

## SECTION 66

### GABIONS

#### 66.1 DESCRIPTION

**A. General:** This work consists of furnishing, assembling and filling woven wire gabions with stones as specified in the contract in conformance with the dimensions, lines, and grades shown on the plans or established by the Engineer.

**B. Related Work:**

Section 202 Geosynthetics for Roadways  
Section 203 Submittals

#### 66.2 MATERIALS

**A. Gabions:** Shall be supplied in various lengths and heights. The lengths shall be multiples (2, 3, or 4) of the horizontal width. The heights shall be fractions (1, 1/2, or 1/3) of the horizontal width. The horizontal width shall not be less than 36 inches. Gabions shall be of uniform width.

Gabions shall be fabricated so the sides, ends, lid, and diaphragms can be assembled at the construction site into a rectangular basket. Gabions shall be of single unit construction. Base, lid, ends, and sides shall be either woven into a single unit or one edge of these members connected to the base section of the gabion so strength and flexibility at the point of connection is at least equal to that of the mesh.

The gabion shall be furnished with diaphragms the same mesh and gauge as the body of the gabions, secured in proper position on the base in such a manner that no additional tying at this juncture will be necessary. The spacing of the diaphragms shall be the same as the horizontal width.

The gabions shall be made of woven wire mesh. The woven wire mesh shall be made of galvanized steel wire having a minimum size of U.S. steel wire gauge #11. The tensile strength of the wire shall be 60,000 to 85,000 psi when tested in accordance with ASTM A392. The minimum zinc coating of the wire shall be 0.8 oz. per square foot of uncoated wire surface as determined by ASTM A90. The maximum linear dimension of the mesh opening shall not exceed 4½ inches and the area of the mesh opening shall not exceed 10 square inches.

The wire mesh shall have elasticity permitting elongation to a minimum of 10% of the length of the section of the mesh without reducing the gauge or tensile strength of individual wires to values less than those for wire one gauge smaller.

A section of the mesh 6 feet long and not less than 3 feet wide, after the elongation test shall withstand a load test of 6,000 pounds applied to an area of 1 square foot in the center of the section.

An uncut section of mesh 6 feet long, not less than 3 feet wide, including selvedge bindings, shall have the ends securely clamped for 3 feet along the width of the sample. When the width of the sample exceeds 3 feet, the clamps will be placed in the middle and the excess width will fall free on each side of the clamped section. The sample shall be subjected to sufficient tension to cause 10% elongation of the section between the clamps. After elongation and while clamped, the section shall be subjected to a load applied to an area of 1 square foot in the center of the sample section and perpendicular to the direction of the tension force. The sample shall withstand, without rupture of wire or opening of mesh fastening, an actual load of 6,000 pounds. The ram head used in the test shall be circular with its edges beveled or rounded to prevent cutting of the wires.

The wire mesh shall resist pulling apart at the twists or connections forming the mesh when a single wire is cut and the section of mesh then subjected to the load test described in the elasticity test.

Each shipment of gabions shall be accompanied by a certificate, which states that the material conforms to the requirements.

**GAUGE TABLE FOR ZINC COATED STEEL WIRE**

<b>Wire Gauge</b>	<b>Equivalent Diameter</b>
<b>Designation</b>	<b>Inches</b>
9	0.148
10	0.135
11	0.120
11½	0.113
12	0.105
12½	0.099
13	0.0915
14	0.080

Materials shall conform to the following requirements and Sections.

- B. PVC Coating:** When specified, the wire used in the fabrication of the bank and channel protection shall be PVC coated. After zinc coating, the PVC coating shall be extrusion bonded on the wire. The PVC coating shall have a nominal thickness of 0.02165 inches and a minimum thickness of 0.015 inches. The lacing wire shall also be PVC coated.

The PVC coating shall not crack, peel, blister, split, or have any other defects. The coating material shall be resistant to the effects of weather and exposure to ultraviolet rays.

- C. Lacing and Internal Connecting Wire:** Shall be 0.0866 inch diameter steel wire ASTM A641 Class 3 soft temper measured after galvanizing and for PVC coated baskets shall be 0.0866 inch diameter steel wire measured after galvanizing but before PVC coating.

All perimeter edges of the mesh forming the baskets, including end panels and top of the diaphragms, shall be selvedged with selvedge wire. For sound structural integrity, the gabion mesh wires shall be wrapped around the selvedge wire with a number of turns necessary to interconnect each of them with the adjacent mesh wire.

For multitiered structures, the internal connecting wires shall be furnished. The internal connecting wires shall meet the same specifications as the wire used in the mesh.

Tie wire or connecting wire shall securely fasten all edges of the gabion and diaphragms to provide for four internal connecting wires in each cell one-half unit high and eight internal wires in each cell one unit high. The tie wire shall meet the same specifications as the wire used in the mesh except that the tie wire may be two gauges smaller.

- D. Interlocking Fasteners:** For galvanized gabions shall be high tensile 0.120 inch diameter galvanized steel wire measured after galvanizing. The galvanizing shall conform to ASTM A641 Class 3 coating. Fasteners shall also be in accordance with ASTM A764, Class II, Type C.

Interlocking fasteners for PVC coated gabions shall be high tensile 0.120 inch diameter stainless steel wire conforming to ASTM A313, Type 302, Class I.

The use of alternate fasteners shall be permitted in lieu of lacing wire provided the following has been demonstrated.

1. The ability of the alternate fastener to contain a minimum of four selvedge wires while remaining overlapped a minimum of 1 inch for overlapped type or in a locked and closed condition.
2. The proposed fastener system can consistently produce a four selvedge wire joint with a strength of 1400 pounds per linear foot for a galvanized joint and 1200 pounds per linear foot for PVC coated gabion joints.
3. The proper installation can be readily verified by visual inspection.

- E. Stone:** Shall be durable stone or ledge rock, free of seams, cracks, and defects. Slabby stone pieces will not be acceptable. The stone shall range in size from a minimum of 4 inches to a maximum of 8 inches in the greatest dimension. The majority of the stones shall be in the 5 to 6 inch range and cubical or rounded in shape. Stone shall not have an L.A. Abrasion of more than 40%.

**F. Separation Fabric:** Shall conform to Class 1 non-woven separation fabric per Section 202.

### 66.3 CONSTRUCTION REQUIREMENTS

Slopes to be protected by gabions shall be free of brush, trees, stumps and other objectionable material and shall be dressed to a smooth surface. Soft or spongy material shall be removed to the specified depth and replaced with suitable material. Filled areas shall be thoroughly compacted. The bank and channel protection shall be assembled individually by erecting the sides, ends and diaphragm(s) with all creases in the correct position and the top of all sides satisfactorily level. Lacing wire, fasteners, or both shall be used to assemble the units and to join the units together.

**A. Lacing:** The lacing procedure is as follows:

1. Cut a length of lacing wire approximately 1½ times the distance to be laced but not exceeding 5 feet.
2. Secure the wire terminal at the corner by looping and twisting.
3. Proceed lacing with alternating single and double loops at a spacing not to exceed 6 inches.
4. Securely fasten the other lacing wire terminal.

**B. Interlocking Fasteners:** May be used for basket assembly as final construction of gabion structures. Spacing of fasteners during all phases of assembly and construction shall not exceed 6 inches.

**C. Fabric:** When separation fabric is specified, the surface to be covered shall be smooth, free of obstructions, and shall conform to plan shown dimensions prior to placement of the separation fabric.

The separation fabric shall be placed under and along all sides of the bank and channel protection that is in contact with earth, unless otherwise shown on the plans. Lapped joints in the separation fabric shall be placed transverse to the direction of flow with the overlap in the direction of flow. All lapped joints shall be lapped a minimum of 12 inches. Vehicles and equipment shall not be operated directly on the separation fabric.

**D. Installation:** A standard fence stretcher, chain fall, or iron rod may be used to stretch the bank and channel protection and hold alignment. The units shall be filled with stone carefully placed by hand or machine to assure alignment and avoid bulges with a minimum of voids. To allow for settlement, overfilling of 2 to 3 inches is required. After each unit has been filled, the lid shall be stretched tight over the stone fill using only an approved lid closing tool, until the lid meets the perimeter edges of the front and end panels. Using crowbars or other single point leverage

bars for lid closing shall be prohibited.

After the units are filled, the lid(s) shall be folded over to meet the sides and edges and secured with lacing wires, fasteners, or both. When PVC coated bank and channel protection is specified, special care shall be taken during the filling operation to avoid damaging the coating. Bank and channel protection on which the PVC coating has been damaged shall be repaired or replaced.

Whenever a structure requires more than one tier, the upper empty cells shall also be connected to the top of the lower tier along the front and back edges of the contact surface using the same connecting procedure described above using lacing wire or fasteners or both.

Internal connecting wires shall be installed in multi-tiered structures as follows:

**36 Inch High Gabions:** Shall be filled in three layers, 1 foot at a time. After the placement of each layer, that is at 1 foot high and 2 feet high, connecting wires shall be placed according to the manufacturer's recommendations to connect the exposed face of a cell to the opposite side of the cell. An exposed face is any side of a cell that will be exposed or unsupported after the structure is completed.

**18 Inch High Gabions:** Do not require connecting wires unless the cells are used to build vertical structures. In some cases, these units shall be filled in two layers, 9 inches at a time. After the placement of the first layer, connecting wires shall be placed according to the manufacturer's recommendations to connect the exposed face of a cell to the opposite side of the cell. An exposed face is any side of a cell that will be exposed or unsupported after the structure is completed.

#### 66.4 METHOD OF MEASUREMENT

- A. **Bank and Channel Protection Gabions:** Will be measured to the nearest 0.1 cubic yard. If a substitution is made, the dimensions of the bank and channel protection installed shall be equal to or greater than the dimensions specified. Payment will be based on plans quantity, unless changes are ordered in writing by the Engineer.
- B. **Separation Fabric:** Will not be measured.

#### 66.5 BASIS OF PAYMENT

- A. **Bank and Channel Protection Gabions:** Will be paid for at the contract unit price per cubic yard. Payment will be full compensation for materials, equipment, labor, excavating, shaping and incidentals required.
- B. **Separation Fabric:** Will be incidental to the unit price bid for gabions.

**END OF SECTION**