

SECTION 02378

RIPRAP AND GRANULAR FILL



PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes requirements for furnishing and installing riprap and granular fill and filling and burying riprap, when required.

1.2 MEASUREMENT AND PAYMENT

- A. Where there is not a separate item listed on the Unit Price Schedule for work in this Section, no separate measurement and payment is made. Include cost for work under this Section in the related item listed on the Unit Price Schedule.
- B. Measurement and payment is as noted on the Unit Price Schedule.
- C. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- D. Excavation for riprap and buried riprap will not be measured separately, but is incidental to riprap surface measurement.
- E. Riprap and granular fill used in toe walls, grade beams or termination trenches are incidental to surface measurement.
- F. On-site topsoil will not be measured and paid separately, but is incidental to riprap surface measurement.
- G. Imported topsoil will be paid for as noted on the Unit Price Schedule.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Keep the storage area clean, firm, smooth and well drained in order that the product can be placed with a minimum of foreign matter.
- B. Stockpile and handle riprap and granular fill to minimize segregation of particle sizes either in the stockpile or while loading, hauling and handling.

PART 2 – PRODUCTS

2.1 RIPRAP

- A. Provide riprap consisting of broken concrete or stone. Provide riprap that is dense, durable and hard material free from cracks, seams and other defects which would increase deterioration from handling and natural causes.
- B. Shape and Dimensions.
 - 1. Provide riprap in cubic form, rather than elongated (flat) shapes.
 - 2. Provide riprap with a minimum thickness of 6 inches.

3. No more than 25 percent shall have a length greater than 2-1/2 times the width or thickness. No length shall exceed 3 times the width or thickness.
- C. Do not provide spalls, fragments and chips exceeding 5 percent by weight. The dimension and shape limitations do not apply to this portion of the riprap.
- D. Where broken concrete is used, cut exposed metal flush with the surface prior to placing the riprap.
- E. Provide riprap conforming to the following tables:

TABLE 1
RIPRAP GRADATION NO. 1

Percent Lighter by Weight	Stone Weight Lbs.		Volume Cubic Ft (2)		Cubical Shape Ft (Each Side)		Spherical Shape Ft (Dia.)	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
	Limit	Limit	Limit	Limit	Limit	Limit	Limit	Limit
100	180	265	1.20	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:

1. The theoretical cube and sphere size is presented for guidance only. Paragraph 2.1 shall control riprap shape and dimensions.
2. Volume is based on 150 pcf, unit weight.
3. Riprap Gradation No. 1 is to be used where an 18 inch thick riprap mat is noted on the Plans.

TABLE 2
RIPRAP GRADATION NO. 2

Percent Lighter by Weight	Stone Weight Lbs.		Volume Cubic Ft (2)		Cubical Shape Ft (Each Side)		Spherical Shape Ft (Dia.)	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
	Limit	Limit	Limit	Limit	Limit	Limit	Limit	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:

1. The theoretical cube and sphere size is presented for guidance only. Paragraph 2.1 shall control riprap shape and dimensions.
2. Volume is based on 150 pcf, unit weight.
3. Riprap Gradation No. 2 is to be used where a 24 inch thick riprap mat is noted on the Plans.

2.2 GRANULAR FILL

- A. Provide granular fill consisting of concrete or stone. Provide granular fill that is dense, durable and hard material.
- B. Provide granular fill, as shown on the Plans or as directed by the Engineer, to the following dimensions:
 1. Provide 3 inch to 5 inch granular fill with no material diameter less than 3 inches and no material diameter greater than 5 inches.

2. Provide 4 inch to 8 inch granular fill with no material diameter less than 4 inches and no material diameter greater than 8 inches.
 3. Provide riprap Gradation No. 1 and Gradation No. 2 as shown on the Plans or as directed by the Engineer.
- C. Do not provide spalls, fragments and chips exceeding 5 percent by weight.
- D. Where broken concrete is used, cut exposed metal flush with the surface prior to placing granular fill.

2.3 GEOTEXTILE

- A. Refer to Section 02379 – Geotextiles for Erosion Control Systems.

PART 3 – EXECUTION

3.1 GRADE PREPARATION

- A. Refer to Section 02241 – Care and Control of Water.
- B. Trim and dress the channel bottom and side slopes to proper lines and grade prior to placing riprap or granular fill. Where shown on the Plans, place geotextile in accordance with Section 02379 – Geotextiles for Erosion Control Systems.
- C. The Engineer will inspect prepared section prior to placing geotextile, riprap or granular fill.

3.2 EXCAVATION AND FILL

- A. Excavate the channel. Refer to Section 02315 – Excavating and Backfilling.
- B. Excavate for riprap. Refer to Section 02316 – Structural Excavating and Backfilling.

3.3 RIPRAP OR GRANULAR FILL PLACEMENT

- A. Place the riprap or granular fill to the slopes, lines and grades as shown on the Plans.
- B. To establish a well-graded mass of riprap with minimal voids, fill voids 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 riprap or granular fill.
- C. Install riprap and granular fill mat to the thickness as shown on the Plans. Riprap shall have minimum mat thickness as shown on the gradation tables.
- D. Place the riprap and granular fill to avoid displacement or damage to the prepared surface or geotextile and in a manner to avoid segregation of particle sizes.

- E. Fill riprap voids and bury riprap a minimum of 6 inches with topsoil on side slopes as directed by the Engineer.

END OF SECTION