



Department of
Transportation

TEST METHOD

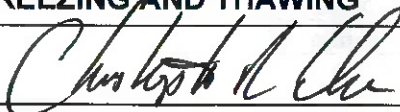
NEW YORK STATE DEPARTMENT OF TRANSPORTATION
MATERIALS BUREAU ALBANY, NY 12232-0861

Test Method NY 703-08-2

Issue Date: August 2020

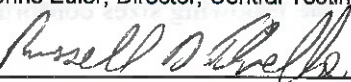
SUBJECT: STANDARD TEST METHOD FOR RESISTANCE OF COARSE AGGREGATES TO FREEZING AND THAWING

APPROVED:


Chris Euler, Director, Central Testing Laboratory

Supersedes: Test Method 703-08P,G
Dated: November 2000

APPROVED:


Russell Thielke, Materials Bureau

1. SCOPE:

This test method describes the procedure for determining the resistance of coarse aggregate to disintegration by repeated exposure to freezing and thawing in a 3% sodium chloride (NaCl) solution.

2. REFERENCED DOCUMENTS:

2.1 AASHTO Standards

M 231 Standard Specifications for Weighing Devices Used in the Testing of Materials

2.2 ASTM Standards

E11 Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves

E100 Standard Specifications for ASTM Hydrometers

3. SUMMARY OF METHOD:

The sample of aggregate is prepared to a specified gradation. It is washed, dried and weighed. It is soaked in a container of NaCl solution (brine). The aggregate in its container of brine is then alternately frozen and thawed for 25 cycles. The sample is washed, dried, and back sieved over specified sieves. The mass of aggregate passing those sieves is designated as the aggregate disintegrated by the freezing and thawing in brine.

4. APPARATUS:

4.1 **Freezing/Thawing Apparatus** – A room, tank, or chamber capable of lowering the internal temperature of the sample in its container of brine from $21.1^{\circ} \pm 2.8^{\circ}\text{C}$, to minus $23.3^{\circ} \pm 2.8^{\circ}\text{C}$ and then raising it to $21.1^{\circ} \pm 2.8^{\circ}\text{C}$ in a 24-hour period. This apparatus is capable of automatic recordation of the temperature of the apparatus and the internal temperature of the sample.

4.2 **Freeze/Thaw Containers** – The containers are cylindrical, open at the top, and capable of holding the aggregate and brine during the test. These containers are made of semi-rigid polyethylene and have the following dimensions:

Freeze/Thaw Container Dimensions	
Outside Diameter	135 mm
Inside Diameter	125 mm
Outside Height	240 mm
Inside Height	230 mm
Side Wall Thickness	5 mm
Base Thickness	8 mm

4.3 **Sieves** – Sieves made of wire with square openings of the following sizes conforming to ASTM E11:

25 mm
19 mm
16 mm
12.5 mm
6.3 mm
4.75 mm

4.4 **Oven** – An oven of appropriate capacity capable of maintaining a uniform temperature of $110^{\circ} \pm 5^{\circ}\text{C}$.

4.5 **Balance** – The balance shall conform to AASHTO M 231, Class G5.

4.6 **Specific Gravity Measurement** – A hydrometer conforming to the requirements of ASTM E100, or suitable combination of graduated glassware and balance, capable of measuring the brine specific gravity to within ± 0.001 shall be used.

5. SODIUM CHLORIDE SOLUTION (BRINE):

Prepare a solution of sodium chloride (NaCl), having a concentration of 3% by mass, by adding rock salt (halite) to water. Adjust the concentration of the solution by adding either water or rock salt (halite) until the specific gravity of the brine is at 1.020 at $23.3^{\circ} \pm 5^{\circ}\text{C}$.

6. SAMPLE:

6.1 **Coarse Aggregate** - NYSDOT sizes No. 2 and No. 1 coarse aggregate may be used for testing. A representative sample from the source is tested, having been prepared using wire sieves with square openings and with the sample mass listed below:

Passing Sieve	Retaining Sieve	Mass (grams)
25 mm	19 mm	1500 ± 50
19 mm	12.5 mm	1000 ± 30
12.5 mm	6.3 mm	1000 ± 30

7. PREPARATION:

Separate the sample into the different sizes shown in Section 6.1. Do not use any of the material sticking in the meshes of the sieves. Obtain approximately the mass indicated in Section 6.1 for each size fraction by splitting or quartering. Thoroughly wash and dry the sample to a constant mass at $110^{\circ} \pm 5^{\circ}\text{C}$. Allow the sample to cool to room temperature. Weigh each fraction and determine that each fraction conforms to the mass shown in Section 6.1. Record the mass of each fraction.

8. PROCEDURE:

8.1 *Soaking of sample* – Place each fraction in a freeze/thaw container, add 950 ml of a 3% NaCl solution. Allow the sample to soak for 24 hours \pm 4 hours at a temperature of $23.3^{\circ} \pm 5^{\circ}\text{C}$.

8.2 *Freezing the sample* – Immediately following Step 8.1, place the sample in the freeze/thaw apparatus and cool until the internal temperature (see Note 1) of the sample reaches minus $23.3^{\circ} \pm 2.8^{\circ}\text{C}$. The freezing portion of each cycle is completed in approximately 13 hours.

8.3 *Thawing the sample* – Immediately following completion of the freezing portion of each cycle, heat the sample until the internal temperature (see Note 1) reaches $21.1^{\circ} \pm 2.8^{\circ}\text{C}$. The thawing portion of each cycle is completed in approximately 11 hours.

Note 1 - Determine the internal temperature by placing the sensor of the temperature recorder in the sample approximately 38 mm from the bottom of the sample container and equidistant from the sides of the container. In actual practice the temperature sensor is placed in one of the many samples being tested. However, the Laboratory should determine and should be capable of demonstrating that the internal temperature of all samples reaches $21.1^{\circ} \pm 2.8^{\circ}\text{C}$ and minus $23.3^{\circ} \pm 2.8^{\circ}\text{C}$.

8.4 *Cycles* – Each cycle consists of one period of freezing and one period of thawing. Repeat the process of alternate freezing and thawing until 25 cycles have been completed. One complete cycle should not exceed 24 hours. If the test is interrupted, leave the sample covered in a thawed condition until testing can be resumed.

8.5 *Solution Change* – After the completion of 12 or 13 cycles of freezing and thawing, replace the 3% NaCl solution with fresh brine.

9. QUANTITATIVE EXAMINATION:

9.1 *Washing* – After the completion of 25 cycles of freezing and thawing, wash the sample to remove all of the NaCl solution. Dry each sample at $110^{\circ} \pm 5^{\circ}\text{C}$

9.2 *Back sieving* – Sieve the aggregate by hand over the sieve shown below for the appropriate size fraction. Use only enough agitation to assure that all the undersize material passes the designated sieve. Do not use any extra manipulation to break up particles or cause them to pass the sieve. Record the mass of the material retained on each sieve.

Size of Aggregate	Sieve Used to Determine Loss
25 mm to 19 mm	16 mm
19 mm to 12.5 mm	9.5 mm
12.5 mm to 6.3 mm	4.75 mm

9.3 **Calculation** – The original mass determined in Section 7 for each size fraction minus the mass retained on the corresponding sieve used in Section 9.2 is the mass loss for that size fraction.

10. REPORT:

10.1 **Data for Testing No. 1 aggregate** – Include the following data in the report (See Table 1, “Suggested format for recording No. 1 Aggregate Freeze-Thaw Test Data”)

10.1.1 Original mass: The mass of the aggregate retained on the 6.3 mm sieve before the test.

10.1.2 Retained mass on the 4.75 mm sieve after 25 cycles; the mass loss of the 6.3 mm size fraction; and the mass loss of the size fraction expressed as a percentage of the original mass of that fraction.

10.1.3 The original mass; the mass loss, and the total loss expressed as a percentage, determined by dividing the mass loss by the original mass.

10.2 **Data for Testing No. 2 aggregate** - Include the following data in the report (see Table 2, “Suggested format for recording No. 2 Aggregate Freeze-Thaw Test Data”).

10.2.1 Original masses: The original mass of the aggregate retained on both the 19 mm sieve and on the 12.5 mm sieve, before the test.

10.2.2 Retained masses on the 16 mm and the 9.5 mm sieves after 25 cycles; the mass loss of each size fraction; and the mass loss of each fraction expressed as a percentage of the original mass of that fraction.

10.2.3 The combined original mass (the sum of the original masses retained on the 19 mm and 12.5 mm sieves); the combined mass loss; and the total loss expressed as a percentage, determined by dividing the combined mass loss by the combined original mass.

TABLE 1

Suggested format for recording No. 1 Aggregate Freeze-Thaw Test Data
(With Illustrative Test Values)

No. 1 Size Aggregate Data	Mass
Original mass of sample (grams) ¹	1000
Mass after 25 cycles (grams) ²	923
Mass loss (grams)	77
Total Loss (percent)	7.7%

1. Retained on the 6.3 mm sieve.

2. Retained on the 4.75 mm sieve.

TABLE 2

Suggested format for recording No. 2 Aggregate Freeze-Thaw Test Data
(With Illustrative Test Values)

No. 2 Size Aggregate Data	Mass	
	+19 mm Fraction	+12.5 mm Fraction
Original mass of sample (grams) ¹	1500	1000
Mass after 25 cycles (grams) ²	1400	900
Mass Loss (grams)	100	100
Loss (percent)	6.7%	10.0%
Combined original mass (grams)	2500	
Combined loss (grams)	200	
Total loss (percent)	8.0%	

1. Retained on the 19 mm and 12.5 mm sieves, respectively.

2. 19 mm fraction losses are measured on the 16 mm sieve, and 12.5 mm fraction losses are measured on the 9.5 mm sieve.

