

DATE: July 13, 2011

TO: MAG Specification and Details Committee Members

FROM: Brian Gallimore, Materials Working Group/AGC

RE: Section 703 – Rip Rap

PURPOSE: Defined properties of material. Consolidated other section references to rip rap.

REVISIONS: a) Define new section number
b) Indicate proper aggregate size
c) Specify testing methods

SECTION 703

RIPRAP

703.1 ~~STONE~~-GENERAL:

Aggregate for grouted and ungrouted riprap shall meet the requirements of Section 703.2 unless otherwise stated in the project specifications. . Aggregate shall be sound and resistant to degradation. Service records may be used to determine the acceptability of the stone. The Engineer may require additional testing to approve the material source. . The Contractor shall notify the Engineer, in writing, at least 10 days prior to use of the material unless the material is currently acceptable for use as determined by the Engineer.

703.2 PHYSICAL PROPERTIES:

- (A) The maximum aggregate size shall be 150% of the indicated D_{50} size and the minimum aggregate size shall be 50% of the indicated D_{50} size.
- (B) Aggregate shall be not exceed 3:1 ratio for flat and/or elongated pieces when determined by test method ASTM D-4791.
- (C) Apparent specific gravity shall be a minimum 2.65 when determined by test method AASHTO T-85.
- (D) Resistance to degradation shall be a maximum of 40 percent loss when determined by test method ASTM C-535 at 1000 revolutions.

End of Section

SECTION 701703

RIPRAP

703.1 STONE: GENERAL:

Stone Aggregate for plain and grouted and ungrouted riprap shall meet the requirements of Section 701.4703.2 unless otherwise stated in the project specifications. 3. Stone shall be angular, rounded stone shall only be allowed when specified. Flat or needle shapes will not be acceptable unless the thickness of the piece is more than 1/3 the length. Stone Aggregate shall be sound and durable, hard, resistant to degradation, abrasion, free from laminations, weak cleavages, and undesirable weathering, leaching, exfoliation tendencies, and slaking; and of such character that it will not disintegrate from the action of air, water, or the conditions to be met in handling and placing. Stone shall be clean and free from deleterious impurities, including alkali, earth, clay, refuse, and adherent coatings. Suitable tests and/or Service records will may be used to determine the acceptability of the stone. Tests to which the material may be subjected include petrographic analysis, X ray diffraction, specific gravity, absorption, abrasion, rock drop, soundness, wetting and drying, and such other tests as may be considered necessary to demonstrate to The Engineer may require additional testing to approve the material source, that the materials are acceptable for use in the work. In connection therewith, the Contractor shall notify the Engineer in writing at least 60 days prior to use of the intended sources of quarry stone. The Contractor shall notify the Engineer, in writing, at least 10 days prior to use of the material unless the material is currently acceptable for use as determined by the Engineer.

Stone shall be color matched with adjacent landscape aggregate if specified on the plans or in the special provisions.

703.2 SIZE OF STONE: PHYSICAL PROPERTIES:

- (A) Unless otherwise indicated t The maximum stone aggregate size shall be 150% of the indicated D₅₀ size and the minimum stone aggregate size shall be 50% of the indicated D₅₀ size.
- (B) Aggregate shall be not exceed 3:1 ratio for flat and/or elongated pieces when determined by test method ASTM D-4791.
- (C) Apparent specific gravity shall be a minimum 2.65 when determined by test method AASHTO T-85.
- (D) Resistance to degradation shall be a maximum of 40 percent loss when determined by test method ASTM C-535 at 1000 revolutions.

703.3 Test Requirements: Riprap shall meet the following requirements except as may be otherwise provided on the plans and in the special provisions:

(A) Apparent specific gravity: 2.65 minimum, as determined by ASTM C 127.

(B) Breakdown Abrasion: Abrasion characteristics to be determined by either Rock Drop Test or Los Angeles Rattler, ASTM C 131, as required on the plans or the special provisions:

- (1) Rock drop breakdown shall be 5 percent maximum when tested as listed below:

Standard Rock Drop Test. Tests shall be made on groups of 5 accurately weighed sizes of rocks: No. 1, ranging from 75 to 100 lbs.; No. 2, 100 to 125 lbs.; No. 3, 125 to 150 lbs.; No. 4, 150 to 175 lbs.; No. 5, 175 to 225 lbs.

Each rock of the 5 sizes shall be dropped 3 times on the group of the other 4, in an enclosure, from successive heights of 10, 15, and 18 feet. The enclosure shall have a flexible medium weight galvanized iron floor or equivalent, set on a solid foundation.

Order of dropping shall be Nos. 3, 2, 4, 1, 5. All rock passing a 3-inch square mesh screen after test shall be weighed and recorded as a percentage of the total initial weight of the 5 rocks:

Rock drop breakdown: 5 percent maximum

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~~(2) Los Angeles abrasion shall be 40 percent maximum at 1000 revolutions when tested in accordance with ASTM C 535.~~

~~Abrasion breakdown at 1000 revolutions: 40 percent maximum~~

~~(C) Wetting and drying: The breakdown after 10 cycles of wetting and drying shall be 5 percent maximum when tested and calculated as detailed below:~~

~~Wetting and drying: The stone shall be crushed, screened, and 1000 or 1500 grams of the 3/4 inch to 3/8 inch fraction taken for the test.~~

~~The crushed and graded stone shall be submerged in water for 18 hours at room temperature, after which the sample shall be drained and oven dried at 140°F. When dry, the sample shall be cooled to room temperature. This would complete one cycle.~~

~~The percent loss shall be determined by screening the tested sample on a No. 4 sieve and shall be computed as follows:~~

$$\frac{100 \times \text{Weight of Materials Passing No. 4 Sieve}}{\text{Total Weight of Sample}} = \% \text{ Loss}$$

~~Breakdown after 10 cycles of wetting and drying: 5 percent maximum~~

~~(D) Solubility in water, breakdown, or softening: Test samples shall exhibit no change when subjected to the accelerated water breakdown and solubility test. To test, air dry samples of representative stone weighing approximately 1 lb. each, and immerse for 8 hours at 140°F., in distilled water, local tap water, or 3.5 percent sodium chloride solution.~~

~~None~~

701.4.3 Test Methods: Unless otherwise specified in the special provisions or indicated on the plans, test methods for quarry stone shall be as follows:

(A) Apparent specific gravity per ASTM C 127.

(B) Abrasion characteristics to be determined by either Rock Drop Test or Los Angeles Rattler, ASTM C 131, as required on the plans or the special provisions.

(1) Standard Rock Drop Test. Tests shall be made on groups of 5 accurately weighed sizes of rocks: No. 1, ranging from 75 to 100 lbs.; No. 2, 100 to 125 lbs.; No. 3, 125 to 150 lbs.; No. 4, 150 to 175 lbs.; No. 5, 175 to 225 lbs.

Each rock of the 5 sizes shall be dropped 3 times on the group of the other 4, in an enclosure, from successive heights of 10, 15, and 18 feet. The enclosure shall have a flexible medium weight galvanized iron floor or equivalent, set on a solid foundation.

Order of dropping shall be Nos. 3, 2, 4, 1, 5. All rock passing a 3 inch square mesh screen after test shall be weighed and recorded as a percentage of the total initial weight of the 5 rocks.

(2) Los Angeles abrasion machine, per ASTM C 131, Grading B.

(C) Wetting and drying: The stone shall be crushed, screened, and 1000 or 1500 grams of the 3/4 inch to 3/8 inch fraction taken for the test.

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The crushed and graded stone shall be submerged in water for 18 hours at room temperature, after which the sample shall be drained and oven-dried at 140°F. When dry, the sample shall be cooled to room temperature. This would complete one cycle.

The percent loss shall be determined by screening the tested sample on a No. 4 sieve and shall be computed as follows:

$$\frac{100 \times \text{Weight of Materials Passing No. 4 Sieve}}{\text{Total Weight of Sample}} = \% \text{ Loss}$$

(D) Accelerated water breakdown and solubility test. Air-dry samples of representative stone weighing approximately 1 lb. each shall be immersed for 8 hours at 140°F., in distilled water, local tap water, or 3.5 percent sodium chloride solution.

End of Section

Comment [DR9]: Changes pulled from section 701.4 and re-formatted. MAG 220.2 refers to 703 for riprap materials properties, and 703 formerly referred to 701.4 which has been deleted.