Section 2546. Gabions and Revet Mattresses

2546.01 DESCRIPTION.

Gabions are intended for high strength installations in both horizontal and vertical structures. Revet mattresses are intended for lower strength, horizontal or nearly horizontal structures.

2546.02 MATERIALS AND FABRICATION.

Ensure gabions and mattresses are constructed using materials meeting the following requirements. Ensure they are fabricated as required for gabions, unless mattresses are specifically designated in the contract documents. At the Contractor's option, for lid fastening of twisted mesh baskets at edges and diaphragms, either "Lacing Wire" or "Steel Ring Fastener System" may be used. For welded wire mesh baskets, use “Lacing Wire” for lid fastening at edges and diaphragms. Baskets shall be fabricated by twisting or welding a mesh from steel wire.

A. Baskets.

1. Double Twisted Wire Baskets.

- **a.** Twisted wire mesh for gabion baskets and revet mattresses shall be formed in a uniform hexagonal pattern with double twists so bound as to prevent unraveling.
- **b.** Twisted wire mesh baskets shall meet the requirements of ASTM A 975 and fabricated from soft temper galvanized wire with a Class III Coating in accordance with ASTM A 641 (Style 1) and, if specified, subsequently coated with PVC (Style 3).
- **c.** For gabions, the mesh opening shall not exceed 4.5 inches (115 mm), and area shall not exceed 10 square inches (6450 mm^2).
- **d.** For mattresses, the maximum linear dimension of mesh opening shall not exceed 3.25 inches (80 mm).
- **e.** Wire for twisted wire mesh gabion baskets, revet mattresses, edges and selvage shall have a tensile strength of 60,000 to 70,000 psi (413.7 to 485 MPa).
- **f.** Wire for lacings and connections of twisted wire mesh gabions and mattresses shall have a tensile strength of 60,000 to 75,000 psi (413.7 to 515 MPa).

2. Welded Wire Baskets.

- **a.** Welded wire baskets shall meet the requirements of ASTM A 974, Style 2, manufactured from uncoated hard drawn steel wire conforming to ASTM A 853 and the fabric subsequently coated with zinc using the hot dip process; if specified, the galvanized fabric may have an additional coating of PVC (Style 5).
- **b.** Weight of the zinc coating on the fabric shall conform to the requirements of ASTM A 641 Class 3.
- **c.** Welded wire mesh for gabion baskets shall have each connection welded to obtain a minimum average shear strength of 584 pounds (2600 N), with a minimum shear strength of 450 pounds (2000 N).
- **d.** For revet mattresses, the minimum average shear strength of welded connections shall be 292 pounds (1300 N), with a minimum shear strength of 225 pounds (1000 N).
- **e.** Wire shall have a minimum tensile strength of 80,000 psi (550.0 MPa) for welded wire baskets and mattresses.
- **f.** For gabions, the mesh opening shall not exceed 3 inches (76.2 mm), and area shall not exceed 9 square inches (5806 mm^2).
- **g.** For mattresses, the mesh opening shall not exceed 3 by 1.5 inches (76 by 38 mm

3. Wire.

Ensure wire complies with the following:

- **a.** Mesh, edge, and selvage wire are the same material.
- **b.** Minimum sizes shown in Table 2546.02-1:

Table 2546.02-1: Minimum Wire Sizes

	Gabions	Mattresses
Mesh	11 gage (3.06 mm)	13 1/2 gage (2.18 mm)
Edges and selvage	9 gage (3.76 mm)	11 gage (3.06 mm)
Lacing and connecting	13 1/2 gage (2.18 mm)	13 1/2 gage (2.18 mm)

4. Steel Ring Fastener System.

Steel Ring Fastener System may be used only with twisted mesh wire baskets. Ensure one of the following is used:

- Galvanized 11 gage (3.05 mm) wire with a tensile strength meeting the requirements of ASTM A 764, Class I Tensile, and with a Class 3, Type B or C coating of a minimum of 0.80 ounce (244 g) of zinc per square foot (square meter).
- Stainless steel 11 gage (3.05 mm) wire (use only with PVC coated gabion baskets and mattresses) with a tensile strength meeting the requirements of ASTM A 313, Type 302, Class I.

5. Basket Fabrication.

a. Ensure baskets are fabricated as shown in the contract documents. Standard sizes are shown in Table 2546.02-2:

Table 2546.02-2: Gabion Basket Fabrication

GABIONS				
Dimensions, ft. (m)[(a)]			Number of Cells or Compartments	Capacity yd^3 (m^3)
Length	Width	Height		
6 (1.8)	3 (0.9)	3 (0.9)	2	2.0 (1.5)
9 (2.7)	3 (0.9)	3 (0.9)	3	3.0 (2.3)
12 (3.6)	3 (0.9)	3 (0.9)	4	4.0 (3.1)
6 (1.8)	3 (0.9)	1.5 (0.5)	2	1.0 (0.8)
9 (2.7)	3 (0.9)	1.5 (0.5)	3	1.5 (1.1)
12 (3.6)	3 (0.9)	1.5 (0.5)	4	2.0 (1.5)
6 (1.8)	3 (0.9)	1 (0.3)	2	0.66 (0.5)
9 (2.7)	3 (0.9)	1 (0.3)	3	1.0 (0.8)
12 (3.6)	3 (0.9)	1 (0.3)	4	1.33 (1.0)
MATTRESSES				
Dimensions, ft. (m)[(a)]			Number of Cells or Compartments	Capacity yd^3 (m^3)
Length	Width	Height		
9 (2.7)	6 (1.8)	0.50 (0.17)	3	6 (5.2)
12 (3.6)	6 (1.8)	0.50 (0.17)	4	8 (6.69)
9 (2.7)	6 (1.8)	0.75 (0.23)	3	6 (5.2)
12 (3.6)	6 (1.8)	0.75 (0.23)	4	8 (6.69)
9 (2.7)	6 (1.8)	1.0 (0.3)	3	6 (5.2)
12 (3.6)	6 (1.8)	1.0 (0.3)	4	8 (6.69)

[(a)] Dimensions are subject to a tolerance of ±5%.

b. Ensure baskets are fabricated into panels in such a manner that the base, sides, and ends can be assembled into a single, rectangular unit of the specified size. Ensure all perimeter edges of the baskets are selvaged with the specified wire so that the selvaged connections have the same strengths as the body of the mesh.

c. Baskets will normally be furnished in bundles of flat panels of appropriate sizes. On site assembly is intended.

d. Ensure the gabion units are furnished with the necessary diaphragms secured in proper position on the base in a manner so that no additional tying at this juncture will be necessary.

e. Ensure the mattress units are subdivided into compartments by the insertion of diaphragms made of the same mesh as the rest of the mattress. Ensure the diaphragms are factory secured in proper position at the base with a continuous spiral wire, in such a manner that no additional tying at this junction will be necessary.

6. Elongation.

Ensure the wire mesh permits elongation equivalent to a minimum of 10% of the length of the section under test without reducing the gage or tensile strength of the individual wire.

7. Elasticity.

a. Ensure the mesh withstands, without rupture of any wire or opening of any mesh fastening, the following load test:

1) The ends of an uncut section of mesh 6 feet (1.8 m) long, not less than 3 feet (1 m) wide and including all selvage binding, are securely clamped for 3 feet (1 m) along the width of the sample. When the width of the sample under test exceeds 3 feet (1 m), the clamps will be placed in the middle portion of the width, and the excess width will be allowed to fall free on each side of the clamped section.

2) The sample is then subjected to sufficient tension to cause 10% elongation of the sample section between the clamps.

3) After elongation and while clamped as described above (and otherwise unsupported), the section is subjected to a load applied to an area of 1 square foot (0.1 m^2), located approximately in the center of the sample section between the clamps, and in a direction perpendicular to the direction of the tension force. For gabions, use a load equaling or exceeding 6000 pounds (26.7 kN). For mattresses, use a load equaling or exceeding 4000 pounds (17.8 kN).

b. Ensure the ram head used in the test is circular with its edges beveled or rounded to prevent cutting of the wires.

8. Certification.

a. As a condition of source approval, the manufacturer may be required to furnish test results which show compliance with elongation and elasticity requirements.

b. Ensure each shipment of wire structures to a job site is accompanied by a certification which states that the material meets the requirements of this specification. A shipment consists of all materials arriving at the job site at substantially the same time.

c. Ensure all certifications are signed by an authorized representative of the company.

B. Anchor Stakes.

Use anchor stakes made from 2 inch (50 mm) nominal diameter, galvanized standard weight pipe meeting the requirements of ASTM A 53. The length will be shown in the contract documents.

C. Engineering Fabric.

Use engineering fabric meeting the requirements of Article 4196.01, B, 3.

D. Gabion Stone.

Meet the requirements of Article 4130.06.

E. Grout.

Apply Article 2507.02, B.

2546.03 CONSTRUCTION.

A. Perform the work as required by the contract documents. Excavate or smooth the area, or both, as necessary for proper placement of the gabions or mattresses, as shown in the contract documents. The contract documents may also require compaction of the prepared surface, or placement of selected or special backfill material in preparing the surface.

B. When specified, furnish and transport concrete grout and place within the voids to the full width of the gabion basket.

C. When designated in the contract documents, place engineering fabric under and behind the baskets. Place the fabric in vertical strips, or transverse to the flow line, lapped at least 3 inches (75 mm) with the downstream strip to the outside of the structure.

D. At the construction site, assemble the baskets into rectangular baskets of the specified sizes. Assemble them to be single unit construction. Weave the base, lid, and sides into a single unit. Connect the ends to the base section in a manner so that strength and flexibility at the point of connection is at least equal to that of the mesh.

E. Carefully place the baskets into their proper positions for slope and alignment as shown in the contract documents. When the slope is not shown, slope the faces of gabions at 1 (horizontal) to 6 (vertical).

F. When anchor stakes are designated for mattresses, drive them into position as shown in the contract documents. The top of the anchor stake should be at the elevation of the tops of adjacent baskets. Securely tie the anchor stakes to adjacent baskets at the top and the base of the baskets.

G. Connect adjacent baskets in a manner so that the connection is strong enough that a failure will occur in the mesh, rather than the lacing. Adjoining gabions and mattresses are to be connected at vertical corner edges and diaphragms. Stacked gabions are to be also connected at the horizontal edges, front and back. Lace all connections with loops at approximate 4 inch (100 mm) intervals, and as recommended by the manufacturer. To achieve proper alignment during filling, use a come-along or other means to tension gabions 3 feet (0.9 m) high placed in a line.

H. Carefully fill each basket with the revetment stone specified. Machine placement will be permitted. However, considerable handwork is necessary and will be required to assure orientation for maximum density without bulges, a compact and dense exposed face, and maximum aggregate contact with the lid and other baskets placed or to be placed in the structure.

I. For gabions 3 feet (0.9 m) high, fill in three lifts, 1 foot (300 mm) at a time, orienting the stones with each lift as necessary.

J. When a 3 foot (0.9 m) high cell is to be exposed in the finished structure, securely install two connecting wires between each lift, connecting each cell face to be exposed with the opposite face or diaphragm. Locate the wires with equal horizontal spacing. Install the wires by looping each end around two mesh openings, then wrapping the wire tightly around itself with at least four full wraps. Lock the end of the wire in place by lacing it under the previous lap. (For each 3 foot (0.9 m) high cell with one face to be exposed, four connecting wires are required. For the same cell as an end unit, there are two exposed faces and eight connecting wires are required.)

K. Connecting wires are not required for mattresses.

L. Fasten the lids in place at edges and diaphragms as specified above.

M. If steel ring fasteners are used, limit spacing to nominal 5 inches (±1.0 inch) (125 mm (± 25 mm)).

N. Special features or details may also be required. Construct these as shown in the contract documents.

O. When specified, do not place grout until the Engineer has inspected and approved the gabion. Sufficient jarring of rocks may be done to aid penetration of the grout to ensure all voids are filled and the grout fully penetrates the basket. Place grout according to Article 2507.03, E.

P. When the structure is completed, finish the earthwork as shown in the contract documents.

2546.04 METHOD OF MEASUREMENT.

A. Gabions or Mattresses.

1. Gabions or Mattresses: Calculated volume satisfactorily placed. When placement is according to the contract documents, plan quantities will be used.

2. Anchor Stakes (if required for mattresses): by count.

3. Associated earthwork: Article 2402.04 or 2102.04 applies.

B. Concrete Grout for Gabions.
Article 2507.04 applies.

2546.05 BASIS OF PAYMENT.

Payment will be for the contract unit price as follows:

A. Gabions or Mattresses.

1. Gabions or Mattresses:
   a. Per cubic yard (cubic meter).
   b. Payment is full compensation for:
      - Furnishing and placing engineering fabric as shown in the contract documents,
      - Furnishing, assembling, and placing the baskets, and
      - Furnishing and placing the revetment stone in the baskets.

2. Anchor Stakes: each.

3. Associated earthwork: Article 2402.05 or 2102.05 applies. For small quantities, the contract documents may designate this work as incidental. If so, it will not be paid for separately.

4. Special features or details: as shown in the contract documents. They may be made incidental, with no separate payment.

B. Concrete Grout for Gabions.
Article 2507.05 applies.