### A. GENERAL BUSINESS ITEMS

#### OLD BUSINESS

(No items were listed)

#### NEW BUSINESS

1. *Approval of the Minutes from the April 21, 2016 meeting*

DISCUSSION: Mr. Pankow requested a motion to approve the minutes from the April 21, 2016 meeting.

Motion: Mr. Cales  
Second: Ms. Phillips  
Ayes: 8  
Nays: 0

ACTION: PASSED AS SUBMITTED

B. CONCEPTUAL PROPOSAL ITEMS

OLD BUSINESS

(No items were listed)

NEW BUSINESS

(No items were listed)

C. STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS PROPOSED ITEMS

OLD BUSINESS

(No items were listed)

NEW BUSINESS

Item No. 1 (2016 SS) Mr. Boruff pg 3

Recurring Special Provision:  
617-T-XXX HIGH FRICTION SURFACE TREATMENT

ACTION: PASSED AS REVISED

Item No. 2 (2016 SS) Mr. Beeson pg 14

Recurring Special Provision:  
413-R-634 FULL DEPTH RECLAMATION, FDR

ACTION: PASSED AS REVISED

Item No. 3 (2016 SS) Mr. Beeson pg 26

Recurring Special Provision:  
416-R-XXX COLD IN-PLACE RECYCLING, CIR

ACTION: PASSED AS SUBMITTED

cc: Committee Members  
FHWA  
ICI

STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS  
REVISION TO STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS

---

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: In 2014, there were 705 fatal crashes in Indiana. Approximately 25% of fatal crashes occur at horizontal curves and roadway departure crashes remain an emphasis area in Indiana's Strategic Highway Safety Plan.

PROPOSED SOLUTION: FHWA is encouraging state DOT's to deploy high friction surface treatments (HFST) at horizontal curves and other critical locations as part of its Every Day Counts initiative. HFST has been shown to dramatically reduce crashes at horizontal curves. HFST consists of a high friction aggregate (primarily calcined bauxite aggregate) set in a polymer resin binder.

More info on HFST is at: <http://www.fhwa.dot.gov/innovation/everydaycounts/edc-2/hfst.cfm>

APPLICABLE STANDARD SPECIFICATIONS: No

APPLICABLE STANDARD DRAWINGS: No

APPLICABLE DESIGN MANUAL SECTION: No

APPLICABLE SECTION OF GIFE: No

APPLICABLE RECURRING SPECIAL PROVISIONS: No

PAY ITEMS AFFECTED: No

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Ad hoc review by Mike Holowaty, Shuo Li, Scott Trammell, and Kenny Anderson

IMPACT ANALYSIS (attach report): Yes, attached.

Submitted By: Joe Bruno on behalf of Dave Boruff

Title: Traffic Administration Engineer

Organization: INDOT

Phone Number: (317) 234-7949

Date: 4/25/2016

STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS  
REVISION TO STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS

IMPACT ANALYSIS REPORT CHECKLIST

Explain the business case as to why this item should be presented to the Standards Committee for approval. Answer the following questions with Yes, No or N/A.

Does this item appear in any other specification sections? No

Will approval of this item affect the Approved Materials List? No

Will this proposal improve:

Construction costs? No

Construction time? No

Customer satisfaction? Yes

Congestion/travel time? No

Ride quality? No

Will this proposal reduce operational costs or maintenance effort? No

Will this item improve safety:

For motorists? Yes

For construction workers? No

Will this proposal improve quality for:

Construction procedures/processes? No

Asset preservation? Yes

Design process? No

Will this change provide the contractor more flexibility? No

Will this proposal provide clarification for the Contractor and field personnel? No

Can this item improve/reduce the number of potential change orders? No

Is this proposal needed for compliance with:

Federal or State regulations? No

AASHTO or other design code? No

Is this item editorial? No

Provide any further information as to why this proposal should be placed on the Standards Committee meeting Agenda: N/A

REVISION TO STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS  
PROPOSED NEW 617-T-XXX HIGH FRICTION SURFACE TREATMENT

617-T-XXX HIGH FRICTION SURFACE TREATMENT

(Adopted xx-xx-16)

The Standard Specifications are revised as follows:

SECTION 617, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

**SECTION 617 – ~~BLANK~~ HIGH FRICTION SURFACE TREATMENT**

**617.01 Description**

*This work shall consist of applying a high friction surface treatment, HFST, on asphalt or concrete pavement to enhance the skid resistance.*

*The HFST shall be composed of calcined bauxite aggregate bound with a polymeric resin.*

**617.02 Materials**

*Materials shall be in accordance with the following:*

**(a) General**

*The Contractor shall provide a type A certification in accordance with 916 and test reports from an independent laboratory for both the polymeric resin binder and aggregate stating that the materials meet the requirements listed in ~~Tables 1 and 2~~ accordance with 617.02(b) and 617.02(c), respectively, at least 14 days prior to application.*

*Materials shall be stored in a clean, dry environment and in accordance with the manufacturer's recommendations.*

*Material safety data sheets, product data sheets, and other information pertaining to the safe practices for the storage, handling, and disposal of the materials, and their health hazards shall be obtained from the manufacturer and posted at the material storage areas. A copy of such information shall be provided to the Engineer.*

**(b) Polymeric Resin Binder**

*The polymeric resin binder shall consist of a two part thermosetting polymer resin compound which holds the aggregate firmly in position, and in accordance with the following: ~~table~~.*

<b>POLYMERIC RESIN BINDER MATERIAL PROPERTIES REQUIREMENTS</b>		
<i>Property</i>	<i>Test Method</i>	<i>Requirements</i>
<i>Adhesion Strength, psi @ 24 hrs</i>	<i>ASTM C 1583</i>	<i>250 minimum or 100% substrate failure</i>
<i>Compressive Strength, psi</i>	<i>ASTM C 579, Method B</i>	<i>1,000 minimum (3 hours) 5,000 minimum (7 days)</i>

REVISION TO STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS  
 PROPOSED NEW 617-T-XXX HIGH FRICTION SURFACE TREATMENT

<i>Cure Rate (Dry through time), hours</i>	<i>ASTM D 1640, 55 mil wet thickness @ 75°F</i>	<i>3 maximum</i>
<i>Durometer Hardness (Shore D)</i>	<i>ASTM D 2240, Type I precision type D method</i>	<i>60 - 80</i>
<i>Elongation at Break Point, %</i>	<i>ASTM D 638, Type I specimens</i>	<i>30 - 80</i>
<i>Gel Time for concrete surfaces, minutes</i>	<i>ASTM C 881</i>	<i>10 minimum</i>
<i>Mixing Ratio</i>	<i>Provide manufacturer's recommendations a minimum of 14 days prior to application.</i>	<i>Per Manufacturer</i>
<i>Modulus @ 77°F, psi</i>	<i>ASTM C 881</i>	<i>≤ 90,000</i>
<i>Ultimate Tensile Strength, psi</i>	<i>ASTM D 638, Type I specimens</i>	<i>1,500 - 5,000</i>
<i>Viscosity, poises</i>	<i>ASTM D 2556</i>	<i>7 - 30</i>
<i>Water Absorption, %</i>	<i>ASTM D 570</i>	<i>1 maximum</i>

The binder test specimens shall be cured for seven days at  $73 \pm 2^\circ\text{F}$ , and tested immediately upon curing.

**(c) Aggregate**

The aggregate shall be calcined bauxite that is clean, dry, free from foreign matter, and in accordance with the following tables:

<b>CALCINED BAUXITE AGGREGATE MATERIAL REQUIREMENTS</b>		
<i>Property</i>	<i>Test Method</i>	<i>Requirements</i>
<i>Aluminum Oxide, %</i>	<i>ASTM C 25</i>	<i>87 minimum</i>
<i>Gradation</i> <i>Sieve Designation:</i> <i>No. 4 (4.75 mm)</i> <i>No. 6 (3.35 mm)</i> <i>No. 16 (1.18 mm)</i> <i>No. 30 (0.6 mm)</i>	<i>AASHTO T 27</i>	<i>Percent Passing:</i> <i>100</i> <i>95.0-100.0</i> <i>0.0-5.0</i> <i>0.0-1.0</i>
<i>Hardness</i>	<i>Moh's Scale</i>	<i>8 minimum</i>
<i>Micro-Duval Abrasion (NMAS-9.5 mm)</i>	<i>AASHTO T 96</i>	<i>10 maximum (C grading)</i>
<i>Moisture Content, %</i>	<i>AASHTO T 255</i>	<i>0.2 maximum</i>
<i>Polished Stone Value</i>	<i>AASHTO T 279</i>	<i>38-44</i>
<i>Sodium Sulfate Soundness, %</i>	<i>AASHTO T 104</i>	<i>12 maximum</i>

**(d) Quality Control Plan**

The Contractor shall submit a Quality Control Plan, QCP, to the District Testing Engineer for approval at least 14 days prior to application. The QCP shall show proposed

REVISION TO STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS  
PROPOSED NEW 617-T-XXX HIGH FRICTION SURFACE TREATMENT

---

*methods to control the equipment, materials, mixing, and paving operations to ensure conformance with these specifications. The QCP shall contain, at a minimum, the following information:*

1. *Key personnel with contact information.*
2. *Polymeric resin production plants, location of plants, personnel qualifications, inspection and record keeping methods, equipment calibration records, and accreditation certificates.*
3. *Aggregate production plant locations, personnel qualifications, inspection and record keeping methods, equipment calibration records, and accreditation certificates.*
4. *Mix design in accordance with the manufacturer's recommendations.*
5. *Moisture control methods of aggregate.*
6. *List of manufacturer recommendations for storage of material, weather restrictions, working and set-up time, curing time, and opening to traffic.*
7. *Cleaning and maintenance schedule for truck mounted application machine, including metering and monitoring devices.*
8. *Corrective actions that shall be taken for unsatisfactory construction practices and deviations from specifications.*
9. *A technical expert from the polymeric resin manufacturer shall be on call or on site for the startup operations to advise construction personnel in placing the HFST.*
10. *The QCP shall designate a QC Manager. The QC Manager shall be on the jobsite at all times during placement of the HFST.*

~~*A field technician shall be present at the job site unless otherwise approved in the QCP. The field technician*~~*QC Manager shall be responsible for the required field quality control sampling and testing in conformance with the approved quality control plan and contract documents. All sampling shall be performed in the presence of and in locations as directed by the Engineer. The Contractor shall maintain and make available upon request complete records of sampling, testing, actions taken to correct problems, and quality control inspection results.*

### **CONSTRUCTION REQUIREMENTS**

REVISION TO STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS  
PROPOSED NEW 617-T-XXX HIGH FRICTION SURFACE TREATMENT

---

**617.03 Truck Mounted Application Machine**

*The HFST application machine shall be capable of the uniform application of the binder and aggregate at a minimum continuous application rate of 2300 sq yd/h.*

**617.04 Weather Restrictions**

*The polymeric resin binder material shall be applied on dry surfaces, between April 1 and October 31, when the ambient temperature is at least 60°F and rising, but no more than 105°F, unless the polymeric resin manufacturer can provide test data to support installation outside ~~thi~~these ranges.*

*The HFST materials shall not be placed when rain is forecast during application or curing. There shall be no visible moisture present on the surface of the pavement at the time of application of the HFST. A plastic sheet, 18 in. by 18 in. that is left taped in place for a minimum of two hours, in accordance with ASTM D 4263, shall be used to identify moisture in the pavement.*

**617.05 Preparation**

*Roadway patching shall be performed in accordance with 408304 for asphalt pavement and 506 for PCCP.*

*All inadequately sealed joints and cracks 1/4 to 1 3/4 in. wide shall be cleaned and filled with a sealant approved by the polymeric resin manufacturer, which will bond to the specified polymeric resin binder. Cracks shall be blown clean using a compressed air lance. The cleaned cracks shall be filled with the approved sealant such that the surface is flush with the pavement.*

*The Contractor shall protect utilities, drainage structures, curbs, and any other structure within or adjacent to the area to be treated. The Contractor shall cover and protect all bridge expansion joint devices, existing pavement markings, preformed joint seal, raised pavement markers, and vehicle detection materials that will remain prior to HFST application.*

*HFST applied on either new HMA or new PCCP surface or patches in a ~~project~~contract, shall be applied at least 30 days after placement of the underlying pavement.*

*All receiving surfaces shall be clean, dry and free of dust, oil, debris and other material that might interfere with the bond between the polymeric resin binder material and existing surfaces.*

*Existing PCCP surfaces shall be cleaned by shot blasting to remove all curing compounds, loosely bonded mortar, surface carbonation, and deleterious material. The prepared surface shall comply with the International Concrete Repair Institute, ICRI, standard for surface roughness CSP 5. After shot blasting, air wash, with a minimum of 180 cu ft/min of clean and dry compressed air, to remove all dust, debris, and deleterious*



REVISION TO STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS  
PROPOSED NEW 617-T-XXX HIGH FRICTION SURFACE TREATMENT

---

*material. The Contractor shall maintain the air lance perpendicular to the surface and the tip of the air lance within 12 in. of the surface.*

*Existing HMA surfaces shall be air washed with a minimum of 180 cu ft/min of clean and dry compressed air to remove all dust, debris, and deleterious material. The Contractor shall maintain the air lance perpendicular to the surface and the tip of the air lance within 12 in. of the surface.*

*The Contractor shall obtain approval from the Engineer to proceed with installation upon completion of surface preparation.*

**617.06 Test Section**

*For quantities greater than 1000 sq yds, a minimum test section of 200 sq yds shall be applied within the ~~project~~contract to demonstrate the truck mounted application machine has been properly calibrated. This test section shall be considered part of the HFST quantity on the ~~project~~contract. The Contractor shall correct any deficient areas before opening to traffic as directed by the Engineer at no additional cost. The test section shall be opened to traffic only after curing has completed, and no uncovered polymeric resin remains exposed. The field conditions, including ambient and surface temperatures, anticipated for the production work shall be replicated during the test. The Contractor shall document the settings on the applicator equipment, initial quantities of polymer binder resin and aggregate topping, and unused quantities of resin and aggregate topping remaining in the applicator equipment after applying the HFST. The “dry through time” for the polymer binder resin system shall be noted. The test notes shall be provided to the Engineer.*

**617.07 HFST Application**

*A self-propelled, fully automated truck mounted application machine shall be used. Automated applications shall be completed in one course for widths up to 12 ft.*

**(a) Binder Application**

*The binder components shall be mixed proportionally in accordance with the manufacturer’s recommended ratio. The polymeric resin binder shall be applied by a truck mounted application machine onto the pavement section to be treated. The binder shall be applied at a uniform application rate of 3.5 sq yd/gal. with a uniform thickness of 50 mils onto the pavement. The binder shall not separate in the mixing lines, cure, dry, chill, set up, or otherwise impair retention bonding of the high friction surfacing aggregate. No seams shall be visible in the middle of the traffic lanes of the finished work after application of the surface aggregate.*

**(b) Aggregate Application**

*The aggregate shall be applied by the same truck mounted application machine, which includes an aggregate drop or broadcast spreader, immediately after placing the polymeric resin binder. The Contractor shall not use chip spreaders, vehicle tires, rollers, vibratory compactors or devices that throw loose aggregate onto any part of the live*

## REVISION TO STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS

## PROPOSED NEW 617-T-XXX HIGH FRICTION SURFACE TREATMENT

roadway lanes for applying the aggregate onto the wet uncured resin. Recovered bauxite aggregate may only be reused once and shall be blended with new bauxite at a rate of two parts of new bauxite to one part of recovered bauxite. The aggregate shall be applied uniformly to ensure complete coverage of the wet polymeric resin binder and result in a retained rate of 11 to 15 lbs/sq yd. No exposed polymeric resin shall remain visible on the surface.

**617.08 Curing and Clean Up**

The HFST shall be allowed to cure in accordance with the polymeric resin manufacturer recommendations. Two separate clean up processes shall be performed by removing the excess aggregate on the treated area and adjacent areas. The Contractor shall perform the initial clean up before opening to traffic. A secondary clean up shall be performed three to five days after construction.

**617.09 Field Acceptance Testing**

The Contractor shall remove and re-apply HFST where any patches of exposed polymeric resin exist, or where the HFST separates from the pavement at no additional cost. The HFST treated area will be tested ~~by the Department~~, at the discretion of the Engineer, within 60 days after construction in accordance with the requirements in the following tables. Deficient locations shall be repaired or replaced as directed by the Engineer.

<b>FIELD ACCEPTANCE TESTING REQUIREMENTS</b>			
<i>Property</i>	<i>Requirement, minimum</i>	<i>Frequency</i>	<i>Test Method</i>
<i>FN40R (Corrected Field FN)</i>	72	Every 0.1 mile in each lane.	ASTM E 274 (Ribbed tire)
<i>Field Dynamic Friction Value* (12 mph)</i>	0.90	1 per location, or 1 every 1500 lane-feet, whichever is shorter.	ASTM E 1911
<i>Mean Profile Depth*, in.</i>	1.0	1 per location, or 1 every 1500 lane-feet, whichever is shorter.	ASTM E 2157

\* Denotes an optional test.

<b>Speed Correction Factors for ASTM E 274 Testing Using a Ribbed Tire</b>					
<i>Test Speed (mph)</i>	<i>FN Correction</i>	<i>Test Speed (mph)</i>	<i>FN Correction</i>	<i>Test Speed (mph)</i>	<i>FN Correction</i>
20	-9.3	30	-4.8	40	0.0
21	-8.9	31	-4.4	41	0.5
22	-8.4	32	-3.9	42	1.0
23	-8.0	33	-3.4	43	1.5
24	-7.6	34	-2.9	44	2.0
25	-7.1	35	-2.5	45	2.5
26	-6.7	36	-2.0	46	3.1
27	-6.2	37	-1.5	47	3.6
28	-5.8	38	-1.0	48	4.1

REVISION TO STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS  
 PROPOSED NEW 617-T-XXX HIGH FRICTION SURFACE TREATMENT

29	-5.3	39	-0.5	49	4.6
----	------	----	------	----	-----

**617.10 Method of Measurement**

High friction surface treatment will be measured by the square yard, complete in place. The width for measurement will be the width of the top surface as shown on the plans or directed by the Engineer.

Patching will be measured in accordance with ~~408.07~~304.06 for asphalt pavement and 506.12 for PCCP.

Pavement marking removal will be measured in accordance with 808.12.

**617.11 Basis of Payment**

The accepted quantity of the high friction surface treatment will be paid for at the contract unit price per square yard.

Patching will be paid for in accordance with ~~408.08~~304.07 for asphalt pavement and 506.13 for PCCP.

Pavement marking removal will be paid for in accordance with 808.13.

Payment will be made under:

**Pay Item**

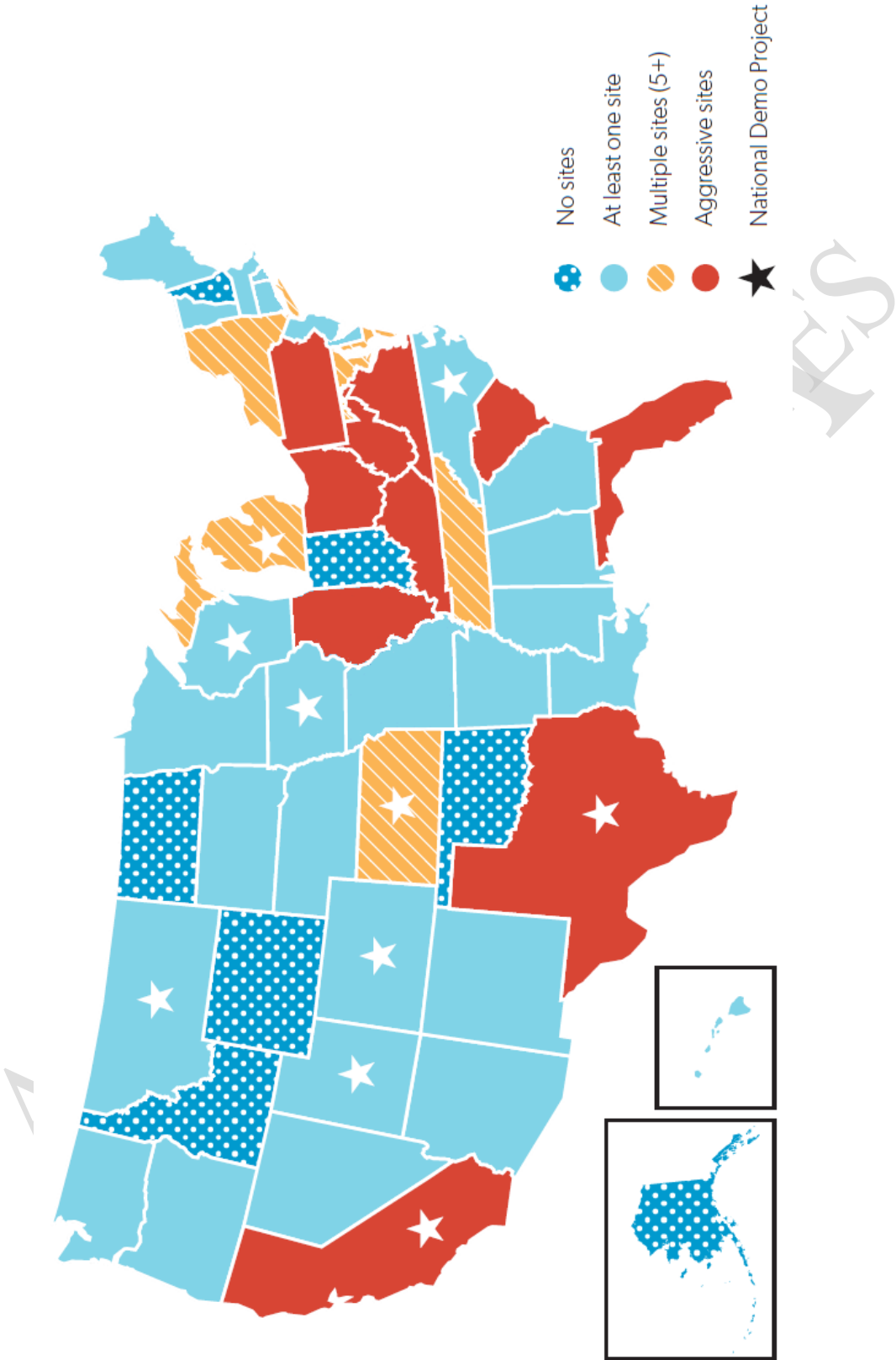
**Pay Unit Symbol**

High Friction Surface Treatment, ~~Calcined Bauxite~~ ..... SYS

The cost of all materials, equipment, preparation, and testing necessary to apply and clean-up the high friction surface treatment shall be included in the cost of high friction surface treatment.

BACKUP 01

HFST PROJECTS ACROSS THE US (as of 3/1/2016)



COMMENTS AND ACTION

617-T-XXX HIGH FRICTION SURFACE TREATMENT

DISCUSSION:

This item was introduced and presented by Mr. Bruno, sitting in for Mr. Boruff, who stated that approximately 25% of fatal crashes occur at horizontal curves and roadway departure crashes remain an emphasis area in Indiana's Strategic Highway Safety Plan. Mr. Bruno also added that FHWA is encouraging state DOT's to deploy high friction surface treatments at horizontal curves and other critical locations as part of its Every Day Counts initiative. HFST has been shown to dramatically reduce crashes at horizontal curves. HFST consists of a high friction aggregate, primarily calcined bauxite aggregate, set in a polymer resin binder.

Mr. Koch addressed some items in need of editorial revision, to which Mr. Bruno agreed. Those revisions are shown in these minutes. Mr. Bruno proposed to accept this item as revised.

Further discussion ensued concerning the material used in reference to the friction requirements. Mr. Koch mentioned that we need to inform designers that it is only necessary to install the HFST between the pavement markings, making pavement marking not a necessary item in this type of contract. Mr. Bruno stated that most of the projects will consist of calcined bauxite, while other materials, such as steel slag, may be considered. Ms. Phillips asked how this differs from the polymeric treatment for bridge decks. Mr. Beeson and Mr. Koch clarified that this is a coarser material.

Mr. Goldner inquired about the 60 day testing requirement that may extend into the winter months and that the Contractor may have to come out and repair the area the following season. Mr. Pankow mentioned the test section and how that will affect the schedule and length of time of the project. All concurred that each project may take at least two days.

Motion: Mr. Bruno Second: Mr. Cales Ayes: 8 Nays: 0 FHWA Approval: <u>YES</u>	Action:  <u>    </u> Passed as Submitted <u>  X  </u> Passed as Revised <u>    </u> Withdrawn
Standard Specifications Sections referenced and/or affected:  SECTION 617 - BLANK	<u>    </u> 2018 Standard Specifications <u>  X  </u> Revise Pay Items List
Recurring Special Provision affected:  NONE	<u>  X  </u> Create RSP (No.617-T-213) Effective <u>Jan. 01, 2017</u> Letting RSP Sunset Date: <u>TBD</u>
Standard Drawing affected:  NONE	<u>    </u> Revise RSP (No. <u>    </u> ) Effective <u>    </u> Letting RSP Sunset Date:
Design Manual Sections affected:  NONE	<u>    </u> Standard Drawing Effective
GIFE Sections cross-references:  NONE	<u>    </u> Create RPD (No. <u>    </u> ) Effective <u>    </u> Letting  <u>    </u> GIFE Update <u>  X  </u> SiteManager Update

STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS  
REVISION TO SPECIAL PROVISION

---

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Recently approved for RSP, but realized some improvements that could be made

PROPOSED SOLUTION: incorporate proposed revision

APPLICABLE STANDARD SPECIFICATIONS: None

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: 304-6.03(05)

APPLICABLE SECTION OF GIFE: none

APPLICABLE RECURRING SPECIAL PROVISIONS: 413-R-634

PAY ITEMS AFFECTED: None

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Mike Prather.

IMPACT ANALYSIS (attach report):

Submitted By: Matt Beeson

Title: State Materials Engineer

Organization: INDOT Office of Materials Management

Phone Number: 317.610.7251 x204

Date: 4/25/16

STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS  
REVISION TO SPECIAL PROVISION

IMPACT ANALYSIS REPORT CHECKLIST

Explain the business case as to why this item should be presented to the Standards Committee for approval.  
Answer the following questions with Yes, No or N/A.

Does this item appear in any other specification sections? No

Will approval of this item affect the Approved Materials List? No

Will this proposal improve:

Construction costs? Possibly

Construction time? Possibly

Customer satisfaction? Yes

Congestion/travel time? No

Ride quality? No

Will this proposal reduce operational costs or maintenance effort? Y

Will this item improve safety:

For motorists? No

For construction workers? No

Will this proposal improve quality for:

Construction procedures/processes? Yes

Asset preservation? Yes

Design process? Yes

Will this change provide the contractor more flexibility? No

Will this proposal provide clarification for the Contractor and field personnel? Yes

Can this item improve/reduce the number of potential change orders?

Yes

Is this proposal needed for compliance with:

Federal or State regulations? No

AASHTO or other design code? No

Is this item editorial? No

Provide any further information as to why this proposal should be placed on the Standards Committee meeting Agenda: Recent committee work was done to draft a cold in-place recycling USP. The CIR spec was based on the FDR spec. In committee discussion, it was realized some of the FDR spec should be updated as well.

REVISION TO SPECIAL PROVISION  
 413-R-634 FULL DEPTH RECLAMATION, FDR

413-R-634 FULL DEPTH RECLAMATION, FDR

(Adopted 12-17-15)

The Standard Specifications are revised as follows:

SECTION 413, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

**SECTION 413 - ~~BLANK~~ FULL DEPTH RECLAMATION, FDR**

**413.01 Description**

*This work shall consist of pulverizing and stabilizing an existing asphalt pavement and underlying material to construct a reclaimed base course, RBC, to the approved design properties in accordance with 105.03.*

**413.02 Quality Control**

*A quality control plan, QCP, shall be submitted to the Engineer a minimum of 15 calendar days prior to beginning the pulverization operation. The QCP shall include the proposed RBC mix design; a start to finish process ~~narrative~~ description to include discussion on corrective action measures; a list of proposed equipment; a list of proposed QC tests and testing frequencies; the curing methods applied to the stabilized RBC and the stabilization process applied to the RBC or subgrade after a failed proofroll. All QC test results shall be maintained during the duration of the contract and made available to the Engineer upon request.*

<i>QC TESTING</i>	
<i>Test</i>	<i>Frequency*</i>
<i>Depth of Pulverization</i>	<i>1 per 500 ft</i>
<i>Pulverized Material Gradation</i>	<i>1 per 0.5 day of production</i>
<i>Asphalt Emulsion Content or Cement Application Rate</i>	<i>1 per 500 ft</i>
<i>Optimum Moisture and Maximum Dry Density</i>	<i>1 per 0.5 day of production</i>
<i>Compacted In-Place Field Density</i>	<i>1 per 0.25 mile 1000 ft</i>

\* *The Contractor shall perform all QC tests within the first 500 ft after startup or after any change in the mix design.*

**MATERIALS**

**413.03 Materials**

*RBC shall consist of a homogenous blend of asphalt pavement in addition to base and subgrade materials that are combined with asphalt or cement materials, water, additives and corrective aggregate, when required. The actual materials used are dependent on the mix design and project requirements.*

*Materials for use in RBC shall be in accordance with the following:*

*Asphalt Emulsion .....As Defined\**



REVISION TO SPECIAL PROVISION  
 413-R-634 FULL DEPTH RECLAMATION, FDR

Aggregate to correct the RBC gradation:

1. Coarse or Dense Graded Aggregate, Class C or Higher\*\* .....904.03
  2. Fine Aggregate\*\* .....904.02
  3. Reclaimed asphalt pavement, RAP, shall be the product resulting from the cold milling or crushing of an existing HMA pavement. The RAP coarse aggregate shall be processed so that 100% passes the 1 1/2 in. (37.5 mm) sieve.
- Fly Ash, Class C .....901.02  
 Lime ..... 913.04(b)  
 Portland Cement, Type I .....901.01(b)  
 Water .....913.01

\* The requirements for asphalt emulsion shall be in accordance with the following:

CHARACTERISTIC	TEST METHOD	MIN.	MAX.
Viscosity, Saybolt Furol @ 77°F (25°C), s	AASHTO T 59	20	100
Sieve Test, No. 20, retained on sieve, %	AASHTO T 59		0.10
Storage Stability Test, 24 h, %	AASHTO T 59		1.0
Distillation Test <sup>1</sup> , Residue by Distillation, %	AASHTO T 59	64.0	
Oil Distillate by volume, %	AASHTO T 59		1.0
Penetration, 77 °F, 100 g, 5 s, dmm	AASHTO T 49	50	200
Note 1: Modified AASHTO T 59 – distillation temperature of 347 ± 9°F with a 20 minute hold.			

\*\* ~~When used to correct the RBC gradation.~~

**413.04 Mix Design**

The mix design and all associated testing shall be performed, using samples of the existing pavement and underlying material from the project site representing the reclaiming depth, by a design laboratory that is AASHTO Material Reference Laboratory, AMRL, accredited for soil, aggregates and concrete or HMA and asphalt, depending on the stabilizing additive used. Additional mix designs shall be performed when the in-place material changes significantly in order to establish representative mixes for the entire job. The Contractor is responsible for obtaining all samples required to develop the mix design. One sample per lane mile of planned RBC shall be the minimum sampling frequency for mix design preparation.

The Contractor shall provide a mix design or designs of either type for approval at least 15 calendar days prior to beginning the pulverization operation. The maximum dry density and optimum moisture content of the final mix design shall be determined in accordance with AASHTO T 180. The mix design shall include all test results performed. If new materials are added, a new mix design, including the revised test results, shall be submitted at least one day prior to implementation.

Asphalt stabilized RBC mix designs<sup>1, 2, 3</sup> shall be comprised of asphalt emulsion and have a design gradation of 100% passing the 2 in. (50 mm) sieve, ≥ 35% passing the No.4 (4.75 mm) sieve and 2% to 20% passing the No.200 (75 μm) sieve.

REVISION TO SPECIAL PROVISION  
 413-R-634 FULL DEPTH RECLAMATION, FDR

The design strength shall be as follows:

Test	Procedure	Requirement
Indirect Tensile Strength <sup>4,5</sup>	ASTM D 4867	45 psi, min., dry 30 psi, min., wet

- Notes:
1. Allowable ratio of asphalt stabilizer to total cementitious shall be 3:1 min.
  2. Allowable total cementitious shall be 1.0% max.
  3. 30 gyration, 6 in. diameter specimens prepared in accordance with AASHTO T 312.
  4. Indirect tensile strengths shall be determined on fully cured specimens.
  5. Dry specimens tested at 25°C; wet specimens tested at 25°C at minimum 55% saturation after 24 h soak.

Cement stabilized RBC mix designs shall have a design gradation of 100% passing the 2 in. (50 mm) sieve, ≥ 55% passing the No.4 (4.75 mm) sieve and 5% to 20% passing the No.200 (75 μm) sieve. The 7- day unconfined strength shall be based on the overlay lay rate specified on the plans:

Test	Procedure	Requirement
7-Day Unconfined Strength	ASTM D 1633, Method A	see notes 1, 2, 3
Notes:		
1. 300 psi minimum when a HMA overlay with a total lay rate ≥ 330 lb/sq yd is specified on the plans.		
2. 400 psi minimum when a HMA overlay with a total 165 lb/sq yd ≤ lay rate < 330 lb/sq yd is specified on the plans.		
3. 500 psi minimum when a HMA overlay with a total lay rate < 165 lb/sq yd or an applied seal coat surface is specified on the plans.		

## CONSTRUCTION REQUIREMENTS

### 413.05 Construction Requirements

Snowplowable raised pavement markers shall be removed in accordance with 808.11(e) and all areas of soft or yielding subgrade, as ~~indicated~~ shown on ~~project~~ the plans, shall be corrected prior to pulverization operations.

Grass and other vegetation shall be removed from the edge of the existing pavement to prevent contamination of the RBC during milling operation.

Adjustments may be made to the stabilizer, water, additives and corrective aggregate, when required, to produce a RBC with optimal performance that meets specification requirements.

The stabilizer used in cement stabilized RBC and the additives used in either asphalt or cement stabilized RBC may be dry powder or slurry with a minimum dry solids content of 30%. The Contractor shall address the application methods and fugitive dust control procedures in the QCP when dry powder materials are used.

REVISION TO SPECIAL PROVISION  
413-R-634 FULL DEPTH RECLAMATION, FDR

---

**413.06 Equipment**

*The equipment shall be capable of pulverizing the existing asphalt and underlying materials. The equipment used for mixing the pulverized materials with stabilizer, water, additives and corrective aggregate, when required, shall be capable of producing a homogenous and uniformly blended RBC. The equipment used for placement of the RBC shall be capable of placement to the lines, grades and guidelines provided herein and as shown on the plans.*

*The equipment shall consist of the following major components:*

**(a) Spreaders and Distributors**

*Spreaders or distributors used to apply dry powder additives shall be non-pressurized mechanical vane-feed, cyclone or screw type capable of providing a consistent, accurate and uniform distribution of material while minimizing dust during construction. Corrective aggregate, when required, may be placed by a mechanical spreader, a conventional paver or by tailgating with end dump trucks and spread to a uniform thickness with a motor grader.*

**(b) Additive Slurry Storage and Supply Equipment**

*Slurry shall be produced using a batch or continuous-flow type stationary mixer equipped with calibrated metering and feeding devices that introduce the cement, water and additives into the mixer in the specified quantities. Additive slurry storage and supply equipment shall have agitators or similar equipment to keep the slurry in suspension when held in the slurry batch or storage tanks. Slurry shall be kept in suspension during transport using agitator equipment.*

**(c) Mixing and Reclaiming Equipment**

*Only self-propelled, high powered, minimum 500 hp rotary mixers or reclaimers capable of mixing in-place to a depth of 14 in. shall be used. The minimum cutting drum width shall be 7 ft and fitted with cutting teeth capable of trimming earth, aggregate and HMA and be so designed that they may be accurately adjusted vertically and held in-place. The machine shall not weigh less than 25,000 lbs. and shall have the strength and rigidity so that it shall not develop a center deflection of more than 1/8 in.*

*The mixer or reclaimer shall be fitted with an integrated water and stabilizer injection system capable of introducing material into the cutting drum during the mixing process. The metering device shall be capable of automatically adjusting the flow of material to compensate for any variation in the amount of reclaimed material introduced into the mixing chamber. The water or stabilizer shall be calculated on a volumetric basis tied to a speed gauge, ft/min, using a calibrated meter that is capable of accurately measuring the amount of material to within 0.5% of the rate required. Automatic digital readings shall be displayed for both the flow rate and total amount of reclaimed material in appropriate units of weight and time.*

**(d) Motor Grader**

REVISION TO SPECIAL PROVISION  
413-R-634 FULL DEPTH RECLAMATION, FDR

---

*A motor grader for pre-shaping, aerating, spreading and final shaping of the material shall be provided. The motor grader shall have a cross slope indicator.*

***(e) Rollers***

*The RBC shall be compacted using self-propelled rollers, complete with properly operating scrapers. The number, weight and types of rollers shall be as necessary to obtain the required compaction throughout the entire RBC thickness. The rollers may be used in any combination and may include a pneumatic tire roller, an 84 in. wide drum vibratory pad-foot roller equipped with a knockdown blade or a 10 t minimum single or double drum vibratory steel roller.*

***(f) Water Trucks***

*Water truck for supplying water to the reclaimer or roadway for addition of moisture and for curing during the reclaiming operation shall be provided. The water truck shall be capable of providing a controlled and consistent spray without eroding or otherwise damaging the compacted RBC.*

***413.07 Weather Restrictions***

*The work shall not be performed when the soil, aggregate or subgrade is frozen, when the ambient temperature is below 45°F or when freezing temperatures are anticipated within seven days of the end of RBC placement. The Engineer may restrict work when the heat index is greater than 100°F. The Engineer may restrict work when the weather is foggy or rainy.*

***413.08 Pulverization***

*The existing pavement shall be pulverized and stabilized in separate operations. Corrective aggregate, when required, shall be spread onto the existing surface using a mechanical spreader, a conventional paver or by tailgating with end dump trucks and spread to a uniform thickness with a motor grader. The pre-determined full depth of HMA, base and subgrade materials shall be pulverized, along with the corrective aggregate, to a homogenous mixture. The mixture shall be brought to the desired moisture content during this process by means of surface application or through the mixing or reclaiming equipment's integrated fluid injection system. The base course shall not contain roots, sod, topsoil, weeds, wood or any material deleterious to its reaction with the asphalt or cement stabilizer.*

*For asphalt stabilized RBC, the pulverization shall produce a gradation that has 100% passing the 2 in. (50 mm) sieve and  $\geq 35\%$  passing the No.4 (4.75 mm) sieve.*

*For cement stabilized RBC, the pulverization shall produce a gradation that has 100% passing the 2 in. (50 mm) sieve and  $\geq 55\%$  passing the No.4 (4.75 mm) sieve.*

*When a paving fabric is encountered during the pulverization operation, the Contractor shall make the necessary changes in equipment or operations so that incorporation of shredded fabric into the RBC does not affect the performance parameters*

REVISION TO SPECIAL PROVISION  
413-R-634 FULL DEPTH RECLAMATION, FDR

---

*or inhibit placement or compaction of the RBC. The Contractor shall be required to remove and properly dispose of oversized pieces of paving fabric. The Contractor shall make the necessary adjustments in equipment or operations so that the shredded fabric in the recycled material is no more than 5 sq in. Additionally, no fabric piece shall have a dimension exceeding a length of 4 in.*

*Rubberized crack filler, ~~pavement markers~~ durable pavement markings, loop wires, ~~thermoplastic markers~~ and other-like non-pavement materials shall be removed as observed from the roadway during the pulverization process. Residual materials that cannot be completely removed may be incorporated into the mixture if the Contractor can demonstrate that those added materials will not adversely affect performance.*

*Any such materials retained in the mixture shall be appropriately sized and blended so as to not adversely affect the strength of the RBC.*

**413.09 Stabilization**

*The pulverized surface shall be scarified or knifed prior to applying materials in slurry form to prevent runoff or ponding. Any dry additives used shall be spread onto the pulverized surface using a mechanical spreader. The pulverized material shall be mixed with the stabilizer and additives as required by the mix design to create a homogeneous RBC.*

*Asphalt stabilizing materials shall have an application tolerance determined by adding  $\pm 0.25\%$  to the percent total asphalt emulsion content.*

*Cement stabilizing materials shall have an application tolerance determined by adding  $\pm 0.5\%$  to the percent total cement content.*

*The Contractor can request the stabilizing percentage to exceed the upper tolerance provided the mix design evaluated the RBC properties at or above the requested percentage. The request will be subject to approval by the Engineer.*

*The stabilized material shall be spread and leveled in accordance with 301.07. The profile grade and cross section of the RBC shall be finished within a tolerance of  $\pm 1/2$  in. from the plan RBC elevation by using a motor grader or other mechanical means prior to profile milling.*

*The compaction operation shall be performed while the RBC remains in a workable condition and continued until roller marks no longer appear.*

**413.10 Control Strip and Compaction**

*A minimum 500 ft long control strip shall be conducted the first day of production to verify the construction process meets the requirements as specified. The control strip shall allow the Contractor to:*

REVISION TO SPECIAL PROVISION  
413-R-634 FULL DEPTH RECLAMATION, FDR

---

- (a) *demonstrate the equipment, materials and processes proposed to produce a RBC layer in accordance with specification requirements;*
- (b) *determine the optimal rates for the stabilizer, water and any additives recommended for the reclaimed material;*
- (c) *determine the sequence and manner of rolling necessary to obtain strength in one uniformly compacted layer.*

*The optimum moisture content and maximum dry density of the RBC shall be determined in accordance with AASHTO T 180. The moisture content, at the start of compaction, shall be within - 1% to + 2% of the design optimum.*

*A control strip will be accepted when a five consecutive test average of 95% of the design maximum dry density with no single test below 94% of the design maximum dry density is demonstrated. A control strip that does not meet the density requirements shall be reworked at no additional cost.*

*The RBC density shall be achieved with the same equipment, materials and construction methods used on the accepted control strip and monitored in accordance with AASHTO T 310 in the direct transmission mode for the remainder of compaction operations.*

*All tests shall be conducted at the stated QC testing frequencies. A new control strip shall be constructed if changes are made to the original mix design, equipment or construction methods.*

**413.11 Curing**

*The stabilized RBC shall be cured for a sufficient time period to allow proofrolling.*

*Asphalt stabilized RBC shall be cured for a time period that achieves in-place moisture contents below 2.5% or the in-place moisture contents have stabilized at 50% or less of the design optimum moisture content for a continuous time period of five days.*

*Cement stabilized RBC shall be cured for a time period that achieves the minimum required seven day unconfined strength.*

*The planned method and duration of curing for asphalt or cement stabilized RBC shall be detailed in the QCP.*

**413.12 Asphalt Milling**

*The stabilized RBC shall be asphalt milled in accordance with 306 to the specified cross-slope in preparation for the overlay. Construction engineering in accordance with 105.08(b) shall be provided.*

REVISION TO SPECIAL PROVISION  
413-R-634 FULL DEPTH RECLAMATION, FDR

---

**413.13 Proofrolling**

*The stabilized RBC shall be proofrolled in accordance with 203.26, after asphalt milling operations have been completed, using a tandem or tri-axle dump truck loaded to the legal limit and operated between 2 to 4 mph over the RBC. The Engineer will determine the limits for any area that has deflection or rutting greater than 1/2 in.*

*The Contractor shall rework the areas failed in proofrolling by re-pulverizing and re-stabilizing the RBC in-place at no additional cost or by removing the RBC and stabilizing the subgrade in accordance with 207. The process for achieving subgrade stabilization and replacing the RBC material shall be detailed in the QCP. The reworked areas shall be proofrolled for final acceptance.*

*In locations of failing subgrade the RBC shall be removed and subgrade treatment shall be placed in accordance with 207. HMA patching, type B shall be placed in accordance with 304.*

**413.14 Underdrain Installation**

*Underdrain installation in accordance with 718, when required, shall begin after having completed the proofrolling.*

**413.15 RBC Overlay**

*The overlay atop the RBC shall be as shown on the plans. The overlay shall be placed after having completed the proofrolling.*

*The RBC shall be swept with a rotary power broom in accordance with 409 immediately prior to placing the overlay. The RBC shall be swept lightly to avoid damage to the RBC.*

*A tack coat shall be required only for the HMA overlay and shall be applied to the RBC in accordance with 406 immediately following sweeping operations.*

*Monuments shall be reestablished in accordance with 615.10*

**413.16 Opening to Traffic**

*The FDR treated pavement shall be opened to traffic, ~~beyond~~ in addition to local traffic and construction equipment, only after the overlay atop the RBC has been constructed.*

**413.17 Method of Measurement**

*The RBC will be measured by the square yard complete in place. Additional stabilizing material, when required, will be measured by the ton in accordance with 109.05(b) for the type specified. Subgrade treatment will be measured in accordance with 207.05. Aggregate, when used to correct the RBC gradation, will be measured by the ton of material used. Asphalt milling will be measured in accordance with 306.09. HMA patching, type B will be measured in accordance with 304.06. Re-established monuments*

REVISION TO SPECIAL PROVISION  
 413-R-634 FULL DEPTH RECLAMATION, FDR

*will be measured by the number of units installed in accordance with 615.13. Removal of snowplowable raised pavement markers will be measured in accordance with 808.12.*

**413.18 Basis of Payment**

*The RBC will be paid for as full depth reclamation at the contract unit price per square yard, complete in place. The accepted quantities of additional stabilizing material will be paid for at the contract unit price per ton for the type specified, complete in place. Subgrade treatment will be paid for in accordance with 207.06. Aggregate used to correct the RBC gradation will be paid for at the contract unit price per ton, complete in place. Asphalt milling will be paid for in accordance with 306.10. HMA patching, type B will be paid for in accordance with 304.07, of the thickness specified on the plans. Re-established monuments will be paid for at the contract unit price per each complete in place in accordance with 615.14. Removal of snowplowable raised pavement markers will be measured paid for in accordance with 808.13.*

*Payment will be made under:*

<b>Pay Item</b>	<b>Pay Unit Symbol</b>
<i>Corrective Aggregate .....</i>	<i>TON</i>
<i>Full Depth Reclamation .....</i>	<i>SYS</i>
<i>Stabilizing Material, _____</i>	<i>TON</i>
<i>Type</i>	
<i>Stabilizing Material, Asphalt Emulsion .....</i>	<i>TON</i>
<i>Stabilizing Material, Portland Cement .....</i>	<i>TON</i>

*The costs of the RBC mix design and QC testing shall be included in the cost of the full depth reclamation.*

*The costs of removing grass and vegetation, pulverizing, stabilizing, compacting and curing the RBC shall be included in the cost of the full depth reclamation.*

*The costs of the asphalt emulsion or portland cement stabilizing material shall be included in the cost of the stabilizing material pay item.*

*The costs of removing existing material to maintain profile shall be included in the cost of the asphalt milling.*

*In the locations of failing subgrade, removal of the RBC shall be included in the cost of subgrade treatment.*



COMMENTS AND ACTION

413-R-634 FULL DEPTH RECLAMATION, FDR

DISCUSSION:

Mr. Beeson introduced and presented this item stating the need for revisions to the recently approved Recurring Special Provision 413-R-634, for full depth reclamation.

Mr. Prather explained the revisions shown throughout the RSP and stated that these revisions are a result of the work done to put together the specification for the Cold-In-Place special provision.

Mr. Koch asked what comprises a reclaimed base course, RBC, which was clarified by Mr. Prather.

Mr. Prather commented on sub base failures in the last 4 of 5 projects using FDR. Mr. Prather stated that the projects had not considered existing moisture issues under the existing base material. Forensic testing of the failed areas exposed a density gradient issue, caused by subgrade moisture wicking up into the FDR. Mr. Prather also stated that this process is still in the developmental stage and they are learning from these experiences. The use of vibratory rollers, in some situations, has shown to cause ground water to rise up into the material.

Mr. Prather also mentioned that this special provision will continue to evolve with applications from lessons learned. Minor editorial revisions to this RSP are as shown.

<p>Motion: Mr. Beeson                  Second: Mr. Cales                  Ayes: 8                  Nays: 0                  FHWA Approval: <u>YES</u></p>	<p>Action:  <input checked="" type="checkbox"/> Passed as Submitted  <input type="checkbox"/> Passed as Revised  <input type="checkbox"/> Withdrawn</p>
<p>Standard Specifications Sections referenced and/or affected:                   SECTION 413 - BLANK</p>	<p><input type="checkbox"/> 2018 Standard Specifications  <input type="checkbox"/> Revise Pay Items List</p>
<p>Recurring Special Provision affected:                   413-R-634 FULL DEPTH RECLAMATION,                  FDR</p>	<p><input type="checkbox"/> Create RSP (No. _____)                  Effective _____ Letting                  RSP Sunset Date:</p>
<p>Standard Drawing affected:                   NONE</p>	<p><input checked="" type="checkbox"/> Revise RSP (No. <u>413-R-634</u>)                  Effective <u>Sept. 01, 2016</u> Letting                  RSP Sunset Date: <u>TBD</u></p>
<p>Design Manual Sections affected:                   304-6.03(05)</p>	<p><input type="checkbox"/> Standard Drawing Effective  <input type="checkbox"/> Create RPD (No. _____)                  Effective _____ Letting</p>
<p>GIFE Sections cross-references:                   NONE</p>	<p><input type="checkbox"/> GIFE Update  <input type="checkbox"/> SiteManager Update</p>

Mr. Beeson  
Date: 5/19/16

STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS  
REVISION TO SPECIAL PROVISIONS

---

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Cold in-place recycling is a viable and cost effective construction method for recycling asphalt pavements. No specifications currently exists

PROPOSED SOLUTION: Add as USP

APPLICABLE STANDARD SPECIFICATIONS: None

APPLICABLE STANDARD DRAWINGS: None

APPLICABLE DESIGN MANUAL SECTION: 304-6.04(03)

APPLICABLE SECTION OF GIFE: none

APPLICABLE RECURRING SPECIAL PROVISIONS: none

PAY ITEMS AFFECTED: NEW Cold In-place Recycling (SYS)

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Mike Prather, Scott Chandler, Nathan Awwad, Jason Wielinski (Heritage Research Group)

IMPACT ANALYSIS (attach report):

Submitted By: Matt Beeson

Title: State Materials Engineer

Organization: INDOT Office of Materials Management

Phone Number: 317.610.7251 x204

Date: 4/25/16

STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS  
REVISION TO SPECIAL PROVISIONS

IMPACT ANALYSIS REPORT CHECKLIST

Explain the business case as to why this item should be presented to the Standards Committee for approval. Answer the following questions with Yes, No or N/A.

Does this item appear in any other specification sections? No

Will approval of this item affect the Approved Materials List? No

Will this proposal improve:

Construction costs? Yes

Construction time? Yes

Customer satisfaction? Yes

Congestion/travel time? No

Ride quality? No

Will this proposal reduce operational costs or maintenance effort? Y

Will this item improve safety:

For motorists? No

For construction workers? Y

Will this proposal improve quality for:

Construction procedures/processes? Yes

Asset preservation? Yes

Design process? Yes

Will this change provide the contractor more flexibility? Y

Will this proposal provide clarification for the Contractor and field personnel? Yes

Can this item improve/reduce the number of potential change orders?

Yes

Is this proposal needed for compliance with:

Federal or State regulations? No

AASHTO or other design code? No

Is this item editorial? No

Provide any further information as to why this proposal should be placed on the Standards Committee meeting Agenda: Recent project on US40 in Terre Haute (Crawfordsville District). This USP has been edited after some on the job learning of how the spec could be improved. Hope to get a few more projects completed before submitting as RSP

REVISION TO SPECIAL PROVISION

PROPOSED NEW 416-R-XXX COLD-IN-PLACE RECYCLING, ~~CIR~~CIR

416-R-XXX COLD IN-PLACE RECYCLING, CIR

(Adopted xx-xx-xx)

The Standard Specifications are revised as follows:

SECTION 416, BEGIN LINE 1, INSERT AS FOLLOWS:

**SECTION 416 - COLD IN-PLACE RECYCLING, CIR**

**416.01 Description**

*This work, cold in-place recycling, CIR, shall consist of milling and pulverizing a portion of the existing asphalt pavement to specified depth and maximum size, mixing asphalt emulsion, water and additives to produce a recycled asphalt layer. This material shall then be placed and compacted to the approved design properties in accordance with 105.03.*

**416.02 Quality Control**

*A quality control plan, QCP, shall be submitted to the Engineer a minimum of 15 calendar days prior to beginning the CIR operation. The QCP shall include the proposed CIR mix design, a start to finish process ~~narrative~~description to include discussion on corrective action measures, a list of proposed equipment, a list of proposed QC tests and testing frequencies, and the curing methods applied to the CIR. All Contractor QC test results shall be maintained during the duration of the contract and made available to the Engineer upon request.*

*The following table provides the type and minimum frequency for tests.*

<b>QC TESTING</b>	
<i>Test</i>	<i>Frequency<sup>1,2</sup></i>
<i>Depth of Pulverization</i>	<i>1 per 500 ft</i>
<i>Pulverized Material Gradation</i>	<i>1 per 0.5 day of processing</i>
<i>Asphalt Emulsion Content</i>	<i>1 per 500 ft</i>
<i>Water Content</i>	<i>1 per 500 ft</i>
<i>Compacted In-Place Field Density</i>	<i>1 per 1000 ft</i>
<i>Note 1: The Contractor shall perform all quality control tests within the first 500 ft after startup or after any change in the mix design.</i>	
<i>Note 2: Testing frequency is based upon linear feet of CIR processing.</i>	

**MATERIALS**

**416.03 Materials**

*CIR shall consist of a homogenous blend of reclaimed asphalt pavement, RAP, combined with asphalt emulsion ~~recycling agent~~, water, ~~and~~ recycling additives, corrective aggregate or cement, when required. The actual materials used are dependent on the CIR mix design and project requirements.*

REVISION TO SPECIAL PROVISION  
 PROPOSED NEW 416-R-XXX COLD-IN-PLACE RECYCLING, ~~CIR~~CIR

Materials for use in CIR shall be in accordance with the following:

- Asphalt Emulsion .....As Defined\*
- Aggregate to correct the CIR gradation:
1. Coarse or Dense Graded Aggregate, Class C or Higher .....904.03
  2. Fine Aggregate.....904.02
  3. Reclaimed asphalt pavement, RAP, shall be the product resulting from the cold milling or crushing of an existing HMA pavement. The RAP coarse aggregate shall be processed so that 100% passes the 1 1/2 in. (37.5 mm) sieve.
- Portland Cement, Type I .....901.01(b)
- Water .....913.01

\* The requirements for asphalt emulsion shall be in accordance with the following:

1. ~~Asphalt emulsion shall be in accordance with the following:~~

<i>CIR ASPHALT EMULSION<sup>1</sup></i>			
<i>Test</i>	<i>Procedure</i>	<i>Minimum</i>	<i>Maximum</i>
<i>Viscosity, Saybolt Furol, @ 77 °F, SFS</i>	<i>AASHTO T 59</i>	<i>20</i>	<i>100</i>
<i>Sieve Test, No. 20, retained on sieve, %</i>	<i>AASHTO T 59</i>		<i>0.10</i>
<i>Storage Stability Test, 24 hr, %</i>	<i>AASHTO T 59</i>		<i>1.0</i>
<i>Distillation Test<sup>2</sup>, Residue from distillation, %</i>	<i>AASHTO T 59</i>	<i>64.0</i>	
<i>Oil distillate by volume, %</i>	<i>AASHTO T 59</i>		<i>1.0</i>
<i>Penetration, 77 °F, 100 g, 5 s, dmm</i>	<i>AASHTO T 49</i>	<i>50</i>	<i>200</i>
<i>Note 1: The asphalt emulsion shall be selected for the project by the asphalt emulsion supplier based on the Contractor's mixture design. The penetration of the supplied asphalt emulsion shall be within ± 25% of the penetration of the design emulsified asphalt. The asphalt emulsion shall be received on the job site at a temperature no greater than 120°F.</i>			
<i>Note 2: Modified AASHTO T 59 – distillation temperature of 347 ± 9°F with a 20 minute hold.</i>			
<i>Note 3: Type A certification will be required to furnished by the asphalt emulsion supplier.</i>			

2. ~~Portland cement shall be Type I in accordance with 901.01(b).~~

3. ~~Aggregate to correct the CIR gradation:~~

- ~~a. Coarse or Dense Graded Aggregate, Class C or Higher .....904.03~~
- ~~b. Fine Aggregate.....904.02~~
- ~~c. Reclaimed asphalt pavement, RAP, shall be the product resulting from the cold milling or crushing of an existing HMA pavement. The RAP coarse aggregate shall be processed so that 100% passes the 1.5 in. (37.5 mm) sieve.~~

4. ~~Water shall be in accordance with 913.01.~~

REVISION TO SPECIAL PROVISION

PROPOSED NEW 416-R-XXX COLD-IN-PLACE RECYCLING, ~~CIR~~CIR

**416.04 Mix Design**

*The mix design and all associated testing shall be performed, using samples of the existing pavement material from the project site representing the recycling depth, by a design laboratory that is AMRL accredited in HMA and asphalt. Additional mix designs shall be performed when the in-place material changes significantly in order to establish representative mixes for the entire job. The Contractor shall be responsible for obtaining all samples required to develop the mix design. One sample per lane mile of planned CIR shall be the minimum sampling frequency for mix design preparation.*

*CIR mix designs shall be comprised of existing RAP, emulsified asphalt and recycling additives if necessary. The CIR mixture shall have a design gradation of 100% passing the 1 1/2 in. (37.5 mm) sieve. The minimum CIR mix design requirements shall meet all of the requirements specified in ITM 592.*

*The Contractor shall provide a mix design or designs for approval at least 15 calendar days prior to beginning the CIR operation. The mix design shall include all test results performed. If new materials are added, a new mix design, including the updated test results, shall be submitted at least one day prior to implementation.*

**CONSTRUCTION REQUIREMENTS**

**416.05 Equipment**

*The recycling equipment shall be capable of milling the existing roadway, sizing the resulting RAP and mixing the RAP with the materials stipulated in the mix design. The recycling equipment shall be capable of meeting the specified sizing requirement with either the milling process or with additional sizing equipment. The recycling equipment shall be capable of producing a homogenous and uniformly coated CIR mixture by mixing the RAP with the asphalt emulsion, water and any other additives, either in the cold planer housing or in an additional mixing chamber. The equipment used for placement of the CIR mixture shall be capable of the placement in accordance to 105.03.*

*The CIR equipment shall consist of the following major components.*

**(a) Cold In-place Recycler Equipment**

*The cold in-place recycling equipment will include either a single unit recycler or a multi-unit recycler.*

**1. Single Unit Recycler**

*The single-unit recycler shall be a self-propelled cold milling machine/cold recycling machine with a down cutting cutter head capable of pulverizing and recycling the existing ~~hot mix asphalt~~HMA pavement to a maximum depth of 5 inches., incorporate the asphalt emulsion and water and mix the materials to produce a homogenous mixture. The machine shall have two systems for adding emulsified asphalt and water, with each system having a full width spray bar with a positive displacement pump interlocked to the machine's ground speed to insure that the amount of emulsified asphalt and water being*

REVISION TO SPECIAL PROVISION

PROPOSED NEW 416-R-XXX COLD-IN-PLACE RECYCLING, CRICIR

*added is automatically adjusted with changes to the machine's ground speed. Each additive system shall have its own spray bar equipped with two nozzles per foot of spray bar and be capable of incorporating up to 7 gal./sq yd of asphalt emulsion and/or water. Individual valves on the spray bar shall be capable of being turned off as necessary to minimize asphalt emulsion and water overlap on subsequent passes.*

**2. Multi-Unit Recycler**

*A multi-unit recycler ~~train~~ may be utilized instead of a single unit recycler. The multi-unit train shall contain the following:*

- a. A self-propelled cold milling machine that is capable of pulverizing the existing bituminous material in a single pass to the depth shown on the plans and to a minimum width of not less than 12 1/2 ft. The machine shall have automatic depth controls to maintain the cutting depth to within  $\pm 1/4$  in. of that shown on the plans, and shall have a positive means for controlling cross slope elevations. The use of a heating device to soften the pavement ~~is will not permitted~~ be allowed.*
- b. A material sizing unit having screening and crushing capabilities to reduce the cold pulverized material to the appropriate size. The screening and crushing unit shall have a closed circuit system capable of continuously returning oversized material to the crusher. All of the pulverized material, (100 percent%), shall be processed to the maximum size requirements specified.*
- c. A mixing unit equipped with a belt scale for the continuous weighing of the pulverized and sized bituminous material and a coupled/interlocked computer controlled liquid metering device. The mixing unit shall be an on-board completely self-contained pugmill. The liquid metering device shall deliver the amount of asphalt emulsion to within  $\pm 0.25$  percent% of the required amount by weight of the pulverized bituminous material. The asphalt emulsion pump ~~should~~ shall be sufficient capacity to allow emulsion contents up to 4.0% by weight of pulverized material. Also, automatic digital readings shall be displayed for both the flow rate and total amount of pulverized bituminous material and asphalt emulsion in appropriate units of weight and time.*

**(b) Spreaders for Dry Cement**

*Spreaders used to apply dry cement recycling additives shall be non-pressurized mechanical vane-feed, cyclone or screw type capable of providing a consistent, accurate and uniform distribution of material while minimizing dust during construction.*

**(c) Spreading of Corrective Aggregate**

REVISION TO SPECIAL PROVISION

PROPOSED NEW 416-R-XXX COLD-IN-PLACE RECYCLING, CIR/CIR

*Corrective aggregate, when required shall be placed with a mechanical spreader or a conventional paver.*

**(d) Water Truck**

*A water truck for supplying water to the milling equipment during CIR operation shall be provided. The water truck system shall be able to supply the mixing chamber, if necessary, so as to provide an independent source of water to properly disperse the asphalt emulsion.*

**(e) Paving Equipment**

*The processed CIR mixture shall be spread uniformly across the recycling width using either a self-propelled paver or screed integral to the recycling equipment. In either case, the screed shall be controlled by electronic grade and cross slope control. The equipment shall be of sufficient size and power to spread the recycled material in one continuous pass, without segregation, in accordance with 105.03. Heating of the screed shall not be ~~permitted~~ allowed. In utilizing a self-propelled paver, material shall either be loaded directly into the paver hopper from the recycling equipment or loaded by a pickup device from a windrow. If utilizing a pickup device, it shall be capable of removing and transferring the entire windrow of recycled mix in a single pass. The pick-up machine ~~must~~ shall be within 150 ft of the mixing unit throughout the treatment process.*

**(f) Rollers**

*Compaction of the CIR mixture shall be completed using self-propelled rollers complete with properly operating scrapers and water spray systems. The number, weight, and types of rollers shall be as necessary to obtain required compaction. At a minimum, the following rollers shall be used:*

- 1. At least one pneumatic tired roller with a minimum weight of not less than 22 tons. The tires on the pneumatic roller shall be evenly inflated and matched in size and profile as to maximize compactive effort.*
- 2. At least one double drum vibratory roller with a minimum weight of not less than 10 tons.*

**416.06 Weather Restrictions**

*The Engineer may restrict work when the weather is foggy or rainy. CIR operations shall be performed when the RAP temperature, or pavement surface temperature, is above 50°F with overnight ambient temperatures above 35°F. Recycling may be performed during light precipitation so long as the Contractor can demonstrate that the performance of the CIR pavement will not be adversely affected. The Engineer may restrict work when the heat index is greater than 100°F. The CIR shall not be performed before May 1st or after October 1st.*

**416.07 Roadway Preparation**



REVISION TO SPECIAL PROVISION

PROPOSED NEW 416-R-XXX COLD-IN-PLACE RECYCLING, CIR/CIR

---

*Grass and other vegetation shall be removed from the edge of the existing pavement to prevent contamination of the pulverized bituminous material during milling operation.*

*Snowplowable raised pavement markers shall be removed prior to CIR operations in accordance with 808.11(e).*

*Grade adjustments of existing structures shall be made in accordance with 720.04 except existing structures shall be lowered prior to CIR operations, properly covered and filled with material compatible with the CIR mix design to maintain traffic prior to CIR operations.*

*All areas of soft or yielding subgrade, as indicated on project plans, shall be corrected prior to CIR operations.*

**416.08 Processing and Mixing Operation**

*For CIR mixtures, the pulverization shall produce a gradation that has 100% passing the 1 1/2 in. (37.5 mm) sieve.*

*Corrective aggregate, when required, shall be spread onto the existing surface using a mechanical spreader or a conventional paver.*

*The pulverized material shall be processed through a mixing unit capable of combining the pulverized material, asphalt emulsion, and any additives to produce a homogenous recycled mixture. The asphalt emulsion shall be incorporated into the pulverized bituminous material at the initial rate determined by the mix design(s) and approved by the Engineer. Sampling and mix design may determine different levels of asphalt emulsion at various portions of the project.*

*When a paving fabric is encountered during the pulverization operation, the Contractor shall make the necessary changes in equipment or operations so that incorporation of shredded fabric into the CIR does not affect the performance parameters or inhibit placement or compaction of the CIR. The Contractor shall be required to remove and properly dispose of oversized pieces of paving fabric. The Contractor shall make the necessary adjustments in equipment or operations so that the shredded fabric in the recycled material is no more than 5 square inches. Additionally, no fabric piece shall have a dimension exceeding a length of 4 inches.*

*Rubberized crack filler, durable pavement markings, loop wires, and other non-pavement materials shall be removed as observed from the roadway during the CIR process. Residual materials that cannot be completely removed may be incorporated into the mixture if the Contractor can demonstrate that those added materials will not adversely affect performance.*

*Any such materials retained in the mixture shall be appropriately sized and blended so as to not adversely affect the strength of the CIR.*

REVISION TO SPECIAL PROVISION

PROPOSED NEW 416-R-XXX COLD-IN-PLACE RECYCLING, ~~CIR~~CIR

*Asphalt emulsion shall have an application tolerance determined by adding  $\pm$  0.25% to the percent total asphalt emulsion content recommended by the mix design.*

*The Contractor can request the asphalt emulsion percentage to exceed the upper tolerance provided the mix design evaluated the CIR properties at or above the requested percentage. The request will be subject to approval by the Engineer.*

**416.09 Control Strip and Compaction**

*A minimum 500 ft long control strip shall be conducted the first day of production to verify the construction process meets the requirements as specified. The control strip shall allow the Contractor to:*

- 1. Demonstrate the proposed equipment, materials and processes can produce a CIR layer in accordance with specification requirements.*
- 2. Determine the optimal rates for the emulsified asphalt, water and any additives recommended for the reclaimed material.*
- 3. Determine the sequence and manner of rolling necessary to obtain specified density requirements.*

*The CIR density shall be achieved with the same equipment, materials and construction methods used on the accepted control strip.*

*A rolling pattern shall be determined during the control strip to achieve optimum field density. The Contractor shall provide a sequence and manner of rolling which will define maximum compaction by establishing a rolling versus density chart that shows the progress of densification from initial lay down through maximum obtainable density using a properly calibrated nuclear gauge in accordance to ASTM D 2950. The Contractor shall perform compaction testing during production to ensure compaction is between 97% and 102~~percent~~% of the target density established during the control strip. If two successive tests indicate compaction is over 102~~percent~~% of the target density, a new rolling pattern shall be established.*

*All tests shall be conducted at the stated QC testing frequencies. A new control strip shall be constructed if changes are made to the original mix design, equipment or construction methods.*

**416.10 Opening to Traffic**

*After ~~the completion of~~ compaction of the recycled material, no traffic, including that of the Contractor, shall be ~~permitted~~ allowed on the completed recycled material for at least two hours. After two hours, ~~rolling~~ vehicle traffic may be ~~permitted~~ allowed on the recycled material. This time may be adjusted by the Engineer to allow establishment of*

REVISION TO SPECIAL PROVISION

PROPOSED NEW 416-R-XXX COLD-IN-PLACE RECYCLING, ~~CIR~~CIR

*sufficient cure so traffic will not initiate raveling or permanent deformation. All loose particles that may develop on the pavement surface shall be removed by power brooming.*

*After opening to traffic, the surface of the recycled pavement shall be maintained in a condition suitable for the safe movement of traffic.*

*If locations of failing subgrade are found below the CIR, the CIR shall be removed and subgrade treatment per geotechnical recommendations shall be placed in accordance with 207. HMA Patching Type B shall be placed in accordance with 304.*

**416.11 Maintenance**

*The Contractor shall maintain the recycled pavement in a manner satisfactory to the Engineer until the surface course has been constructed.*

**416.12 Curing**

*The CIR mixture shall be cured for a time period that achieves in-place moisture contents below 2.5%, ~~and~~ and approval by the Engineer prior to the placement of the HMA overlay. The planned method and duration of curing for CIR shall be ~~detailed in the project QCP~~ in accordance with 416.02. The specified surface course shall be placed within two weeks of the pavement final cure, but no later than November 1.*

**416.13 Asphalt Milling**

*The CIR shall be ~~asphalt~~ milled in accordance with 306 to the specified cross-slope in preparation for the overlay. Construction engineering in accordance with 105.08(b) shall be provided.*

**416.14 CIR Surface Course**

*The CIR shall be swept with a rotary power broom in accordance with 409 immediately prior to placing the overlay. The CIR shall be swept lightly to avoid damage to the CIR.*

*A tack coat shall be required only for the HMA overlay and shall be applied to the CIR in accordance with 406 immediately following sweeping operations.*

*The surface course atop the CIR shall be as shown on the plans.*

*Monuments shall be reestablished in accordance with 615.10*

**416.15 Method of Measurement**

*The CIR will be measured by the square yard, complete in place. Asphalt emulsion will be measured by the ton in accordance with 109.05(b). Subgrade treatment will be measured in accordance with 207.05. Corrective aggregate, when used to correct the CIR gradation, will be measured by the ton of material used. Stabilizing material, Portland cement, used as a recycling additive will be measured by the ton in accordance with 109.05(b). Asphalt milling will be measured in accordance with 306.09. HMA Patching*

REVISION TO SPECIAL PROVISION

PROPOSED NEW 416-R-XXX COLD-IN-PLACE RECYCLING, ~~CIR~~CIR

*will be measured in accordance with 304.06. Re-established monuments will be measured by the number of units installed in accordance with 615.13. Grade adjustment of existing structures will be measured in accordance with 720.06. Removal of snowplowable raised pavement markers will be measured in accordance with 808.12.*

**416.16 Basis of Payment**

*The CIR will be paid for at the contract unit price per square yard, complete in place. The accepted quantities of additional stabilizing material will be paid for at the contract unit price per ton for the type specified, complete in place. Subgrade treatment will be paid for in accordance with 207.06. ~~If required, corrective aggregate or recycling additives will be paid for at the contract unit price per ton, complete in place.~~ Asphalt milling will be paid for in accordance with 306.10. HMA patching will be paid for in accordance with 304.07, of the thickness specified on the plans. Re-established monuments will be paid for at the contract unit price per each complete in place in accordance with 615.14. Grade adjustment of existing structures will be paid for at the contract unit price in accordance with 720.07. Removal of snowplowable raised pavement markers will be ~~measured~~paid for in accordance with 808.13.*

*Payment will be made under:*

<b>Pay Item</b>	<b>Pay Unit Symbol</b>
<i>Cold In-place Recycling.....</i>	<i>SYS</i>
<i>Corrective Aggregate.....</i>	<i>TON</i>
<i>Stabilizing Material, Asphalt Emulsion.....</i>	<i>TON</i>
<i>Stabilizing Material, Portland Cement.....</i>	<i>TON</i>

*The costs associated with the CIR mix design and quality control testing shall be included in the cost of the CIR.*

*The costs associated with removal of grass and vegetation, pulverizing, stabilizing, compacting, curing and maintenance of the CIR not related to failing subgrade shall be included in the cost of the CIR.*

*The costs associated with the asphalt emulsion shall be included in the cost of the stabilizing material pay item.*

*The costs associated with removing existing material to maintain profile shall be included in the cost of the asphalt milling.*

*In the locations of failing subgrade, removal of the CIR shall be included in the cost of subgrade treatment.*

COMMENTS AND ACTION

416-R-XXX COLD-IN-PLACE RECYCLING, CIR

DISCUSSION:

This item was introduced and presented by Mr. Beeson who proposed that cold-in-place recycling is a viable and cost effective construction method for recycling and preserving asphalt pavements. The intention is to approve this provision as a unique special provision and fine tune it after completing several projects before presenting this as a recurring special provision. However, following the discussion from the FDR item, Mr. Beeson and Mr. Prather feel it may best to present this as a RSP instead of a USP to avoid potential unauthorized edits.

Mr. Prather further clarified the intention behind this pavement preservation treatment proposal.

Mr. Koch inquired of the type of emulsion, whether cationic or anionic, and Mr. Wielinski, from the Heritage Research Group, explained that cationic is preferred since past experiences have proven it to out-perform anionic emulsion.

Mr. Beeson inquired of the committee's recommendation as to whether this provision should be a RSP or a USP. Ms. Phillips suggested it be a RSP and the committee concurred.

Minor editorial revisions are as shown.

Motion: Mr. Beeson Second: Mr. Cales Ayes: 8 Nays: 0 FHWA Approval: <u>YES</u>	Action: <u>X</u> Passed as Submitted <u>    </u> Passed as Revised <u>    </u> Withdrawn
Standard Specifications Sections referenced and/or affected:  NONE	<u>    </u> 2018 Standard Specifications  <u>X</u> Revise Pay Items List
Recurring Special Provision affected:  NONE	<u>X</u> Create RSP (No.416-R-638) Effective <u>Sept. 01, 2016</u> Letting RSP Sunset Date: <u>TBD</u>
Standard Drawing affected:  NONE	<u>    </u> Revise RSP (No. <u>    </u> ) Effective <u>    </u> Letting RSP Sunset Date:
Design Manual Sections affected:  NONE	<u>    </u> Standard Drawing Effective
GIFE Sections cross-references:  NONE	<u>    </u> Create RPD (No. <u>    </u> ) Effective <u>    </u> Letting  <u>    </u> GIFE Update  <u>X</u> SiteManager Update