

## Product Profile

### Section:

### 03200 – Concrete Reinforcement/Fibrous Reinforcing

#### 1. Product:

Nycon SF Type I Steel Fibers

#### 2. Source:

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#### 3. Product Description:

Nycon SF Type I steel fibers are discrete fibers for use as reinforcement in cement mortar and concrete. The product is a low-carbon steel fiber available in one standard configuration, which is continuous-deformed. Lengths can range from ¾" to 2 ½" (19 to 63 mm) and the cross-section is crescent-shaped (semi-circle). Dosage levels can range from 20 to 150 pounds per cubic yard (10 to 100kg/m<sup>3</sup>).

#### 4. Standards/Specifications:

Steel fibers for use in concrete must meet either ASTM A820 Type I or Type II specifications and ASTM C 1116. ASTM A820 provides the physical property requirements the fibers must meet to insure uniform performance. ASTM C1116 is used as a general requirement for fibers in concrete and shotcrete. Nycon SF Type I is a cold drawn wire steel fiber meeting the ASTM A820 Type I requirements as well as C1116, Section 4.1.1 requirements. In addition, the manufacturing facility is ISO 9001 certified.

#### 5. Product Properties:

Specific Gravity: 7.8  
Tensile Strength: 100 ksi (689 MPa) minimum  
Modulus of Elasticity:  
29 x 10<sup>6</sup> @ 70° F (20°C).  
The cold drawn wire equivalent diameter is 0.035" (0.889mm).  
Aspect Ratio ranges from 21 (¾" long fibers) to 71(2 ½" long fibers).

#### 6. Design Considerations:

The application and thus the specific properties required of the steel fiber reinforced concrete dictate the type and length of fiber to be specified, as well as the dosage rate. Specific engineering properties for a given concrete mix incorporating steel fibers must be verified by conducting standard tests, some of which are specific to fiber reinforced concrete.

Steel fibers will contribute to the flexural strength at dosage levels of 40 lbs/cy (25 kgs/m<sup>3</sup>) and above.

The fiber's aspect ratio, deformation and tensile strength are additional factors to be considered. Two documents are available to help in developing SFRC criteria for a specific application:

- ACI 544.4 Design Considerations for Steel Fiber Reinforced Concrete
- ACI 506.I State-of-the-art Report on fiber reinforced shotcrete.

Adjustments to the mix design may be required as the fiber volume increases to accommodate the additional fiber surface area. Preconstruction evaluation of a given steel fiber reinforced concrete (SFRC) mix should be standard practice to ensure target test values are achieved.

Nycon's engineering staff can provide a complete analysis for any project.

#### 7. Design

Dosage Rate: There are five distinct application dosage ranges:

- 1) For shrinkage control, 20-40 pounds per cubic yard (10-25 kg/m<sup>3</sup>). Length is a factor. At this level, ¾ inch (19mm) – 1 inch (25mm) fiber length is typically specified. Fiber count is also a consideration. Impeding or modifying crack growth is one of the benefits of a higher fiber count. There are quantifiable durability benefits provided at this dosage level.
- 2) For light traffic and/or static loading, 30-50 pounds per cubic yard (20-30 kg/m<sup>3</sup>). At this dosage level the fiber configuration is a factor. The length typically specified is ¾ inch (19mm) – 1 inch (25mm). Fiber count is also a factor. At this dosage level the steel fibers provide secondary/temperature-shrinkage reinforcement and durability benefits. A degree of load carrying can be assigned to the steel fibers at the upper end of the range. Composite deck systems for elevated slabs provide an additional application area.
- 3) For medium dynamic and/or static loading, 30-65 pounds per cubic yard (20-40kg/m<sup>3</sup>). At this dosage level the fiber configuration is a factor. The length typically specified is 1 inch (25mm) – 2 inch (50mm). The fibers at this dosage level provide secondary /temperature – shrinkage reinforcement, durability benefits and for slabs-on-ground a degree of load carrying. Utilization in wet method shotcrete and precast products yields benefits.
- 4) For heavy dynamic and/or static loading, 65-125 pounds per cubic yard (40-75 kg/m<sup>3</sup>). At this dosage level, configuration and length are major contributors to mechanical bonding, which translates into enhanced engineering properties. The length typically specified is 1 inch (25mm) – 2 inch (50mm). Applications include runways, taxi-ways, tunnel liners, Slope stabilization and jointless floors.
- 5) For special applications 100-170 lbs/CY (60-100 kg/m<sup>3</sup>) is the dosage range. These applications include ballistic panels and thin architectural panels.

#### 8. Related Work

03210 Reinforcing steel  
03300 Cast-in-place concrete  
03370 Specially paced concrete  
03400 Precast concrete  
03500 Cementitious decks and underlayments

#### 9. References for Steel Fiber Reinforced Concrete (SFRC)

##### ACI

544.1R	Fiber reinforced concrete.
544.2R	Measurement of properties of fiber reinforced concrete.
544.3R	Guide for specifying, proportioning, mixing, placing and finishing steel fiber reinforced concrete.
544.4R	Design considerations for steel fiber reinforced concrete.
506R	Guide to shotcrete.
506.1R	State-of-the-art report of fiber reinforced shotcrete.
506.2	Specification for shotcrete.
440R	State of the art report on fiber reinforced plastic (FRP) reinforcement for concrete structures.
302.1R	Guide for concrete floor and slab construction.
325.10R	State-of-the-art report on roller compacted concrete pavement.
207.5R	Roller compacted mass concrete.
330R	Guide for design and construction of concrete parking lot.
330.1	Standard specification for plain concrete parking lots.
360R	Design of slabs-on-grade.
305R	Hot weather concreting.
306R	Cold weather concreting.
116R	Cement and concrete terminology.

##### ASTM

A280	Specification for steel fiber reinforced concrete.
C1116	Specification for fiber reinforced concrete and shotcrete.
C1609	Test method for flexural toughness and first-crack strength of fiber reinforced concrete.
C1399	Test method for obtaining average residual strength of FRC.
C995	Test method for time of flow of fiber reinforced concrete through inverted slump cone.
C172	Method for sampling freshly mixed concrete.
C31	Method for preparing concrete test specimens, making and curing in the field.
C192	Method for preparing concrete test specimens, making and curing in the laboratory.
C231	Test method for air content of freshly mixed concrete by the pressure method.
C173	Test method for air content of freshly mixed concrete by the volumetric method.
C39	Test method for compressive strength of cylindrical concrete specimens.
C78	Test method for flexural strength of concrete.

## TEST METHODS

C143	Test method for slump of hydraulic cement concrete.
C496	Test method for splitting tensile strength of cylindrical concrete specimens.
C138	Test method for unit weight, yield and air content of concrete.
C944	Test method for abrasions resistance of concrete or mortar surfaces by the rotating cutter method.
C234	Test method for comparing concrete on the basis of bond developed with reinforcing steel.
C827	Test method for change in height at early ages of cylindrical specimens for cementitious mixtures.
C157	Test method of length change of hardened hydraulic-cement mortar and concrete.
C666	Test method for resistance of concrete to rapid freezing and thawing.

## 10. Mixing, Placing, Finishing:

Nycon SF Type I steel fibers are typically packaged in bags. The United States' standard weight of each bag is 50 pounds and the international standard package is 25 kgs. Delivery can be to the ready mix plant, on-site central batch plant or project fiber loading site.

The preferred method for introducing Nycon SF Type I fibers is by ribbon feeding the fibers into the mixing system. As the fibers are being fed into the mixer the drum is rotating at mixing speed.

Special packaging is available on request. Feed/conveyor systems are available for larger projects.

Nycon SF Type I steel fiber reinforced concrete can be placed using conventional methods, either directly discharged from the mixer truck chute or conveyed through a concrete pump. The latter may require mix design review to insure optimum flowability as per standard practice.

Prior to the start up of the project, the steel fiber concrete mix as designed by the engineer should be evaluated to ensure design properties are attained and the mix has the proper workability.

When a concrete pump is used, it is advised to keep the ready mix truck chute approximately 12-18 inches (30-45cm) above the grate on the receiving hopper. This will reduce the potential of the fiber reinforced concrete constricting flow through the grate. Never remove the grate when pumping SFRC.

only standard equipment. The sequence of operation remains consistent with conventional concrete placement. Manual movement of the SFRC should always be handled with a come-a-long; a tined rake should not be used. Ideally, to achieve a good workable surface to finish, use a vibrating screed, roller screed or laser screed. Use only metal hand tools in the finishing operation. Do not over vibrate the concrete. Over vibrating can cause segregation and/or reorientation of the fibers.

For texture surfaces use a stiff bristled broom or wire tined comb. Pull the equipment in one direction only. Never pull in opposite direction or across the established pattern. Do not use wet burlap to texture the concrete surface, as this method will potentially pull out fibers.

A wet-cut saw can be used to cut joints. Curing should commence as soon as possible.

## 11. Beneficial Properties:

The dosage level and length and configuration all have an influence on the hardened concrete properties. With shorter fibers, the higher fiber count for a given mass has a greater influence on arresting crack propagation, whereas, longer fibers are more beneficial in terms of post-first crack concrete strength properties. The configuration of the fiber is a controlling factor in achieving a good mechanical bond to yield enhanced hardened concrete properties.

Basic Benefits Irrespective of dosage:

- Superior micro/macro cracking control
- Enhanced impact resistance
- Increased ductility
- Greater fatigue strength
- Heightened toughness
- Lower long term maintenance costs
- Greater overall durability

It is important to conduct a laboratory program prior to project start-up to verify the capability of a given mix with a particular fiber to achieve specified performance levels, if no relative data is available. This need is most important where higher fiber dosage levels are specified.

## 12. Warranty:

Nycon SF Type I steel fiber meets ASTM A820 Type I specifications. The production process and product quality controls have been certified in accordance with ISO 9001 standards and procedures.

## 13. Safety/Handling:

It is recommended anyone handling the fibers prior to and at point of introduction into the mixer needs to wear heavy work gloves, eye protection and steel-toed shoes.

## 14. Services:

Nycon's engineering staff will provide analysis of any steel fiber reinforced concrete design and assist engineers/designers in using steel fiber reinforced concrete as an alternate design. In addition, Nycon will furnish re-construction and on-site support.

## 15. Packaging:

Nycon SF Type I steel fibers are typically packaged for the United States market in 5-ply paper bags with a polyethylene lining with the net weight 50 pounds. There are 50-50 pound bags per pallet with a net pallet weight of 2,500 pounds. Each pallet is stretch-wrapped. The pallet is labeled as to contents. A truckload is 17 pallets with a net weight of 42,500 pounds.

For international orders the typical bag weight is 25kg. 50 bags per pallet at a net pallet weight of 1,250 kg. In a standard 20-foot container, 14 pallets each weighing 1,250 kg will be double stacked for a net weight of 17,500 kg.

Nycon will provide special packaging to accommodate the customer's requirements or to meet project specifications. Nycon will also participate in finding and implementing special handling systems for introduction of fibers to mixing systems for large projects.

## 16. Shipping:

Fibers are shipped worldwide from distribution centers throughout the United States. Typical shipping units are pallets transported by motor carriers. Quotations on shipping costs are provided upon request. International shipments utilize 20-foot seagoing containers. Pro forma invoices available upon request.



## Fiber Solutions for Reinforcing Concrete

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