

MATERIAL SPECIFICATION

523. Rock for Riprap

1. Scope

This specification covers the quality of rock to be used in the construction of rock riprap.

2. Quality

Individual rock fragments shall be dense, sound and free from cracks, seams and other defects conducive to accelerated weathering. Except as otherwise specified, the rock fragments shall be angular to subrounded in shape. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment.

Except as otherwise provided, the rock shall be tested and shall have the following properties:

a. Rock Type 1

- 1) Bulk Specific Gravity (saturated surface-dry basis): Not less than 2.5 when tested in accordance with ASTM C 127 on samples prepared as described for soundness testing.
- 2) Absorption: Not more than 2 percent when tested in accordance with ASTM C 127 on samples prepared as described for soundness testing.
- 3) Soundness: The weight loss in five (5) cycles shall not be more than ten (10) percent when sodium sulfate is used or more than fifteen (15) percent when magnesium sulfate is used.

b. Rock Type 2

- 1) Bulk Specific Gravity (saturated surface-dry basis): Not less than 2.5 when tested in accordance with ASTM C 127 on samples prepared as described for soundness testing.
- 2) Absorption: Not more than 2 percent when tested in accordance with ASTM C 127 on samples prepared as described for soundness testing.
- 3) Soundness: The weight loss in five (5) cycles shall be not more than twenty (20) percent when sodium sulfate is used or more than twenty-five (25) percent when magnesium sulfate is used.

c. Rock Type 3

- 1) Bulk Specific Gravity (saturated surface-dry basis): Not less than 2.3 when tested in accordance with ASTM C 127 on samples prepared as described for soundness testing.
- 2) Absorption: Not more than 4 percent when tested in accordance with ASTM C 127 on samples prepared as described for soundness testing.
- 3) Soundness: The weight loss in five (5) cycles shall be not less than twenty (20) percent when sodium sulfate is used or more than twenty-five (25) percent when magnesium sulfate is used.

3. Methods of Soundness Testing

- a. Rock Cube Soundness: The sodium or magnesium sulfate soundness test for all rock Types (1, 2, or 3) shall be performed on a test sample of 5000 ± 300 grams of rock fragments, reasonably uniform in size and cubical in shape and weighing, after sampling, approximately 100 grams each. They shall be obtained from rock samples that are representative of

the total rock mass, as noted in ASTM D 4992, and that have been sawed into slabs as described in ASTM D 5121. The samples shall further be reduced in size by sawing the slabs into cubical blocks. The thickness of the slabs and the size of the sawed fragments shall be determined by the size of the available test apparatus and as necessary to provide, after sawing, the approximate 100-gram samples.

Due to internal defects, some of the cubes may break during the sawing process or during the initial soaking period. Do not test any of the cubes that break during this preparatory process. Such breakage, including an approximation of the percentage of cubes that break, shall be noted in the test report.

After the sample has been dried, following completion of the final test cycle and washed to remove the sodium sulfate or magnesium sulfate, the loss of weight shall be determined by subtracting from the original weight of the sample the final weight of all fragments which have not broken into three or more fragments.

The test report shall show the percentage loss of the weight and the results of the qualitative examination.

b. Rock Slab Soundness: When specified, the rock shall also be tested in accordance with ASTM D 5240.

- 1) For projects located north of the Number 20 Freeze-Thaw Severity Index Isoline (Map below approximates the map located in ASTM D 5312): Unless otherwise specified, the average percent weight loss for Rock Type 1 shall not exceed 20 percent when sodium sulfate is used

or 25 percent when magnesium sulfate is used, and for Rock Types 2 and 3, the average percent weight loss shall not exceed 25 percent for sodium sulfate soundness or 30 percent for magnesium sulfate soundness.

- 2) For projects located south of the Number 20 Freeze-Thaw Severity Index Isoline, unless otherwise specified, the average percent weight loss for Rock Type 1 shall not exceed 30 percent when sodium sulfate is used or 38 percent when magnesium sulfate is used, and for Rock Types 2 and 3, the average percent weight loss shall not exceed 38 percent for sodium sulfate soundness or 45 percent for magnesium sulfate soundness.



Map of the Conterminous United States
Showing the Number 20
Freeze-Thaw Severity Index Isoline

Adapted from ASTM D 5312

4. Field Durability Inspection

Rock that fails to meet the material requirements stated above in a, b, or c (if specified), may be accepted only if similar rock from the same source has been demonstrated to be sound after five (5) years or more of service under conditions of weather, wetting and drying, and erosive forces similar to those anticipated for the rock to be installed under this specification.

A rock source may be rejected if the rock from that source deteriorates in three (3) to five (5) years under similar use and exposure conditions expected for the rock to be installed under this specification, even though it meets the testing requirements stated above.

Deterioration is defined as the loss of more than one-quarter ($\frac{1}{4}$) of the original rock volume, or severe cracking that would cause a block to split. Measurements of deterioration are taken from linear or surface area particle counts to determine the percentage of deteriorated blocks. Deterioration of more than 25 percent of the blocks shall be cause for rejection of rock from the source.

5. Grading

The rock shall conform to the specified grading limits after it has been placed within the matrix of the rock riprap.