

## 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. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment. ASTM D4992 provides guidance on selecting rock from a source.

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

#### Rock type 1

- **Bulk specific gravity (saturated surface-dry basis)**—Not less than 2.5 when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Absorption**—Not more than 2 percent when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Soundness**—The weight loss in 5 cycles shall not be more than 10 percent when sodium sulfate is used or more than 15 percent when magnesium sulfate is used.

#### Rock type 2

- **Bulk specific gravity (saturated surface-dry basis)**—Not less than 2.5 when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Absorption**—Not more than 2 percent when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.

- **Soundness**—The weight loss in 5 cycles shall be not more than 20 percent when sodium sulfate is used or more than 25 percent when magnesium sulfate is used.

#### Rock type 3

- **Bulk specific gravity (saturated surface-dry basis)**—Not less than 2.3 when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Absorption**—Not more than 4 percent when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Soundness**—The weight loss in 5 cycles shall be not more than 20 percent when sodium sulfate is used or more than 25 percent when magnesium sulfate is used.

### 3. Methods of soundness testing

**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  $5,000 \pm 300$  grams of rock fragments, reasonably uniform in size and cubical in shape, and weighing, after sampling, about 100 grams each. They shall be obtained from rock samples that are representative of the total rock mass, as noted in ASTM D4992, and that have been sawed into slabs as described in ASTM D5121. 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. The cubes shall undergo five cycles of soundness testing in accordance with ASTM D1512.

Internal defects may cause some of the cubes to 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.

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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 that 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.

**Rock slab soundness**—When specified, the rock shall also be tested in accordance with ASTM D5240. Deterioration of more than 25 percent of the number

of blocks shall be cause for rejection of rock from this source. Rock shall also meet the requirements for average percent weight loss stated below.

- For projects located north of the Number 20 Freeze-Thaw Severity Index Isoline (fig. 523–1). 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. 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.
- 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 per-

**Figure 523–1** Number 20 freeze-thaw severity index isoline (map approximates the map in ASTM D5312)



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cent when sodium sulfate is used or 38 percent when magnesium sulfate is used. 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.

**4. Field durability inspection**

Rock that fails to meet the material requirements stated above (if specified), may be accepted only if similar rock from the same source has been demonstrated to be sound after 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 3 to 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 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 pieces 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. Grading tests shall be performed, as necessary, according to ASTM D5519, Method A, B, or C, as applicable.

