

ITEM 493

RIPRAP

493.1 Description. This item specifies requirements for furnishing and placing of concrete or stone riprap for common erosion protection applications in open channels.

493.2 Materials. The storage area shall be kept clean, firm, and smooth and well drained in order that the riprap can be recovered free from dirt and other foreign matter.

The riprap shall be stockpiled and handled so as not to cause undue segregation of particle sizes either in the stockpile, or while loading, hauling and handling.

The riprap shall consist of broken concrete or stone blocks and shall be dense, durable and hard material free from cracks, seams and other defects which would tend to increase deterioration from handling and natural causes.

Where broken concrete is used, all exposed metal, including rebar and wire mesh, shall be cut off flush with the surface of the block prior to placing.

Spalls, fragments and chips shall not exceed 5% by weight. The dimension and shape limitations do not apply to this portion of the riprap.

Riprap blocks shall be provided in cubic form, rather than elongated (flat) shapes.

The minimum thickness of each block shall be 6 inches.

No more than 25% of the blocks may have a length greater than 2-½ times the width or thickness. No length of block shall exceed 3 times the width or thickness.

The riprap shall be well graded and shall conform to the following tables unless specifically noted otherwise on the drawings:

TABLE 1 -RIPRAP GRADATION NO. 1

Percent Lighter By Weight	Stone Weight (Lbs)		Volume Cubic Foot (2)		Cubical Shape (Ea. Side, ft.)		Spherical Shape (Dia., ft.)	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
100	180	265	120	1.77	1.06	1.21	1.31	1.50
50	80	110	0.53	0.73	0.81	0.90	1.01	1.12
15	40	60	0.27	0.40	0.64	0.74	0.80	0.91

NOTES: The theoretical cube and sphere size is presented in the table for guidance only.

The previous size and shape specifications shall govern.

Volume is based on 150 pcf, unit weight.

This gradation is to be used in normal applications, and may be noted on the drawings as standard riprap, riprap, 18” thick riprap mats, or other similar designations.

TABLE 2 -RIPRAP GRADATION NO. 2

Percent Lighter By Weight	Stone Weight (Lbs)		Volume Cubic Foot (2)		Cubical Shape (Ea. Side, ft.)		Spherical Shape (Dia., ft.)	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
100	260	640	1.73	4.27	1.20	1.62	1.49	2.01
50	130	200	0.87	1.33	0.95	1.10	1.18	1.37
15	40	150	0.27	1.00	0.64	1.00	0.80	1.24

NOTES: Provide a 24" thick mat, minimum, for Riprap Gradation No. 2.

The theoretical cube and sphere size is presented in the table for guidance only. The previous size and shape specifications shall govern.

Volume is based on 150 pcf, unit weight.

The gradation is to be used only where specifically noted on the drawings as “Riprap Gradation No. 2”.

For special applications, gradation, thickness, and other special requirements shall be as shown in the plans.

493.3 Construction Methods. The riprap shall meet the gradation and quality requirements prior to placing. The riprap shall be placed to the slopes, lines, and grades as shown on the drawings, to provide a well-graded mass of riprap without voids.

Thickness of the riprap mat shall be as shown on the drawings, with a minimum mat thickness as shown on the gradation tables.

The riprap shall be placed in one course (lift) across the channel bottom, then up the channel side slopes. Place the riprap carefully in such a manner to avoid displacement or damage to the prepared surface or geotextile and in such a manner to avoid segregation of particle sizes. Place riprap as close to final position as feasible.

The riprap blocks are to be in close contact, well-graded, and free from pockets of small stones or clusters of large stones. Elongated riprap blocks

shall be well distributed throughout the riprap mat. Individual oversized blocks will not be permitted. These shall be broken to acceptable size or removed and replaced with riprap within the gradation limits. Surface irregularities shall be minimal.

Do not drop riprap from such a height to cause breakage or to damage the geotextile (if used).

Prevent mixture or incorporation of dirt or other materials with the riprap during placing operation.

Placing of riprap by any method, machine or hand, will be permitted as long as specified requirements are obtained.

Fill spaces between larger riprap blocks with spalls and smaller blocks of the largest feasible size to form a compact mass. Do not place spalls and small blocks in place of larger size blocks.

493.4 Measurement. Riprap shall be measured by the **square yard** or by the **ton** of riprap material, as noted on the bid sheets. Riprap Gradation No. 1 when measured by the square yard shall be for a minimum specified thickness of 18 inches, complete in place. Riprap Gradation No. 2 when measured by the square yard shall be for a minimum specified thickness of 24 inches, complete in place.

Channel excavation to the top of riprap (finish grade) is measured as shown on the bid sheets.

Excavation for the placement of Riprap Gradation No. 1 to 18 inches beyond the finish grade shall be considered incidental to placement of riprap.

Excavation for the placement of Riprap Gradation No. 2 to 24 inches beyond the finish grade shall be considered incidental to placement of riprap.

Channel fill to the top of riprap (finish grade) is measured as shown on the Bid Sheets. Channel fill, not approved by the Engineer, shall not be measured.

Geotextile under the riprap, where required (as shown on the drawings), shall not be measured and shall be considered incidental to riprap.

493.5 Payment. Payment for riprap shall be based on the unit price per square yard or the price per ton for riprap placed, as shown on the plans. Payment shall be full compensation for providing all labor, materials, geotextile, excavation and equipment necessary to complete the riprap installation.

Excavation for the placement of riprap is considered incidental.

Payment for Channel Excavation to the top of riprap (finish grade) is paid for as shown on the Bid Sheets.

Fill, as approved by the Engineer, to the top of riprap (finish grade) is paid for as shown on the Bid Sheets.

END OF ITEM 493