# Reinforcing Fibers for Bituminous Pavement Material NJSP-17-06C

1. **Description.** This work shall consist of adding a high tensile strength synthetic fiber to the bituminous mixture to be placed as specified in the contract documents. The Fiber Reinforced Asphalt Concrete (FRAC) mixture produced shall meet all Sec 403 requirements. The material properties, handling, mixing and placement of the fibers shall be in accordance with this provision.
2. **Materials**.
	1. **Fiber Properties.** The reinforcing fibers shall contain aramid fibers and a dispersion aid that meet the following material requirements as detailed in Table 1 below:

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| **Table 1 – Aramid Reinforcing Fibers Material Properties** |
| **Property** | **Test Method** | **Criteria** |
| Form | Manufacturer Certification | Aramid Fibers |
| Length (in) | Manufacturer Certification | 0.75 |
| Melting Temperature | Manufacturer Certification | 800 F |
| Nominal Specific Gravity(g/cm3) | ASTM D276 | 1.44 |
| Tensile Strength1 (psi) | ASTM D7269 | 400,000 |

* 1. **Performance Testing**. A FRAC mixture shall meet the following performance test detailed in Table 2 below. Non-aramid fiber blends will not be considered alternatives to this specification. All performance testing results from previous laboratory trial FRAC mixtures shall be submitted to the engineer along with the job mix formula.

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| **Table 2 – FRAC Mixture Performance Requirements** |
| **Performance Measure** | **Test Method** | **Standard** | **Requirement** |
| Dispersion Efficiency, % | Aramid Dispersion State Ratio (ADSR) | Modified ASTM D2172 | ≥ 85 % |
| Cracking Resistance, % increase | Indirect Tensile Strength (IDT) | AASHTO T 322 or ASTM D6931 | ≥ 20 % increase |
| Resistance to Permanent Deformation (Rutting) | Flow Number | AASHTO TP 79 | ≥ 35 % increase |
| Hamburg | AASHTO T 324 | < 3 mm |

Performance testing shall be from previous completed laboratory trials performed on plant mixed FRAC. Testing is not required on samples from the job mix. Performance testing shall 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 testing lab and must be reviewed and approved by the engineer.

Aramid Dispersion State Ratio (ADSR) tests shall be conducted from a minimum of three separate laboratory FRAC trials in accordance with the following:

1. Perform ADSR test in accordance with Modified ASTM D2172 (test method documentation available in the Electronic Deliverables).
2. The average extracted aramid fiber quantity shall 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 shall achieve a minimum ADSR of 85%.

Indirect Tensile (IDT) Strength Tests shall be conducted from a minimum of three (3) separate laboratory trials in accordance with the following:

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 30 percent over control specimen with no samples having less than 25 percent increase of average tensile strength.

Resistance to Permanent Deformation (Rutting) shall be measured on the FRAC mixture by one of the following test methods: Flow Number Test or Hamburg.

Flow Number (FN) testing shall be performed on a minimum of three (3) separate laboratory trials in accordance with the following:

1. Perform flow number testing in accordance with AASHTO TP79.
2. Test results shall include a control mixture and a FRAC mixture. The FRAC mixture shall be identical to the control mix except for the inclusion of fibers added at the same dosage rate as proposed on the project.
3. Results from the FRAC specimens shall each show an average FN increase of at least 35 percent over the control specimens.

Hamburg testing shall be performed on a minimum of three (3) separate laboratory trials in accordance with the following:

1. Perform Hamburg testing in accordance with AASHTO T324.
2. Test results may include only the FRAC mixture at the same dosage rate as proposed on the project.
3. Results from the FRAC specimens shall show less than 3 mm of rutting.
	1. **Required Information**. The contractor shall furnish a manufacturer’s certification to the engineer for each lot of material furnished stating the name of the manufacturer, the chemical composition, and certifying that the material supplied is in accordance with this specification.
4. **Construction.**
	1. **Delivery, Storage, and Handling.** The fiber-reinforcement material shall be delivered, stored, and handled in accordance with the manufacturer’s recommendations and specifically as follows:
5. Deliver fiber-reinforcement in sealed, undamaged containers with labels intact and legible, indicating material name and lot number.
6. Deliver fiber-reinforcement to location where it shall be added to each batch or loaded into the mixer.
7. Store materials covered and off the ground. Keep sand and dust out of boxes and do not allow boxes to become wet.
	1. **Mixing and Production.** The system for adding fibers to the mix shall be approved by the fiber manufacturer. The engineer shall be informed in writing that the system being used to add the fibers in the asphalt mixture meets the fiber manufacturer’s recommendations.

The fiber reinforcement shall be added at the dosage rate that meets the FRAC Mixture Performance Requirements listed in Table 2 as prescribed by the manufacturer. A fiber manufacturer shall be on site during the mixing and production of FRAC material.

The following construction steps shall be used when producing the FRAC or as required by the manufacturer.

**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.

**Drum Plant**: For drum plants, inject fibers through the reclaimed asphalt pavement (RAP) collar using an automatic, metered air blown system to promote rapid and complete fiber dispersion. System must automatically record fiber addition data so as to remove human error. Rate the feeding of fibers with the rate the plant is producing asphalt mix. If there is any evidence of fiber bundles 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.

**For small quantity projects** less than 2000 tons, manual feeding of the fibers may be allowed in accordance with the manufacturer’s recommendations. For projects greater than 2000 tons, manual feeding of the fibers is not allowed.

**For blower tube system**, add fibers continuously and in a steady uniform manner. Provide automated proportioning devices and control delivery within ±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 for blower tube system:

1. Low level indicators
2. No-flow indicators
3. A printout of feed rate status in pounds/ minute
4. A section of transparent pipe in the fiber supply line for observing consistency of flow or feed.
	1. **Quality Control.** A minimum of 25 pounds FRAC sample shall be collected during the first 50 tons of production. The sample shall be visually inspected to determine the uniform dispersion of the aramid fibers in an individual state (no bundles or agitated bundles). If undistributed bundles exist, the plant shall adjust the mixing operations until the aramid fibers are in and individual state.
	2. **Placement.** In addition to the visual inspection the FRAC mix shall be visually observed in the back of first three trucks and every tenth truck thereafter to confirm the adequate blending of the fibers.

**DRAFTER NOTE: THE SPECIFIC SUPERPAVE NOMENCLATURE MUST BE INCLUDED FOR THE MISCELLANEOUS PAY ITEM DESCRIPTION.**

1. **Basis of Payment.** Payment for the high tensile strength synthetic fibers shall be paid for at the contract unit price per ton for Item Number 403-99.10 Misc. High Tensile Strength Synthetic Fiber Asphaltic Pavement SP125Bxxxx/SP190Bxxxx.