This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: A975 – 21

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)[1]

This standard is issued under the fixed designation A975; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers gabions and revet mattresses produced from double-twisted metallic-coated wire mesh, and metallic-coated wire for lacing wire, stiffeners, and fasteners used for manufacturing, assembling, and installation of the product. This specification also covers gabions and revet mattresses in which the wire mesh, lacing wire, and stiffeners are poly(vinyl chloride) (PVC) coated after the metallic coating.

1.2 Double-twisted wire mesh for gabions and revet mattresses is produced in different styles, based on type of coating, as described in Section 4.

1.3 *Units*—The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.4 This specification references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this specification.

1.5 The following safety hazards caveat pertains only to the test methods portion, Section 13, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to consult and establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A90/A90M Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

A313/A313M Specification for Stainless Steel Spring Wire

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A428/A428M Test Method for Weight [Mass] of Coating on Aluminum-Coated Iron or Steel Articles

A641/A641M Specification for Zinc–Coated (Galvanized) Carbon Steel Wire

A764 Specification for Metallic Coated Carbon Steel Wire, Coated at Size and Drawn to Size for Mechanical Springs

A809 Specification for Aluminum-Coated (Aluminized) Carbon Steel Wire

A856/A856M Specification for Zinc-5 % Aluminum-Mischmetal Alloy-Coated Carbon Steel Wire

A902 Terminology Relating to Metallic Coated Steel Products

B117 Practice for Operating Salt Spray (Fog) Apparatus

D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

D746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

D1242 Test Methods for Resistance of Plastic Materials to Abrasion (Withdrawn 2003)[3]

D1499 Practice for Filtered Open-Flame Carbon-Arc Exposures of Plastics

D2240 Test Method for Rubber Property—Durometer Hardness

G23 Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure

[1] This specification is under the jurisdiction of ASTM Committee A05 on Metallic-Coated Iron and Steel Products and is the direct responsibility of Subcommittee A05.12 on Wire Specifications.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

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of Nonmetallic Materials (Withdrawn 2000)[3]

3. Terminology

3.1 *Definitions:*

3.1.1 Refer to Terminology A902 for general terminology relating to metallic-coated steel products.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *double-twisted wire mesh, n*—a nonraveling mesh made by twisting continuous pairs of wires through three one-half turns (commonly called double-twisted) to form hexagonal-shaped openings which are then interconnected to adjacent wires to form hexagonal openings.

3.2.2 *edge wire, n*—a terminal wire used to edge the wire mesh parallel to the double twist by continuously weaving it into the wire mesh.

3.2.3 *fastener, n*—an alternate method to lacing wire used for binding operations for gabions and revet mattresses.

3.2.4 *gabion, n*—a double-twisted wire mesh container of variable sizes, uniformly partitioned into internal cells, interconnected with other similar units, and filled with stone at the project site to form flexible, permeable, monolithic structures such as retaining walls, sea wall, channel linings, revetments, and weirs for erosion control projects (see Fig. 1 and Fig. 2).

3.2.5 *lacing wire, n—for gabions and revet mattresses*, a metallic-coated steel wire or metallic-coated steel wire with PVC coating used to assemble and interconnect empty units, to close and secure stone-filled units, and for internal stiffeners.

3.2.6 *revet mattress, n*—a double-twisted wire mesh container uniformly partitioned into internal cells with relatively small height in relation to other dimensions, having smaller mesh openings than the mesh used for gabions; revet mattresses are generally used for riverbank protection and channel linings (see Fig. 3).

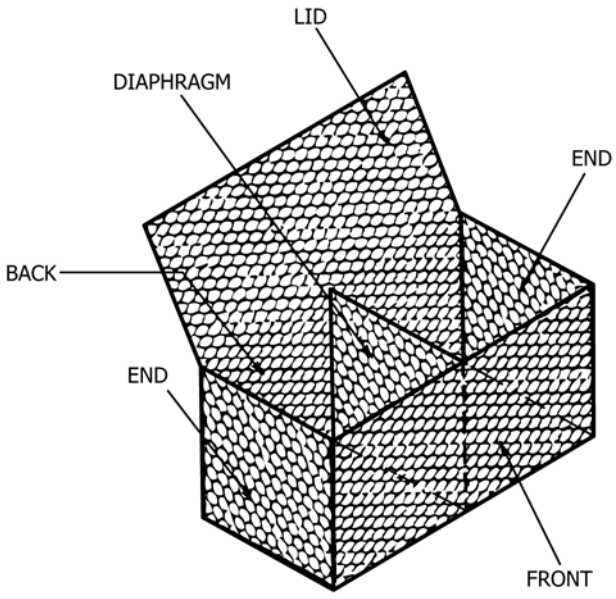


FIG. 1 Gabion

3.2.7 *selvedge wire, n*—a terminal wire used to edge the wire mesh perpendicular to the double twist by mechanically wrapping the mesh wires around it at least 2.5 times or by inserting it throughout the twists and folding one mesh length.

3.2.8 *stiffener, n—for gabions*, a length of metallic-coated steel wire or metallic-coated steel wire with PVC coating used for support of facing by connecting the front panel to the back panel of a gabion (stiffener formed at the project site using wire having the same diameter as for the lacing wire (see Table 1) or across the corners of a gabion cell using preformed stiffener having a diameter as specified in Table 1).

3.3 *Abbreviations:*

3.3.1 *PVC*—poly(vinyl chloride).

3.3.2 *Zn-5A1-MM*—zinc-5 % aluminum-mischmetal alloy.

4. Classification

4.1 Double-twisted wire gabions and revet mattresses are classified according to coating, as follows:

4.1.1 *Style 1*, consists of double-twisted wire mesh made from wire which is zinc coated before being double-twisted into mesh. Fasteners, lacing wire, and stiffeners are produced from zinc-coated wire.

4.1.2 *Style 2*, consists of double-twisted wire mesh made from wire which is coated with Zn-5A1-MM before being double-twisted into mesh. Fasteners, lacing wire, and stiffeners are also produced from Zn-5A1-MM coated wire.

4.1.3 *Style 3*, consists of double-twisted mesh, lacing wire, and stiffeners as Style 1 and overcoated with PVC. Fasteners shall be of stainless steel wire.

4.1.4 *Style 4*, consists of double-twisted mesh made from wire which is aluminum-coated before being double-twisted into mesh. Fasteners, lacing wire, and stiffeners are also produced from aluminum-coated wire.

5. Ordering Information

5.1 Orders for material to this specification shall include the following information:

5.1.1 Quantity (number of units) as shown on plan,

5.1.2 Product type (gabions or revet mattresses),

5.1.3 Size (length by width by height),

5.1.4 Style of coating (Section 4), including the specific style to be furnished, or all acceptable styles,

5.1.5 ASTM designation and year of issue,

5.1.6 Any special requirements (see 8.2.5), and

5.1.7 Certification, if required (see Section 15).

NOTE 1—A typical ordering description is as follows: 100 gabions, 2 by 1 by 1 m or (6 by 3 by 3 ft), 100 revet mattresses 4 by 2 by 0.23 m or (12 by 6 by 0.75 ft), and 100 lids 4 by 2 m or (12 by 6 ft) as shown on plans; Style 1, 2, 3, or 4 with required fasteners or lacing wire and stiffeners; conforming to Specification A975.

6. Material and Manufacture

6.1 The wire used in the manufacture of double-twisted mesh for use in gabions and revet mattresses shall conform to the specifications shown in 6.1.1, 6.1.2, 6.1.3, or 6.1.4 as appropriate for the style ordered, except that the tensile strength shall conform to 7.1.

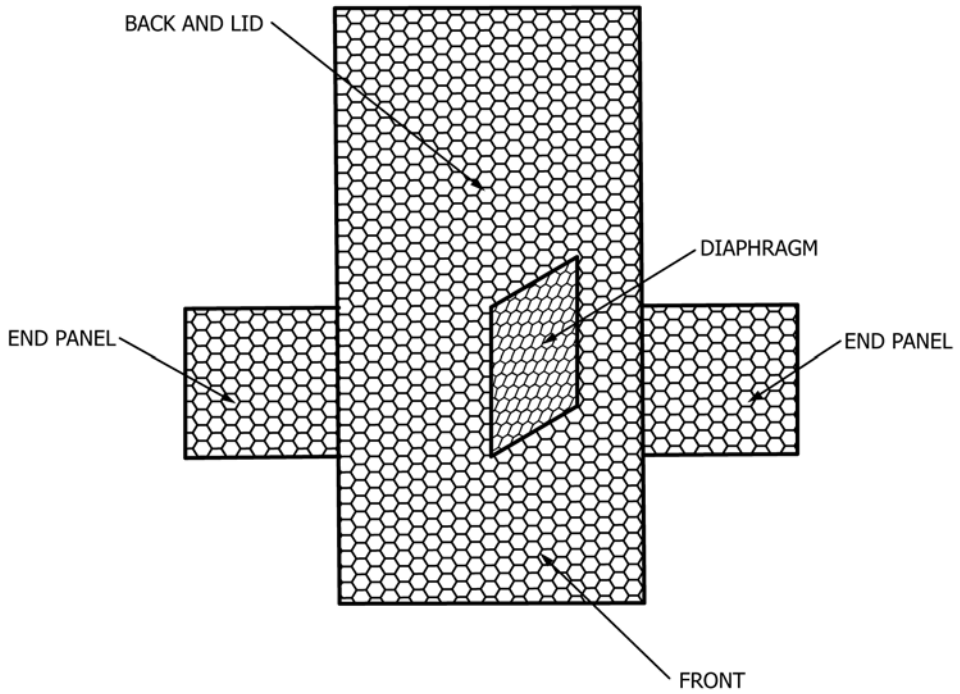


FIG. 2 Mechanically Manufactured Gabion

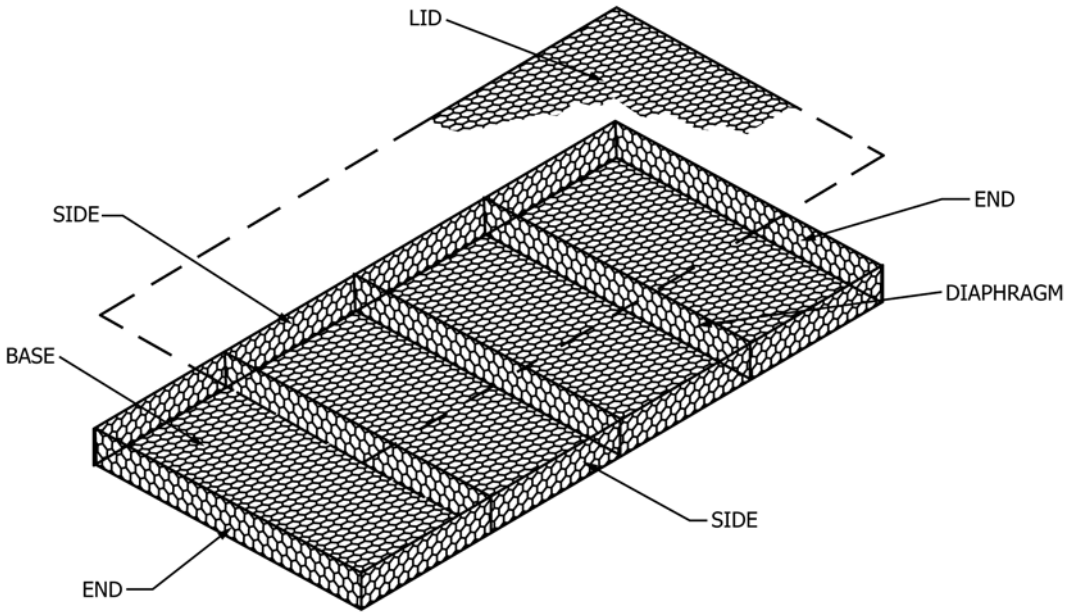


FIG. 3 Revet Mattress

6.1.1 Style 1 double-twisted mesh shall be manufactured from zinc-coated steel wire conforming to Specification A641/A641M, Class 3 coating, soft or medium temper.

6.1.2 Style 2 double-twisted mesh shall be manufactured from Zn-5A1-MM-coated steel wire conforming to Specification A856/A856M, Class 3 coating, soft or medium temper.

6.1.3 Style 3 double-twisted mesh shall be manufactured from the same type of metallic-coated steel wire as Style 1 with an additional PVC coating extruded onto the metallic-coated steel wire. The PVC coating shall conform to the properties in 8.2.

6.1.3.1 Original or modified thermoplastic polymers along with their application methods can be permitted as a substitute for PVC coatings, as long as their performance is equivalent to the performance requirements of the PVC coating.

6.1.4 Style 4 double-twisted mesh shall be manufactured from aluminum-coated steel wire conforming to Specification A809, soft or medium temper.

6.2 Lacing wire and stiffeners shall be made of wire having the same coating material as the double-twisted wire mesh furnished on the order and conforming to Specifications

TABLE 1 Mesh Characteristics[A]

Characteristics	Gabion		Revet Mattresses	
	Metallic Coated	PVC Coated	Metallic Coated	PVC Coated
Mesh Type	8 by 10		6 by 8	
Mesh Opening	83 by 114 mm (3.25 by 4.5 in.)	83 by 114 mm (3.25 by 4.5 in.)	64 by 83 mm (2.5 by 3.25 in.)	64 by 83 mm 2.5 by 3.25 in.)
Mesh wire	3.05 mm (0.120 in.)	2.7 mm (0.106 in.)	2.2 mm (0.087 in.)	2.2 mm (0.087 in.)
Selvedge wire	3.8 mm (0.150 in.)	3.4 mm (0.134 in.)	2.7 mm (0.105 in.)	2.7 mm (0.105 in.)
Lacing wire	2.2 mm (0.087 in.)	2.2 mm (0.087 in.)	2.2 mm (0.087 in.)	2.2 mm (0.087 in.)
Fasteners	3.0 mm (0.118 in.)	3.0 mm (0.118 in.)	3.0 mm (0.118 in.)	3.0 mm (0.118 in.)
Stiffeners:				
Using lacing wire	2.2 mm (0.087 in.)	2.2 mm (0.087 in.)	2.2 mm (0.087 in.)	2.2 mm (0.087 in.)
Preformed	3.8 mm (0.150 in.)	3.4 mm (0.134 in.)	N/A	N/A
PVC coating thickness:				
Nominal	N/A	0.50 mm (0.02 in.)	N/A	0.50 mm (0.02 in.)
Minimum	N/A	0.38 mm (0.015 in.)	N/A	0.38 mm (0.015 in.)

[A] All dimensions and wire diameters are minimum nominal values.

TABLE 2 Minimum Strength Requirements of Mesh and Connections

Test Description	Gabions, Metallic Coated		Gabion, PVC Coated		Revet Mattress Metallic Coated and PVC Coated	
	kN/m	(lbf/ft)	kN/m	(lbf/ft)	kN/m	(lbf/ft)
Parallel to twist	51.1	(3500)	42.3	(2900)	33.6	(2300)
Perpendicular to twist	26.3	(1800)	20.4	(1400)	13.1	(900)
Connection to selvedges	20.4	(1400)	17.5	(1200)	10.2	(700)
Panel to panel connection using lacing wire or fasteners	20.4	(1400)	17.5	(1200)	10.2	(700)
	kN	(lbf)	kN	(lbf)	kN	(lbf)
Punch Test	26.7	(6000)	23.6	(5300)	17.8	(4000)

A641/A641M, A856/A856M, or A809, with a tensile strength in accordance with 7.1

6.3 Fasteners made from zinc-coated steel wire, zinc-5 % aluminum mischmetal alloy-coated steel wire, and aluminum-coated steel wire shall conform to Specification A764, Type A, B, or C, Class 3, with a tensile strength in accordance with 7.2. Fasteners made from stainless steel wire shall conform to Specification A313/A313M, Type 302, with a tensile strength in accordance with 7.2.

6.4 Gabions and revet mattresses shall be manufactured with all components mechanically connected at the production facility with the exception of the mattress lid which is produced separately from the base (see Fig. 1, Fig. 2, and Fig. 3). All gabions (Fig. 1 and Fig. 2) and revet mattresses (Fig. 3) shall be supplied in the collapsed form, either folded and bundled or rolled, for shipping.

7. Mechanical Properties

7.1 *Tensile Strength*— The tensile strength of wire used for double-twisted mesh, lacing wire, and stiffener, when tested in accordance with Test Methods and Definitions A370, shall be in accordance with the requirements of Specifications A641/A641M, A809, and A856/A856M for soft or medium temper wire.

7.2 *Fasteners*—The tensile strength of zinc-coated steel wire, zinc-5 % aluminum mischmetal alloy-coated steel wire, and aluminum-coated steel wire used for fasteners shall be in accordance with the requirements of Specification A764, Type A, B, or C, Table 2 or Table 3. The tensile strength of stainless steel wire used for fasteners shall be in accordance with the requirements of Specification A313/A313M, Type 302, Table 2. Any fastener system shall give the number of fasteners required to comply with Table 2 in accordance with the pull-part resistance test (see 13.1.2). The manufacturer or supplier shall state the number of fasteners required for all vertical and horizontal connections for single- and multiple-basket joinings and shall include a description of a properly installed fastener including drawings or photographs.

7.3 *Mesh and Panel to Panel Joint Strength*—The minimum strength requirements of the mesh, selvedge wire to mesh connection, panel to panel connection, and punch test, when tested in accordance with 13.1, shall be as shown in Table 2.

8. Physical Properties

8.1 *Metallic Coating*—The coating weights shall conform to the requirements of Specification A641/A641M, Class 3, for zinc coating or Specification A856/A856M, Class 3, for Zn-5A1-MM coating, or Specification A809 for aluminum coating.

8.2 *PVC for Coating*—The initial properties of PVC coating material shall have a demonstrated ability to conform to the following requirements:

8.2.1 *Specific Gravity*—In the range from 1.30 to 1.35 when tested in accordance with Test Method D792.

8.2.2 *Tensile Strength*—Not less than 20.6 MPa (2985 psi) when tested in accordance with Test Methods D412.

8.2.3 *Modulus of Elasticity*—Not less than 18.6 MPa (2700 psi) when tested in accordance with Test Methods D412.

8.2.4 *Hardness*—Shore" D" between 50 and 60, when tested in accordance with Test Method D2240.

8.2.5 *Brittleness Temperature*—Not higher than −9 °C (15 °F), or lower temperature when specified by the purchaser, when tested in accordance with Test Method D746 (see Note 2).

NOTE 2—The maximum brittleness temperature should be at least −9 °C (15 °F) below the minimum temperature at which the gabions will be filled.

8.2.6 *Resistance to Abrasion*—The percentage of the weight loss shall be less than 12 %, when tested in accordance with Test Method D1242.

8.2.7 *Salt Spray Exposure and Ultraviolet Light Exposure:*

8.2.7.1 The PVC shall show no effect after 3000 h of salt spray exposure in accordance with Test Method B117.

8.2.7.2 The PVC shall show no effect of exposure to ultraviolet light with test exposure of 3000 h, using apparatus Type E and 63 °C (145 °F), when tested in accordance with Practices D1499 and G23.

8.2.7.3 *Evaluation of Coating After Salt Spray and Ultraviolet Exposure Test*—After the salt spray test and exposure to ultraviolet light as specified in 8.2.7.1 and 8.2.7.2, the PVC coating shall not show cracks nor noticeable change of color, or blisters or splits. In addition, the specific gravity, tensile strength, hardness, and resistance to abrasion shall not change more than 6 %, 25 %, 10 %, and 10 %, respectively, from their initial values.

8.2.8 The PVC coating shall not show cracks or breaks after the wires are twisted in the fabrication of the mesh.

8.3 *Salt Spray Resistance for Fastener*—After testing in accordance with 13.1.3, the fasteners, the selvedge, or mesh wire confined by the fasteners shall show no rusty spots on any part of the surface excluding the cut ends.

9. Dimensions and Tolerances

9.1 The diameter of metallic coated wire shall conform to Table 1 plus or minus the tolerances shown in Specifications A641/A641M, A856/A856M, and A809, as applicable.

9.2 The diameter of metallic-coated wire and stainless steel wire used in the fabrication of fasteners shall conform to Table 7 plus or minus the tolerances shown in Specification A764.

9.3 The minimum and nominal thickness of PVC coating uniformly applied in a quality workmanlike manner shall be as shown in Table 1.

9.4 Gabions shall be manufactured with an 8 by 10 mesh type having a nominal mesh opening of 83 by 114 mm (3.25 by 4.5 in.). Dimensions are measured at right angles to the center axis of the opening (D = 83 mm, see Fig. 4) and parallel to the twist along the same axis.

9.5 Revet mattresses shall be manufactured with a 6 by 8 mesh type having a nominal mesh opening of 64 by 83 mm (2.5 by 3.25 in.). Dimensions are measured at right angles to the center axis of the opening (D = 64 mm, see Fig. 4) and parallel to the twist along the same axis.

9.6 The width, height, and length of the gabion as manufactured shall not differ more than ±5 % from the ordered size prior to filling. (Typical gabion sizes are shown in Tables 3 and 4).



FIG. 4 Wire Mesh Opening Nominal Dimension *D*

TABLE 3 Typical Gabion Sizes (SI Units)

Length, m	Width, m	Height, m	Number of Cells, each	Volume, m^3
2.0	1.0	1.0	2.0	2.0
3.0	1.0	1.0	3.0	3.0
4.0	1.0	1.0	4.0	4.0
2.0	1.0	0.5	2.0	1.0
3.0	1.0	0.5	3.0	1.5
4.0	1.0	0.5	4.0	2.0
2.0	1.0	0.3	2.0	0.6
3.0	1.0	0.3	3.0	0.9
4.0	1.0	0.3	4.0	1.2

TABLE 4 Typical Gabion Sizes (Inch-Pound Units)

Length, ft	Width, ft	Height, ft	Number of Cells, Each	Volume, yd^3
6.0	3.0	3.0	2.0	2.0
9.0	3.0	3.0	3.0	3.0
12.0	3.0	3.0	4.0	4.0
6.0	3.0	1.5	2.0	1.0
9.0	3.0	1.5	3.0	1.5
12.0	3.0	1.5	4.0	2.0
6.0	3.0	1.5	2.0	0.67
9.0	3.0	1.0	3.0	1.0
12.0	3.0	1.0	4.0	1.33

9.7 The width and length of the revet mattress as manufactured shall not differ more than ±5 %, and the height shall not differ more than ±10 % from the ordered size prior to filling. (Typical revet mattress sizes are shown in Tables 5 and 6).

9.8 *Mesh Opening Tolerances*—Tolerances on the hexagonal, double-twisted wire mesh opening shall not exceed ±10 % on the nominal dimension D values, as follows (see Fig. 4):

Mesh Type	Nominal Dimension *D* Values
6 by 8	64 mm (2.50 in.)
8 by 10	83 mm (3.25 in.)

10. Workmanship

10.1 Wire of proper grade and quality, when fabricated in the manner herein required, shall result in a strong, serviceable mesh-type product having substantially uniform openings. It shall be fabricated and finished in a workmanlike manner, as determined by visual inspection, and shall conform to this specification.

11. Sampling

11.1 Samples for determining the mechanical and physical properties of double-twisted wire mesh shall be in accordance with the samples, dimensions, and requirements described in Section 13.

TABLE 5 Typical Revet Mattress Sizes (SI Units)

Length, m	Width, m	Height, m	Number of Cells, Each	Area, m^2
3.0	2.0	0.17	3.0	6.0
4.0	2.0	0.17	4.0	8.0
3.0	2.0	0.23	3.0	6.0
4.0	2.0	0.23	4.0	8.0
3.0	2.0	0.3	3.0	6.0
4.0	2.0	0.3	4.0	8.0

TABLE 6 Typical Revet Mattress Sizes (Inch-Pound Units)

Length, ft	Width, ft	Height, ft	Number of Cells, Each	Area, yd^2
9.0	6.0	0.5	3.0	6.0
12.0	6.0	0.5	4.0	8.0
9.0	6.0	0.75	3.0	6.0
12.0	6.0	0.75	4.0	8.0
9.0	6.0	1.0	3.0	6.0
12.0	6.0	1.0	4.0	8.0

11.2 Samples for determining the mechanical and physical properties of coated steel wire used for mesh, lacing wire, and stiffeners shall be selected at random from wire coils used for manufacturing.

12. Number of Tests

12.1 A minimum of three tests each for conformance to strength of metallic-coated steel wire mesh parallel to twist, perpendicular to twists, connection of metallic-coated steel wire mesh to selvedge, and punch test shall be performed. A minimum of five tests for the conformance of the fastener test shall be performed. A retest for conformance with the aforementioned strength and connection tests shall be required when changes of the physical characteristics of the mesh products occur. For metallic-coated steel wire with PVC coating, follow the same requirements as for the metallic-coated steel wire mesh. The results of all three tests must meet the requirements of Table 2.

12.2 The tensile strength, metallic coating weight, and PVC coating thickness of the metallic steel wire used in the fabrication of mesh, lacing wire, stiffeners, and fasteners must be certified by the steel wire producers for conformance to the requirements of Sections 6 and 7, and Table 1 for each lot shipment to the gabion manufacturer's facility.

13. Test Methods

13.1 *Mechanical Property Tests:*

13.1.1 *Tensile Strength Test*—The wire mesh specimens shall be representative of proper field construction and be taken randomly from a production lot or material delivered to the jobsite, and shall be as large as practical to minimize the effect of variations. The wire mesh specimen shall be rectangular in shape with minimum 25 cm (10 in.) in load direction (L) and 80 cm (32 in.) in the cross direction (W). Wire mesh specimens shall be selvedged on both cross ends by either manually or mechanically inserting a selvedge wire with a diameter shown in Table 1 and securely twisting the wire mesh around it with minimum 2.5 turns before testing. The tests shall be run with the load applied parallel to the axis of twist and repeated on a separate test specimen with the load applied perpendicular to the axis of twist.

13.1.1.1 The apparatus shall grip the wire in such a manner as to allow the wire failures to occur at least one mesh pattern away from the gripping points. If a failure occurs in a wire leading directly to a gripping point, that specimen shall be rejected and not included among the tests reported.

13.1.1.2 To pretension and remove the wire mesh slack, a preload of approximately 4000 N (900 lbf) shall be applied. Once the preloading is reached, the load is then applied at a uniform strain rate of 6 mm/min (0.24 in./min) until first fracture of an individual wire in the mesh occurs. Tensile strength of the mesh is a ratio of breaking load to effective width of the specimen. Failure is defined when no further increment in the tensile strength is observed. The machine head travel at each load increment or sequential incident of wire failure may be stopped for recording pertinent information such as load, fracture type, resulting mesh geometry and elongation, and resulting reduction in wire gauge. The distortion of the mesh or changes in gauge length shall be measured to an accuracy consistent with reporting the percent elongation to the nearest 0.5 %. The results of the tests shall be in accordance with the requirements shown in Table 2.

13.1.2 *Pull-Apart Resistance Test*—A 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 h 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 only transmit tension forces. The load will then be applied at a uniform rate not to exceed 220 N/s (50 lb/s) 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 alternatively the opening between any two closest selvedge wires, applicable to a fastener confining two selvedge wires, becomes greater than the wire mesh opening (D) at any place along the panel width. The strength requirements of the jointed panels at failure shall be as shown in Table 2.

13.1.2.1 *Fastener Test*—The pull-apart test on the fastener shall be done in conjunction with the pull-apart test on panel to panel connection. The test consists of measuring the maximum opening resistance of single fastener used to connect the wire mesh panels together for the pull-apart resistance test. The fasteners used for this test shall be obtained from the same manufacturer production batch as the fasteners used during the panel to panel connection test. The testing tension machine used for the test shall be able to register the maximum tensile strength achieved during the test. The clamping system used shall not interfere with the radius of the fastener when closed. The loads applied to the specimen shall be done perpendicular to the closing axe (see Fig. 5). The load shall be applied without interruption at a speed of 5 mm (0.2 in.) per minute. The test shall be done on five specimens to determine the average maximum resistance of each type of fastener tested.

13.1.2.2 *Report*—The report shall include the pull-apart resistance test and the fastener test, and have the following information:

(1) Type of fastener tested (manufacturer, material composition, coating, and dimension).

(2) Description of the testing apparatus used for both tests, if different.

(3) Table showing the results obtained for the panel to panel connection and the single fastener tests.

(4) Name of the laboratory where the test was done, date of test, and name of the test supervisor.

13.1.3 *Salt Spray Test*— A set of two identical rectangular gabion panels, each with a width about 10½ mesh openings along a selvedge wire, shall be jointed by properly installed

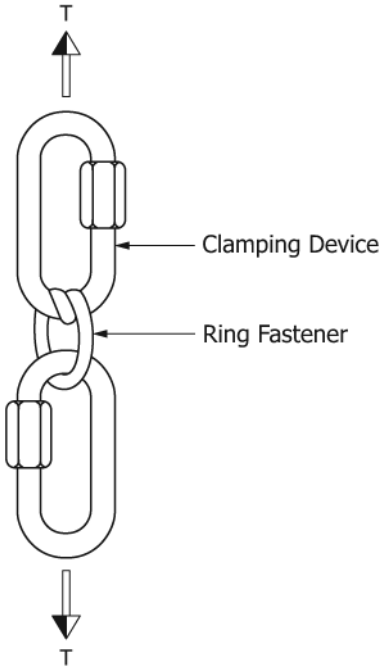


FIG. 5 Single Fastener Test with Load Applied Perpendicular to the Closing Axe

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

13.1.3.1 Each fastener type shall be in a closed position. Each fastener type shall be closed and the free ends of the fastener shall overlap a minimum of 1 in. The set of the jointed panels shall be subject to Salt Spray Test of Test Method B117 for a period not less than 48 ± 1 h cycle length.

13.1.4 *Punch Test*—The wire mesh specimens shall be representative of proper field construction and be taken randomly from a production lot or from materials delivered to the jobsite. The punch test could be done using two different apparatus.

13.1.4.1 *Pre-Tensioned Punch Test*—An uncut section of 1.82 m (6 ft) in length (unselvedged) and not less than 0.91 m (3 ft) in width shall have the ends securely clamped for 0.91 m (3 ft) along the width of the sample. When the width of the section under test exceeds 0.91 m (3 ft), the clamps shall be centered along the width and the excess width will be allowed to fall free on each side of the clamped section. The sample shall then be subjected to tension sufficient to cause 10 % elongation of the sample section between the clamps. After elongation and while clamped as described above (and otherwise unsupported), the section shall be subjected to a load of 960 cm^2 (1 ft^2) applied to the approximate center of the sample section between the clamps and in a direction perpendicular to the direction of the tension force.

13.1.4.2 *Secured Punch Test*—The specimen shall be rectangular in shape with 1.0 m (3.28 ft) side length (L). The tolerance on specimen size shall not exceed ±20 %. The wire mesh specimen shall be securely connected to the perimeter of a rigid square test frame using constraining devices such as grips or links as schematically shown in Fig. 6. After being secured to the test frame, the specimen shall be subjected to a loading disc with a contact area of 960 cm^2 (1 ft^2) applied to the approximate center of the sample section between the clamps and in a direction perpendicular to the direction of the tension force. To remove the wire mesh slack, the specimen shall be preloaded until the maximum vertical deformation at the center is less than 20 % of the side length. Once the preloading is reached, the load is then applied at a uniform strain rate of 10 mm/min (0.4 in./min) until the specimen no longer supports any increase in the applied load. During the test, the applied load and vertical deformation at the center of the wire mesh specimen shall be continuously measured and load versus deformation curve shall be plotted. Failure is determined when no further increment of punching load to the specimen is observed.

13.1.4.3 The sample shall withstand, without rupture of any strand or opening of any mesh fastening, an actual load applied by means of a circular ram at a rate as indicated in 13.1.2 equaling or exceeding the values shown in Table 2. The ram head used in the test shall be circular with a 350 mm (13.8 in.) diameter and have its edges beveled or rounded to prevent cutting of the wire strands.

13.1.5 *Abrasion Resistance Test*—This test method covers the determination of the resistance of polymer coated steel wire to abrasion caused by a linear rubbing action. An abrading wire reciprocates back and forth along a linear path, until it abrades through the polymer coating and the test is automatically stopped. Abrasion is prominent where there is scuffing, scratching, or wearing action caused by actions such as glaciation, movement of solid objects, or waves breaking on coastlines.

13.1.5.1 The polymer coated wire specimens used in this test shall be taken randomly from production lot. A small segment of polymer coating shall be stripped from both ends of the wire specimen before securing in place. A total vertical load of 2400 g ± 50 g (5.3 lbs ± 0.1 lbs) shall be applied to the abrading wire of 0.5 mm ± 0.05 mm (0.02 in. ± 0.002 in.) diameter as shown in Fig. 7. Subject the test specimen to abrasion at a speed of 55 ± 5 cycles per minute for a stroke length of 12.7 mm (0.5 in.). The test shall stop automatically when the polymer coating is worn through to the metal wire. Record the number of cycles. A total of four tests shall be performed on each specimen. For each subsequent test, move the specimen 25 mm and rotate 90°. Replace abradant wire before each test.

13.1.5.2 The final result shall be calculated as the average of 4 tests performed.

13.1.6 *Corrosion Spread Test for Polymer Coatings*—The corrosion spread test is relevant for polymer coatings to assess, in the event of a local damage to an over-sheath, any consequential corrosion of the outer surface of the steel wire core and ensure that the corrosion effect will remain confined

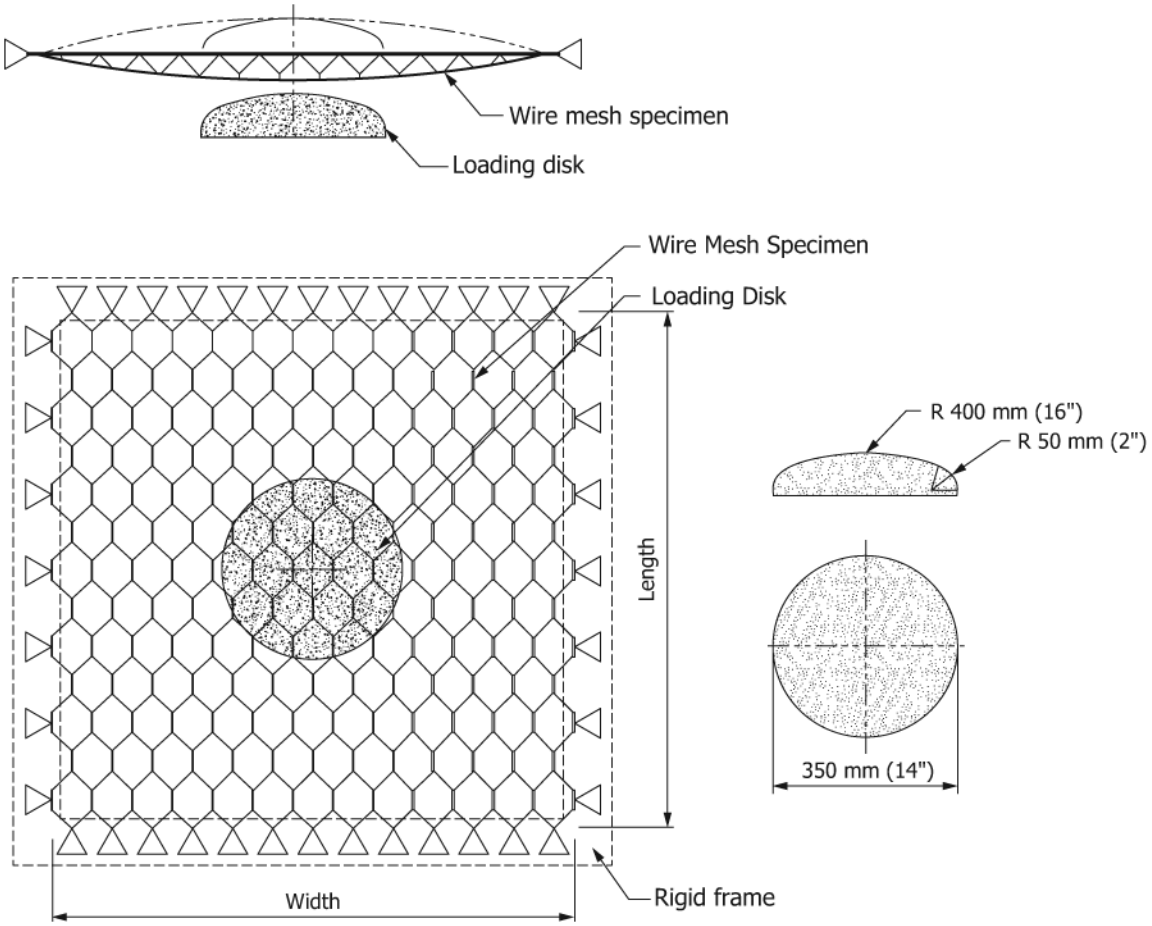


FIG. 6 Secured Punch Test with Every Mesh Clamped

to the damaged area of the covering. The procedure consists of immersing wire samples of 250 mm long in a 5 % solution of HCl by weight. Samples are removed from the solution and analyzed after 100, 500, 1000, 1500, and 2500 hours of immersion. The polymer coating shall be removed, and the length of the corroded wire measured. The part of the wire with reduced diameter is considered as corroded. The average corrosion lengths measured versus time plot shall show the maximum length after which there is no more increase in length with time. This maximum length measured shall be always less than a mesh repetition.

13.2 *Metallic Coating Weight*—Perform coating weight tests as prescribed in Test Methods A90/A90M or A428/A428M as applicable.

13.3 *Polymer Coating Thickness:*

13.3.1 The thickness of the polymer coating shall be determined on a randomly chosen individual piece of wire removed from the mesh.

13.3.2 Measure with a micrometer the diameter of the metallic coated steel wire with polymer coating. Determine the thickness of the polymer coating by stripping the polymer coating from the wire and measure the reduced diameter with a micrometer. The thickness of the coating is the difference between the diameter of the metallic-coated steel wire with polymer coating and the measured diameter of the metallic-coated wire divided by two. This value shall be in accordance with Table 1. When removing the polymer coating by stripping, take care not to remove any of the metallic surface.

14. Inspection

14.1 Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of all inspection and test requirements of this specification. The producer shall use his own or any other suitable facilities for the performance of the inspection and test requirements, at his option, unless disapproved by the purchaser at the time the order is placed. The purchaser at their own expense shall have the right to perform any of the inspections and tests set forth in this specification when such tests are deemed necessary to ensure that the material conforms to the prescribed requirements.

14.2 When requested by owner or purchaser, fasteners used for assembly and installation of the units on the field shall be tested for compliance with the pull-apart resistance certification provided by the producer or supplier in accordance with 13.1.2.2. When tested in accordance with 13.1.2.1, the average maximum resistance of the fasteners from the field shall not be lower than 90 % of the resistance provided in the certification.

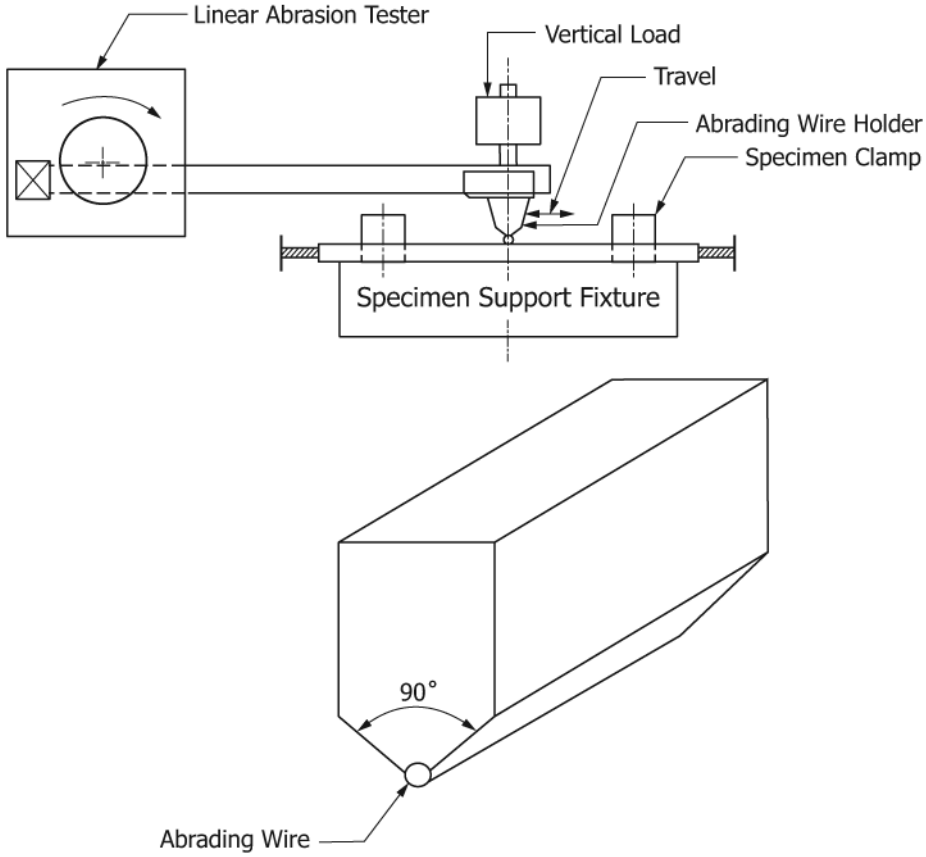


FIG. 7 Linear Abrader

15. Certification

15.1 When specified in the purchase order or contract, a producer's or supplier's certification that the material meets the contract specifications shall be furnished to the purchaser.

16. Keywords

16.1 double-twisted wire mesh; fasteners; gabions; lacing wire; metallic-coated mesh; metallic-coated steel wire; metallic-coated steel wire with PVC coating; preformed stiffeners; revet mattresses; selvedge edge wire; stiffeners

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