SECTION 924
ADMIXTURES FOR CONCRETE

924-1 General.

This Section covers materials for use as admixtures for concrete. The use of admixtures is restricted to those admixtures as may be allowed or required elsewhere in the specifications for specific concrete applications. Admixtures shall comply to applicable AASHTO designation specifications as modified in 924-2.3 and 924-2.4. Admixtures which have been previously qualified for Department use are listed on a Qualified Products List as described in 924-2.1. Admixtures not on the Department's list may be qualified using the procedure described in 924-2.2.

924-2 Acceptance of Admixtures.

924-2.1 Qualified Products List: The Department maintains a list of qualified admixtures for air-entraining, water-reducing, and water-reducing and retarding which have previously been determined as meeting requirements for use on Department projects. Admixtures included on this list, will be permitted without further testing.

The inclusion of any specific product on the Qualified Products List, indicates that the product has been given contingent approval, as evidenced by previous tests and apparent effectiveness under field conditions.

Except as specified in Sections 346 and 347, no further testing will be required for any product on the Qualified Products List unless there is indication in actual field use of inadequate or unreliable results.

924-2.2 Certification: Manufacturers of admixtures not included on the Department's Qualified Products list shall provide certified test results from an independent laboratory acceptable to the Engineer and inspected by the Cement and Concrete Reference Laboratory (CCRL) on a regular basis, with all deficiencies corrected. Test results shall indicate compliance with test requirements as modified herein of AASHTO M 154 for air-entraining, AASHTO M 194 for water-reducing (Type A) or water-reducing and retarding (Type D), accelerating (Type C) and water-reducer and accelerating (Type E), ASTM C 494 for High Range Water Reducer (Type F or Type G), and ASTM G 109 for corrosion inhibitor.

924-2.3 For Air-Entraining: Air-entraining admixtures not on the Department's Qualified Products current list shall meet the requirements of AASHTO M 154, except for the following modifications and exceptions:

1. The coarse aggregate shall be Size No. 57 meeting the requirements of Section 901.
2. The fine aggregate shall meet the requirements of Section 902.
3. The cement shall meet the requirements of Section 921.
4. The flexural strengths, resistance to freezing and thawing, and length change are waived.

924-2.4 For Type A (Water-Reducing) and Type D (Water-Reducing and Retarding): Water-reducing and water-reducing and retarding admixtures not on the Department's Qualified Products list shall meet the requirements of AASHTO M 194 for Type A and D, respectively, except for the following modifications and exceptions:

1. The coarse aggregate shall be Size No. 57 meeting the requirements of Section 901.
2. The fine aggregate shall meet the requirements of Section 902.
3. The cement shall meet the requirements of Section 921.
4. The flexural strengths in Table I (AASHTO M 194) and compressive strength at six months and one year are waived.

924-2.5 For Type F or Type G (High Range Water Reducer): High Range Water Reducers shall meet the requirements of ASTM C 494 and all the additional requirements in 346-2.5.3.

924-2.6 For Corrosion Inhibitors: Corrosion inhibitors shall meet the requirements of ASTM G 109 and all requirements in Section 346.

924-2.6.1 Calcium Nitrite Corrosion Inhibitor: Calcium nitrite is a chemically reactive admixture used in concrete to inhibit the corrosion of embedded reinforcing steel and other metallic components. The calcium nitrite supplier shall furnish the Engineer with test certificates from an independent laboratory indicating compliance with this Specification. The test certificate shall include results of physical tests per AASHTO M 194 and corrosion inhibiting properties per ASTM G 109. Calcium nitrite shall be supplied by the same manufacturing source throughout the project. If a single primary source of calcium nitrite cannot be maintained throughout the project, new test certificates shall be submitted. The Engineer will determine specification compliance of a new supplier's product, and evaluate the effectiveness of the new calcium nitrite product before approving the source.

(1) Only non-accelerating calcium nitrite solution (neutral set version) shall be used in concrete.

(2) The active ingredient shall be calcium nitrite [$Ca(NO_2)_2$].

(3) The calcium nitrite shall be furnished in solution containing not less than 29% calcium nitrite solids. The concentration of the calcium nitrite solution shall be verified by spectrophotometric analysis or other comparable methods. The nitrite concentration shall be measured in accordance with Standard Methods for the Examination of Water and Waste Water, 18th Edition.

(4) A volume of one gallon [3.78 L] of calcium nitrite solution shall weigh within the range of 10.40 to 11.92 lb. [4.71 to 5.40 kg].

(5) Dosage Rate: The calcium nitrite solution shall be added to the concrete mixture at a rate of 4.50 to 4.60 gal/yd^3 [22.2 to 22.9 L/m^3] of concrete.

(6) The addition of calcium nitrite to the concrete mix shall not adversely affect the properties of fresh and hardened concrete. Calcium nitrite concrete shall meet the physical requirements of AASHTO M 194 for concrete containing Type A, water- reducing admixtures except that the requirements for Compressive Strength, min. % of control, shall be 100 for all ages.

The following table lists the corrosion inhibiting test result limits for calcium nitrite concrete tested in accordance with ASTM G 109.

Inhibit Corrosion when tested in accordance with ASTM G 109	
Measured average macrocell current any time during the test	less than 10 μA
Average macrocell current at test completion	less than 2 μA
Average visible corrosion measured as percent corroded area of control	85% or less

924-2.7 Contingency of Continued Approval: The continued approval of admixtures allowed for use, as based on the above specification requirements, will also be subject to the contingencies specified in 924-1.

924-3 Performance Test on Air-Entraining Admixtures, For Effect on Strength of Concrete.

924-3.1 Conditions under which Test is Required: For any air-entraining admixture selected for use the Engineer may call for a performance test (either prior to or at any time during construction) for determining its effect on the strength of the concrete. In general, this check-test will be required only when there is indication that such admixture is giving erratic results or is unduly reducing the strength of the concrete. Testing shall be in accordance with 924-3.2 and 924-3.3.

924-3.2 Permissible Reduction in Strength of the Concrete: For concrete composed of the same cement and aggregates (and in the same proportions) to be used in the work, and containing the admixture under test, in an amount sufficient to produce between 3 and 5% entrained air in the plastic concrete, the compressive strength at seven days shall be at least 90% of the strength of the same concrete without the admixture.

924-3.3 Method of Test for Strength Reduction: The percentage reduction in strength shall be calculated from the average strength of at least three standard 6 inch by 12 inch [150 mm by 300 mm]

cylinders of each class of concrete. Specimens shall be made and cured in the laboratory in accordance with FM 1-T 126, and shall be tested in accordance with FM 1-T 22. The percentage of entrained air shall be determined in accordance with FM 1-T 152 or FM 1-T 196.

924-4 Retesting.

For approved water-reducing and water-reducing and retarding admixtures which, due to indication of giving erratic results, are required to be retested as specified in 924-1, such retesting shall be in accordance with the following procedure. The admixture shall be checked for comparison between infrared spectrophotometry, pH value and solids content. Any marked variation from the original curve, pH value or solids content will be considered sufficient evidence that the chemistry of the original material has been changed and, therefore, the use of this material will be rejected and the material removed from the Qualified Products List.