

SECTION 02273 – RIPRAP

PART 1 - GENERAL

1.01 SUMMARY

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

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 02200 - Site Preparation and Earthwork
- C. Section 02230 - Geotextiles

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 T104 Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.
 - AASHTO M80 Course Aggregate for Hydraulic Cement Concrete.
- C. American Society for Testing and Materials (ASTM):
 - ASTM C33 Standard Specification for Concrete Aggregate.
 - ASTM C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
 - ASTM C136 Standard Test Method for Sieve Analysis of Fine and Course Aggregate.
 - ASTM D75 Standard Practice for Sampling Aggregates.
 - ASTM D1682 Standard Test for Breaking Load and Elongation of Textile Fabrics.
 - ASTM D5519 Particle Size Analysis of Natural and Man-Made Riprap Materials.
 - ASTM D5779 Standard Test Method for Field Determination of Apparent Specific Gravity of Rock and Manmade Materials for Erosion Control.

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 affected 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 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, and material from certain areas, strata, or channels within the approved source may be rejected. The acceptability of the stone will be subject to final approval by the City.
 - 2. Soundness Tests: Soundness of parent material for riprap when tested in accordance with ASTM C88 and as specified.
 - 3. Riprap Gradation: Gradation of riprap (determined from a sample size of not less than 1-1/2 cubic yards.
 - 4. Riprap Bedding Gradation: Gradation of bedding materials.
- 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 of quarry from which the riprap will be obtained. The source and the materials proposed for use shall be acceptable to the City before riprap operations are started.

1.06 QUALITY ASSURANCE

- A. Contractor 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.
- B. 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 material to the Site. If such an inspection is requested, the Contractor shall make arrangements with the quarry and participate in the inspection.

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. No stone shall have an elongation ratio greater than 4:1.
- 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 ½-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 D5779 times 62.3 pounds per cubic foot.
- F. 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.
- G. Gradation type shall be as called out on in the Drawings. Unless otherwise indicated in Section 01015 – Specific Project Requirements, stone shall be reasonably uniformly graded as follows:

Table 1. Riprap Gradation and Placement Information

Criterion	Type 1	Type 2	Type 3	Type 4
Maximum Stone Size (D ₁₀₀), inches	6	10	20	28
Predominant Stone Size (D ₅₀), inches	3	6	12	19
No More than 15% Passing Stone Size, inches	1	3	4	6
Minimum Course Thickness, inches	9	15	30	42
Minimum Riprap Bedding Course Thickness, inches	4	6	6	6
Placement Tolerance, inches	4	6	6	6

- H. Perform gradation tests to assure compliance with contract requirements in accordance with ASTM D5519, Test Method A.

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, or shall be 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 Grading 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.

B. See Section 02230 – Geotextiles.

2.04 GROUTED RIPRAP

A. Grout for riprap shall be one part Portland cement and three parts fine aggregate with sufficient water to form plastic mix without segregation.

PART 3 - EXECUTION

3.01 SITE PREPARATION

- A. Clear and grub areas and dispose of large trees, brush and vegetation before starting construction.
- B. Remove tree stumps and roots larger than 1 ½ inches in diameter
- C. Backfill excavations resulting from clearing and grubbing with suitable materials.
- D. Dispose of large debris off the site as arranged for by Contractor.

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 and no material shall be placed thereon until that area has been approved.
- D. City 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.

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.

- 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 will not be permitted.
- I. No equipment shall be operated directly 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 shall not be permitted.

3.06 GROUTED RIPRAP

- A. When indicated on the plans, the spaces between the stones shall be filled with grout. Grout shall be broomed into the voids until they are completely filled. Grout shall be cured as required for flatwork as referenced in the grout section.

3.07 MAINTENANCE

- A. The Contractor shall maintain the riprap until the end of the correction period and any material deteriorated, disintegrated or displaced by any cause shall be repaired to the lines and grades indicated on the plans.

END OF SECTION