

SECTION 067
SPECIFICATIONS - GABIONS, REVET MATTRESSES, AND RIP-RAP

1.0 Description

This work is the furnishing, assembling, and filling of woven wire mesh baskets with aggregate, forming gabions and mattresses of the type indicated or the installation of rip-rap aggregate with filter fabric as indicated on the plans. The mesh baskets shall be woven wire mesh baskets, or welded steel wire mesh baskets, as indicated on the drawings.

2.0 Rock for Gabions and Revet Mattresses

Rock riprap shall conform to IDOT Standard Specifications for Road and Bridge construction, latest edition, or be approved by the District Engineer. Rock gradation shall be IDOT gradation RR3, Quality designation A or B; otherwise the rock must be approved by the District Engineer.

3.0 Woven Wire Mesh Baskets

Woven wire mesh baskets shall meet the following specifications.

3.1 Galvanized Woven Wire Mesh Baskets

8 x 10 Mesh Gabions and 6 x 8 Mesh Revet Mattresses

3.1.1 Woven Wire Mesh

Galvanized steel wire, Class 3, Finish 5, Soft, in accordance with ASTM A641-89

Tensile strength to be in accordance with ASTM A641-89 (soft)

Zinc coating in accordance with ASTM A641-89 (Class 3, soft), tested in accordance with ASTM A90-81.

3.1.2 Gabions, 8 x 10 Mesh

Wire for mesh - 11 gauge approx. (0.120")
Wire for selvedge - 9 gauge approx. (0.1535")
Wire for lacing - 13.5 gauge approx. (0.0866")
(Wire diameters are measured after galvanizing)
Mesh opening - nominal 3.25" x 4.5"

3.1.3 Revet Mattresses, 6 x 8 Mesh

Wire for mesh - 13.5 gauge approx. (0.0866")
Wire for selvedge - 12 gauge approx. (0.1063")
Wire for lacing - 13.5 gauge approx. (0.0866")
(Wire diameters are measured after galvanizing)
Mesh opening - nominal 2.5" x 3.25"

3.1.4 Tolerances

Wire - Tolerances on the diameter of all wire in the above classes shall be permitted in accordance with ASTM A641-89, Table 3.

Gabions, 8 x 10 Mesh - Tolerances of +/-5% on the width, height and length of the basket shall be permitted.

Revet Mattresses, 6 x 8 Mesh - Tolerances of +/-5% on the width and length, and +/-10% on the height of the basket shall be permitted.

3.1.5 Fabrication

Baskets shall be made from non-raveling, double twisted wire mesh. The mesh will have the ability to resist pulling apart at the twists or connections forming the mesh when a single wire in a mesh section is cut.

Baskets shall be fabricated so that the sides, ends, lids, and diaphragms can be assembled at the construction site into rectangular baskets or the required size. Where the length of the basket exceeds 1.5 times its horizontal width, it shall be equally divided by diaphragms, made of the same type mesh as the body, into cells in which the length does not exceed the horizontal width. The diaphragms shall be secured in position on the base so no additional tying is necessary at this juncture.

Gabions, 8 x 10 Mesh - Baskets shall be of single unit construction. The base, lid, ends and sides shall either be woven into a single unit or have one edge of the above components securely connected to the base section of the basket. All perimeter edges of the mesh forming the baskets, including end panels and tops of diaphragms, shall be selvaged 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.

Revet Mattresses, 6 x 8 Mesh - Baskets shall be of single unit construction. The base, ends and sides shall be woven into a single unit. The top, or lid, shall be a separate unit made of the same type mesh as the basket. All perimeter edges of the mesh forming the basket and top, or lid, shall be selvaged with selvedge wire. For sound structural integrity, either the 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, or the selvedge wire itself shall be securely inserted between the mesh wires at the center of the double twists.

3.1.6 Wire Mesh Tests

Elongation - Tests shall be made on the wire before fabrication of the baskets on a sample twelve inches long. Elongation shall not be less than 12%, in accordance with the requirements of ASTM A370-92.

Strength - The wire mesh does not rupture when subjected to a load of 6,000 pounds for gabions, or 4,000 pounds for revet mattresses, applied as follows:

- 1) Clamp a section 6 feet long, not less than 3 feet wide including selvedge bindings, for 3 feet along the width, or in the middle of widths greater than 3 feet, with the excess falling

free on each side.

2) Apply tension to elongate the section 10%.

3) Apply the load, 6,000 or 4,000 pounds as stated above, to one square foot located approximately in the center of the sample between the clamps. The direction of the load should be perpendicular to the tension force direction and be applied with a circular ram head with the edges beveled or rounded to prevent cutting the wires.

3.2 PVC Coated (Corrosion Resistant) Woven Wire Mesh Baskets

8 x 10 Mesh Gabions and 6 x 8 Mesh Revet Mattresses.

3.2.1 Woven Wire Mesh

Polyvinyl chloride coated, galvanized steel wire, Class 3, Finish 5, soft, in accordance with ASTM A641 -89.

Tensile strength to be in accordance with ASTM A641-89, soft.

Zinc coating in accordance with ASTM A641-89 (Class 3, soft), tested in accordance with ASTM A90-81.

Polyvinyl Chloride Coating - All wire used in the fabrication of the baskets and in the wiring operations during construction shall, after zinc coating, have extruded onto it a coating of polyvinyl chloride, otherwise referred to as "PVC". The coating shall be grey in color. The color will range between series 26187 and 26293 or between series 26373 and 26375, semigloss, as per Federal Standard 595B. The PVC coating shall be of nominal thickness 0.02165 inches and shall nowhere be less than 0.015 inches in thickness.

3.2.2 Gabions, 8 x 10 Mesh

Wire core for mesh - 12 gauge approx. (0.1063")

Wire core for selvedge - 10 gauge approx. (0.1338")

Wire core for lacing - 13.5 gauge approx. (0.0866")

(Wire diameters are measured after galvanizing and before PVC coating)

Mesh opening: nominal 3.25" x 4.5"

3.2.3 Revet Mattresses, 6 x 8 Mesh

Wire core for mesh - 13.5 gauge approx. (0.0866")

Wire core for selvedge - 12 gauge approx. (0.1063")

Wire core for lacing - 13.5 gauge approx. (0.0866")

(Wire diameters are measured after galvanizing and before PVC coating)

Mesh opening: nominal 2.5" x 3.25"

3.2.4 Tolerances - Same As Paragraph 3.1.4

3.2.5 Fabrication - Same As Paragraph 3.1.5

3.2.6 PVC coated wire mesh tests - Same As Paragraph 3.1.6

4.0 Woven Wire Mesh Basket Gabion Installation Instructions

Woven wire mesh basket gabions shall be installed in accordance with the following.

4.1 Explanatory Notes

These instructions cover both galvanized and PVC coated gabion, 8 x 10 mesh, installations.

Paragraph 4.7 is applicable only when the gabion mesh must be cut and folded to suit existing site conditions or when special structures are required.

Gabions shall be assembled and erected according to manufacturer's instructions.

4.2 Assembling

Gabions are supplied folded flat and packed in bundles. Single gabions shall be removed from the bundle, unfolded on a hard flat surface, and have all kinks and bends worked out before assembly.

The gabion unit shall then be assembled individually, by erecting the sides (front and back), ends and diaphragm(s), ensuring that all creases are in the correct position and the tops of all sides satisfactorily leveled.

The four corners of the gabion unit shall be connected first, followed by the edge wires of internal diaphragm(s) to the sides. The edge seam connection and the diaphragm to side connection should be accomplished by using lacing wire or manufacturer recommended fasteners.

Acceptable lacing wire has been described in previous paragraphs 3.1.2 and 3.2.2 for galvanized and PVC coated material respectively. The recommended procedure to apply lacing wire consists of cutting a sufficient length of lacing wire, approximately four and a half to five feet long. Then secure one end of the wire by looping and twisting, then proceed to lace with alternating single and double loops every other mesh opening at intervals of not more than six inches. Then securely fasten the other end of the lacing wire.

The installation of recommended fasteners should be carried out in accordance with the manufacturer's recommendation. Acceptable rings for joining galvanized wire mesh panels shall be formed from 0.120 inch galvanized wire having high tensile strength. Galvanizing shall conform to ASTM A641, Class 3 coating, tested in accordance with ASTM A90-81. Fasteners shall be in accordance with ASTM A764, Class II, Type III. Acceptable rings for joining PVC coated wire mesh panels shall be formed from 0.120 inch stainless steel wire having high tensile strength and shall conform to ASTM A313, Type 302, Class 1. Load tests shall conform to ASTM A370. Tensile strengths to be determined as per ASTM E8/MTP 2004. Spacing of fasteners must not exceed six inches.

Assembly with an air powered gun with stainless steel staples may be approved by the Engineer.

4.3 Installation

The assembled gabion units are carried to job site and placed in their proper location. For structural integrity, the adjoining empty gabions must be securely joined together using the same connection procedures described in paragraph 4.2 along the vertical edges and the top edge of their

contact surfaces in order to obtain a monolithic structure.

Whenever gabion structures require more than one tier, the upper empty gabion tier 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 procedures described in paragraph 4.2.

4.4 Filling

Gabion units shall be filled with hard, durable, clean stone from four to eight inches in size. A five percent tolerance on the upper and lower limit of stone gradation is permitted.

Gabions may be filled by almost any type of earth handling equipment such as: backhoe, trackhoe, gradall, crane, etc. Some manual stone adjustment during the filling operation is required to minimize voids. Care shall be taken when placing fill material to assure that the sheathing on the PVC coated gabions will not be broken or damaged.

The cells in any row shall be filled in stages so that local deformation may be avoided. That is, at no time shall any cell be filled to a depth exceeding one foot more than the adjoining cell. It is also recommended to slightly overfill the gabions by approximately two inches above the top edge to allow for settlement.

It is good practice to backfill gabions walls immediately following the gabion filling operation of each tier, if so permitted by site conditions.

Well packed filling without undue bulging, and secure lacing and/or fastening, is essential in all structures.

4.5 Internal Connecting Wires

Internal connecting wires may be needed when a structure requires various tiers to be stacked on top of each other.

Gabions 36" High

36" high gabions shall be filled in three layers, one foot at a time. After the placement of each layer, that is at one foot high and two feet high, connecting wires shall be placed 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.

Gabions 18" High

Connecting wires are not necessary unless these units are used to build vertical structures. In such cases, these units shall be filled in two layers, nine inches at a time. After the placement of each layer, connecting wires shall be placed 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.

4.6 Lid Closing

The lids shall be stretched tight over the filling using lid closing tools until the lid meets the

perimeter edges of the basket. The lid shall then be tightly laced along all edges, ends and tops of diaphragms in the same manner as described in paragraph 4.2.

Upon completion, the structure shall be checked and all ends of wire shall be folded into the structure. Well packed filling without undue bulging, and secure lacing and/or fastening, is essential in all structures.

4.7 Cutting and Folding Mesh

Where shown on the drawings or otherwise directed by the Engineer, the gabion mesh shall be cut, folded and wired together to suit existing site conditions. The mesh must be cleanly cut and the surplus mesh folded back and neatly wired to an adjacent gabion face. The cut edges of the mesh shall be securely laced together with lacing wire or recommended fasteners in the manner described above for assembly.

Any reshaped gabions shall be assembled, installed, filled and closed as specified above.

5.0 Woven Wire Mesh Basket Mattress Installation Instructions

Woven wire mesh basket mattresses shall be installed in accordance with the following.

5.1 Explanatory Notes

These instructions cover both galvanized and PVC coated revet mattress, 6 x 8 mesh, installations.

Paragraph 5.6 is applicable only when the mattress mesh must be cut and folded to suit existing site conditions or when special structures are required.

Mattresses shall be assembled and erected according to manufacturer's instructions.

5.2 Assembling

The Reno mattress bases are supplied folded flat and packed in bundles. Lids are normally delivered in separate bundles. Single mattress bases shall be removed from the bundle, unfolded on a hard flat surface, and have all kinks and bends worked out before assembly.

The mattresses shall then be assembled individually, by erecting the sides, ends and diaphragms, ensuring that all creases are in the correct position and the tops of all sides are level.

The four corners of the mattress unit shall be laced first, after overlapping the mesh at the corners, followed by lacing or fastening the edges of internal diaphragms to the sides. The lacing or fastening should be accomplished by using lacing wire or manufacturer recommended fasteners.

Acceptable lacing wire has been described in previous paragraphs 3.1.2 and 3.2.2 for galvanized and PVC coated material respectively. The recommended procedure to apply lacing wire consists of cutting a sufficient length of lacing wire, approximately four and a half to five feet long. Then secure the wire terminal by looping and twisting, then proceed to lace with alternating single and double loops every other mesh opening at intervals of not more than six inches. Then securely fasten the other end of the lacing wire.

The installation of recommended fasteners should be carried out in accordance with the manufacturer's recommendation. Acceptable rings for joining galvanized wire mesh panels shall be formed from 0.120 inch galvanized wire having high tensile strength. Galvanizing shall conform to ASTM A641, Class 3 coating, tested in accordance with ASTM A90-81. Fasteners

shall be in accordance with ASTM A764, Class II, Type III. Acceptable rings for joining PVC coated wire mesh panels shall be formed from 0.120 inch stainless steel wire having high tensile strength and shall conform to ASTM A313, Type 302, Class 1. Load tests shall conform to ASTM A370. Tensile strengths to be determined as per ASTM E8/MTP 2004. Spacing of fasteners must not exceed six inches.

Assembly with an air powered gun with stainless steel staples may be approved by the Engineer.

5.3 Installation

The assembled mattress units are carried to the job site and placed in the proper location. For structural integrity, the adjoining empty mattresses must be laced using the same lacing procedure described above along the vertical edges and the top edge of their contact surfaces in order to obtain a monolithic structure.

5.4 Filling

Mattress units shall be filled with hard, durable, clean stone as approved by the Engineer. A suitable grading is from three to six inches in size. A five percent tolerance on the upper and lower limits of the above stone gradation is permitted. For units of six inches nominal depth, the stone size shall not exceed four inches.

It is recommended to slightly overfill mattresses by approximately one inch above the top edge of the mattress to allow for settlement. Mattresses may be filled by almost any type of earth handling equipment such as: backhoe, trackhoe, gradall, crane, etc. Some manual adjustment during the filling operation is required to minimize voids. Care shall be taken when placing fill material to assure that the sheathing on PVC coated mattresses will not be broken or damaged.

Well packed filling without undue bulging, and secure lacing and/or fastening, is essential in all structures.

5.5 Lid Closing

The lids shall be stretched tight over the filling using lid closing tools until the lid meets the perimeter edges of the sides and end panels. The lid shall then be tightly laced along all edges, ends and diaphragms in the same manner as described in paragraph 5.2.

Upon completion, the structure shall be checked and all ends of wire shall be folded into the structure. Well packed filling without undue bulging, and secure lacing and/or fastening, is essential in all structures.

5.6 Cutting and Folding Mesh

Where shown on the drawings or otherwise directed by the Engineer, the mattress mesh shall be cut, folded and wired together to suit existing site conditions. The mesh must be cleanly cut and the surplus folded back and neatly wired to an adjacent gabion face. The cut edges of the mesh

shall be securely laced together with lacing wire or recommended fasteners in the manner described above for assemble.

Any reshaped gabions shall be assembled, installed, filled and closed as specified above.

6.0 Welded Steel Wire Mesh Baskets

Welded steel wire mesh baskets shall meet the following specifications.

6.1 Galvanized Welded Steel Wire Mesh Gabions

Gabions shall be made of pre-galvanized welded steel wire mesh of nominal size 3" X 3". Gabions shall be supplied in various lengths and heights. Dimensions for heights, lengths, and widths are subject to a tolerance of $\pm 5\%$ of manufacturer's stated sizes.

6.1.1 Fabrication

Gabions shall be fabricated in such a manner that the bases, sides, lids, ends, and diaphragms can be assembled at the construction site into a rectangular unit of the specified size. Where the length of the gabion exceeds its width, the gabion shall be divided by diaphragms into cells of equal length.

The wire mesh shall be made of galvanized steel wire having a diameter of 0.120" or 0.106". According to ASTM A-974-97, all wire used in the fabrication of the gabion and in the wiring operations shall conform to US federal specifications QQ-W-461H and possess a soft tensile strength with a class 3 finish 5 zinc coating in accordance with ASTM A-641.

Preformed steel wire spiral binders with a 3" pitch are used to assemble and interconnect empty gabions and shall meet the same specifications as the wire used in the mesh.

After assembly, the individual gabion units are interconnected to each other as per the manufacturer's instructions and then filled with clean, hard stone from 4" to 8" in diameter conforming to paragraph 2.0. The lids are then closed and joined to the top edges of the individual gabions and diaphragms. Ring fasteners and twist ties may be used in lieu of lacing wire for forming individual baskets and joining empty baskets together. A twist tie shall be provided at intervals of approximately 6". The connection shall be accomplished by turning the twist tie through 1½ turns. Ring fasteners, twist ties and lacing wire can be used in lieu of spiral binders.

Installation shall also conform to paragraph 4.0.

Mesh Opening	3" X 3"
Mesh Wire	0.106" - US Gauge 12
Mesh Wire	0.120" - US Gauge 11
Lacing Wire.....	0.087" - US Gauge 13.5
Spiral Binders	0.106" - US Gauge 12
Zinc Coating	ASTM A-90

6.1.2 PVC Coated Gabions

The same specifications as for galvanized gabions apply with the additional polyvinyl chloride (PVC) coating which will be fuse bonded onto the welded mesh as follows:

Mesh Wire	core only	0.106"
Spiral Binders	core only	0.106"
Lacing Wire and Twist Ties	core only	0.087"
PVC Coating Thickness	0.015" minimum per side	0.0216" nominal per side

The protective coating must be resistant to the destructive effects of immersion in acidic, salt, or polluted water, exposure to ultraviolet light and abrasion and shall retain these characteristics after a period of not less than 3,000 hours under tests in accordance with ASTM G-23.

Mesh Opening		3" X 3"
Mesh Wire	0.106" - US Gauge 12	Plus PVC Coating
Mesh Wire	0.120" - US Gauge 11	Plus PVC Coating
Lacing Wire.....	0.087" - US Gauge 13.5	Plus PVC Coating
Spiral Binders	0.106" - US Gauge 12	Plus PVC Coating
Zinc Coating		ASTM A-90

Minimum PVC coating thickness 0.015" per side.
Nominal PVC coating thickness 0.0216" per side.

6.2 Galvanized Welded Steel Wire Mesh Mattresses

Mattresses shall be made of pre-galvanized welded steel wire mesh of nominal size 1½" X 3". Mattresses shall be supplied in various lengths. The thickness shall be 6", 9", 12", or 18". The horizontal width shall be 6'. All dimensions are subject to a tolerance of ±5% of manufacturer's stated sizes.

6.2.1 Fabrication

Mattress units shall be fabricated in such a manner that the bases, sides, lids, ends, and diaphragms can be assembled at the construction site into a rectangular unit of the specified size.

The mattress unit length shall be subdivided into 3' compartments by the insertion of diaphragms made of the same mesh as the rest of the mattress. The wire incorporated in the mesh constituting the body of the mattress shall be made of galvanized steel wire having a diameter of 0.087".

Preformed steel wire spiral binders with a 3" pitch are used to assemble and interconnect empty mattresses and shall meet the same specifications as the wire used in the mesh.

All wire used in the fabrication of mattresses and in the wiring operations shall conform to ASTM A-974-97 and US federal specifications QQ-W-461H and possess a soft tensile strength with a class 3 finish 5 zinc coating in accordance with ASTM A-641.

After assembly, the individual mattress units are interconnected to each other as per the manufacturer's instructions and then filled with clean, hard stone from 3" to 6" in diameter conforming to paragraph 2.0. The lids are then placed and spiraled to the top edges of the individual mattresses and diaphragms. Ring fasteners, twist ties and lacing wire may be used in lieu of spiral binders.

Installation shall also conform to paragraph 5.0.

Mesh Opening	1½" X 3"
Mesh Wire	0.087" - US Gauge 13.5
Lacing Wire.....	0.087" - US Gauge 13.5
Spiral Binders	0.106" - US Gauge 12
Zinc Coating.....	ASTM A-90

6.2.2 PVC Coated Mattresses

The same specifications as for galvanized mattresses apply with the additional polyvinyl chloride (PVC) coating which will be fuse bonded onto the welded mesh as follows:

Mesh Wire	core only	0.087"
Spiral Binders	core only	0.106"
Lacing Wire and Twist Ties	core only	0.087"
PVC Coating Thickness	0.015" minimum per side	
	0.0216" nominal per side	

The protective coating must be resistant to the destructive effects of immersion in acidic, salt, or polluted water, exposure to ultraviolet light and abrasion and shall retain these characteristics after a period of not less than 3,000 hours under tests in accordance with ASTM G-23.

Mesh Opening	1½" X 3"
Mesh Wire	0.087" - US Gauge 13.5 Plus PVC Coating
Lacing Wire.....	0.087" - US Gauge 13.5 Plus PVC Coating
Spiral Binders	0.106" - US Gauge 12 Plus PVC Coating
Zinc Coating.....	ASTM A-90

Minimum PVC coating thickness 0.015" per side.
Nominal PVC coating thickness 0.0216" per side.

7.0 Riprap

Riprap shall be installed in accordance with IDOT Article 281 of the "Standards for Road and Bridge Construction", latest edition, except that broken concrete shall not be allowed. All riprap shall have a quality designation or either A or B.

At locations where sewers cross waterways, streams, and/or creeks, riprap and filter fabric shall be installed from ten (10) feet upstream of the crossing to twenty (20) feet downstream of the crossing along both banks from top of bank to top of bank.

END OF SECTION