



US Army Corps
of Engineers

Wire Mesh Gabions

CIVIL WORKS CONSTRUCTION
GUIDE SPECIFICATION

101.402



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SECTION 2_
WIRE MESH GABIONS

1. SCOPE. This section, in conjunction with the contract drawings, covers wire mesh gabions complete *(except materials and equipment specified to be furnished by the Government).

2. APPLICABLE PUBLICATIONS. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

2.1 Federal Specifications (Fed. Spec.).

QQ-W-461H Wire, Steel, Carbon (Round, Bare, and Coated)

2.2 American Society for Testing and Materials (ASTM).

ASTM A 90	Test Method for Weight of Coating on Zinc-Coated Iron or Steel Articles
ASTM A 185-85	Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
ASTM A 239	Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles by the Preece Test (Copper Sulfate Dip)
ASTM A 313-87	Chromium-Nickel Stainless and Heat-Resisting Steel Spring Wire
ASTM A 428-87	Test Method for Weight of Coating on Aluminum-Coated Iron or Steel Articles
ASTM A 641-89	Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

ASTM A 764-79	Steel Wire, Carbon, Drawn Galvanized and Galvanized at Size for Mechanical Spring
ASTM A 809-88	Specification for Aluminum Coated (Aluminized) Carbon Steel Wire
ASTM B 6	Specification for Zinc
ASTM B 117	Salt Spray (Fog) Testing
ASTM D 412	Rubber Properties in Tension
ASTM D 522	Test Method for Elongation of Attached Organic Coatings with Conical Mandrel Apparatus
ASTM D 570	Test Method for Water Absorption of Plastics
ASTM D 638	Test Method for Tensile Properties of Plastics
ASTM D 746	Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D 792	Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D 1242	Resistance of Plastic Materials to Abrasion
ASTM D 1499	Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics
ASTM D 2240	Test Method for Rubber Property-Durometer Hardness
ASTM D 2287	Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds

ASTM G 23

Operating Light and Water
Exposure Apparatus (Carbon
Arc Type) for Exposure of
Nonmetallic Materials

3. GENERAL. The work under this specification includes furnishing, assembling, filling, and tying open wire mesh rectangular compartmented gabions placed on a prepared surface of *(filter material) (geotextile) (geotextile and filter materials) as specified herein, and in accordance with the lines, grades, and dimensions shown on the drawings or otherwise established in the field by the Contracting Officer's Representative.

4. DESCRIPTION. Gabion units shall consist of compartmented rectangular basket containers filled with stone. *(The required sizes of the gabion units are Length x Width x Depth,....., and L x W x D.) *(Twisted) (or) (welded) wire mesh shall be used. Baskets shall be fabricated from *(galvanized) (aluminized) (extruded or extruded and bonded polyvinyl chloride (PVC) galvanized) (extruded or extruded and bonded PVC aluminized) (fusion bonded PVC galvanized) (fusion bonded PVC aluminized) steel wire formed into a nonraveling mesh.

5. MATERIALS.

*5.1 (Alternate 1) *(Galvanized) (or) (Aluminized) Steel Twisted Wire Mesh Gabions. Gabion basket units shall be of nonraveling construction and fabricated from a double twisted hexagonal wire mesh. The size of mesh openings shall be approximately 3-1/4 inches by 4-1/2 inches. The gabion mesh wires shall be wrapped around the selvage wire no less than 1-1/2 times and shall interconnect with adjacent mesh wires. All steel wire used shall be *(galvanized) (or) (aluminized) prior to

fabrication into mesh. All gabion diaphragm and frame wire shall equal or exceed Fed. Spec. QQ-W-461H and possess soft tensile strength of 60,000 pounds per square inch (psi) with a tolerance of minus 2,000 psi. *(The galvanized wire shall have a Finish 5 Class 3 zinc coating, indicated in ASTM A 641. The weight of coating shall be determined by ASTM A 90. The grade of zinc used for coating shall be High Grade or Special High Grade as prescribed in ASTM B 6, Table 1. The uniformity of coating shall equal or exceed four 1-minute dips by the Preece Test, as determined by ASTM A 239.) (The aluminized wire shall have a minimum coating indicated in ASTM A 809. The weight of aluminum coating shall be determined by ASTM A 428. The surface of coating shall be smooth and show no visible loose flakes and scratch marks due to manufacturing and fabricating process or handling.) Wire used for lacing or as internal connecting wire within basket cells may have soft tensile strength designation. As an alternative to lacing, wire fasteners may be used. All wire used shall meet the following nominal minimum requirements:

*(Galvanized Wire

<u>Type of Wire</u>	<u>Wire Diameter After Coating (inches)</u>	<u>Coating Weight₂ (oz/ft²)</u>	<u>Tensile Strength (psi)</u>
Mesh Wire	0.120	0.85	60,000
Selvage Wire	0.150	0.85	60,000
Lacing Wire or Internal Con- necting Wire)	0.087	0.70	60,000

*(Aluminized Wire

<u>Type of Wire</u>	<u>Wire Diameter After Coating (inches)</u>	<u>Coating Weight (oz/ft²)</u>	<u>Tensile Strength (psi)</u>
Mesh Wire	0.120	0.35	60,000
Selvage Wire	0.150	0.40	60,000
Lacing Wire or Internal Connecting Wire)	0.087	0.30	60,000

Gabion mesh and connections require the following minimum strength:

<u>Strength</u>	<u>Pounds per Linear Foot</u>
Wire mesh strength (pulled parallel to wire twists)	2,000
Wire mesh strength (pulled perpendicular to wire twists)	1,000
Connection of selvage wire to mesh	1,400
Connection of end panel to base	1,200
Connection of diaphragm	600

*5.1 (Alternate 2) PVC-Coated *(Galvanized) (or)

(Aluminized) Steel Twisted Wire Mesh Gabions. PVC-coated gabion basket units shall be of nonraveling construction, fabricated from a double-twisted hexagonal mesh of hot dipped *(galvanized) (or) (aluminized) steel wire coated with a nominal thickness of 0.0216 inches and a minimum thickness of 0.015 inches of extruded or extruded and bonded PVC. The steel core wire used shall be *(galvanized) (or) (aluminized) and PVC-coated prior to fabrication into mesh. Mesh openings shall be hexagonal in shape and uniform in size measuring approximately 3-1/4 inches by 4-1/2 inches. The gabion mesh wires shall be wrapped around the

CW-02541
29 Jul 91

selvage wire no less than 1-1/2 times and shall interconnect with adjacent mesh wires. The core wire of all gabion diaphragm and frame components shall equal or exceed Fed. Spec. QQ-W-461H and possess soft tensile strength of 60,000 psi with a tolerance of minus 2,000 psi. *(The galvanized wire shall have a Finish 5 Class 3 zinc coating, indicated in ASTM A 641. The weight of coating shall be determined by ASTM A 90. The grade of zinc used for coating shall be High Grade or Special High Grade as prescribed in ASTM B 6, Table 1. The uniformity of coating shall equal or exceed four 1-minute dips by Preece Test, as determined by ASTM A 239.) (The aluminized wire shall have a minimum coating indicated in ASTM A 809. The weight of aluminum coating shall be determined by ASTM A 428.) Coated wire used for lacing or as internal connecting wire within basket cells may be of soft tensile strength. As an alternative to lacing, wire fasteners may be used. All wire used shall meet the following nominal minimum requirements:

*(PVC-Coated Galvanized Wire

<u>Type of Wire</u>	<u>Diameter After Coating (inches)</u>	<u>With PVC Coating (inches)</u>	<u>Coating Weight (oz/ft²)</u>	<u>Tensile Strength (psi)</u>
Mesh Wire	0.105	0.145	0.85	60,000
Selvage Wire	0.132	0.172	0.85	60,000
Lacing Wire or Internal Con- necting Wire)	0.087	0.127	0.70	60,000

*(Aluminized Wire

<u>Type of Wire</u>	<u>Aluminized Wire Diameter (inches)</u>	<u>Aluminum Coating (oz/ft²)</u>	<u>Diameter with PVC (inches)</u>	<u>Tensile Strength (psi)</u>
Mesh Wire	0.106	0.35	0.146	60,000
Selvage Wire	0.133	0.40	0.173	60,000
Lacing Wire or Internal Connecting Wire)	0.087	0.30	0.127	60,000

Gabion mesh and connections require the following minimum strength:

<u>Strength</u>	<u>Pounds per Linear Foot</u>
Wire mesh strength (pulled parallel to wire twists)	2,000
Wire mesh strength (pulled perpendicular to wire twists)	900
Connection of selvage wire to mesh	1,400
Connection of end panel to base	1,000
Connection of diaphragm	600

The initial properties of the PVC coating shall meet the following requirements:

Specific Gravity: In the range of 1.30 to 1.34, ASTM D 2287 and ASTM D 792.

Tensile Strength: Not less than 2,980 psi, ASTM D 412

Modulus of Elasticity: Not less than 2,700 psi at 100% strain, ASTM D 412.

Brittleness Temperature: Shall be at least 15 °F below the minimum temperature at which the gabions will be handled or placed, but not higher than 15 °F, ASTM D 746.

CW-02541
29 Jul 91

Resistance to Abrasion: The percentage of the weight loss shall be less than 12%, ASTM D 1242, Method B at 200 cycles, using CSI-A-Abrader with an abrasive tape, 80 grit.

Salt Spray Test: Period of test not less than 3,000 hours, ASTM B 117.

Exposure to Ultraviolet Light: Period of test not less than 3,000 hours, using apparatus type E and at 63 C, ASTM D 1499 and ASTM G 23.

After the salt spray test and exposure to ultraviolet light as specified above, the PVC coating shall not show cracks, blister, split, nor noticeable change of color. In addition, the specific gravity, tensile strength, modulus of elasticity, and resistance to abrasion shall not change more than 6%, 25%, 25%, and 10% respectively from their initial values. *(Adhesion Test: For extruded and bonded PVC wire, three specimens from each lot shall be tested. Measure a distance of 3/4 inches from the end of the specimen. With a regular hand grip wire stripper, exert maximum hand pull parallel to the axis of the wire. Attempt to remove the measured portion of the vinyl sleeve from the core wire. The lot shall be acceptable if the vinyl sleeve is not capable of being removed from the core wire on all three samples.)

*5.1 (Alternate 3) *(Galvanized) (or) (Aluminized) Steel Welded Wire Mesh Gabions. Gabion basket units shall be of nonraveling construction and fabricated from a welded square wire mesh. The size of mesh openings shall be approximately 3 inches by 3 inches. All steel wire used shall be welded and fabricated

into mesh prior to *(galvanization) (or) (aluminization). The welded joints of the wire mesh shall conform to ASTM A 185 except that the weld shears shall be at least 600 pounds. All gabion diaphragm and frame wire shall equal or exceed Fed. Spec. QQ-W-461H and possess soft tensile strength of 60,000 psi with a tolerance of minus 2,000 psi. *(The galvanized wire shall have a Finish 5 Class 3 zinc coating, indicated in ASTM A 641. The weight of coating shall be determined by ASTM A 90. The grade of zinc used for coating shall be High Grade or Special High Grade as prescribed in ASTM B 6, Table 1. The uniformity of coating shall equal or exceed four 1-minute dips by the Preece Test, as determined by ASTM A 239.) (The aluminized wire shall have a minimum coating indicated in ASTM A 809. The weight of aluminum coating shall be determined by ASTM A 428. The surface of coating shall be smooth and show no visible loose flakes and scratch marks due to manufacturing and fabricating process or handling.) Wire used for lacing or as internal connecting wire within basket cells may have soft tensile strength designation. As an alternative to lacing, wire fasteners may be used. All wire used shall meet the following nominal minimum requirements:

*(Galvanized Wire

<u>Type of Wire</u>	<u>Wire Diameter After Coating (inches)</u>	<u>Coating Weight (oz/ft²)</u>	<u>Tensile Strength (psi)</u>
Mesh Wire	0.120	0.85	60,000
Lacing Wire or Internal Con- necting Wire)	0.087	0.70	60,000

*(Aluminized Wire

<u>Type of Wire</u>	<u>Wire Diameter After Coating (inches)</u>	<u>Coating Weight (oz/ft²)</u>	<u>Tensile Strength (psi)</u>
Mesh Wire	0.120	0.40	60,000
Lacing Wire or Internal Con- necting Wire)	0.087	0.35	60,000

*5.1 (Alternate 4) PVC-Coated *(Galvanized) (or)
(Aluminized) Steel Welded Wire Mesh Gabions. Fusion-bonded PVC-coated gabion basket units shall be of nonraveling construction and fabricated from a welded square wire mesh. The size of mesh openings shall be approximately 3 inches by 3 inches. All steel wire used shall be welded and fabricated into mesh prior to *(galvanization) (or) (aluminization) and then coated with a nominal thickness of 0.0216 inches and a minimum thickness of 0.015 inches of PVC coating. The welded joints of the wire mesh shall conform to ASTM A 185 except that the weld shears shall be at least 600 pounds. The core wire of all gabion diaphragm and frame components shall equal or exceed Fed. Spec. QQ-W-461H and possess soft tensile strength of 60,000 psi with a tolerance of minus 2,000 psi. *(The galvanized wire shall have a Finish 5 Class 3 zinc coating, indicated in ASTM A 641. The weight of coating shall be determined by ASTM A 90. The grade of zinc used for coating shall be High Grade or Special High Grade as prescribed in ASTM B 6, Table 1. The uniformity of coating shall equal or exceed four 1-minute dips by Preece Test, as determined by ASTM A 239.) (The aluminized wire shall have a minimum coating indicated in ASTM A 809. The weight of aluminum coating shall be

determined by ASTM A 428.) Coated wire used for lacing or as internal connecting wire within basket cells may be of soft tensile strength. As an alternative to lacing, wire fasteners may be used. All wire used shall meet the following nominal minimum requirements:

(PVC-Coated Galvanized or Aluminized Wire

<u>Type of Wire</u>	<u>Diameter After Coating (inches)</u>	<u>With PVC Coating (inches)</u>	<u>Tensile Strength (psi)</u>
Mesh Wire	0.120	0.160	60,000
Lacing Wire or Internal Connecting Wire)	0.087	0.127	60,000

The properties of PVC coating shall meet the following requirements:

Specific Gravity: In the range of 1.25 to 1.30, ASTM D 792.

Tensile Strength: Not less than 2,275 psi, ASTM D 638.

Modulus of Elasticity: Not less than 1,275 psi @ 100 Strain, ASTM D 638.

Elongation at Break Point: 290%, ASTM D 638.

Hardness: Shore "A" not less than 82 ASTM D 2240.

Brittleness Temperature: Shall be at least 15 °F below the minimum temperature at which the gabions will be handled or placed, but not higher than 15 °F, ASTM D 746.

Resistance to Abrasion: The percentage of the weight loss shall be less than 12%, ASTM D 1242, Method B @ 200 cycles, CSI-A Abrader Tape, 80 Grit.

Salt Spray Test: Shall have no effect after 3,000 hours, ASTM B 117.

Exposure to Ultraviolet Light: Period of test not less than 5,000 hours, using apparatus type E and at 63 C, ASTM D 1499 and ASTM G 23.

After the salt spray test and exposure to ultraviolet light as specified above, PVC coating shall not show cracks, blister, split, nor noticeable change of color. In addition, the specific gravity, tensile strength, and resistance to abrasion shall not change more than 6%, 25%, and 10% respectively from their initial values.

5.2 Alternative Wire Fasteners for Gabions.

5.2.1 General. Subject to approval of the Contracting Officer, wire fasteners including interlocking fasteners, ring fasteners, twist ties, and spiral binders may be used in lieu of lacing wire. When seeking such approval, the Contractor shall demonstrate to the satisfaction of the Contracting Officer:

- (1) that the proposed fastener system can consistently produce a joint with a strength of 1,400 pounds per lineal foot when tested in accordance with paragraph 5.2.3.2, Pull-Apart Test;
- (2) that the proposed fastener system does not cause damage to the protective coating on the wire;
- (3) that the Contractor has the proper equipment and trained employees to correctly install the fasteners; and
- (4) that proper installation can be readily verified by visual inspection. The Contractor shall provide a complete description of the fastener system, including the number of fasteners required, the number and size of wires that fastener

is capable of properly joining, and a description of a properly installed fastener, including drawings or photographs if necessary. A properly installed fastener shall meet the same requirements as that specified for the fasteners at the Salt Spray Test, paragraph 5.2.3.1. If gages or other aids are needed to verify the proper installation of the fasteners, the Contractor shall furnish the Government such gages or aids, in such number as may reasonably be required, for the use of Government inspectors. If more than one wire fastener is proposed (e.g. different gage or length of wire) for different joints, the fasteners shall be readily distinguishable. Alternate wire fasteners shall not be used to join more wires, or larger wires, than for which they were tested and approved. As a minimum, a fastener shall be installed at each mesh opening at the location where mesh wire meets selvage or edge wire. Alternate wire fasteners shall not be used to close basket lids unless specifically approved for that purpose. When seeking approval to use alternate wire fasteners to close basket lids, the Contractor shall demonstrate to the satisfaction of the Contracting Officer's Representative that the fasteners can be properly installed on a properly filled gabion without stretching the gabion to the point that the gabion, or the protective wire coating, is damaged.

5.2.2 Materials. *(Galvanized wire fasteners shall be used with galvanized gabions.) (Aluminized wire fasteners shall be used with aluminized gabions.) (Stainless steel fasteners shall be used with PVC-coated gabions.) (Galvanized wire fasteners,

CW-02541
29 Jul 91

except twist tie and spiral binder fasteners, shall conform to ASTM A 764, Finish 1 with Type III coating.) (Aluminized wire fasteners shall conform to ASTM A 809 for wire diameter and coating, with tensile strength equal to ASTM A 764, Table 2.) (Stainless steel wire fasteners shall conform to ASTM A 313 (302 grade)). Twist tie or spiral binder fasteners shall meet the requirements of lacing wires as specified in paragraph 5.1. Use of extruded or extruded and bonded PVC-coated twist tie fasteners shall be prohibited for gabions with PVC-coated wire.

5.2.3 Testings. Test records made within 5 years by certified laboratories and Government agencies will be used to determine the acceptability of wire fasteners. Samples of wire fasteners with their certified test records shall be submitted at least 60 days in advance to the Contracting Officer's Representative for approval. The Government reserves the right to test additional samples to verify the submitted test records at the Government's expense. When the first test results indicate that the fasteners do not meet the specified requirements, the additional test will be at the Contractor's expense. The fasteners will be rejected after two tests failing to meet the requirements. All types of fasteners including fasteners made of stainless steel shall be subject to the salt spray test and pull-apart resistance test.

5.2.3.1 Salt Spray Test. A set of two identical rectangular gabion panels, each with a width about 10-1/2 mesh openings along a selvage wire, shall be jointed by properly installed wire fasteners along the two selvage wires so that each

fastener confines two selvage and two mesh wires. If the fasteners are also to be used to joint two individual empty gabion baskets, two additional selvage wires which are each mechanically wrapped with mesh wires shall be included so that each fastener confines four selvage and four mesh wires. A properly installed fastener shall meet the following requirements:

- Each interlocking fastener shall be in a locked and closed position.
- Each ring fastener shall be closed, and the free ends of the fastener shall overlap a minimum of 1 inch.
- Each twist tie shall be closed and maintain a minimum of two full turns.
- The spiral binder shall be tied at both ends.

The set of the jointed panels shall be subject to salt spray test, ASTM B 117, for a period of not less than 48 hours. At the end of the test, the fasteners, the selvage, or mesh wires confined by the fasteners shall show no rusty spots on any part of the surface excluding the cut ends.

5.2.3.2 Pull-Apart Resistance Test. A new set of the jointed panels, which are prepared by the same method as specified in the salt spray test but without being subject to the 48-hour salt spray test, shall be mounted on a loading machine with grips or clamps such that the panels are uniformly secured along the full width. The grips or clamps shall be designed to transmit only tension forces. The load will then be applied at a uniform rate of 50 pounds per second until failure occurs. The failure is defined as when the maximum load is reached and a drop of strength is observed with subsequent loading or the opening

between any two selvage wires, applicable to a fastener confining either two or four selvage wires, becomes greater than 2 inches at any place along the panel width. The strength of the jointed panels at failure shall have a minimum of 1,400 pounds per linear foot.

5.3 Stone Fill.

5.3.1 Quality. Stone shall be durable and of suitable quality to ensure permanence in the structure and climate in which it is to be used. It shall be free of cracks, seams, and other defects that would tend to increase unduly its deterioration from natural causes or reduce its size to that which could not be retained in the gabion baskets. The inclusion of more than 5% by weight of dirt, sand, clay, and rock fines will not be permitted. The sources from which the Contractor proposes to obtain the material shall be selected well in advance of the time when the material will be required in the work.

*(Selected stone from the required excavation may be used if satisfying all requirements as to quality and dimensions.) *(All stone shall be obtained from one of the sources listed in paragraph _____. The Contractor may, at his option, propose to furnish stone from one non-listed source. The Government will make such investigations and tests as necessary to determine whether acceptable stone can be produced from the proposed source.) Suitable samples of stone fill material shall be collected in the presence of a Government representative and submitted to the Contracting Officer's Representative for approval prior to delivery of any such material to the site of

the work. Unless otherwise specified, all test samples shall be obtained by the Contractor and delivered at his expense to _____ at least 60 days in advance of the time when the placing of the stone-filled gabions is expected to begin. Suitable tests and/or service records will be used to determine the acceptability of the stone. In the event suitable test reports and service records are not available, as in the case of newly operated sources, the material shall be subjected to such tests as are necessary to determine its acceptability for use in the work. Tests to which the material may be subjected include petrographic analysis, specific gravity, absorption, wetting and drying, freezing and thawing, and such other tests as may be considered necessary to demonstrate to the satisfaction of the Contracting Officer's Representative that the materials are acceptable for use in the work. All tests will be made by or under the supervision of the Government and at its expense.

5.3.2 Gradation. Stone fill used in the gabions shall be a well-graded mixture with sizes ranging between 4 inches and 8 inches, based on US Standard square mesh sieves. No stone shall have a minimum dimension less than 4 inches and a maximum dimension greater than 12 inches in any direction. The ratio of the maximum dimension to the minimum dimension shall not be greater than two. If the height of the gabion basket is 12 inches or less, stone shall have no dimensions greater than 8 inches in any direction.

5.4 Filter Material. The material shall be composed of tough durable particles, reasonably free from thin, flat, and

elongated pieces, and contain no organic matter or soft friable particles in quantities considered objectionable by the Contracting Officer's Representative. Filter material shall consist of sand and gravel or crushed stone, well graded between the prescribed limits listed below, and conform to the requirements of paragraph 5.3.1 as to quality.

<u>Sieve Designations</u> <u>US Standard Square Mesh</u>	<u>Percent by Weight</u> <u>Passing</u>
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*(Filter fabrics shall meet the provisions of Section _____, plastic filter fabric.)

5.5 Acceptance Requirements. For each shipment of wire materials to the site, the Contractor shall furnish the Contracting Officer's Representative, in duplicate, a manufacturer's certificate or affidavit signed by a legally authorized official from the company manufacturing the gabion units and wire fasteners, that all material contained within that

shipment meets the composition, physical, and manufacturing requirements stated in this specification.

6. FOUNDATION PREPARATION. *(No foundation preparation work shall take place on frozen or snow-covered ground.) After excavation or stripping to the extent indicated on the drawings or as directed by the Contracting Officer's Representative, all remaining loose or otherwise unsuitable materials shall be removed. All depressions shall be carefully backfilled to grade. If pervious materials are encountered in the foundation depressions, the areas shall be backfilled with free-draining materials. Otherwise, the depressions shall be backfilled with suitable materials from adjacent required excavation, or other approved source, and compacted to a density at least equal to that of the adjacent foundation. Any buried debris protruding from the foundation that will impede the proper installation and final appearance of the gabion layer shall also be removed, and the voids carefully backfilled and compacted as specified above. Immediately prior to placing the material, the prepared foundation surface shall be inspected by the Contracting Officer's Representative, and no material shall be placed thereon until that area has been approved.

7. FILTER PLACEMENT. Filter material shall be spread uniformly on the prepared foundation surface in a manner satisfactory to the Contracting Officer's Representative, and to the slopes, lines, and grades as indicated on the drawings or as directed. Placing of filter material by methods which will tend to segregate particle sizes will not be permitted. Any damage to

the foundation surface during filter placement shall be repaired before proceeding with the work. Compaction of the filter materials will not be required, but it shall be finished to present a reasonably even surface free from mounds or windrows.

8. FABRICATION.

8.1 *(PVC-Coated) Galvanized or Aluminized Steel Wire Mesh Gabions. Gabions shall be fabricated in such a manner that the sides, ends, lid, and diaphragms can be assembled at the construction site into rectangular baskets of the sizes specified and shown on the drawings. Gabions shall be of single unit construction, i.e., the 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 in such a manner that the minimum strengths of the wire mesh and connections as stated in paragraph 5. MATERIALS are met. Where the length of the gabion exceeds one and one-half its horizontal width, the gabion shall be equally divided by diaphragms of the same mesh and gage as the body of the gabions, into cells whose length does not exceed the horizontal width. The gabion shall be furnished with the necessary diaphragms secured in proper position on the base in such a manner that no additional tying at this juncture will be necessary. For twisted wire gabions, all perimeter edges of the mesh forming the gabion shall be securely selvaged so that the joints formed by tying the selvages have at least the strengths as specified in paragraph 5. MATERIAL. In addition, the selvaged edges shall be so wrapped and reinforced with the mesh ends that the selvage wire will not be deformed locally

about the lacing wire or wire fasteners when baskets are filled or during lid closing. Lacing wire, connecting wire, and/or wire fasteners shall be supplied in sufficient quantity for securely fastening all diaphragms and edges of the gabion.

9. ASSEMBLY AND INSTALLATION.

9.1 Precaution for PVC-Coated Materials. If PVC-coated materials are required, no work shall take place using these materials unless the ambient temperature and the temperature of the PVC materials are at least 15 °F above the brittleness temperature of the PVC materials.

9.2 Assembly and Installation. Empty gabion units shall be assembled individually and placed on the approved surface to the lines and grades as shown on the drawings or as directed by the Contracting Officer's Representative, with the sides, ends, and diaphragms erected in such a manner to ensure the correct position of all creases and that the tops of all sides are level. Filling of gabion units in one place and then transporting them to their final position in the work will not be permitted. The front row of gabion units shall be placed first and successively constructed toward the top of the slope or the back of the structure. All gabion units shall be properly staggered *(horizontally) (and vertically) as shown on the drawings. Finished gabion structure shall have no gaps along the perimeter of the contact surfaces between adjoining gabion basket units. All adjoining empty gabion units shall be connected by lacing wire/or wire fasteners along the perimeter of their contact surfaces in order to obtain a monolithic structure. Lacing of

adjoining basket units shall be accomplished by continuous stitching with alternating single and double loops at intervals of not more than 5 inches, and a half hitch shall be included at every double loop. All lacing wire terminals shall be securely fastened. Wire fasteners may be used in lieu of lacing wire for forming individual baskets and joining empty baskets together prior to stone filling. All joining shall be made through selvage-to-selvage or selvage-to-edge wire connection; mesh-to-mesh or selvage-to-mesh wire connection is prohibited except in the case where baskets are offset or stacked and selvage-to-mesh or mesh-to-mesh wire connection would be necessary. Wire fasteners shall not be used to tie or join stone-filled baskets, unless approved by the Contracting Officer's Representative. Each wire fastener shall be properly installed and closed as specified in paragraph 5.2.3.1. As a minimum, a fastener shall be installed at each mesh opening at the location where mesh wire meets selvage or edge wire. The initial line of basket units shall be placed on the prepared filter layer surface and partially filled to provide anchorage against deformation and displacement during filling operations. After adjoining empty basket units are set to line and grade and common sides with adjacent units thoroughly laced or fastened, they shall be placed in tension and stretched to remove any kinks from the mesh and to a uniform alignment. The stretching of empty basket units shall be accomplished in such a manner as to prevent any possible unraveling. Stone filling operations shall carefully proceed with placement by hand or machine so as not to damage

*(galvanized) (aluminized) (PVC) wire coating, to assure a minimum of voids between the stones, and the maintenance of alignment throughout the filling process. Undue deformation and bulging of the mesh shall be corrected prior to further stone filling. To avoid localized deformation, the basket units in any row are to be filled in stages consisting of maximum 12-inch courses, and at no time shall any cell be filled to a depth exceeding 1 foot more than the adjoining cell. The maximum height from which the stone may be dropped into the basket units shall be 36 inches. For gabion units in excess of 2 feet in height, two uniformly spaced internal connecting wires shall be placed between each stone layer in all front and side gabion units, connecting the back and the front faces of the compartments. Connecting wires or alternatively the preformed stiffeners shall be looped around two twisted wire mesh openings or a welded wire joint at each basket face and the wire terminals shall be securely twisted to prevent their loosening. *(For twisted wire gabions, the internal connecting wires or preformed stiffeners are installed as shown on the attached Figure No. 1.) *(For welded wire gabion units, preformed stiffeners are installed across the corners of gabion panels as shown on the attached Figure No. 2.)

NOTE: FOR GABION UNITS IN EXCESS OF 4 FEET IN THICKNESS, AND PLACED IN HORIZONTAL OR NEAR HORIZONTAL POSITION TO RESIST HIGH VELOCITY FLOW, OR AS PART OF A STILLING BASIN FEATURE, A MINIMUM OF TWO UNIFORMLY SPACED VERTICAL CONNECTING WIRES PER CELL LINKING THE FOUNDATION MESH TO BASKET LID MESH SHOULD BE SPECIFIED.

Along all exposed faces, the outer layer of stone shall be carefully placed and arranged by hand to ensure a neat and compact appearance. The last layer of stone shall be uniformly overfilled 1 to 2 inches to compensate for the future settlement in rock but still allow for the proper closing of the lid and to provide an even surface that is uniform in appearance. Final adjustments for compaction and surface tolerance shall be done by hand. Lids 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. The lid shall then be tightly tied with lacing wire, or with wire fasteners if approved by the Contracting Officer's Representative, along all edges, ends, and internal cell diaphragms by continuous stitching with alternating single and double loops at intervals of not more than 5 inches, and a half hitch shall be included at every double loop. Special attention shall be given to see that all projections or wire ends are turned into the baskets. The Contractor shall have the option of providing gabion baskets with separate roll-out lids for the ___ foot by ___ foot *(slope) baskets. Roll-out lids shall be fabricated of the same material as the basket units and shall be furnished in ___ foot width as required for the contract work. Where shown on the drawings or as directed by the Contracting Officer's Representative, or where a complete gabion unit cannot be installed because of space limitations, the basket unit shall be cut, folded, and wired together to suit existing site

conditions. The mesh must be cleanly cut and the surplus mesh cut out completely, or folded back and neatly wired to an adjacent gabion face. The assembling, installation, filling, lid closing, and lacing of the reshaped gabion units shall be carried out as specified above.

10. MEASUREMENT AND PAYMENT.

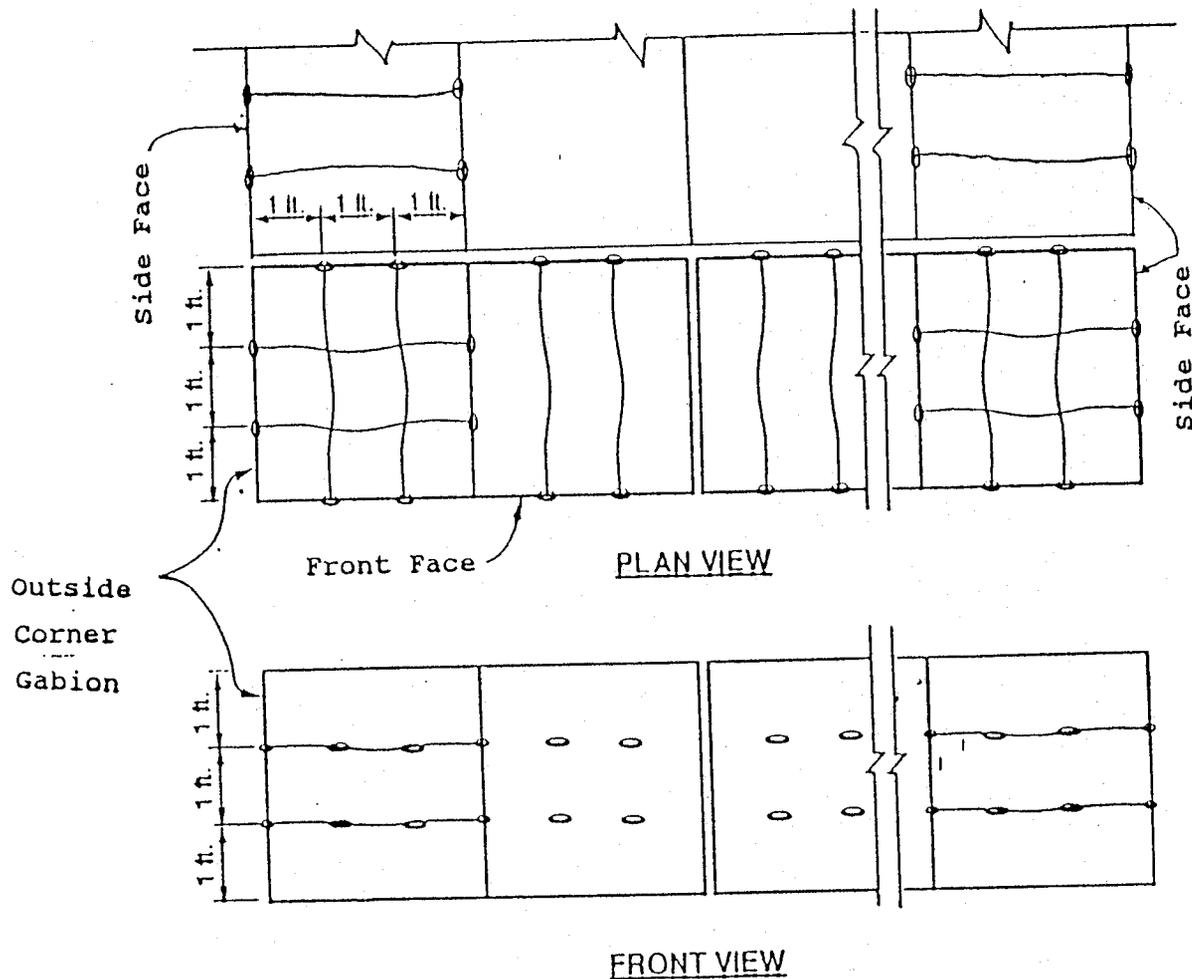
10.1 Filter Material. The quantity of filter material to be paid for will be computed from the theoretical filter thickness as specified herein or as shown on the drawings, and the areas acceptably placed where shown on the drawings or staked in the field. Payment for filter will be made at the contract unit price per cubic yard for payment Item No. _____ "Filter Material," which price shall include all costs of furnishing, hauling, placing, and maintenance of the filter layers until placement of the gabion cover is completed and accepted. No payment will be made for excess thickness of filter layers or for material required to replace material lost by rain wash, wind erosion, or otherwise, except for additional filter material ordered in writing by the Contracting Officer's Representative.

10.2 Gabions. Gabions meeting the requirements of these specifications and acceptably placed within the limits indicated on the drawings or otherwise established in the field by the Contracting Officer's Representative, will be measured by the cubic yard of stone-filled gabions in place. Payment will be made at the contract unit price per cubic yard under payment Item No. _____ "Gabion Protection," which price shall include the costs of furnishing, assembling, and placing the wire baskets,

CW-02541
29 Jul 91

the stone fill, and all other materials, labor, equipment, tools, supplies, and incidental costs in connection with completing this item of work.

NOTE: FOR SMALL PROJECTS, THE DISTRICT MAY OPT TO USE LUMP SUM PAYMENT.



NOTES

No connecting wires or stiffeners are required for interior cells and the back face.

Figure 1. Typical internal connecting wires for 3-foot-high gabions on front face and side faces

ALTERNATE FASTENER SPECIFICATION

The use of alternate fasteners shall be permitted in lieu of tie wire provided the following has been demonstrated: 1) the ability of the alternate fastener to contain a minimum of 4 (four) selvedge wires while remaining closed (minimum of 1 (one) inch overlap or closed and locked for interlocking fasteners, (2) the proposed fastener system can consistently produce a 4 (four) selvedge wire joint with a strength of 1,400 pounds per linear foot for galvanized joint and 1,200 pounds per linear foot for PVC coated gabion joints, (3) the proper installation can be readily verified by visual inspection, and (4) the proposed fastener system does not cause damage to the protective coating on the wire.

Galvanized fasteners shall conform to ASTM A-764, Finish 1 with Type III coating. Stainless steel wire fasteners shall conform to ASTM A 313, Grade 302.