## SP-XX, GABION BASKETS AND RENO MATTRESSES

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**1.0 DESCRIPTION**

Work covered in this special provision shall include furnishing, assembling, filling and backfilling PVC-coated woven galvanized wire mesh gabion baskets and/or Reno mattresses with rock as specified to the dimensions, lines and grades shown on the plans, or as determined by the Engineer. Work covered by this special provision includes, but is not limited to, excavation; furnishing and placing stone bedding; furnishing and placing geotextile fabric; furnishing, assembling and placing wire mesh baskets and mattresses; furnishing stone material; filling baskets and mattresses with stone material; and backfilling in accordance with the provisions of these specifications and in accordance with the requirements as directed by the Engineer.

Gabions and Reno mattresses shall consist of rectangular wire mesh formed containers filled with rock and shall be furnished as baskets or mattresses as shown on the Drawings. Gabion and mattress mesh will conform to one of the following types:

1. Woven mesh—Non-raveling, double twisted, hexagonal wire mesh consisting of two wires twisted together in two 180-degree turns.
2. Welded mesh—Welded-wire mesh with a uniform square or rectangular pattern and a resistance weld at each intersection. The welded wire connections shall conform to the requirements of ASTM A 185, including wire smaller than W1.2 (0.124 in.), except that the welded connections shall have a minimum average shear strength of 70% and minimum shear strength of 60% of the minimum ultimate tensile strength of the wire.

**2.0 Submittals**

Submit manufacturer’s product data including installation instructions and manufacturer’s shop drawings including section layout.

**3.0 Materials**

1. Reference Standards (America Society For Testing and Materials) ASTM latest edition:
	1. ASTM A313 / A313M - 10e1 Standard Specification for Stainless Steel Spring Wire
	2. ASTM A370 - 10 Standard Test Methods and Definitions for Mechanical Testing of Steel Product
	3. ASTM A641 / A641M - 09a Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
	4. ASTM A764 - 07 Standard Specification for Metallic Coated Carbon Steel Wire, Coated at Size and Drawn to Size for Mechanical Springs
	5. ASTM A975 - 97(2003) Standard Specification for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire With Poly(Vinyl Chloride) (PVC) Coating)
	6. ASTM B117 - 09 Standard Practice for Operating Salt Spray (Fog) Apparatus
	7. ASTM D412 - 06ae2 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
	8. ASTM D746 - 07 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
	9. ASTM D792 - 08 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
	10. ASTM D2240 - 05(2010) Standard Test Method for Rubber Property-Durometer Hardness
2. Gabion and Reno mattress foundation bedding stone shall be placed as called for on the drawings.
3. Wire (Zinc Coated): all tests on the wire mesh must be performed prior to manufacturing the mesh.
	1. Tensile strength: both the wire used for the manufacture of gabions and the selvedge wire, shall have a tensile strength of 54,000 to 75,000 psi, in accordance with ASTM A641-09a (latest revision).
	2. Elongations: the test must be carried out on a sample at least 12 in. long. Elongation shall not be less than 12% in accordance with ASTM A370-10.
	3. Zinc Coating: minimum quantities of zinc according to ASTM A641-09a, Class III soft temper coating.
	4. Adhesion of zinc coating: the adhesion of the zinc coating to the wire shall be such that, when the wire is wrapped six turns around a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with the bare fingers, in accordance with ASTM A641-09a.
4. PVC Coating:
5. Specific gravity: 81-84 pcf in accordance with ASTM D792-08 Table 1
6. Hardness: between 50 and 60 Shore D, according to ASTM D2240-05 (2010)
7. Tensile strength: not less than 2,985 psi, ASTM D412-06ae2
8. Modulus of elasticity: not less than 2,700 psi, ASTM D412-06ae2 (latest revision)
9. Abrasion Resistance: the percentage of the weight loss shall be less than 12% according to ASTM D (latest revision).
10. Creeping corrosion: Max penetration of corrosion of the wire form a square cut end shall be less than 1 in. when the specimen has been immersed for 2,000 hrs in a 50% solution HCl.
11. Salt spray test: test period 3,000 hours, test method ASTM B117-09.
12. Exposure to UV rays: test period 3,000 hours at 145ºF
13. Brittleness Temperature: no higher than 15 º F or lower temperature when specified by the purchase, when tested in accordance with ASTM D746M-02 (2007).
14. Galvanized and PVC coating wire mesh Gabions (8 x 10 mesh type) and Reno mattresses (6 x 8 mesh type):
15. Mesh Wire: Diameter – 0.087” internal, 0.127” external
16. Selvedge Wire: Diameter – 0.106” internal, 0.146” external
17. Mesh Opening: Nominal Dimension D=2.5 inch opening between wrapped wire.
18. Galvanized (zinc coated) and PVC coating lacing wire and internal stiffeners:
	* 1. Lacing Wire: Diameter – 0.087in.
		2. Cross tie/stiffener wire: Diameter – 0.087 in.
		3. Preformed Stiffener: Diameter – 0.153 in. internal
19. Steel Mesh Properties:
20. Mesh Tensile Strength shall have a minimum strength of 3,500 lb/ft when tested in accordance with ASTM A975 section 13.1.1.
21. Punch Test Resistance shall have a minimum resistance of 6,000 lb when tested in accordance with ASTM A975 section 13.1.4.
22. Connection to selvedges shall have a minimum resistance of 1,400 lb/ft when tested in accordance with ASTM A975.
23. Overlapping Fasteners:
24. Overlapping stainless steel fasteners may be used in lieu of selvedge wire for basket assembly and installation. The spacing of the fasteners during all phases of the assembly and installation shall be in accordance with spacing based on 1,400 lb/ft pull apart resistance for galvanized mesh when tested in accordance with ASTM A975 section 13.1.2, with a nominal spacing of 4 inches, and not to exceed 6 inches.
25. Overlapping stainless steel fasteners may be used in lieu of selvedge wire for basket assembly and installation. The spacing of the fasteners during all phases of the assembly and installation shall be in accordance with spacing based on 1,200 lbs. pull apart resistance for PVC coated mesh and with a nominal spacing of 4 inches, and not to exceed 6 inches.
26. Stainless Steel Galvanized Fasteners: Diameter 0.120inch, according to ASTM A313, Type 302 Class I.
27. Tensile strength: 230,000 to 273,000 psi in accordance with ASTM A764-07.
28. Proper installation of rings: A properly formed hog ring fastener shall have a nominal overlap of one (1) inch after closure
29. Tolerances:
30. Wire: Zinc coating, in accordance with ASTM A641-09a, Class III soft temper coating
31. Gabion and Reno Mattress sizes: +/- 5% on the length, width, and height.
32. Mesh opening: Tolerances on the hexagonal, double twisted wire mesh opening shall not exceed +/- 10% on the nominal D values.
33. Rock Fill: The rock for gabions and Reno mattresses shall conform to Section 1042 of the NCDOT Standard Specifications for Roads and Structures. Gabion and Reno Mattress rocks shall be NCDOT aggregate between 4 inches and 8 inches. The range in sizes may allow for a variation of 5% oversize and/or 5% undersize rock, provided it is not placed on the gabion exposed surface.
34. Geotextile Fabrics: Geotextile fabrics shall be Type 2, per Section 1056 of the NCDOT Standard Specifications for Roads and Structures.
35. Bedding Stone: Bedding stone shall meet the requirements of section 1016 Select Materials Class VI of the NCDOT Standard Specifications for Roads and Structures.

**4.0 FABRICATION**

Gabions and Reno mattresses shall be manufactured and shipped with all components mechanically connected at the production facility. The front, base, back and lid of the gabions shall be woven into a single unit. The ends and diaphragm(s) shall be factory connected to the base. All perimeter edges of the mesh forming the basket and top, or lid, shall be selvedge with wire having a larger diameter.

The gabion and Reno mattress is divided into cells by means of diaphragms positioned at approximately 3 foot centers. The diaphragms shall be secured in position to the base so that no additional lacing is necessary at the jobsite.

**5.0 CONSTRUCTION METHODS**

1. Foundation Preparation: Excavate area to receive gabions and Reno mattresses to elevations as called for on the drawings, including the area below gabions and mattresses to allow for bedding stone.

Maintain the foundation in a dry condition.

Install the Geotextile fabric in accordance with Section 1056 of the NCDOT Standard Specifications for Roads and Structures. Geotextile fabrics shall be placed between the gabion baskets or Reno mattresses and the bedding stone and the surrounding soil.

The gabion baskets or Reno mattresses shall be bedded on minimum 6” layer of #57 crushed bedding stone.

1. Assembly: Gabions and Reno mattresses are supplied folded flat and packed in bundles. The units are assembled individually by erecting the sides, ends, and diaphragms, ensuring that all panels are in the correct position, and the tops of all sides are aligned. The four corners shall be connected first, followed by the internal diaphragms to the outside walls. All connections should use lacing wire or fasteners as previously described.
2. Fastening: The procedure for using selvedge wire consists of cutting a sufficient length of wire, and first looping and/or twisting the lacing wire to the wire mesh. Proceed to lace with alternating double and single loops through every mesh opening approximately every 6 inches pulling each loop tight and finally securing the end of the lacing wire to the wire mesh by looping and/or twisting.

The use of fasteners shall be in accordance with the manufacturer’s recommendations as specified above.

1. Installation: After assembly, the gabion baskets and Reno mattresses are carried to their final position and are securely joined together along the vertical and top edges of their contact surfaces using the same connecting procedure(s) described above.

Stagger the vertical joints between the gabions of adjacent rows and layers by a half of a cell length.

1. Filling: Baskets and mattresses shall be filled with rock as specified above. During the filling operation some manual stone placement is required to minimize voids. The rock filling shall be placed in lifts of 12 inches maximum, with a minimum of 2 lifts per gabion or mattress. It is also recommended to slightly overfill the baskets by 1 to 2 inches to allow for settlement of the rock. The exposed faces of vertical structures may be carefully hand placed to give a neat, flat, and compact appearance.

The cells shall be filled in stages so that local deformation may be avoided. That is, at no time shall any cell be filled to a depth exceeding 1-foot higher than the adjoining cells. Behind gabion walls, compact the backfill material simultaneously to the same level as the filled gabions. All backfill must be in accordance with *SP- Earthwork, Excavation, Unsuitable Materials, and Backfill Materials.*

1. Lid Closing: Once the gabions baskets and Reno mattresses are completely full, the lids will be pulled tight until the lid meets the perimeter edges of the basket. A tool such as a lid closer can be used. The lid must then be tightly laced and/or fastened along all edges, ends and tops of diaphragm(s) in the same manner as described earlier.
2. Mesh Cutting and Folding: Where shown on the drawings or otherwise directed by the Engineer, the basket mesh shall be cut, folded and fastened together to suit existing site conditions. The mesh must be cleanly cut and surplus mesh either folded back or overlapped so that it can be securely fastened together with lacing wire or fasteners in the manner described earlier. Any reshaped gabions shall be assembled, installed, filled and closed as specified in the previous sections.

**6.0 MEASUREMENT**

The quantity of gabions and mattresses will be the number of cubic yards of gabions and mattresses installed and accepted. No separate measurement will be made for excavation, rock used to fill the gabions or mattresses, geotextile material, or bedding stone material.

**7.0 Payment**

All work covered by this special provision will be paid for at the contract unit price per cubic yard for “Gabion Baskets” or “Reno Mattresses”. Such payment will be full compensation for all labor, materials, and equipment to complete the work covered in this special provision, including but not limited to all excavation; furnishing, assembling and placing basket; furnishing rock and filling baskets and mattresses; furnishing and placing stone bedding; and furnishing and placing geotextile fabric. Backfill will be paid in accordance with *SP- Earthwork, Excavation, Unsuitable Materials, and Backfill Materials.*

Payment will be made under:

**GABION BASKETS CY**

**RENO MATTRESSES CY**