

Addendum #1
Payment for Fiber per pound and adjusted bid sheet

REINFORCING FIBERS FOR ASPHALT
Material and Mixing Specifications

A. DEFINITIONS

1. Reinforcing Fibers: High tensile strength aramid fiber blend specially formulated to reinforce hot mix asphalt.
2. Fiber reinforced asphalt concrete (FRAC): A mixture of hot or warm mix asphalt and reinforcing fibers that has greater resistance to rutting, thermal cracking, fatigue cracking, and reflective cracking as compared to conventional non-fiber asphalt mixes.
3. Aramid Dispersion State Ratio (ADSR): The mass of aramid in the individual state compared to the total mass of extracted aramid fibers, expressed as a percentage.

B. REFERENCES

1. ASTM D2172, Standard Test Methods for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
2. ASTM D6931, Standard Test Method for Indirect Tensile (IDT) Strength of Bituminous Mixtures.
3. AASHTO T322, Determining the Creep Compliance and Strength of Hot-Mix Asphalt (HMA) Using the Indirect Tensile Test Device.
4. Zeiada, W., Underwood, S., Stempihar, J., “Extraction of Aramid Fibers from Fiber Reinforced Asphalt Concrete – Special Test Method”, Arizona State University, May 11, 2016.

C. SUBMITTALS

1. Submit the following as part of the bid package:
 - a. Representative fiber product sample.
 - b. Fiber product data sheet and certification from the Manufacturer that the fiber product supplied meets the requirements of this specification.
 - c. Manufacturer’s instructions and general recommendations.
 - d. Performance test results of IDT testing from a minimum of three separate laboratory trials.
 - e. Performance test results of ADSR testing from a minimum of two tests.

2. Submit a minimum of two unique project examples and references where the reinforcing fiber product was used within 500 miles of the project location.

D. MATERIALS

1. Reinforcing fiber properties

- a. Provide a reinforcing fiber blend of virgin polyolefins and virgin aramids that meets the requirements in Table 1 and Table 2 below.

Table 1

Reinforcing Fiber Material Properties			
Property	Test Method	Polyolefin	Aramid
Form	Manufacturer Certification	Serrated	Monofilament
Nominal Specific Gravity	ASTM D276	0.91	1.44
Tensile Strength (psi)	ASTM D7269	NA ¹	400,000
Length (in)	Manufacturer Certification	0.75	0.75

1. Polyolefin fibers will melt or become plastically deformed during production

Table 2

Reinforcing Fiber Performance Properties		
Performance Test	Test Method	Requirement
Indirect Tensile Strength (IDT)	AASHTO T322 or ASTM D6931	≥ 20% increase
Aramid Dispersion State Ratio (ADSR)	Modified ASTM D2172	≥ 85%

- b. Forta-Fi[®], provided by the Forta Corporation, is an acceptable product and meets the performance and material properties outlined in this section.
- c. If a different aramid-based fiber blend is proposed, performance test results complying with Section D-2 below must be submitted at least two weeks prior to bid date for approval by engineer.
- d. Non-aramid fiber blends will not be considered as acceptable alternatives to this specification.

2. Performance testing requirements

Testing shall be from previously completed laboratory trials performed on plant mixed FRAC. Testing is not required on samples from the job mix.

Performance testing must be from laboratory trials at a fiber dosage rate equal to the rate proposed for the project. Tests must be performed by an AASHTO accredited laboratory or nationally recognized university testing lab and must

be reviewed and approved by the project engineer.

- a. Indirect Tensile (IDT) Strength Tests from a minimum of three (3) separate laboratory trials.
 1. Perform indirect tensile tests using the protocol from AASHTO T322 or ASTM D6931
 2. Tests results shall include a control and a fiber reinforced mix. FRAC mix shall be identical to control mix except for the inclusion of fibers added at the same dosage as proposed on the project.
 3. Indirect tensile test results from fiber specimens shall show an average tensile strength increase of 20 percent over control specimen with no less than 15 percent increase of average tensile strength.

- b. Aramid Dispersion State Ratio (ADSR) Tests from a minimum of two (2) separate laboratory trials.
 1. Perform ADSR test based on modified ASTM D2172 procedures as provided in the document entitled "Extraction of Aramid Fibers from Fiber Reinforced Asphalt Concrete – Special Test Method". A copy of the modified extraction methodology can be obtained by making an inquiry to the Pavement and Materials Laboratory at Arizona State University at NCE@asu.edu.
 2. To validate ADSR results, average extracted aramid fiber quantity must equal 0.007 percent by total sample weight with no individual result less than 0.005 percent of the total sample weight.
 3. All tested fiber mixes must achieve a minimum ADSR of 85%.

E. DELIVERY, STORAGE, AND HANDLING

1. Deliver fiber-reinforcement in sealed, undamaged containers with labels intact and legible, indicating material name and lot number.
2. Deliver fiber-reinforcement to location where it will be added to each batch or loaded into the mixer.
3. Store materials covered and off the ground. Keep sand and dust out of boxes and do not allow boxes to become wet.

F. MIXING AND PRODUCTION

1. Add aramid and polyolefin reinforcing fiber blends at a dosage rate of one (1) pound fiber per one (1) ton of asphalt.

2. Add alternative aramid fiber blends at a rate proposed by the manufacturer that achieves the IDT and ADSR results required by Section D.
3. Have a fiber manufacturer's representative on site during mixing and production. This requirement can be waived if fiber manufacturer and asphalt producer can supply evidence of manufacturer's brand of fiber being successfully produced a minimum of three times at the asphalt plant to be used for the project.
4. Batch Plant. When a batch plant is used, add fiber to the aggregate in the weigh hopper and increase both dry and wet mixing times. Ensure that the fiber is uniformly distributed before the injection of asphalt cement into the mixture.
5. Drum Plant:
 - a. Inject fibers through the RAP collar by placing fibers on the RAP belt for by feeding them with a blower tube system. Rate the feeding of fibers with the rate the plant is producing asphalt mix. If there is any evidence of fiber balls at the discharge chute, increase the mixing time and/or temperature or change the angle of the fiber feeder line to increase dry mixing time.
 - b. For manual feeding, place fibers on the RAP belt at intervals based on the plant production rate.
 - c. When using a blower tube system, add fibers continuously and in a steady uniform manner. Provide automated proportioning devices and control delivery within $\pm 10\%$ of the mass of the fibers required. Perform an equipment calibration to the satisfaction of the fiber manufacturer's representative to show that the fiber is being accurately metered and uniformly distributed into the mix.

Include the following with the blower tube system:

- Low level indicators
- No-flow indicators
- A printout of feed rate status in pounds/minute
- A section of transparent pipe in the fiber supply line for observing consistency of flow or feed.
- Manufacturer's representative's approval of fiber addition system

G. PLACEMENT

1. Follow manufacturer's and engineer's recommendations for placement of FRAC.
2. Visually observe FRAC mix in the back of first three trucks and every tenth truck thereafter to confirm adequate blending of the fiber.
3. Remove any observed fiber balls from placed mixture and adjust operations per the manufacturer's recommendation to eliminate future fiber ball development.

H. PAYMENT

Payment shall be based on per pound of fiber in asphalt mix.

Bid Form
2017 Upper Valley Pike Pavement Reclamation
Champaign County, Ohio

Item	Quantity	Unit	Description	Unit Price	Extension
1	280	Sq. Yd	Item 202- Wearing Course Removed		
2	1,064	Tons	Item 206 - Cement		
3	318	Cu. Yd.	Item 411 - Stabilized Crushed Aggregate		
4	916	Cu. Yd.	Item 441 - Asphalt Concrete Surface 1" of Type 1 PG64-22		
5	1380	Cu. Yd.	Item 441 - Asphalt Concrete Intermediate 1.5" of Type 2, PG 64-22		
6	2.50	Mile	Item 642 - Center Line		
7	5.00	Mile	Item 642 - Edge Line		
8	1	L.S.	Item 614 - Maintaining Traffic		
9	35,677	Sq. Yd.	Item Special - Chemically Stabilized Subgrade		
10	4592	LBS	Reinforcing Fibers for Asphalt		
				Total	

I certify that I have inspected the job and have read and understand the plans and specifications, including the required completion date. Any questions or concerns about any quantities should be directed to the office of the Champaign County Engineer prior to submitting any bid.

By: _____

 Company: _____

 Address: _____

 Phone: _____
