

TRANSPORT FOR NSW (TfNSW)

QA SPECIFICATION R55

ROCK FILLED GABIONS AND MATTRESSES

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REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 2	R79.2.1	Amended 1st para re corrosion protection of wire mesh	GM,CMS	10 Sep 91
	R79.2.2	Amended 1st para re corrosion protection of wire mesh. 2nd para changed from 600mm to 1 m.		
	R79.2.4	Amended 1st para re corrosion protection of wire mesh		
	R79.2.6	Added to (b) Size –or 250 mm, whichever is the lesser		
	R79.4.1	Amended 1st para changed gabions to wire mesh		
	R79.4.2	Amended 1st para changed rods or stakes to galvanized star pickets		
	R79.5.1	Amended 1st para changed mattresses to wire mesh		
	R79.5.2	Amended 2nd para changed 1000 mm to 1 m		
	R79.7.4	Amended (c) Compaction changed 1000 mm to 1 m		
R79.8	Amended Pay Item R79P1 —2nd para add rock filling and star pickets			
Ed 1/Rev 3	R79.2.2	Selvedge wire diameter reduced from 3.0 mm to 2.4 mm for mattresses. New requirements for mattresses over 350 mm thick. Note added allowing diaphragms formed by folding the base layer.	GM, CMS (H Larrea)	20 Aug 92
	R79.3	New notes re: excavation for gabions, mattresses and/or Tarramesh panels.		

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 3 (cont'd)	R79.8	Pay Item R79P1 reworded. Added Pay Item R79P5 —Excavation for Gabions and Mattresses.		
Ed 2/Rev 0		Clause numbers and lists have been renumber to suit the new format. Hold points have been restructured and rewritten. 2.6 Sentence has been modified. 3 1st sentence has been modified. 6 2nd para —Information to be included in the QP. 7.2 Clarification of 3rd paragraph	GM,CEC (J.Woodward)	6 Mar 95
Ed 2/Rev 1		Specification Number changed from R79 to R55. Converted to MS Word 6.0c. References to RTA Specifications changed. 1.2 RTA specifications added. 2.6.1 “10% fines value” changed to “wet/dry strength variation”. 6 Filter fabric specified to R63. 7.4.3 Compaction standard redefined. Annex R55/1 Reference specification changed	GM, RNIC (J Woodward)	10 Jan 97
Ed 3/Rev 0	“Notice” Global 1.2.4 2.1 & 2.2 2.3 2.4 2.5	RTA PO Box and Fax numbers updated Specification reformatted. Text revised to direct imperative style. “Contractor” replaced by “you”. “Superintendent” replaced by “Principal”. Some clauses moved to Annexures. Minor editorial changes to clarify intent. Definitions of “you” and “your” inserted. Gabion and mattress dimensions and physical properties of steel wire, galvanizing and PVC coatings to conform to ASTM A975-97. Selvedge lacing requirements to conform to ASTM A975-97. Use of alternative fastener systems now permitted. Terramesh panel steel wire, galvanizing and PVC coatings to conform to ASTM Standard A975-97. Lacing and connecting wire to conform to ASTM Standard A975-97. Use of alternative fastener systems now permitted.	GM, IC	30.06.09

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 3/Rev 0 (cont'd)	2.6.1 Annexure B Annexure M	Rockfill durability - maximum Wet/Dry strength permitted reduced to 35% when tested in accordance with RTA T215. Measurement and Payment – standard “deemed to have allowed for” clause added. ASTM Standard A975-97 added to list of reference documents.		
Ed 3/Rev 1	Global 1.2.3 1.2.4 2.3 4.3 & 5.2 6 Pay Item R55P5 Annex C Annex D Annex M	Minor editing to improve clarity. Clause revised due to inclusion of Schedule of Identified Records. Clause on Project Quality Plan added. Use of alternative fastener systems for selvages revoked. Hold Points prior to filling of gabions or mattresses inserted. Geotextile requirement clarified to be non woven Strength Class C and Filtration Class 2. Pay item for excavation sub-divided into separate pay items for gabions and for mattresses. Payment for topsoil removal made under R44. Schedule of Hold Points amended to include the two new Hold Points. Schedule of Identified Records added. Schedule of Planning Documents added. Reference documents updated.	GM, IC	16.07.09
Ed 3/Rev 2	Global	References to “Roads and Maritime Services” or “RMS” changed to “Transport for NSW” or “TfNSW” respectively.	DCS	22.06.20



ROCK FILLED GABIONS AND MATTRESSES

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VERSION FOR: DATE:

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FOREWORD

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REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification TfNSW R55 Edition 3 Revision 1.

All revisions to the previous version (other than minor editorial and project specific changes) are indicated by a vertical line in the margin as shown here, except when it is a new edition and the text has been extensively rewritten.

PROJECT SPECIFIC CHANGES

Any project specific changes are indicated in the following manner:

- (a) Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. ***Additional Text***.
- (b) Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. ~~Deleted Text~~.

TfNSW QA SPECIFICATION R55

ROCK FILLED GABIONS AND MATTRESSES

1 GENERAL

1.1 SCOPE

This Specification sets out the requirements for the supply of materials and for the installation of rock filled gabions and mattresses.

1.2 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of annexures that detail additional requirements.

1.2.1 (Not Used)

1.2.2 Measurement and Payment

The method of measurement and payment must comply with Annexure R55/B.

1.2.3 Schedules of HOLD POINTS and Identified Records

The schedules in Annexure R55/C list the **HOLD POINTS** that must be observed. Refer to Specification TfNSW Q for the definition of **HOLD POINTS**.

The records listed in Annexure R55/C are **Identified Records** for the purposes of TfNSW Q Annexure Q/E.

1.2.4 Planning Documents

The PROJECT QUALITY PLAN must include each of the documents and requirements listed in Annexure R55/D and must be implemented.

In all cases where this Specification refers to the manufacturer's recommendations, these must be included in the PROJECT QUALITY PLAN.

1.2.5 Referenced Documents and Definitions

Unless specified otherwise, the applicable issue of a referenced document, other than a TfNSW Specification, must be the issue current at the date one week before the closing date for tenders, or where no issue is current at that date, the most recent issue.

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 2350). For convenience, the full titles are given in Annexure R55/M.

The terms "you" and "your" mean "the Contractor" and "the Contractor's" respectively.

2 MATERIALS

2.1 GABIONS

Gabions must be flexible, woven, galvanized wire mesh boxes of dimensions as shown on the Drawings conforming to ASTM A975-97. Where specified on the Drawings, the galvanized wire mesh must be coated with PVC.

The galvanizing coating must be a 95% Zinc, 5% Aluminium Mischmetal alloy conforming to the requirements of ASTM A975-97. The physical properties of the steel wire and PVC coating must conform to the requirements of ASTM A975-97.

The boxes must be divided by diaphragms into cells of length not greater than the width of the gabion plus 100 mm, or as shown on the Drawings.

Gabions must have a nominal mesh size of 80 mm x 100 mm. The minimum diameter of mesh wire must be 2.7 mm. The minimum diameter of galvanized selvedge wire must be 3.4 mm.

2.2 MATTRESSES

Mattresses must be flexible, woven, galvanized wire mesh boxes of dimensions as shown on the Drawings conforming to ASTM A975-97. Where specified on the Drawings, the galvanized wire mesh must be coated with PVC.

The galvanizing coating must be a 95% Zinc, 5% Aluminium Mischmetal alloy conforming to the requirements of ASTM A975-97. The physical properties of the steel wire and PVC coating must conform to the requirements of ASTM A975-97.

The boxes must be divided into cells by diaphragms across the width of the unit and at not more than 1 m centres, or as shown on the Drawings.

Diaphragms may be formed by folding the base layer of a mattress, provided that the bottom of each of the diaphragm halves is securely tied together so that the transmission of tensile forces in the mesh of the base layer is not impeded.

Mattresses must have a mesh size of 60 mm x 80 mm. For mattresses less than 350 mm thick, the minimum diameter of mesh wire must be 2.0 mm and the minimum diameter of galvanized selvedge wire must be 2.4 mm. For mattresses with thickness between 350 mm and 550 mm, the minimum diameter of mesh wire must be 2.4 mm and the minimum diameter of galvanized selvedge wire must be 3.0 mm.

2.3 SELVEDGES

All edges of the gabions, mattresses, diaphragms and end panels must be selvedged with a continuous wire in accordance with ASTM A975-97.

The selvedging must be such that the mesh will not unravel and such that the strength of the connection between the selvedge wire and the mesh must be equal to or greater than the breaking strength of the mesh.

2.4 TERRAMESH PANELS

Terramesh panels must be flexible woven wire, heavily galvanized, of dimensions as shown on the Drawings supplied by *Maccaferri Australia Pty Ltd* or approved equivalent. Where specified on the Drawings, the galvanized wire mesh must be coated with PVC.

The galvanizing coating must be a 95% Zinc, 5% Aluminium Mischmetal alloy conforming to the requirements of ASTM A975-97. The physical properties of the steel wire and PVC coating must conform to the requirements of ASTM A975-97.

Terramesh panels must have a nominal mesh size of 80 mm x 100 mm. The minimum diameter of mesh wire must be 2.7 mm.

2.5 LACING AND CONNECTING WIRE

Lacing and connecting wire must be supplied with the gabions, mattresses and mesh panels to perform all the wiring operations to be carried out in construction of the gabions or mattresses. Materials must conform to ASTM A975-97. The minimum diameter of the wire (or wire core in the case of PVC coated wires) must be 2.2 mm.

Alternative fastener systems such as “C” clips in place of lacing and connecting wire are permitted but must conform to the requirements of ASTM A975-97.

2.6 ROCKFILL

Rockfill must be dense, hard, durable and clean rock.

2.6.1 Aggregate Wet/Dry Strength

Rock from all sources must have a wet strength of at least 100 kN and a maximum wet/dry strength variation of 35% when tested in accordance with Test Method TfNSW T215. The rock may be crushed by the testing authority so as to produce material that is suitable for testing by Test Method TfNSW T215.

2.6.2 Size

For gabions, the minimum and maximum rock size must be 100 mm and 250 mm respectively.

For mattresses, the minimum rock size must be 75 mm, and the maximum rock size must be two thirds of the thickness of the mattress or 250 mm, whichever is the lesser.

HOLD POINT

Process Held: Use of rockfill.

Submission Details: Details regarding the properties and source of the rockfill.

Release of Hold Point: The Principal will consider the submitted documents for compliance with the Specification, prior to authorising the release of the Hold Point.

3 INSTALLATION - GENERAL

Assemble and install all gabions, mattresses and Terramesh panels in accordance with the requirements of this specification and the manufacturer's recommendations.

Carry out the excavation shown on the Drawings prior to the installation of the gabions, mattresses and/or Terramesh panels.

Use the excavated material for the construction of embankments, or dispose of it to spoil in accordance with Specification TfNSW R44.

4 INSTALLATION OF GABIONS

4.1 ASSEMBLY

Prior to assembly, open the wire mesh out flat on the ground and stretch it to remove all kinks and bends.

Assemble the gabion boxes 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.

Lace the four corners of the gabion boxes and mattresses first, followed by the edges of internal diaphragms to the sides.

In all cases, commence the lacing by twisting the end of the lacing wire around the selvedge(s), then passing it round the two edges being joined using alternate single and double loops through each mesh in turn and tie it off securely at the bottom.

Turn the ends of all lacing wires to the inside of the box on completion of each lacing operation.

4.2 ERECTION

Only assembled boxes, or groups of boxes, may be positioned in the structure. The side, or end, from which work is to proceed, must be secured either to the completed work, or by galvanized star pickets driven into the ground at 1 m spacing. The star pickets must be firmly embedded in the ground and reach at least to the top of the gabion box.

Further gabion boxes must be positioned in the structure as required, with each securely laced to the preceding one along all common corners and diaphragms.

4.3 STRETCHING

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

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

HOLD POINT

Process Held:	Filling of gabions.
Submission Details:	Verification that the gabion units have been supplied and assembled in accordance with specification requirements
Release of Hold Point:	The Principal will inspect the installed gabion baskets prior to authorising the release of the Hold Point.

4.4 FILLING

Carry out filling of the gabion boxes only while the gabion boxes are under tension.

Place the rocks at the front face, and all other faces which will be exposed in the completed structure, by hand packing so as to produce a neat face free from excessive bulges, depressions and voids.

Provide internal bracing wires at the rate of 4 per cubic metre at 330 mm centres to prevent distortion of the gabion units during filling and in the completed structure.

Wrap these bracing wires around two of the mesh wires and extend them from front to back.

Provide additional bracing wires at the exposed ends at a rate of 4 per square metre of face.

Mechanical filling equipment may be used provided that adequate precautions are taken to protect any PVC coating from abrasion during filling operations.

Release the tension on the gabion boxes only when fully laced and sufficiently full to prevent the mesh from slackening.

4.5 FINAL LACING

Closing and lacing down of lids must proceed as soon as practicable after the filling operations particularly where there is a likelihood of storm or flood during construction.

Stretch the lids tightly over the filling with suitably designed closing tools and lace down securely through each mesh along all edges, ends and diaphragms before commencing work on the next layer of gabion. The ends of all lacing and bracing wires must be turned into the gabion box on completion of all lacing operations.

5 INSTALLATION OF MATTRESSES

5.1 ASSEMBLY

Prior to assembly, open the wire mesh out flat on the ground and stretch it to remove all kinks and bends.

Assemble the mattresses 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.

If the height of the sides is different, adjust the position of the diaphragms so that the sides hinge up on the thicker wire woven in the mesh.

Attach the diaphragms in place by twisting the short lengths of selvedge wire firmly over the tops of the sides. Helical wire connecting the diaphragm to the base is to be pulled out only enough to wire up the sides. Wiring must be done as a continuous operation through each mesh in turn and securely tied off at the top. Turn the ends of all lacing wires to the inside of the mattress on completion of each lacing operation. Use lacing wire to lace up the four corners.

In all cases, commence the lacing by twisting the end of the lacing wire around the selvedge(s), then passing it round the two edges being joined using alternate single and double loops through each mesh in turn and tie it off securely at the bottom. Maintain tightness of the mesh and wiring at all times.

5.2 ERECTION

Only assembled mattress or groups of mattresses may be positioned in the structure, with each mattress being securely laced to the surrounding ones along the perimeter.

When the mattress is laid on a slope steeper than 1(V) in 1.5(H), secure the upper edge by galvanized star pickets driven at 1 m centres a minimum of 900 mm into the ground, or as shown on the Drawings.

HOLD POINT

Process Held:	Filling of mattresses.
Submission Details:	Verification that the mattress units have been supplied and assembled in accordance with specification requirements.
Release of Hold Point:	The Principal will inspect the installed mattresses prior to authorising the release of the Hold Point.

5.3 FILLING

Mechanical filling equipment may be used provided that adequate precautions are taken to protect any PVC coating from abrasion during filling operations.

Redistribute the filling materials by hand to ensure that all diaphragm compartments are fully filled and to produce a neat and level top surface.

Mattress units must be overfilled by 25 mm to 50 mm to allow for subsequent settlement.

5.4 FINAL LACING

Closing and lacing down of lids must proceed as soon as practicable after the filling operations have been completed.

Stretch the lids tightly over the filling with suitably designed closing tools and lace down securely through each mesh along all edges, ends and diaphragms. The ends of all lacing wires must be turned into the mattress on completion of all lacing operations.

6 GEOTEXTILE FOR GABIONS AND MATTRESSES

Before laying out gabions or mattresses, place the geotextile between the wire cage and the material being protected or retained. The geotextile must be a non-woven type meeting the requirements of Geotextile Strength Class C and Filtration Class 2 in accordance with Specification TfNSW R63.

7 INSTALLATION OF TERRAMESH PANELS

7.1 ASSEMBLY

Prior to installation, open the mesh panels out flat on the ground and stretch them to remove all kinks and bends.

Place the mesh panels in the wall sandwiched between adjacent gabion layers, as shown on the Drawings.

Extend the panel to the front faces of the upper gabion and orientate the mesh so that the twists are at right angles to the face of the wall, i.e. aligned with the line of maximum tension.

7.2 LACING

Lace the panels fully to both upper and lower gabions along two separate lines, which are usually the front of the upper gabion and back of the lower gabion.

Lace adjacent panels longitudinally to provide a homogeneous reinforcement layer.

Lacing must be in accordance with Clause 4.1, i.e. using alternate single and double loops. The loops must be at 100 mm centres.

All panel lacing must be PVC coated.

7.3 GEOTEXTILE

Place the geotextile at the back of each gabion layer and extend it 1.0 m along the lower Terramesh panel and 1.0 m along the upper Terramesh panel perpendicular to the back of the gabion to prevent migration of fines.

7.4 SELECT BACKFILL

7.4.1 Material

Select backfill must be granular and free draining.

The maximum particle size must be limited to 50 mm. The Plasticity Index as determined by Test Method TfNSW T109 must not be less than 2 or more than 12.

The pH must not be less than 5.0 when determined by Test Method TfNSW T123.

HOLD POINT

Process Held:	Use of select backfill material.
Submission Details:	Details of the properties and source of the select backfill material proposed to be used.
Release of Hold Point:	The Principal will consider the submitted documents prior to authorising the release of the Hold Point.

7.4.2 Alternative Material

Materials not satisfying the above size and Plasticity Index criteria may be accepted provided that the internal friction angle as determined by an appropriate test method is greater than 28 degrees.

HOLD POINT

Process Held:	Use of alternative material.
Submission Details:	Details of the properties and source of the select backfill material proposed to be used.
Release of Hold Point:	The Principal will consider the submitted documents for compliance with the Specification, prior to authorising the release of the Hold Point.

7.4.3 Compaction

Compact the select backfill in lifts not exceeding 150 mm and to a minimum characteristic relative compaction of 98.0% in accordance with Specification TfNSW R44.

Take care to ensure that heavy compaction equipment does not come into contact with the Terramesh panels or within 1 m of the gabions.

Compact backfill adjacent to the gabions using small rollers or plate compacters.

ANNEXURE R55/A – (NOT USED)

ANNEXURE R55/B – MEASUREMENT AND PAYMENT

Payment will be made for all costs associated with completing the work detailed in this Specification in accordance with the following Pay Items.

Where no specific pay items are provided for a particular item of work, the costs associated with that item of work are deemed to be included in the rates and prices generally for the Work Under the Contract.

Unless specified otherwise, a lump sum price for any of these items will not be accepted.

Pay Item R55P1 - Rock Filled Gabions

The unit of measurement is the cubic metre of rock filled gabions.

The volume is determined from the actual volume of gabions in the completed work.

The schedule rate includes the supply and installation of gabions, rock filling, filter fabric and star pickets.

Pay Item R55P2 - Rock Filled Wire Mattresses

The unit of measurement is the square metre of rock filled mattress.

The area is determined from the actual slope area of the completed work.

The schedule rate includes the supply and installation of mattresses, rock filling, filter fabric and star pickets.

Pay Item R55P3 - Terramesh Panels

The unit of measurement is the square metre of terramesh panel.

The area is determined from the actual area of panel placed including the area between gabions.

The schedule rate includes the supply and installation of panels.

Pay Item R55P4 - Select Backfill for Terramesh Panels

The unit of measurement is the cubic metre measured as bank volume of compacted fill.

The volume is determined from the volume contained behind the gabions to the extremities of the Terramesh panels.

The schedule rate includes all activities associated with the excavation of material from cuttings or borrow sites, the haulage and compaction of the material, and any pretreatment such as breaking down or blending material.

Pay Item R55P5 - Excavation for Gabions and Mattresses.

The unit of measurement is the cubic metre measured as bank volume.

Pay Item R55P5.1 – Excavation for Gabions

The volume of excavation for gabions is determined by multiplying the plan area of the bottom layer of completed gabions by the average actual depth from the bottom layer to the ground surface after removal of topsoil.

The schedule rate includes excavation for the installation of the gabions, backfilling and incorporation into the backfill or disposal to spoil of the excavated material.

The schedule rate must also include any additional associated excavation or any other work necessary for the temporary excavated batter stability or for the provision of access for the gabion construction.

Pay Item R55P5.2 – Excavation for Mattresses

The volume of excavation for mattresses is determined by measurement of the actual volume of excavation carried out.

The schedule rate includes excavation for the installation of the mattresses, backfilling and incorporation into the backfill or disposal to spoil of the excavated material.

The removal of topsoil will be paid under the relevant Pay Items in TfNSW R44.

ANNEXURE R55/C – SCHEDULES OF HOLD POINTS AND IDENTIFIED RECORDS

Refer to Clause 1.2.3.

C1 SCHEDULE OF HOLD POINTS

Clause	Description
2.6	Submission of details of rockfill
4.3	Verification of supply and assembly of gabion units
5.2	Verification of supply and assembly of mattress units
7.4.1	Submission of details of select backfill
7.4.2	Submission of details of alternative select backfill

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
2.6.2	Details of the properties and source of the rock fill
4.3	Conformity records for the supply and assembly of gabion units
5.2	Conformity records for the supply and assembly of mattress units
7.4	Details of the properties and source of the select backfill material proposed to be used for Terramesh panels

ANNEXURE R55/D – PLANNING DOCUMENTS

Refer to Clause 1.2.4.

The following documents are a summary of documents that must be included in the PROJECT QUALITY PLAN. The requirements of this Specification and others included in the Contract must be reviewed to determine additional documentation requirements.

The information to be submitted as part of the PROJECT QUALITY PLAN must include, but is not limited to, the following:

- (a) Details of method of installation of gabions (Clause 4);
- (b) Details of method of installation of mattresses (Clause 5);
- (c) Details of method of installation of Terramesh Panels (Clause 7).

ANNEXURES R55/E TO R55/K – (NOT USED)**ANNEXURE R55/L – MINIMUM FREQUENCY OF TESTING**

Clause	Characteristic Analysed	Test Method	Minimum Frequency Of Testing
2.6	Rock strength	TfNSW T215	One sample per 200 m ³
7.4	pH of select backfill	TfNSW T123	One sample per 500 m ³
7.4	Plasticity Index of select backfill	TfNSW T109	One sample per 500 m ³
7.4	Compaction of earthworks		Refer to TfNSW R44

ANNEXURE R55/M – REFERENCED DOCUMENTS

Refer to Clause 1.2.5.

TfNSW Specifications

TfNSW Q	Quality Management System
TfNSW R44	Earthworks
TfNSW R63	Geotextiles (Separation and Filtration)

TfNSW Test Methods

TfNSW T109	Plastic Limit and Plasticity Index of Road Construction Materials
TfNSW T123	pH Value of Soil (Electrometric Method)
TfNSW T215	Wet/Dry Strength Variation

Other Standards

ASTM A975-97	Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic Coated Steel Wire or Metallic Coated Steel Wire with PVC Coating)
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