



AUS-SPEC

Infrastructure Specifications

**0294 Gabion Walls and Rock Filled
Mattresses**



0294 GABION WALLS AND ROCK FILLED MATTRESSES

IMPORTANT: This document has been adapted from the NATSPEC suite of specification templates for use in the MidCoast Council area by both Council and industry. NATSPEC regularly updates the base templates (currently in April and October each year), and Council may incorporate changes into its version of AUS-SPEC from time to time. To assist in highlighting any changes made by Council to the NATSPEC templates, the following conventions are used.

- See ANNEXURE M at the end of this document which contains (where practical) MidCoast Council customisations (also known as 'office master' text). References to the Annexure are to also be inserted at relevant clauses in the main body of the document.
- Where content is added to the main body of the document, it is to be shown **in brown text like this**.
- Where content is deleted or excluded from the main body of the document, it is to be shown ~~struck through like this~~. Such clauses are to have no effect.

Where there is a conflict between main body text and MidCoast Council specific clauses, Council's specific clauses shall prevail.

1 GENERAL

1.1 RESPONSIBILITIES

General

Requirement: Provide gabion walls and rock mattresses, as documented.

1.2 CROSS REFERENCES

General

Requirement: This worksection is not a self-contained specification. In addition to the requirements of this worksection, conform to the following:

- 0136 *General requirements (Construction)*.
- 0152 *Schedule of rates (Construction)*.
- 0161 *Quality management (Construction)*.
- 1101 *Traffic management*.
- 1102 *Control of erosion and sedimentation (Construction)*.
- 1111 *Clearing and grubbing*.
- 1112 *Earthworks (Road reserve)*.

1.3 STANDARDS

General

Steel wire mesh: To ASTM A975.

1.4 INTERPRETATION

Definitions

General: For the purposes of this worksection, the following definitions apply:

- Double-twisted wire mesh: Non-ravelling mesh made by twisting continuous pairs of wires through three one-half (180°) turns to form hexagonal shaped openings.
- Fasteners: An alternative method to lacing wire used for binding operations.
- Gabion: Double-twisted wire mesh container, uniformly partitioned into internal cells, interconnected with other units and filled with rocks to form flexible, permeable, monolithic structures.
- Lacing wire: Wire used to assemble and interconnect empty units to close and secure rock-filled units or used as internal stiffeners.
- Prefilled gabion: A gabion assembled and filled, then lifted and transported before installation.

- Rock filled mattress: Double-twisted wire mesh container, uniformly partitioned into internal cells, approximately 300 mm high, interconnected with other units and filled with rocks.
- Selvedge wire: Terminal wire used to edge the wire mesh perpendicular to the double twist by mechanically wrapping the wires around 2.5 times minimum or by inserting it throughout the twists and folding one mesh length.
- Stiffeners: Wire used for support of facing by connecting the front panel to the back panel of the gabion.

1.5 TOLERANCES

General

Maximum gabion length, width and height deviation: $\pm 5\%$.

Maximum rock filled mattresses length, width and height deviation: $\pm 10\%$, for height and $\pm 5\%$ for length and width.

Maximum mesh opening width deviation: $\pm 10\%$.

1.6 SUBMISSIONS

Execution details

Prefilled gabions work method: If proposed, submit procedure details for filling, lifting and transportation of filled gabions. Include details of procedures for achieving the surface tolerance of 75 mm from a 3 m straightedge across the surface after installation.

Products and materials

Material conformance: Submit details of the following, verifying conformance with the requirements of this worksection:

- Gabion/mattress unit and fasteners: Properties and source.
- Body and selvedge wire tensile strength.
- Rock fill material: Properties and source.
- Backfill material: Properties and source.

Samples

Material sample: Submit a sample of the following:

- Gabion mesh unit.
- Mattress mesh unit.
- Geotextile material.
- Rock fill material.

Variations

Alternative backfill material: If proposed, submit details for approval, including properties and sources of backfill.

1.7 INSPECTIONS

Notice

General: Give notice so that inspection may be made of the following:

- Installation: Gabion units erected, positioned in place and stretched before filling.

2 MATERIALS

2.1 GENERAL

Delivery

Gabions and mattresses other than prefilled: Deliver gabions and mattresses in the collapsed form, folded and bundled or rolled, with all components (including ends and diaphragms) mechanically connected at the production facility with the exception of the mattress lid. Provide mattress lid separately from the base.

Geotextile: Deliver to site in the manufacturer's original packing at least 14 days before commencement of installation, legibly marked to show type and batch number.

Storage and handling

Gabions and mattresses: Deliver and store materials in the original packaging, away from site traffic to prevent accidental damage.

PVC coating: Handle materials carefully to prevent damaging the PVC coating.

Geotextile: Store above ground, under protective cover or wrapped in waterproof, opaque UV protective sheeting to the manufacturer's recommendations.

Fasteners and braces

Fastener material: Stainless steel wire conforming to the following:

- Minimum tensile strength: 1500 MPa.
- Minimum diameter: 3.0 mm.
- Able to be folded around 4 selvedge wires with minimum overlap of 25 mm.

Bracing materials: Galvanized wire conforming to the following:

- Minimum tensile strength: 380 MPa.
- Wire coating class and type to AS/NZS 4534: W10Z.

Bracing fabrication: Formed by folding one wire to form a U shape with strands of 1 m nominal length, spanning 200 mm nominal. Provide 100 mm nominal length returns at the open end of the brace.

Gabion and mattress fabrication

Mesh perimeter edges: Selvedge with wire conforming to the following:

- To prevent unravelling of mesh.
- Connection strength between the selvedge wire and mesh not less than the breaking strength of the mesh.

Diaphragm: Secure in position so that no additional lacing is required on site.

Partitions: Divide units with diaphragms into uniform cells not greater than the width of the gabion plus 100 mm.

2.2 GABIONS

Steel wire mesh

Material: Flexible woven galvanized wire conforming to the following:

- Body and selvedge wire tensile strength: Minimum 380 MPa, tested to ASTM A975 clause 13.
- Wire coating class and type to AS/NZS 4534: W10Z.

Minimum core wire diameter: Conform to the following:

- Body wire: 2.7 mm.
- Lacing and connecting wire: 2.2 mm, including for stiffeners.
- Preformed stiffeners: 3.4 mm.
- Selvedge wire: 3.4 mm.

Alternative connectors in place of lacing and connecting wires: C clips, conforming to ASTM A975.

Mesh size: 80 x 100 mm nominal.

PVC coating

PVC wire coating minimum thickness: 0.4 mm, before forming.

2.3 ROCK FILLED MATTRESSES

Steel wire mesh

Material: Flexible woven galvanized wire conforming to the following:

- Body and selvedge wire tensile strength: Minimum 380 MPa, tested to ASTM A975 clause 13.
- Wire coating class and type to AS/NZS 4534: W10Z.

Minimum core wire diameter: Conform to the following:

- Body wire:
 - . Mattresses less than 350 mm thick: 2 mm.
 - . Mattresses 350 to 550 mm thick: 2.4 mm.
- Lacing and connecting wire: 2.2 mm, including for stiffeners.

- Preformed stiffeners: 3.4 mm.
- Seldge wire:
 - . Mattresses less than 350 mm thick: 2.4 mm.
 - . Mattresses 350 to 550 mm thick: 3.4 mm.

Alternative connectors in place of lacing and connecting wires: C clips, conforming to ASTM A975.

Mesh size: 60 x 80 mm nominal.

PVC coating

PVC wire coating minimum thickness: 0.4 mm, before forming.

2.4 ROCK FILL MATERIALS

General

Standard: To AS 2758.4.

Aggregate property: Clean, dense, durable hard rock conforming to the following:

- Consistent in size and shape to allow interlocking and with the required durability.
- With less than two broken or angular faces.
- Free from staining, laminations, cracks and other structural defects which may reduce its mechanical strength.

Wet strength tested to AS 1141.22: > 100 kN.

Wet/dry strength variation tested to AS 1141.22: < 35%.

Weak particles content: To AS 2758.4 clause 9.

Minimum apparent particle density: 24.5 t/m³ tested to AS 1141.6.1.

Aggregate dimension: To AS 2758.4 Table 1.

- Gabions: Size aggregate to allow minimum 3 layers of rock when filling the gabions.

Rock unit weight for gabion retaining walls: Minimum 24.5 kN/m³.

2.5 GEOTEXTILE

General

Type: Non-woven geotextile conforming to Austroads AGPT04G.

Geotextile strength and filtration requirements table

Application	Geotextile strength class ⁽¹⁾	EOS and flow rate requirements for $D_{15} \leq 75 \mu\text{m}^{(3)}$ (predominantly low permeability soils including clays and silts)	EOS and flow rate requirements for $D_{15} > 75 \mu\text{m}^{(3)}$ (predominantly pervious granular soils)	Filtration class
Drainage and separation behind retaining structures, including rock filled mattresses and joints of pipes and arches.	C	$\text{EOS} \leq 120 \mu\text{m}^{(2)}$ $Q_{100} \geq 30 \text{ L/s/m}^2^{(3)}$ $\psi \geq 0.3 \text{ s}^{-1}$	$\text{EOS} \leq 250 \mu\text{m}^{(2)}$ $Q_{100} \geq 50 \text{ L/s/m}^2^{(3)}$ $\psi \geq 0.5 \text{ s}^{-1}$	2

Source: RMS R63.

(1) Geotextile strength class for survivability for the given application. Geotextile survivability refers to the ability of the geotextile to withstand the installation stresses during construction. It is related to the construction method, subgrade condition, backfill material including stone size, and other factors.

(2) Equivalent opening size (EOS), defined as O_{95} , taken to be the mean value of the test results in conformance with AS 3706.1 and AS 3706.7. It is recognised that wet sieving generally results in lower EOS values than dry sieving.

(3) Q_{100} , the flow rate under 100 mm constant head and permittivity (ψ) determined in conformance with AS 3706.9.

2.6 BACKFILL

General

Requirement: Granular and free draining.

Maximum particle size: 50 mm.

Plasticity index tested to RMS T109: 2 to 12.

Minimum pH level tested to RMS T123: 5.0.

3 EXECUTION

3.1 ESTABLISHMENT

Set-out

Requirement: Using recovery pegs, set out gabions and mattresses, as documented. Identify the line for top of the cut batter and location, length and height of the wall.

Excavation and foundation preparation

Requirement: Excavate to the required depth, width and batter angle behind the finished face of the gabion/mattress.

Surplus excavated material: Use in the construction of embankments or remove from site.

Finished level of excavation for mattresses: Excavate and shape to form a uniform channel cross section, to allow the mattress to finish flush with the surrounding ground.

Compaction of foundation material: Not less than 95% for standard compactive effort to AS 1289.5.4.1.

Test roll: Test roll excavated area, and rectify unstable areas if it exceeds 20% of the area being test rolled by ripping out the whole of the area, re-compacting, and re-presenting for test rolling.

Foundation for gabion retaining walls: Make sure slope of prepared surface is 10(H):1(V) maximum.

Geotextile and drainage

Before laying gabions or mattresses: Place geotextile between the mesh units and the material being protected or retained.

Geotextile behind gabion layer: Place at the back of each layer and extend it 1.0 m along the lower units and 1.0 m along the upper units, perpendicular to the back of the gabion to prevent migration of fines.

- Overlaps: Minimum 300 mm.

Granular layer: Provide a continuous granular drainage layer behind gabion wall and geotextile as follows:

- For the full height of the wall.
- In the documented width, measured perpendicular to the face of the wall.
- Progressively placed in layers of 150 mm maximum, compacted in conformance with

COMPACTION.

Granular layer material: Broken stone or river gravel of clean, hard, durable particles graded from 50 mm to 10 mm to AS 1141.11.1 as follows:

- Maximum particle dimension: 50 mm.
- Passing the 9.5 mm AS sieve: Not more than 5% by mass.

Gabion retaining walls subsurface drainage: Place drainage pipe at the base of rear of the gabion before laying gabions.

Drainage pipe properties: 100 mm diameter perforated plastics Class 400 pipe, with 2 mm perforation size and a knitted seamless sleeve.

3.2 INSTALLATION

Mesh assembly

General: Assemble to the mesh manufacturer's recommendations.

Unpacking: Unfold wire mesh on flat ground and stretch or stamp to remove all kinks and bends. Make sure all creases are in the correct position for forming the box/unit.

Assembling: Assemble units individually, by raising sides, ends and diaphragms. Align all sides and tops and connect using lace wire or fasteners at 150 mm maximum intervals.

Lacing: Conform to the following:

- Secure lace wire to the mesh by looping and/or twisting and passing it around the two edges being joined.
- Use alternate single and double loops through each mesh opening. Make sure each loop is tight.
- Secure end of lace wire to the mesh by looping and/or twisting.
- On completion, turn all ends of lace wires to the inside of the unit.

Mattresses: If the height of the sides is different, conform to the following:

- Adjust the position of the diaphragm so that the sides hinge up on the thicker wire woven in the mesh.
- Attach diaphragm in place by twisting short lengths of selvedge wire firmly over the tops of the sides.
- Continuously wire each mesh and securely tie off at the top. Turn lacing wires to the inside of the mattress.

Erection

Requirement: Place assembled mesh unit in its final position, and securely join together along the vertical and top edges of all abutting edges/surfaces in conformance with **Mesh assembly**.

Structures with multiple layers: Securely join mesh units in the upper layer with the top surface of units in the lower layer in conformance with **Mesh assembly** and the following:

- First layer of gabion retaining walls: Before filling, make sure the top of layer has a slope of 10(H):1(V). If required, use temporary and permanent supports.
- Subsequent layers of gabion retaining wall: Before filling, make sure the slope at the top of the layer is 10(H):1(V). If required, place a 70 mm screed layer of gabion fill on the underlying layer to maintain the slope.
- Gabion retaining walls ≥ 6 m high: Install gabions in a stretcher bond pattern.

Temporary and permanent supports: Provide galvanized star pickets or structural steel sections, as required, so that the sides of installed gabions do not vary by more than 50 mm from a 3 m straightedge, during and after filling.

- Gabion: Conform to the following:
 - . Picket/structural steel height: Sufficient to allow firm embedment of 900 mm minimum into the ground and reach the top of the gabion mesh unit.
 - . Picket spacing: Maximum 1 m.
- Rock filled mattresses: Conform to the following:
 - . Picket embedment and connection: Driven into the foundation to 500 mm minimum depth and connected to the base of the mattress with a fastener.
 - . Picket spacing for mattresses: Minimum 1 x 1 m grid.
- Mattresses laid on slopes steeper than 1(V):1.5(H): Secure the upper edge with galvanized star pickets at maximum 1 m intervals, embedded 900 mm minimum into the ground.

Stretching

Final stretching: Using a minimum 1 tonne capacity pull-lift, firmly secured to the free end of the assembled unit, stretch gabion mesh units. Whilst under tension, lace the gabion units along edges and diaphragm points to all adjacent units.

Prefilled gabions

Alternative system: If use is approved, provide framing to stretch mesh unit taut before filling. Before lifting, stiffen top horizontal edges with 20 mm diameter reinforcing bars to maintain shape during lifting, and remove after positioning.

Lifting filled units: Use lifting frames and slings.

Bulges and depressions after installation: If greater than 75 mm, replace.

Mesh cutting

Site cutting and folding: If required, cut mesh cleanly and fold back or overlap surplus mesh and securely fasten together with lacing wire or fasteners in conformance with **Mesh assembly**.

Reshaped units: Conform to **Mesh assembly**, **Erection** and **FILLING**.

3.3 FILLING

General

Requirement: Fill mesh units under tension. Place rocks, by hand, at the front and other exposed faces to form a neat face free of bulges, depressions and voids.

Bracing: Install bracing wires in conformance with the following:

- To prevent distortion as filling proceeds, install 4 wires/m³, at 330 mm centres,.
- Wrap bracing wires around 2 mesh wires, extending from front to back.
- Provide additional bracing wires at exposed ends at a rate of 4 wire/m² of face.

1000 mm high gabions: Fill in 3 layers, provide bracing after filling $\frac{1}{3}$ of the unit and additional bracing after filling $\frac{2}{3}$ of the unit.

500 mm high gabions: Fill in 2 layers, 250 mm at a time. Provide bracing after placement of the first layer.

Gabion retaining walls ≥ 6 m: Install evenly distributed internal braces at maximum 250 mm horizontal centres.

Mechanical filling: If used, protect PVC coating from abrasion during filling. Redistribute fill materials by hand so that all diaphragm compartments are fully filled and to produce a neat, levelled top surface.

Overfill: Overfill units by 25 to 50 mm to allow for settlement of rocks.

- Rock filled mattresses: Overfill units by 25 mm to allow for settlement of rocks.

Backfill materials behind gabion: Compact backfill material simultaneously to the same level as the filled gabions.

Releasing of tension on gabion units: Replace only when units are fully laced and sufficiently full to prevent mesh from slackening.

Bulges and depressions after filling: If greater than 50 mm, refill.

Final lacing

Closing and lacing lids: Once mesh units are completely full, stretch lid over fill so that all perimeter edges meet. Securely lace lid along all edges, ends and tops of diaphragms in conformance with **INSTALLATION**, **Mesh assembly**. If required, remove some fill to prevent lid from being over-stretched.

3.4 COMPACTION

Backfill

Compaction: Compact backfill in lifts not more than 150 mm.

Minimum characteristic relative compaction: 98%.

Heavy compaction equipment: Maintain a distance of 1 m from the gabions and mattresses.

Backfill adjacent to gabions and mattresses: Use small rollers or plate compacters.

3.5 COMPLETION

General

Requirement: Make sure all edges are fastened/laced securely and remove any temporary supports or tensioning.

4 ANNEXURES

4.1 ANNEXURE – SUMMARY OF HOLD AND WITNESS POINTS

For private developments, certain Hold and Witness Points where specifically noted below require representatives of both the Superintendent and the Principal Certifier (e.g. Council) to authorise release.

Clause and description	Type*	Submission/Inspection details	Submission/Notice times	Process held
SUBMISSIONS, Execution details Prefilled gabions work method	H	Proposed procedures and procedures for achieving tolerance.	28 days before delivery of materials to site	Materials ordering and delivery
SUBMISSIONS, Materials Material conformance	H	Details of material conformance.	28 days before delivery of materials to site	Materials ordering and delivery
SUBMISSIONS, Samples Material sample	H	Material samples.	28 days before delivery of materials to site	Materials ordering and delivery
SUBMISSIONS, Variations Alternative backfill material	H – Superintendent and Principal Certifier	Proposed alternative backfill material.	28 days before delivery of materials to site	Backfill materials ordering and delivery
INSPECTIONS, Notice Installation	H	Assembled gabion unit positioned in place.	3 working days before inspection	Filling of gabion units
*H = Hold Point, W = Witness Point				

4.2 ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
	Material quality:			
	- Wet strength	1 contract	1 contract	AS 1141.22
	- Wet/dry strength variation	1 contract	1 contract	AS 1141.22
	Minimum apparent particle density	1 contract	1 contract	AS 1141.6.1
	Backfill:			
	- Plasticity index	1 contract	1 contract	RMS T109
	- Minimum pH level	1 contract	1 contract	RMS T123

4.3 ANNEXURE – PAY ITEMS

This Annexure applies to Council projects. For private development works use of this schedule is optional, at the Superintendent's discretion.

Pay items	Unit of measurement	Schedule rate inclusions
0294.1 Excavation	m ³ , measured in bank volume of excavation. Determine the volume by the End Area Method using design cross-sectional areas calculated at each change in height or	Include in the rate for excavation: - Excavation and backfilling of all types of materials, with no separate rates for earth and rock.

Pay items	Unit of measurement	Schedule rate inclusions
	width of the wall/mattress.	<ul style="list-style-type: none"> - The disposal of surplus material. - The control of stormwater runoff. Do not include: <ul style="list-style-type: none"> - Drying out wet excavated material or replacement of over excavation beyond the design cross-sectional limits defined above.
0294.2 Rock filled gabions	m ³ of rock filled gabions.	All costs associated with: <ul style="list-style-type: none"> - Wall volume taken from the drawings and adjusted for any changes. - Supply and placement of geotextile materials behind the gabion and subsurface drainage. - Supply and placement of temporary/permanent supports. - Supply and assembly of gabion. - Supply and placing of rock fill in the gabion. - Supply and placing of backfill material.
0294.3 Rock filled mattresses	m ³ of rock filled mattresses.	All costs associated with: <ul style="list-style-type: none"> - Wall volume taken from the drawings and adjusted for any changes. - Supply and placement of geotextile materials. - Supply and placement of temporary/permanent supports. - Supply and assembly of mattress. - Supply and placing of rock fill in the mattress.
Traffic management	Lump sum.	To 1101 <i>Traffic management</i> .
Erosion and sedimentation control		To 1102 <i>Control of erosion and sedimentation (Construction)</i> .

4.4 ANNEXURE - REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:

AS 1141		Methods for sampling and testing aggregates
AS 1141.6.1	2000	Particle density and water absorption of coarse aggregate - Weighing-in-water method
AS 1141.11.1	2009	Particle size distribution - Sieving method
AS 1141.22	2019	Wet/dry strength variation
AS 1289		Methods of testing soils for engineering purposes
AS 1289.5.4.1	2007	Soil compaction and density tests - Compaction control test - Dry density ratio, moisture variation and moisture ratio

AS 2758		Aggregates and rock for engineering purposes
AS 2758.4	2017	Aggregate for gabion baskets and wire mattresses
AS 3706		Geotextiles - Methods of test
AS 3706.1	2012	General requirements, sampling, conditioning, basic physical properties and statistical analysis
AS 3706.7	2014	Determination of pore-size distribution - Dry sieving method
AS 3706.9	2012	Determination of permittivity, permeability and flow rate
AS/NZS 4534	2006	Zinc and zinc/aluminium-alloy coatings on steel wire
Austrroads AGPT		Guide to pavement technology
Austrroads AGPT04G	2009	Geotextiles and geogrids
RMS R63	2017	Geotextiles (separation and filtration)
RMS T109	2012	Plastic limit and plasticity index of road construction materials
RMS T123	2012	pH value of a soil (Electrometric method)
ASTM A975	2016	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)

5 ANNEXURE M – MIDCOAST COUNCIL SPECIFIC CLAUSES

M1.	Variations to or non-conformances with Council's AUS-SPEC are to be evaluated with reference to the procedure in Council's <i>Development Engineering Handbook</i> . Acceptance is to be obtained in writing from: <ul style="list-style-type: none"> a) an authorised representative of Council's Director of Infrastructure and Engineering Services, or b) an accredited certifier where they are the Principal Certifier and hold the relevant accreditation category for the type of work. 	Variation procedure
M2.	This specification applies in addition to any development consent (DA) conditions. If there is any inconsistency, the conditions of consent shall prevail.	DA conditions
M3.	Refer to the MidCoast Council <i>Development Engineering Handbook</i> for final inspection, works-as-executed and handover requirements.	Completion

6 AMENDMENT HISTORY

0	14/12/2020	First Published
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