SPECIFICATION FOR MACCAFERRI® GABIONS

1. MATERIALS SPECIFICATION

1.1 INTRODUCTION

The specification below applies to Maccaferri® Gabions units and to the materials from which these are manufactured.

For simplicity the word "gabion" is used. This may be changed for or have the words Maccaferri® Gabion added singularly or in combination as appropriate. Unless specifically stated otherwise.

1.2 DEFINITIONS

Maccaferri® Gabions are defined as heavily galvanized (or PVC coated heavily galvanized) steel wire mesh box-shaped baskets of various sizes. The baskets are filled on site with clean-hard stones.

The selvedges of the gabions are the thicker perimeter and edge wires to which the wire mesh is securely tied to withstand sudden or gradual stress from any direction.

The diaphragms are the internal wire mesh partitions which divide the gabion into equal sized cells.

Lacing and bracing wire is the wire used to assemble and join the gabion units.

Connecting wires are the internal wires used to prevent the gabions from bulging.

1.3 GENERAL DESCRIPTION

Gabions shall be "Maccaferri" type flexible 80mm type woven wire mesh boxes of dimensions as specified in the Contract drawings or an approved equivalent. The wire mesh shall bear the marking of the manufacturer's name, "*Maccaferri*" along the selvedge wire to enable visual inspection.

All material supplied must be accompanied by a manufacturing certificate from the factory for quality control and quality management purposes. The material shall come from an ISO 9001/2 certified factory.

The boxes shall be divided by diaphragms into cells of one metre length, or otherwise as shown in the Contract.

The woven wire mesh twists shall be oriented horizontally along the length of the gabion.

End panels of all Gabions shall be mechanically selvedged to the Gabion base as specified in clause 1.7.

Diaphragms shall be connected to the base by a spiral wire passing in turn through the mesh opening of the base and each mesh opening of the diaphragm panel as specified in clause 1.8.

1.4 STEEL WIRE

1.4.1 General

All steel wire used in the fabrication of the gabions and in the wiring operations during construction shall be to BS 1052, having a tensile strength of not less than 380 N/mm^2 and not exceed 500 N/mm^2.

1.4.2 Wire Diameter

Wire diameters, relevant tolerances and zinc coating shall be in accordance with the following table:

Wire Diameter mm	Tolerance mm
2.20	± 0.06
2.70	± 0.08
3.40 - 3.90	± 0.10

1.4.3 Zinc Coating

All wire used in the fabrication of the gabions and in the wiring operations during construction shall be heavily galvanised and exceed BS 443, the minimum mass of the zinc coating shall be according to the figures shown in the table below :

Diameter of Wire mm	Weight of Coating G/sq.m
2.20	240
2.70	260
3.40	275
3.90	290

The adhesion of the zinc coating to the wire shall be such that when the wire is wrapped six times around a four wire diameter size mandrel it shall not flake or crack to such an extent that any zinc can be removed.

1.4.4 PVC Coating

Where PVC Coated Gabions are stated in the Contract drawings, the Gabions shall fabricated from PVC coated steel wire to the following specifications:

All wire used in the fabrication of PVC coated gabions and in the wiring operations during construction shall have extruded onto it (after coating it with zinc in accordance with the foregoing specification) a coating of Poly Vinyl Chloride, otherwise referred to as "PVC" or other plastic material having superior characteristics than PVC as otherwise approved.

The coating shall be 0.50mm average thickness with a tolerance of ± 0.05mm, and nowhere shall be less than 0.40mm thickness.

The PVC shall be grey in colour.

It shall be capable of resisting deleterious effects of natural weather exposure, immersion in salt water and not show any material difference in its initial characteristics which are :

a. Specific Gravity
Shall be 1.30 to 1.35 in accordance with ASTM D 792-91

b. Durometer Hardness
Shall be 50 to 60 shore D, in accordance with ASTM D 2240-91 (ISO 868-1985)

c. Volatile Loss
At 105°C for 24 hours - Shall not be greater than 5%
In accordance with ASTM D 2287-92 E2.
Residual Ashes shall be less than 2% according to ASTM D2124-62T.

d. Tensile Strength
Shall not be less than 210 kg/sq.cm in accordance with ASTM D 412-92.

e. Elongation
Shall not be less than 200% and not greater than 280% in accordance with ASTM D 412-92.

f. Modulus of Elasticity at 100% of Elongation
Shall not be less than 190 kg/sq.cm in accordance with ASTM D 412-87.

g. Resistance of Abrasion
The loss in volume shall be less than $0.30cm^3$ in accordance with ASTM D 1242-56.

h. Creeping Corrosion
Maximum penetration of corrosion of the wire core from a square cut end shall not be greater than 25mm when the specimen has been immersed for 2000 hours in a 50% solution of HCL (Hydrochloric Acid 12 BE).

Testing for deterioration shall be as described below. Variation of the initial characteristics may be allowed, as specified hereunder, when the specimen is submitted to the following test :

a. Salt Spray
According to ASTM B 117-90
Period of test = 1500 hours

b. Exposure to Ultraviolet Light
According to ASTM D 1499-92 and ASTM G 23(93) apparatus type E.
Period of test = 2000 hours at 63°C.

c. Exposure at High Temperature
According to ASTM D 1203-89, (ISO 176-1976) and ASTM D 2287-(92)E2.
Period of test = 240 hours at 105°C.

d. Brittleness temperature : cold bend less than -30°C test method BS2782-104A; cold flex less than +15°C in accordance with BS2782-151A(84).

After the above tests have been performed, the PVC coating shall exhibit the following properties :

a. Appearance
The vinyl coating shall not crack, blister or split and shall not show any marked change in colour.

b. Specific Gravity
Shall not show change higher than 6% of its initial value.

c. Durometer Hardness
Shall not show change higher than 10% of its initial value.

d. Tensile Strength
Shall not show change higher than 25% of its initial value.

e. Elongation
Shall not show change higher than 25% of its initial value.

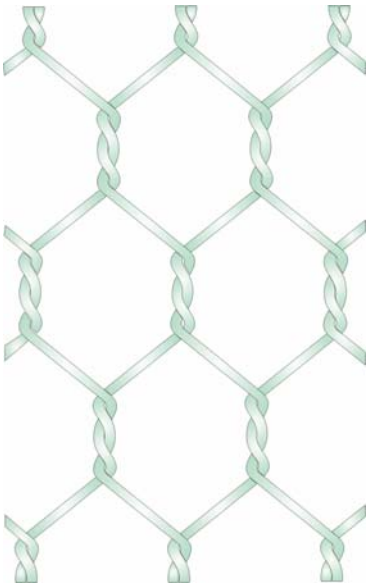
f. Resistance to Abrasion
Shall not show change higher than 10% of its initial value.

g. Brittleness Temperatures
Cold-bend not exceeding -20°C; cold-flex not exceeding +18°C.

1.5 WIRE MESH

Wire mesh shall be mechanically pre-fabricated to become a uniform hexagonal woven mesh wherein the joints are formed by twisting each pair of wires through three half-turns (commonly known as double twist), in such a manner that unraveling is prevented.

Double-twist mesh is demonstrated in the sketch below-



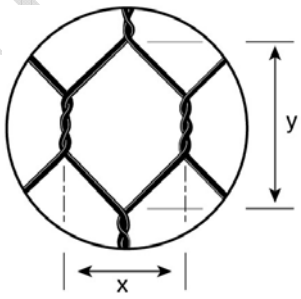
The tightness of the twisted joints shall be such that a force of not less than 1.7 kN is required when pulling on one wire to separate it from the other wire, provided each wire is prevented from turning under the applied forces, and the wire is all in the same plane.

The core wire diameter shall be as follows :

Coating	Mesh Type	Wire Diameter
ZN	80	2.70
ZN + PVC	80	2.70

Certain other wire diameters may be utilized if specified by the engineer.

The wire mesh dimensional layout is as per the diagram below:



Mesh	X (mm)	Y (mm)	Tolerance %
8	82	122	± 5 %

1.6 SELVEDGES

The cut edges of all mesh used in the construction of Gabions, except the bottom edges of end panels and diaphragms, shall be tightly selvedged with a wire having a diameter as shown in the table below.

The side selvedge of all and any mesh panels shall be woven integrally with the main mesh as described in the above clause 1.5 with a selvedge wire with the following diameter :

Wire Diameter	Selvedge Wire Dia.
2.7	3.4

Where the selvedge is not woven integrally with the mesh but has to be fastened to the cut ends of the mesh, it must be attached by mechanically binding the cut ends of the mesh two and half turns around the selvedge wire or by other approved method, provided that the force of not less than 8.5 kN applied in the same plane as the mesh, at a point on the selvedge of a mesh sample one metre long, is required to separate it from the mesh.

1.7 DIAPHRAGMS AND END PANELS

The end panels and diaphragms shall be selvedged on the top and vertical sides as described in clause 1.6.

The end panels shall be attached by mechanically twisting the cut ends of the mesh wires at the bottom of the panel to the selvedge wire on the base of the gabion.

Similarly, the diaphragms shall be connected to the base by a spiral wire passing in turn through mesh openings of the base and each mesh of the diaphragm panel. The wire for the spiral shall be of the same type of the mesh wire but the diameter shall be 2.00 mm.

In each case the force required to separate the panels from the base shall be not less than that required to break the mesh over the same length.

1.8 LACING AND BRACING WIRE

Sufficient lacing and bracing wire of the same type of the mesh wire, must be supplied with the gabion cages to perform all the wiring operations to be carried out in the construction of the gabion work.

The diameter of the lacing and bracing wire shall be 2.20 mm.

1.9 BOX SIZES

Gabions shall be mechanically pre-fabricated in such a manner that the sides, ends, lids and diaphragms can be assembled at the construction site into rectangular baskets of the standard sizes indicated below or as specified and shown in the Drawings.

Mesh type	80mm
Length (L)	2m, 3m and 4m
Width (W)	1m
Depth (D)	0.5m and 1m
Diaphragm	every 1m

All gabion dimensions shall be within a tolerance limit of 5% of the required size.

1.10 STONE FILL

The material used for gabion fill shall be clean, hard, dense and durable stone, rounded and angular shape.

No rock shall exceed 250mm and at least 85% by weight of the stones shall have a size equal to or larger than 100mm. No rock shall pass through the mesh.

2. ASSEMBLY AND ERECTION

2.1 SCOPE

This specification details the requirements from the assembly stage through to the final wiring of the completed gabion product.

The contractor shall provide to the Engineer, for his approval, full details and specifications of the gabion he proposes to use in this contract. Only those products so approved by the Engineer shall be allowed to be incorporated in the works.

2.2 ASSEMBLY

Prior to assembly, the gabion material shall be opened out flat on the ground and stretched to remove all kinks and bends.

The gabion boxes shall be assembled individually, by raising the sides, ends and diaphragms, ensuring that all creases are in the correct position and that the tops of all four sides and the diaphragms are even.

The four corner edges of the Gabion boxes shall be laced first, followed by the edges of internal diaphragms to the sides.

In all cases, lacing shall commence by twisting the end of the lacing wire tightly around the selvedge/s. It shall then pass round the two edges being joined using alternate single and double

loops at 100mm intervals and be securely tied off at the bottom. The ends of all lacing wires shall be turned to the inside of the box on completion of each lacing operation. Each loop shall be pulled tight to prevent the joint opening during filling. Tightness of the lacing is essential.

2.3 ERECTION

Assembled boxes, or groups of boxes, shall be positioned in the structure. The side, or end, from which work is to proceed, shall be secured either to the completed work, or by rods or stakes driven into the ground at the corner. These stakes must be secure and reach at least to the top of the gabion box.

Further gabion boxes shall be positioned in the structure as required, each being securely laced to the preceding one along all common corners and diaphragms. Using the lacing technique described above.

2.4 GEOTEXTILE

Non-woven geotextile, as specified in the contract drawings and approved by the Engineer, shall be placed vertically at the back of each gabion box, and extend backwards into the fill at least 0.5m parallel to the mesh of homogeonous lower panel and also 0.5m below the panel directly above the unit, to prevent migration of fines.

2.5 STRETCHING

Final stretching of the gabion boxes shall be carried out using a pull-lift of at least one tonne capacity, firmly secured to the free end of the assembled gabion boxes.

Whilst under tension, the gabion boxes shall be securely laced along all edges (top, bottom and sides) and at diaphragm points, to all adjacent boxes.

2.6 FILLING

Filling shall be carried out whilst gabion boxes are under tension.

The front face and all other faces which will be exposed in the completed structure shall be “hand packed” with the stones placed so as to produce a neat face free from excessive bulges, depressions and voids.

Internal bracing wires shall be provided on the exposed faces at the rate of 4/cu.m at 330mm centres to prevent distortion of the gabion units during filling and in the completed structure. These bracing wires shall be wrapped around two of the mesh wires and extend from front to back. Additional bracing wires shall be provided on exposed ends at a rate of 4/sq.m of face.

Mechanical filling equipment may be used with the approval of the Engineer and providing adequate precautions are taken to protect the PVC coating from abrasion during filling operations.

Tension on the gabion boxes shall be released only when fully laced and sufficiently full to prevent the mesh from slackening.

All gabions shall be overfilled by 25mm using flat stone to allow for minor settlement and to provide a level surface for subsequent layers.

2.7 FINAL LACING

Closing and lacing down of lids shall proceed as soon as practicable after filling operations especially if exposed to the likelihood of storm or flood during construction.

Lids shall be stretched tight over the filling with suitably designed closing tools and laced down securely through each mesh along all edges, ends and diaphragms using the lacing method described above before commencing work on the next layer of gabion. The ends of all tying and bracing wires shall be turned into the gabion box on completion of each lacing operation.