

AR Glass	<p>Test Data: Effectiveness of NyconAR Glass Fibers ½” as Concrete Reinforcement</p>
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Overview The testing program was based on the criteria established for plastic shrinkage and temperature-shrinkage reinforcement, which are Levels I and II (Sections 4.1.1 & 4.1.2) in ICC ES Acceptance Criteria 32. Tests were conducted at Stork’s Twin City Testing Corporation, Project #032346.

Material Description ½” (12mm) AR-glass fiber

Matrix Dosage Rate 1.0 pounds/cubic yard (0.60 kg/cubic meter) of concrete

ICC Test Procedure	Plain Concrete	NyconAR Reinforced Concrete	% of Plain Concrete	ICC Specs
Compressive Strength	30.62 MPa (4,440 psi)	33.17 MPa (4,810 psi)	108.3%	≥ Ctl
Flexural Strength	4.62 MPa (670 psi)	4.62 MPa (670 psi)	100.0%	≥ Ctl
Freeze/Thaw Durability	76.1%	76.9%	101.1%	≥ Ctl
Bond Strength	55.25 kN (12,420 lbs)	71.53 kN (16,080 lbs)	129.5%	≥ Ctl
Plastic Shrinkage Cracking		75.0% reduction		40% min
Impact Resistance 7 Days 14 Days	8 blows 9 blows	18 blows 17 blows	225% 189%	≥ 200% ≥ 150%

Standard Test Methods Used In Program:

Compressive Strength	ASTM C39
Flexural Strength	ASTM C78
Freeze/Thaw Durability	ASTM C666 Method A
Bond Strength	ASTM C234
Plastic Shrinkage	ICC ES AC 32 Appendix B
Impact Resistance	ICC ES AC 32 Appendix C-2
Compatibility with Concrete	ICC ES AC 32 Annex B-2

Specimens per Test Set

Three test specimens were used per test set for compressive, flexural, freeze/thaw and bond strength, plastic shrinkage and compatibility with concrete. Five test specimens were used per test set for impact strength.

Discussion of Performance Criteria

Through a joint committee of ICC ES personnel and Synthetic Fiber Industry representatives, performance criteria utilizing specific test methods with minimum test result values were established for four levels of applications.

The test program conducted at Stork's Twin City Testing Corporation was specifically intended to determine the compliance of NyconAR ½" (12mm) fibers at 1.0 lbs/cy with ICC ES AC 32 Level I and Level II, Synthetic Fiber-Reinforced Concrete used as Plastic Shrinkage and Temperature-Shrinkage Reinforcement.

The Compressive, Flexural, Freeze/Thaw and Bond Strength tests were conducted to insure that the synthetic fiber, in this case 1.0 pound per cubic yard of ½", (12mm), NyconAR, did not compromise the results for these tests when compared to plain concrete.

The Plastic Shrinkage test is required to show that, in fact, the NyconAR-glass fibers do provide a reduction in measurable crack formation and growth. A minimum reduction in measurable shrinkage of 40% is required.

The Impact Resistance test is required to show that the NyconAR-glass fibers can hold the concrete together after it cracks, which is the sole performance requirement of temperature-shrinkage reinforcement. Again, a minimum performance level is required. For tests conducted when NyconAR-glass fiber specimens have been aged for seven days the minimum improvement, compared to plain concrete at the same age, is 200%, when comparing number of blows to total failure. The improvement when specimens are 28 days old is 150%.

Discussion of Test Results

The data reported for the test program conducted by Stork's Twin City Laboratories Corporation shows that NyconAR 12mm fibers meet the Criteria of ICC ES AC 32, Levels I and II, Plastic Shrinkage and Temperature-Shrinkage Reinforcement. The compression, flexural, freeze/thaw and bond strength test results exceeded the result for the plain concrete. This proves that NyconAR ½" (12mm) fibers enhance the soundness of the concrete matrix. The three-dimensional distribution of the fibers provides for isotropic distribution of load over a greater volume of concrete.

The Plastic Shrinkage test results show a major reduction of 75.0% in measurable cracks (*specification calls for a minimum reduction of 40%*) when compared to the plain concrete. The value of this benefit from NyconAR ½" (12mm) fibers can best be stated as durability enhancement. If there are fewer cracks created during the plastic and initial hardening phases and the crack widths are less, then the concrete will be less permeable. This translates into greater resistance to freeze/thaw, which is doubly proven in this program. It also means improved fatigue strength.

The Impact Resistance data shows the excellent ability of the NyconAR ½" (12mm) fibers to bond with the concrete, thus providing a resistance to the cracked concrete's tendency to push apart. This test illustrates the ability of the fibers to hold the concrete together after it cracks, as noted, which points to benefits other than just performing as secondary reinforcement. The most prominent application of this attribute would be found in developing seismic and blast-resistant structures.

The test results for Compatibility with Concrete Accelerated Aging have not been reported to date.

Summary/Conclusions

The data generated from the program conducted at Stork's Tri-City Testing Corporation proves the value of NyconAR ½" (12mm) fibers as plastic shrinkage and secondary/temperature-shrinkage reinforcement in concrete.



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