

SECTION 02273 – RIPRAP

PART 1 - GENERAL

1.01 SUMMARY

- A. This section covers the furnishing of all labor, materials and equipment for the placing of riprap at the locations and to the lines and grades shown on the drawings. This section is suitable for the following applications:
1. Ditch lining.
 2. Culvert aprons.
 3. Streambank stabilization.
 4. Erosion control measures.

1.02 SPECIFICATION MODIFICATIONS

- A. It is understood that throughout this section these Specifications may be modified by appropriate items in Section 01015 – Specific Project Requirements, or as otherwise indicated on the Contract Drawings.

1.03 RELATED SECTIONS

- A. Section 01015 – Specific Project Requirements.
B. Section 01570 – Temporary Erosion and Sediment Control.
C. Section 02180 – Clearing and Grubbing.
D. Section 02200 – Earthwork.
E. Section 02230 – Geotextiles.
F. Section 03000 – Miscellaneous Concrete.

1.04 CODES AND STANDARDS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
AASHTO M288 Standard Specification for Geotextile Specification for Highway Applications.
- C. American Society for Testing and Materials (ASTM):
ASTM C33 Standard Specification for Concrete Aggregate.
ASTM D75 Standard Practice for Sampling Aggregates.
ASTM C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
ASTM C127 Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C136 Standard Test Method for Sieve Analysis of Fine and Course Aggregate.
ASTM D1682 Standard Test for Breaking Load and Elongation of Textile Fabrics.
ASTM D4992 Evaluation of Rock to be Used for Erosion Control
ASTM D5312 Evaluation of Durability of Rock for Erosion Control Under Freezing and Thawing Conditions
ASTM D5313 Evaluation of Durability of Rock for Erosion Control Under Freezing and Thawing Conditions

ASTM D5519 Particle Size Analysis of Natural and Man-Made Riprap Materials.

1.05 SUBMITTALS

- A. Submit as specified in Section 01300 – Submittals.
- B. Certified test reports, indicating compliance with the requirements of these specifications, must be received and approved by the City prior to the delivery of any materials to the site.
- C. Test Reports:
 - 1. Contractor shall submit certified test reports from a qualified independent testing laboratory, selected and compensated by Contractor. Selection of the independent testing laboratory shall be subject to the City’s approval. No materials shall be used until approval of the designated source is obtained. The approval of a source shall not be construed as approval of all materials from that source. Material from certain areas, strata, or channels within the approved source may be rejected. The acceptability of the stone is subject to final approval by the City.
 - 2. Soundness Tests: Soundness of parent material for riprap shall be tested in accordance with ASTM C88.
 - 3. Riprap Gradation: Gradation of riprap (determined from a sample size of not less than 1-1/2 cubic yards) shall be done in accordance with ASTM C136 and D75.
 - 4. Riprap Bedding Gradation: Gradation of bedding materials shall be done in accordance with ASTM C136 and D75.
- D. Certificates:
 - 1. Quarry Information: Riprap shall be obtained from a quarry and ledge approved by the Missouri Department of Transportation or the U.S. Army Corps of Engineers, Kansas City District. Contractor shall submit information on the quarry from which the riprap will be obtained. The geologic unit that is the source of the riprap must be pre-approved by a Geologist, registered in the State of Missouri, selected and compensated by the Contractor. The source and the materials proposed for use shall be acceptable to the City before riprap operations are started.
 - 2. Geotextile: Furnish manufacturer’s certification for each lot of material furnished stating the name of the manufacturer, the chemical composition of the filaments or yarns and certifying that the material supplied is in accordance with this specification. The certification shall include or have attached typical results of test from specific lots for all specified requirements.

1.06 QUALITY ASSURANCE

- A. The Contractor is responsible for the quality assurance and quality control of the Work.
- B. Experience: All riprap work shall be performed by a contractor having demonstrated experience in riprap placement on projects of similar size. The work shall be prepared by experienced personnel who are familiar with the required work and who are under the supervision of a qualified foreman at all times when the work is in progress. The contractor shall have access to all equipment necessary to perform the work.
- C. As an additional measure of quality control, the City may request to conduct a visual inspection of the quarry ledge and/or stockpiles prior to delivery of the material to the

Site. If such an inspection is requested, the Contractor shall make arrangements with the quarry and participate in the inspection.

- D. Curing Time: Stone shall be cured for a minimum of 30 calendar days before being shipped to the project site to allow freshly quarried stone to cure. City can waive requirement if the stone has characteristics that make curing unnecessary. Conduct curing operations on freshly quarried stone to allow it to release stored energy and moisture and to allow the stone to demonstrate that it will not fracture during the energy release and drying-out phase.
- E. Quarrying Exclusion Period: Stone quarried between the 15th of October and the 15th of April will not be approved for use in the project. If the stone is not affected by freeze-thaw cycles, and the durability history of the stone demonstrates that quarrying during the exclusion period has no adverse effect on the durability of the stone and the City approves the use of the stone quarried during the exclusion period, the stone quarrying period exclusion may be waived by the City.

PART 2 - PRODUCTS

2.01 RIPRAP

- A. Stone for riprap shall be sound, hard, and durable rock, free from cracks, seams, shale partings and overburden spoil.
- B. Stone shall be approximately rectangular in cross section, free from thin, slab-like pieces. Flat or elongated stones having a small dimension less than 1/3 of the large dimension shall not be used.
- C. The quantity of stone having an elongation ratio greater than 3:1 shall not exceed 20 percent by weight.
- D. Deleterious substances such as shale and clay balls (in material retained on the 1/2-inch sieve) shall not exceed 7 percent by weight.
- E. The minimum weight of stone shall be 160 pounds per cubic foot as computed by multiplying the specific gravity (bulk-saturated surface dry basis) determined in accordance with ASTM D127 times 62.3 pounds per cubic foot.
- F. Stone maximum loss not more than 10% on stone when subjected to freezing and thawing or wetting and drying shall be in accordance with ASTM D5312 and D5313, respectively.
- G. Not more than 10% of the stone shall show splitting, crumbling, or spalling when subjected to 5 cycles of the sodium soundness test as required by ASTM C88.
- H. Perform gradation tests to assure compliance with contract requirements in accordance with ASTM D5519, Test Method A.
- I. Gradation type shall be as called out on the Drawings. Unless otherwise indicated in Section 01015 – Specific Project Requirements, stone shall be reasonably uniformly graded as shown in Table 1 on the following page.

Table 1. Riprap Gradation and Placement Information

Criterion	Light 12*	Light 18*	Light 24	1/4 Ton	1/2 Ton	1 Ton**
Maximum Stone Size (D ₁₀₀), lbs.	85	300	600	2500	3500	8000
Predominant Stone Size (D ₅₀), lbs.	25	85	200	500	1000	2000
No More than 15% Passing Stone Size, lbs.	5	20	40	150	250	500
Minimum Course Thickness, inches	12	18	27	36	48	54
Minimum Riprap Bedding Course Thickness, inches	6	6	6	6	9	9
Placement Tolerance, inches	3	3	6	6	6	6

* Riprap types only for use in approved ditch liner and erosion control application.

** Geotextile fabric will not be allowed as a filter for these riprap types

2.02 RIPRAP BEDDING

- A. Bedding for the riprap shall be furnished prior to placement of the riprap as specified herein.
- B. Bedding shall be sound, durable limestone particles, free from cracks, seams, shale partings and soil. It shall be a natural gravel composed of hard, tough and durable particles free from adherent coatings. Bedding larger than one-inch standard sieve size shall be reasonably free from flat elongated particles.
- C. Bedding material shall meet the quality requirements of ASTM C33 and shall be reasonably well graded within the limits specified:

Table 2. Riprap Bedding Material Gradation Limits

Sieve Size	Percent Passing by Weight
3 inch	Maximum Allowable Size
1-1/2 inch	75% - 95%
1/2 inch	40% - 60%
No. 4	5% - 25%

- D. Contractor shall perform gradation tests to assure compliance with contract requirements and shall maintain detailed records. The bedding material shall be sampled in accordance with ASTM D75 and tested in accordance with ASTM C136.

2.03 GEOTEXTILE

- A. Unless otherwise indicated on the Drawings, geotextile material shall be installed below the bedding material to increase soil stabilization. See also Section 02230 – Geotextiles.
- B. Filter fabric shall be woven or nonwoven, polyester or polypropylene material that comply with the general physical and the geotextile property requirements for subsurface drainage, separation, and stabilization in AASHTO M 288.
 - 1. The minimum permittivity shall be 1.0 sec-1.
 - 2. The material shall be AASHTO Class 1.
- C. Store and handle geotextiles according to ASTM D 4873. Do not use torn or punctured geotextiles.

PART 3 - EXECUTION

3.01 SITE PREPARATION

- A. Clear and grub areas, dispose of large trees, brush and vegetation before starting construction. This work shall be done in accordance with Section 02180 – Clearing and Grubbing.
- B. Remove tree stumps and roots larger than 1 ½ inches in diameter.
- C. Backfill all excavations resulting from the clearing and grubbing operations with suitable materials in accordance with Section 02200 – Earthwork.
- D. The contractor shall arrange for and dispose of large debris off the site.
- E. Install temporary erosion control measures where shown on the drawings. Erosion control work shall be done in accordance with Section 01570 – Temporary Erosion and Sediment Control.

3.02 BASE PREPARATION

- A. Areas on which riprap is to be placed shall be graded and/or dressed to conform to the contract drawings within an allowable tolerance of plus 2 inches and minus 4 inches from the theoretical lines and grades.
- B. Where such areas are below the allowable minus tolerance limit they shall be brought to grade by fill with earth similar to the adjacent material and then compacted to a density equal to the adjacent in place material.
- C. As an alternative, these areas may be filled with riprap bedding material at no additional cost. Immediately prior to placing the geotextile or riprap bedding material, the prepared base will be inspected by the City/Design Professional and no material shall be placed thereon until that area has been approved.
- D. The City/Design Professional will inspect all subgrade material to determine conformance with indicated lines and grades.

3.03 GEOTEXTILE

- A. Geotextile shall be placed on the base and below the riprap bedding. See also Section 02230 – Geotextiles.
- B. Filter fabric joints shall be lapped in accordance with the manufacturer's installation instructions, but not less than least 3 feet.
- C. A minimum 2 percent slack shall be provided in both directions.
- D. Fabric shall be installed in conformity with all other manufacturer's requirements.

3.04 RIPRAP BEDDING

- A. Bedding shall be spread uniformly to the minimum riprap bedding course thickness as indicated in Table 1, as modified in Section 01015 – Specific Project Conditions or as indicated on the Drawings.
- B. Bedding shall be placed using methods which will avoid damage to the prepared base and geotextile.
- C. Bedding shall be placed using methods that minimize segregation.
- D. Any damage to the underlying surface during placement of the bedding shall be repaired before proceeding with the Work.
- E. Compaction of the bedding layer will not be required. However, the bedding surface shall be reasonably smooth.

3.05 RIPRAP

- A. Stone for riprap shall be placed in a manner that will produce a well-graded mass of rock. Rock riprap shall not be placed on slopes steeper than 1.5H:1V.
- B. Riprap shall be placed uniformly to the minimum course thickness indicated in Table 1, as modified in Section 01015 – Specific Project Conditions or as indicated on the Drawings.
- C. Riprap shall be placed to its full course thickness in one operation and in such a manner as to avoid displacing the riprap bedding material or damaging the geotextile.
- D. Placement shall begin at the bottom of the area to be covered and continue up the slope. Subsequent loads of material shall be placed against previously placed material in such a manner as to ensure a relatively homogenous mass.
- E. The finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones.
- F. Riprap shall be placed to the lines and grades indicated on the Drawings. The placement tolerance for the finished surface shall be as indicated in Table 1. The placement tolerance is in addition to the specified course thickness.
- G. Desired distribution shall be obtained by selective loading at the quarry; by controlled dumping of successive loads during final placing; or by other methods of placement which will produce the specified results.
- H. Placing riprap in layer, hauling over riprap after placement will not be permitted. Placing riprap by dumping it at the top of the slope and pushing it down the slope shall not be permitted. Moving stone by drifting and manipulating stone by means of dozers or other blade equipment is not permitted.
- I. No equipment shall be operated on the completed stone protection system.
- J. Rearranging of individual stones shall be required to the extent necessary to obtain a well-graded distribution of stone sizes as specified above. However, manipulating stone by means of dozers or other blade equipment is not permitted.

3.06 MAINTENANCE

- A. The Contractor shall maintain the riprap until the end of the performance and maintenance period. Any riprap or material that is deteriorated, disintegrated or displaced by any cause shall be repaired to the lines and grades shown on the drawings.

END OF SECTION