Technical Specification

Transport and Main Roads Specifications MRTS278 Supply of Structural Fasteners

November 2020

Queensland Government

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Contents

1 Introduction

This Technical Specification applies to the supply of the following structural fasteners up to a size M39:

- structural bolt assemblies, and
- manufactured bolts.

Bolt sizes in excess of M39 shall be supplied and tested in accordance with a Project Specific Technical Specification.

This new Technical Specification has incorporated the information provided in Technical Note TN66 *Commercial and Fabricated Bolts and Nuts*.

> For steelwork fabrication refer to MRTS78 *Fabrication of Structural Steelwork*.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements* and other Technical Specifications as appropriate.

> The use of commentary text, such as this, is covered by Clause 16 of MRTS01 *Introduction to Technical Specifications*.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

2 Definition of terms

The terms used in this Technical Specification shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Specifications*.

In addition, terms listed in Table 2 are applicable to this Technical Specification.

Table 2 – Definition of terms

Term	Definition
Approved	Approved by the Administrator (this may be on the advice from Structures Construction Materials unit)
Bolt Assembly	Comprises bolt, washers and nut
bolts	A bolt with a forged hexagonal head and a portion of its length unthreaded
business days	Monday to Friday and excluding public holidays
Commercial Bolts	Purpose made bolts readily available
Contractor	Unless noted otherwise, the entity responsible for procuring and using the fasteners. The use of this term does not diminish the responsibility of the Principal Contractor to ensure all works are in accordance with the Contract, nor does it make any comment on the form of agreement between the various parties involved in the contract

Term	Definition
designer	The Registered Professional Engineer of Queensland (RPEQ) responsible for the design of the component
Director (SCM)	The Director of Structures Construction Materials
double ended stud	A bolt without a forged hexagonal head – and threaded at either end in accordance AS 2528 *Bolts, studbolts and nuts for flanges and other high and low temperature applications*
Engineering Drawings	RPEQ certified design drawings as detailed in the Project Contract
fastener	Components used to connect structural members together as shown on the Engineering Drawings. For example, bolts, screws, nuts and washers
heat(s)	The heat number provided by the manufacturer during production.
ILAC	International Laboratory Accreditation Cooperation
K class	The type of relationship classification between the torque applied and the resulting tension
manufactured bolts	Where a commercial bolt is not available, refer to Clause 6.2 for details
manufacturer	The entity responsible for the processing and the production of the fastener
manufacturing lot	Product manufactured from the same heat and processed over a continuous period of time with production controls
NATA	National Association of Testing Authorities
order	The number of fasteners purchased which determines the number of MRTS278 Assembly Test required – refer to Clause 6.3.2.1
Product Grade	Dimensional tolerances of the fastener, Grade A, B, C, with Grade A the most precise and C the least.
Property Class	Numeric code to indicate the ratio of tensile to yield strength, for example, Property Class 4.6 bolt has a nominal tensile strength of 600 MPa, with a Yield of 240MPa (0.6 x 4 x 100 MPa)
proprietary fasteners	Fasteners designed and manufactured to the manufacturer's in-house standards with no equivalent Australian Standards
SCM	Structures Construction Materials
screws	A bolt which is fully threaded along its length
threaded rod	Rods threaded along the entire length
MRTS278 Assembly Test	Transport and Main Roads specific assembly test, refer to Clause 5 and Clause 6.3.2
WPS	Welding Procedure Specification

3 Referenced documents

Table 3 lists documents referenced in this Technical Specification.

Table 3 – Referenced documents

Reference	Title
AS 1111.1	*ISO metric hexagon bolts and screws – Product grade C, Part 1: Bolts*
AS 1111.2	*ISO metric hexagon bolts and screws – Product grade C, Part 2: Screws*

Reference	Title
AS 1112.3	*ISO metric hexagon nuts, Part 3: Product grade C*
AS 1237.1	*Plain washers for metric bolts, screws and nuts for general purposes, Part 1: General plan*
AS 1237.2	*Tolerances for fasteners, Part 2: Washers for bolts, screws and nuts – Product grades A, C and F*
AS 1275	*Metric screw threads for fasteners*
AS 1444	*Wrought alloy steels – Standard, hardenability (H) series and hardened and tempered to designated mechanical properties*
AS 1817.1	*Metallic materials – Vickers hardness test - Test methods*
AS 1897	*Fasteners – Electroplated coatings*
AS 2528	*Bolts, studbolts and nuts for flanges and other high and low temperature applications*
AS 4291.1	*Mechanical properties of fasteners made of carbon steel and alloy steel, Part 1: Bolts, screws and studs*
AS 5100.1	*Bridge design, Part 1: Scope and general principles*
AS/NZS 1214	*Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)*
AS/NZS 1252.1	*High-strength steel fastener assemblies for structural engineering - Bolts, nuts and washers, Part 1: Technical requirements*
AS/NZS 1252.2	*High-strength steel fastener assemblies for structural engineering - Bolts, nuts and washers, Part 2: Verification testing for bolt assemblies*
AS/NZS 3679.1	*Structural Steel, Part 1: Hot rolled bars and sections*
AS/NZS 4291.2	*Mechanical properties of fasteners made of carbon steel and alloy steel, Part 2: Nuts with specified properties classes – Coarse thread and fine pitch thread*
AS/NZS 5131	*Structural steelwork – Fabrication and erection*
EN 10204	*Metallic Products: Types of Inspection Documents*
EN 14399	*High Strength Structural Bolt Assemblies for preloaded bolts*
MRTS01	*Introduction to Technical Specifications*
MRTS50	*Specific Quality System Requirements*
MRTS71	*Reinforcing Steel*
MRTS78	*Fabrication of Structural Steelwork*
-	*Registration Scheme: Product Index for Bridges and Other Structures*

4 Standard test methods

As required by this Technical Specification the following verification tests stated in Table 4 shall be used.

All tests for the purpose of compliance are to be performed and reported by a National Association of Testing Authorities (NATA) accredited (or International Laboratory Accreditation Cooperation (ILAC) registered equivalent) laboratory, whose scope of accreditation encompasses the test method used.

Table 4 – Standard test methods

Property to be Tested	Method No.
Dimensions	AS/NZS 1252.2, Table 2.1
Mechanical Characteristics	AS/NZS 1252.2, Table 2.2, and Appendix A of this Technical Specification
MRTS278 Assembly Test	Appendix B of this Technical Specification

5 Quality system requirements

5.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications*.

The Hold Points, Witness Points and Milestones applicable to this Technical Specification are summarised in Table 5.1.

Table 5.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
6.5.2		1. Selecting of bolts by the administrator for assembly testing	Notification of fastener supplier and dates for selecting bolts (5 business days)
7	1. Approval of fasteners		Submission of documents (10 business days)

6 Fasteners

6.1 General

Fasteners shall be supplied in accordance with the current version of the applicable standard and comply with Clause 8.2 of AS/NZS 5131.

Unless noted otherwise on the Engineering Drawings, all fasteners shall be hot-dipped galvanised in accordance with AS/NZS 1214 or electroplated in accordance with AS 1897.

Welding of fasteners is not permitted. In exceptional circumstances, the welding of fasteners shall only occur with the use of specialist Welding Procedure Specification (WPS). Such procedures shall be qualified subject to destructive testing agreed in advance with the department's Director of Structures Construction Material (SCM). This may include tensile, bend and impact testing.

The practice of manufacturing bolts by welding nuts to the end of a threaded rod or round bar is not permitted.

Bolts and screws of Property Class 12.9 shall not be used.

6.2 Structural bolt assemblies (Commercial Bolts)

6.2.1 Bolts Property Class 4.6

Property Class 4.6 bolt assemblies and associated items shall comply with Clause 6.5 and the following Australian Standards.

Table 6.2.1 – Relevant Australian Standard for Property Class 4.6

Assembly	Bolt	Nut	Washer
Commercial Bolts Property Class 4.6	AS 1111.1 for bolts AS 1111.2 for screws Property Class 4.6	AS 1112.3 Property Class 5	AS 1237.1 AS 1237.2

6.2.2 Bolt Assemblies Class 8.8 and 10.9

Property Class 8.8 and 10.9 bolt assemblies and associated items shall comply with Clause 6.5 and the following Australian Standards.

Table 6.2.2 – Relevant Australian Standard for Property Class 8.8 and 10.9

Assembly	Bolt	Nut	Washer
High Strength Structural Assemblies Property Class 8.8	AS/NZS 1252.1 Property Class 8.8	AS/NZS 1252.1 Property Class 8	AS/NZS 1252.1
High Strength Structural Assemblies Property Class 10.9	AS 4291.1 Property Class 10.9	AS/NZS 4291.2 Property Class 10	AS/NZS 1252.1

Bolts of Property Class 8.8 and 10.9 shall be verified in accordance with AS/NZS 1252.2, and product conformity shall be prepared in accordance with Clause 3.2 of AS/NZS 1252.2.

Where it is not possible to provide conformity documentation in accordance with AS/NZS 1252.2, the Contractor shall source and supply bolts to Clause 6.2.3 of this Technical Specification.

6.2.3 Alternative assembly type manufactured and supplied to EN 14399

Property Class K2 8.8 HR bolt assemblies complying with the requirements of EN 14399 are exempt from the AS/NZS 1252.2 verification testing, and MRTS278 Assembly Test provided that:

a) The order is fully traceable as detailed in Clause 6.6, and

b) The following quality assurance documentation is supplied:

   i. European Conformity (CE) Certificate

   ii. Factory Production Control (FPC) Inspection Certificate

   iii. Declaration of Performance (DoP), and

   iv. Type 3.1 Inspection certificate to EN 10204 verifying compliance to the relevant specification and any surface coating applied.

6.2.4 Proprietary fasteners

Proprietary fasteners shall be an Approved Transport and Main Roads product. The product approval shall be sought through the *Product Index for Bridges and other Structures*.

In addition to the requirements of the *Product Index for Bridges and other Structures*, as a minimum the following information shall be provided:

- intended purpose and suitable materials to join, and
- service life of the component and corresponding environments including testing and case studies.

6.3 Manufactured bolts

6.3.1 General

Bolts over the following lengths are not commercially available:

- M12 x 200 mm
- M16 x 700 mm
- M20 x 800 mm
- M24 x 750 mm
- M30 x 725 mm, and
- M36 x 600 mm

If the design requires a bolt which is not commercially available (a commercial bolt) there may be a need to assemble a bolt from threaded bar to suit. The bolts outlined in the clauses below have been deemed as an acceptable alternative provided they are fully detailed on the Engineering Drawings and the designer has based all capacity calculations on A_c, the minor diameter area of the bolt, as defined in AS 1275.

> If the designer has based the capacity calculations on the nominal plain shank area of the bolt, that is the unthreaded portion, then substituting this for a threaded bar is not equivalent due to the reduced shear area (A_c) in the threaded section. In this instance, a double ended stud bolt is more appropriate, refer to Clause 6.3.2.

6.3.2 Double ended stud bolt

6.3.2.1 Manufacture – Property Class 8.8

To manufacture a double ended stud in lieu of a Property Class 8.8 bolt the following shall be undertaken:

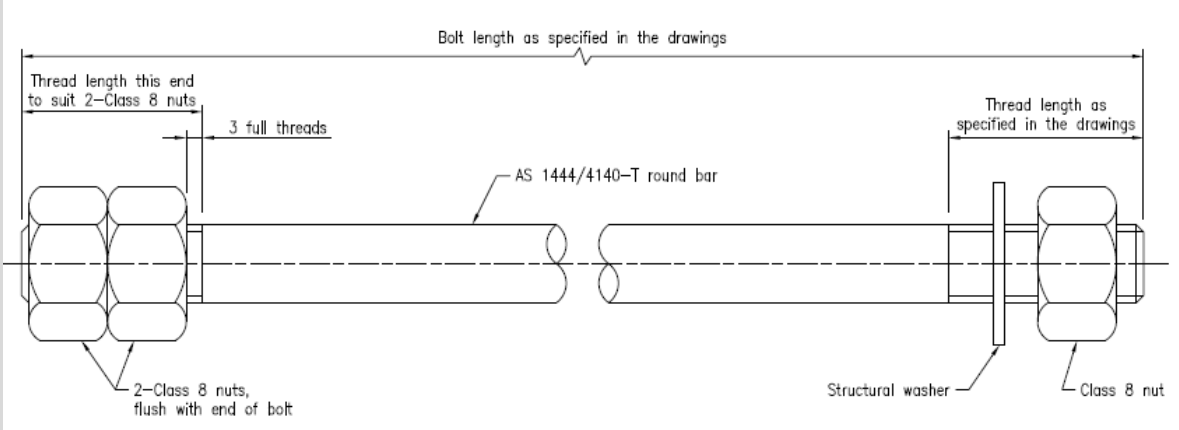
- The shank of the bolt shall be fabricated from material which is equivalent to a Property Class 8.8 bolt in terms of chemical composition and tensile properties.
- A thread is placed on one end of the bar to suit the thread length specified on the Engineering Drawings. The dimensional requirements of the thread shall comply with AS 1275.
- A shorter thread is placed on the other end to suit two Property Class 8 nuts. The dimensional requirements of the thread shall comply with AS 1275.
- The bolt is hot-dip galvanised after threading.
- After hot-dip galvanising the threads shall be cleaned so the nut is free running.

- A galvanised Property Class 8 nut and structural washer is placed on the longer threaded end, and
- Two galvanised Property Class 8 nuts are placed on the end with the shorter thread, refer to Figure 6.3.2.1.

An example of the material which could be used is Grade 4140-T round bar to AS 1444.

The second Property Class 8 nut on the short thread end acts as a 'locking' nut to prevent the top bolt from turning.

Figure 6.3.2.1 – Manufactured double ended stud



6.3.2.2 Manufacture – Property Class 4.6

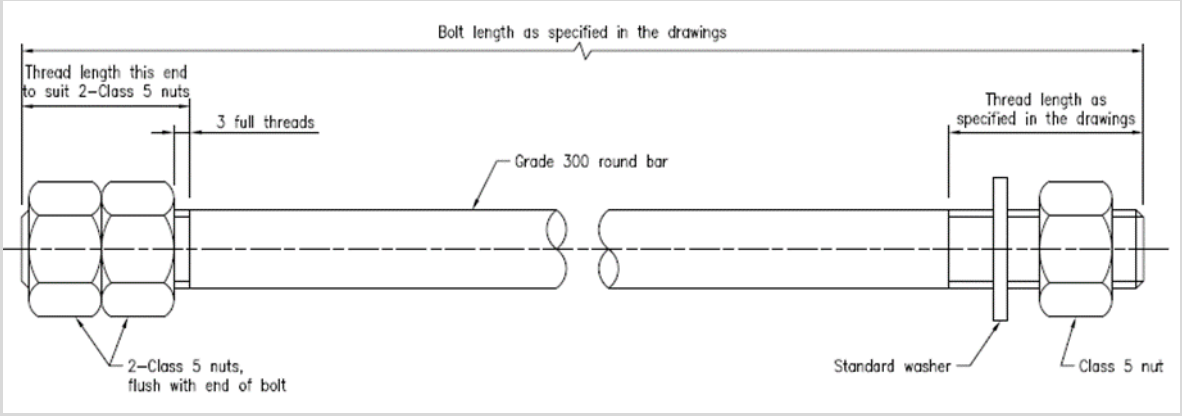
To manufacture a double ended stud in lieu of a Property Class 4.6 bolt the following shall be undertaken:

- The shank of the bolt shall be fabricated from material which is equivalent to a Property Class 4.6 bolt in terms of chemical composition and mechanical properties.
- A thread is placed on one end of the bar to suit the thread length specified on the Engineering Drawings. The dimensional requirements of the thread must comply with AS 1275.
- A shorter thread is placed on the other end to suit two Property Class 5 nuts. The dimensional requirements of the thread must comply with AS 1275.
- The bolt is hot-dip galvanised after threading.
- After hot-dip galvanising the threads shall be cleaned so the nut is free running.
- A galvanised Property Class 5 nut and washer is placed on the longer threaded end, and
- Two galvanised Property Class 5 nuts are placed on the end with the shorter thread, refer to Figure 6.3.2.2.

An example of the material which could be used is a Grade 300 round bar to AS/NZS 3679.1.

The second Property Class 5 nut on the short thread end acts as a 'locking' nut to prevent the top bolt from turning.

Figure 6.3.2.2 – Manufactured double ended stud



6.3.2.3 Testing

The testing of the bolts may be carried out on a shorter length sample. The manufactured bolt and testing sample shall be fabricated from the same material heat and manufacturing process. Assembly testing shall be carried out in accordance with Clause 6.5.2.

6.3.3 Threaded rod bolt

6.3.3.1 Manufacture – Property Class 8.8

To manufacture a threaded rod bolt in lieu of a Property Class 8.8 bolt the following shall be undertaken:

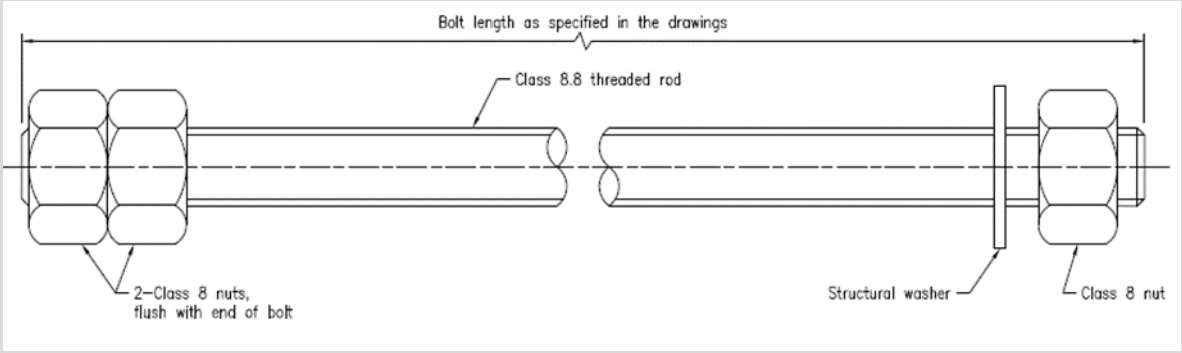
- Purchase hot-dip galvanised threaded rod to ISO-965, refer to Clause 6.5.1 for the Material Test Certificate requirements.
- Cut a threaded rod to the length specified on the Engineering Drawings.
- Paint the cut face with a zinc rich primer in accordance with the coating manufacturer's specifications.
- A galvanised Property Class 8 nut and structural washer is placed at the end of the threaded rod with the uncut face, and
- Two Property Class 8 nuts are placed at the end of the threaded rod with the cut face, refer to Figure 6.3.3.1.

Where the bolt is cast in, only the original galvanised finished face, the uncut face, can be exposed. Where both ends of the bolt are exposed, cutting of the bar is prohibited.

For a threaded rod a maximum of two bolts shall be manufactured out of any one length. Any remaining threaded rod material shall be discarded.

The second Property Class 8 nut on the short threaded end acts as a 'locking' nut to prevent the top bolt from turning.

Figure 6.3.3.1 – Threaded rod double ended stud



6.3.3.2 Testing

The testing of the bolts may be carried out on a shorter length sample. The manufactured bolt and testing sample shall be fabricated from the same material heat and manufacturing process. Assembly testing shall be carried out in accordance with Clause 6.5.2.

6.4 Anchor cages

This clause applies where reinforcement is threaded and used with a nut to form holding down bolts (anchor cages). An order for anchor cages shall be split into maximum batches of 500 individual threaded reinforcement bars. If the anchor cage contains four (4) threaded reinforcement bars, then each batch shall contain a maximum of 125 anchor cages. Each batch shall be subject to Assembly tests in accordance with Clause 6.5.2. Testing as an assembly is to confirm the thread and nut interaction.

The reinforcement shall be supplied in accordance with MRTS71 *Reinforcing Steel*.

The nuts and washer shall be supplied in accordance with this Technical Specification.

The purpose of this clause is to ensure the consistency and quality of the threading, so reinforcement may be from different heats.

6.5 Variation to the Australian Standard

The following clauses of this Technical Specification apply to all fasteners that are supplied to Transport and Main Roads projects and are additional requirements to the Australian Standards.

6.5.1 Material Test Certificates – Property Class 4.6

For Property Class 4.6 bolt assemblies, the Australian Standard does not specify a Material Test Certificate to be supplied. To satisfy the requirements of this Technical Specification, testing by a NATA accredited (or ILAC registered equivalent) laboratory on a sample from each heat number shall be undertaken. The endorsed report shall state as a minimum the following:

- applicable laboratory accreditation number
- chemical composition in accordance with AS 4291.1, and
- mechanical properties – refer to Appendix A.

6.5.2 MRTS278 Assembly Test

Samples for testing shall be selected in the presence of the Administrator. **Witness Point 1** This may be undertaken at the bolt supplier's premises. No fewer than five business days **Milestone** prior to selecting bolts for the MRTS278 Assembly Test, the Contractor shall provide the following to the Administrator:

a) proposed supplier

b) dates available for selecting assemblies

c) order reference number, if applicable, and

d) bolt sizes and quantities for selection.

Testing fasteners as an assembly, that is a bolt and nut combination from the products being supplied to the project, ensures there will be minimal issues during installation and have been manufactured correctly.

One of the purposes behind development of the MRTS278 Assembly Test was to ensure the thread of the bolt and the thread of the nut do not strip during tensioning.

Another purpose was to ensure the commercially available bolts had been produced in accordance with the Australian Standards. The bolt shown in Figure 6.5.2 failed during assembly testing. The head of the bolt stripped off the shank under the test load. A failure of this type during the tightening process on site could endanger lives.

Figure 6.5.2 – Failed bolt

6.5.2.1 Number of test samples

The number of bolt and nut assemblies to be Transport and Main Roads assembly tested is based on the number of each size purchased in an order. Table 6.5.2.1 is the minimum number of test samples needed for a specific order. If the order is made up from a number of different heats, the rate of sampling is per heat – refer to the commentary for examples. For certain products the order size shall be agreed in advance with the Director (SCM).

Table 6.5.2.1 – Number of test samples to be selected

Order size	Minimum number of assemblies to be tested
1 to 10	2
11 to 50	3
51 to 500	4
501 to 35,000	8
35,001 and above	16

A bolt order for M24 x 200 contains 50 bolt assemblies and is supplied from 2 heat numbers, the total number to be tested is based on the totals within that heat. For example, if 25 bolt assemblies were provided from Heat A, and 25 provided from Heat B, 3 assemblies from each heat would require testing, a total of 6 tests. If 10 bolt assemblies were provided from Heat A and 40 from Heat B, 5 tests in total would be required, 2 from Heat A and 3 from Heat B.

6.5.2.2 Acceptance criteria

All assemblies selected for testing shall pass. If an assembly fails, the Administrator shall be notified and provided with the relevant heats from the failed assemblies. These heats shall be removed from the order and replaced. The replacement assemblies shall be sampled and tested in accordance with this Technical Specification.

6.6 Traceability of materials

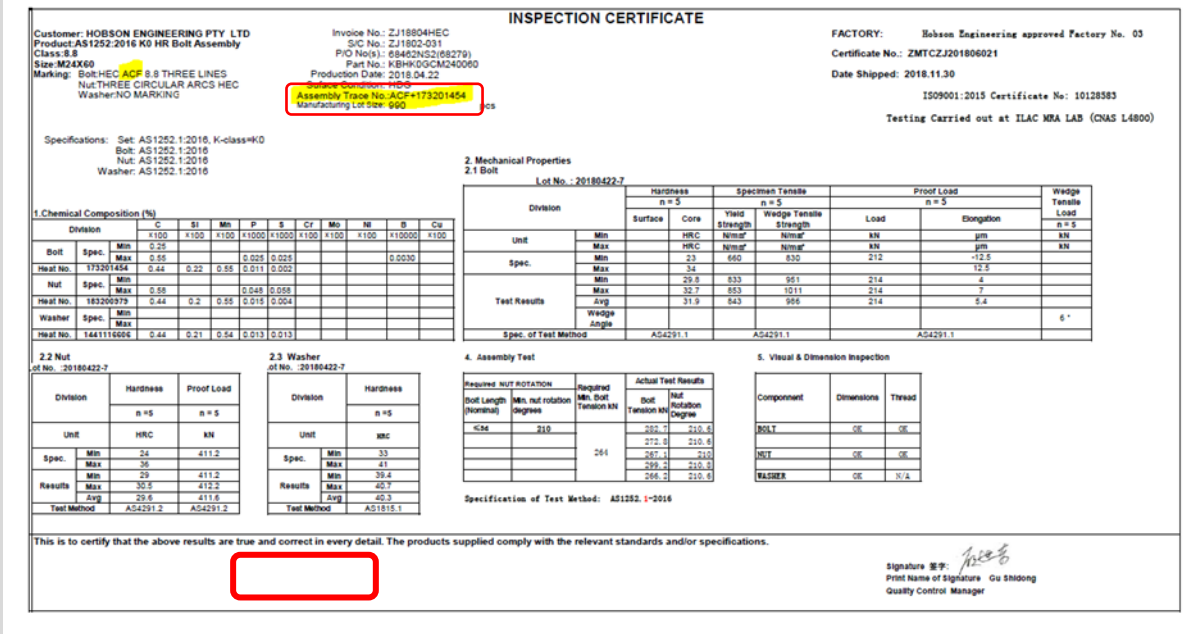
The fasteners shall be supplied in a box or packaging which states a unique identifier. This identifier shall be traceable to both the Material Test Certificate and the NATA-endorsed report for the MRTS278 Assembly Test, where applicable.

Fasteners without traceability shall be rejected and replaced with ones with traceability.

The label shown in Figure 6.6(a) shows an example of the traceability of a box of structural assemblies. The heat number in this figure below is also found on the corresponding Material Test Certificate, Figure 6.6(b) and NATA-endorsed MRTS278 Assembly Test report, Figure 6.6(c).

Figure 6.6(a) – Assembly box for traceability

Figure 6.6(b) – Example Material Test Certificate



INSPECTION CERTIFICATE

Customer: HOBSON ENGINEERING PTY LTD
Product:AS1252:2016 K0 HR Bolt Assembly
Class:8.8
Size:M24X60
Marking: Bolt:HEC ACF 8.8 THREE LINES
Nut:THREE CIRCULAR ARCS HEC
Washer:NO MARKING

Invoice No.: ZJ18804HEC
S/C No.: ZJ1802-031
P/O No(s): 68462NS2(68279)
Part No.: KBHK0GCM240060
Production Date: 2018.04.22
Surface Condition: HDG
Assembly Trace No.:ACF+173201454
Manufacturing Lot Size: 990 pcs

FACTORY: Hobson Engineering approved Factory No. 03
Certificate No.: ZMTCZJ201806021
Date Shipped: 2018.11.30
ISO9001:2015 Certificate No: 10128583
Testing Carried out at ILAC MRA LAB (CNAS L4800)

Specifications: Set: AS1252.1:2016, K-class=K0
Bolt: AS1252.1:2016
Nut: AS1252.1:2016
Washer: AS1252.1:2016

1.Chemical Composition (%)

Division			C x100	Si x100	Mn x100	P x1000	S x1000	Cr x100	Mo x100	Ni x100	B x10000	Cu x100
Bolt	Spec.	Min	0.25									
		Max	0.55			0.025	0.025				0.0030	
Heat No.	173201454		0.44	0.22	0.55	0.011	0.002					
Nut	Spec.	Min										
		Max	0.58			0.048	0.058					
Heat No.	183200979		0.44	0.2	0.55	0.015	0.004					
Washer	Spec.	Min										
		Max										
Heat No.	1441116606		0.44	0.21	0.54	0.013	0.013					

2. Mechanical Properties
2.1 Bolt
Lot No. : 20180422-7

Division		Hardness n=5 Surface	Hardness n=5 Core	Specimen Tensile n=5 Yield Strength	Specimen Tensile n=5 Wedge Tensile Strength	Proof Load n=5 Load	Proof Load n=5 Elongation	Wedge Tensile Load n=5
Unit	Min		HRC	N/mm²	N/mm²	kN	μm	kN
	Max		HRC	N/mm²	N/mm²	kN	μm	kN
Spec.	Min		23	660	830	212	-12.5	
	Max		34				12.5	
Test Results	Min		29.8	833	951	214	4	
	Max		32.7	853	1011	214	7	
	Avg		31.9	843	986	214	5.4	
	Wedge Angle							6°
Spec. of Test Method		AS4291.1		AS4291.1		AS4291.1		

2.2 Nut
Lot No. :20180422-7

Division		Hardness n=5	Proof Load n=5
Unit		HRC	kN
Spec.	Min	24	411.2
	Max	36	
Results	Min	29	411.2
	Max	30.5	412.2
	Avg	29.6	411.6
Test Method		AS4291.2	AS4291.2

2.3 Washer
Lot No. :20180422-7

Division		Hardness n=5
Unit		HRC
Spec.	Min	33
	Max	41
Results	Min	39.4
	Max	40.7
	Avg	40.3
Test Method		AS1815.1

4. Assembly Test

Required NUT ROTATION Bolt Length (Nominal)	Min. nut rotation degree	Required Min. Bolt Tension kN	Actual Test Results Bolt Tension kN	Nut Rotation Degree
≤3d	210	264	282.7	210.4
			272.8	210.6
			267.1	210
			299.2	210.2
			266.2	210.6

Specification of Test Method: AS1252.1-2016

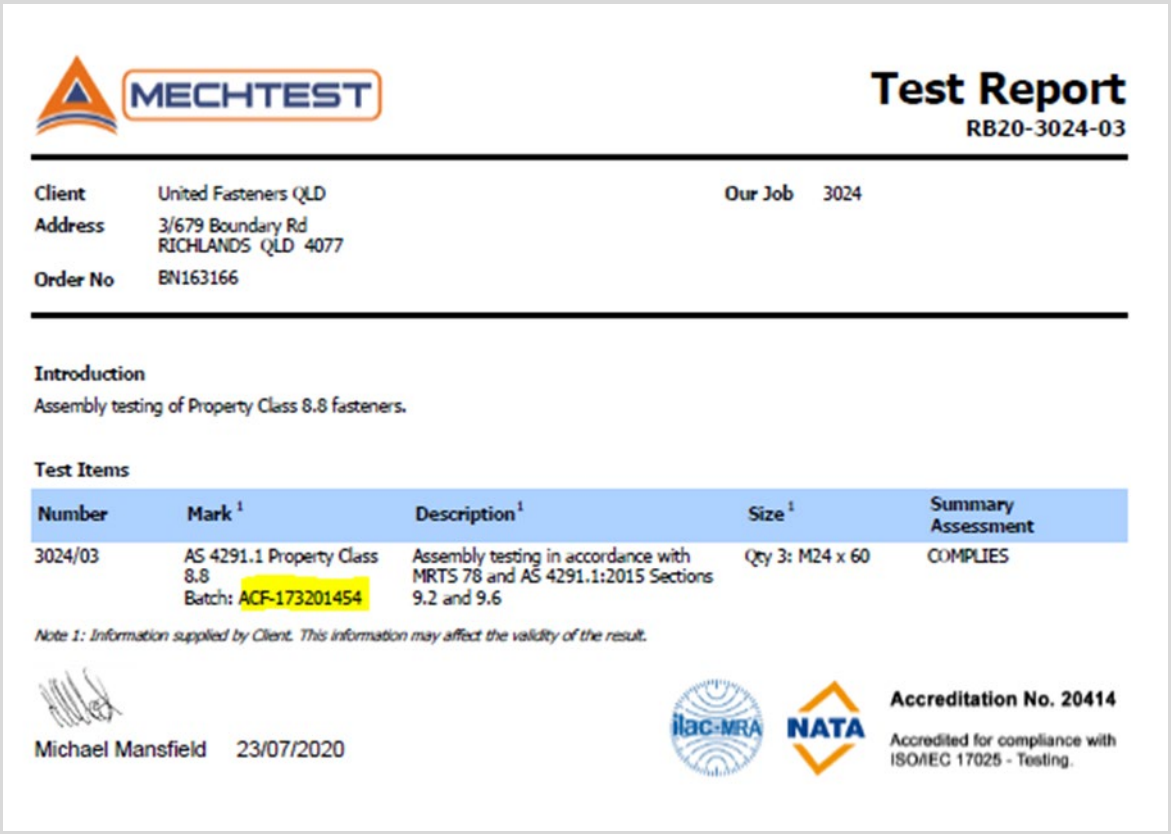
5. Visual & Dimension Inspection

Component	Dimensions	Thread
BOLT	OK	OK
NUT	OK	OK
WASHER	OK	N/A

This is to certify that the above results are true and correct in every detail. The products supplied comply with the relevant standards and/or specifications.

Signature 签字:
Print Name of Signature Gu Shidong
Quality Control Manager

Figure 6.6(c) – Example Assembly Test Report



MECHTEST

Test Report
RB20-3024-03

Client	United Fasteners QLD	**Our Job**	3024
Address	3/679 Boundary Rd RICHLANDS QLD 4077		
Order No	BN163166		

Introduction

Assembly testing of Property Class 8.8 fasteners.

Test Items

Number	Mark [1]	Description [1]	Size [1]	Summary Assessment
3024/03	AS 4291.1 Property Class 8.8 Batch: ACF-173201454	Assembly testing in accordance with MRTS 78 and AS 4291.1:2015 Sections 9.2 and 9.6	Qty 3: M24 x 60	COMPLIES

Note 1: Information supplied by Client. This information may affect the validity of the result.

Michael Mansfield 23/07/2020

ilac-MRA NATA

Accreditation No. 20414

Accredited for compliance with ISO/IEC 17025 - Testing.

7 Approval of fastener documentation

Any fasteners which are M10 and below do not need to be supplied with a Material Test Certificate or MRTS278 Assembly Test report.

Any proposed changes to the Property Class as shown on the Engineering Drawings shall be agreed in writing with the designer prior to the supply of fasteners.

The supply of holding downs bolts for gantries shall Property Class 4.6 to comply with the requirements under Clause 23.3 of AS 5100.1, and as such cannot be changed to a higher Property Class.

No fewer than ten business days **Milestone** prior to their intended use in the works, the Contractor shall supply the following fastener documentation to the Administrator:

For bolt assemblies supplied to Clause 6.2.1 or Clause 6.2.2:

a) Material Test Certificate in accordance with AS/NZS 1252.1 and AS/NZS 1252.2, or Clause 6.5.1, and

b) MRTS278 Assembly Test, as applicable, refer to Clause 6.5.2.

For EN bolt assemblies supplied to Clause 6.2.3:

a) documentation outlined in Clause 6.2.3.

For manufactured bolt assemblies supplied to Clause 6.3:

a) Material Test Certificate for the parent material which complies with AS 4291.1

b) Material Test Certificate for the nuts which complies with AS/NZS 4291.2

c) Material Test Certificate for the washer which complies with Appendix A or AS/NZS 1252.1, and

d) MRTS278 Assembly Test, refer to Clause 6.5.2.

Fasteners supplied with a third-party certification shall be assessed by the Director (SCM) on a case by case basis.

The use of the fasteners shall not commence until the Administrator has reviewed and Approved the above documentation. **Hold Point 1**

Third-Party certification can be undertaken by an independent party for product conformity assessment. The certifying body shall be acceptable to Transport and Main Roads. The certification will be carried out on the manufacturer of the raw material.

Material Test Certificates are still required to prove traceability.

Transport and Main Roads (SCM) unit can assist with the review of this documentation if the Administrator is unsure of the technical requirements. A copy of the Engineering Drawings is required to undertake this review.

8 Delivery, storage and installation

Fasteners shall be delivered in accordance with Clause 1.9.6 of AS/NZS 1252.1.

Fasteners shall be stored as complete assemblies in sealed weatherproof containers with a suitable referencing system that includes traceability. A Bolt Assembly shall not be interchanged with parts from another manufacturing lot.

The fasteners shall be stored clear of the ground and protected from damage.

Fasteners not stored in accordance with this Clause may be rejected. The Contractor shall resupply the fasteners at no cost to the Principal.

Unlubricated bolt threads shall be coated with a stick wax prior to assembling the nut, in accordance with the stick wax manufacturer's instructions.

Appendix A: Test requirements for Property Class 4.6 Bolts, Class 5 nuts

Minimum level of testing for the mechanical properties of Property Class 4.6 Bolts and Class 5 nuts shall be:

Part	Mechanical Property	Test	Reference Standard and Clause
Bolt	R_m Minimum tensile strength	Tensile test under wedge loading for bolts of length > 2.5d	AS 4291.1, Clause 9.1
		Tensile test	AS 4291.1, Clause 9.2
	% elongation after fracture	Tensile test	AS 4291.1, Clause 9.3
	$S_{p,nom}$ Stress under proof load	Proof load test	AS 4291.1, Clause 9.6
	Hardness	Hardness test	AS 4291.1, Clause 9.9
Nut	Stress under proof load	Proof load test	AS/NZS 4291.2, Clause 9.1
	Hardness	Hardness test	AS/NZS 4291.2, Clause 9.2

Washers for Property Class 4.6 bolts and nuts shall be supplied in accordance with AS 1237. Washers shall have a hardness of 100 HV and tested in accordance with AS 1817.1.

Appendix B: Test Method, MRTS278 Assembly Test

1 Source

This method applies to the principles of AS/NZS 1252.2 and AS 4291.1.

2 Scope

This method describes the testing procedure to ensure the supplied bolt and the supplied nut work as required as an assembly.

3 Application

The bolts shall be sampled in accordance with Table 6.5.2.1 of Clause 6.5.2.1. The testing shall apply to all fasteners outlined in this Technical Specification.

4 Apparatus

The following apparatus are required for this testing:

- high strength mandrel
- testing jig, and
- a calibrated device for measuring elongation of the sample

5 Materials

Fastener samples in accordance with Clause 6.5.2 of this Technical Specification.

6 Testing Procedure

Procedure A – Proof Load Test

A.1 Prepare the ends of the sample as per Detail X of Figure 5, Clause 9.6.4 of AS 4291.1.

A.2 Measure the sample length.

A.3 Place sample into an appropriate test jig as per Figure 5, Clause 9.6.4 of AS 4291.1.

A.4 Apply the proof load for Procedure A, outlined in Appendix C, at a uniform rate.

A.5 Hold the load for a period of 15 seconds as per Clause 9.6.5 of AS 4291.1.

A.6 Release the load.

A.7 Remove the sample from the test jig.

A.8 Verify if the nut is free running up and down the thread of the bolt or manufactured bolt as applicable. Nut shall be rotated by hand.

A.9 Measure the sample length.

A.10 Record the variation in length.

A.11 Report a pass, fail or to be tested to Procedure B.

Pass – change in length is not greater than ±12.5 µm from the original length and the nut is free running along the length of the thread. If the sample passes the test continue to Procedure C.

Fail – the nut does not run freely at Step A.8.

Continue to Procedure B – change in length is greater than ±12.5 µm from the original length and the nut is free running along the length of the thread.

Procedure B – Proof Load Test

B.1 Place sample into an appropriate test jig as per Figure 5, Clause 9.6.4 of AS 4291.1.

B.2 Apply the proof load for Procedure B, outlined in Appendix C, at a uniform rate.

B.3 Hold the load for a period of 15 seconds as per Clause 9.6.5 of AS 4291.1.

B.4 Release the load.

B.5 Remove the sample from the test jig.

B.6 Verify if the nut is free running up and down the thread of the bolt or manufactured bolt as applicable. Nut shall be rotated by hand.

B.7 Measure the sample length.

B.8 Record the variation in length.

B.9 Report a pass or fail.

Pass – change in length is not greater than ±12.5 µm from the length after Procedure A and the nut is free running along the length of the thread. If the sample passes the test continue to Procedure C.

Fail – change in length is greater than ±12.5 µm from the length after Procedure A and / or the nut does not run freely at Step B.6.

Procedure C – Minimum Ultimate Tensile Strength (UTS) Load Test Procedure

C.1 Place sample into an appropriate test jig.

C.2 Apply the minimum UTS load for Procedure C, outlined in Appendix C, at a uniform rate.

C.3 Hold the load for a period of 15 seconds.

C.4 Release the load.

C.5 Remove the sample from the test jig.

C.6 Verify if the nut is free running up and down the thread of the bolt or manufactured bolt as applicable. Nut shall be rotated by hand.

C.7 Report a pass or fail.

Pass – the nut is free running along the length of the thread at Step C.6.

Fail – the nut does not run freely at Step C.6.

7 Reporting

The report produced by the testing facility shall include:

- assembly size, length and Property Class
- date of testing
- name, position, signature and date of the person authorising the report
- heat number of all assembly components
- number of assemblies tested and number in the order

- results of Procedure A, for each assembly tested
- results of Procedure B, where applicable for each assembly tested
- results of Procedure C, for each assembly tested
- NATA signatory, and
- conclusion.

Appendix C: Proof Load and Ultimate Tensile Load

C1 Class 4.6 Bolts

Class 4.6 bolts and nuts (coarse thread) the test loads shall be:

Table C1 – Proof and ultimate loads for Class 4.6 bolts

Size	Proof Load of Bolt (kN)	Proof Load of Bolt +3%	Minimum Ultimate Tensile
M12	19	19.6	33.7
M16	35.3	36.4	62.8
M20	55.1	56.8	98
M22	68.2	70.2	121
M24	79.4	81.8	141
M27	103	106.1	184
M30	126	129.8	224
M33	156	160.7	278
M36	184	189.5	327
M39	220	226.6	390

Reference – AS 4291.1 – Table 5 – Proof loads – ISO metric coarse pitch thread

Reference – AS 4291.1 – Table 4 – Minimum ultimate tensile loads – ISO metric coarse pitch thread

C2 Class 8.8 Bolts

Property Class 8.8 (coarse thread) shall conform to the following table:

Table C2 – Proof and ultimate loads for Class 8.8 bolts

Size	Proof Load of Bolt (kN)	Proof Load of Bolt +3%	Minimum Ultimate Tensile
M12	50.7	52.2	70
M16	94.8	97.6	130
M20	147	151.4	203
M22	182	187.5	252
M24	212	218.4	293
M27	275	283.3	381
M30	337	347.1	466
M33	416	428.5	576
M36	490	504.7	678
M39	586	603.6	810

Reference – AS 4291.1 – Table 5 – Proof loads – ISO metric coarse pitch thread

Reference – AS 4291.1 – Table 4 – Minimum ultimate tensile loads – ISO metric coarse pitch thread

C3 Class 10.9 Bolts

Property Class 10.9 (coarse thread) shall conform to the following table:

Table C3 – Proof and ultimate loads for Class 10.9 bolts

Size	Proof Load of Bolt (kN)	Proof Load of Bolt +3%	Minimum Ultimate Tensile
M12	70	72.1	87.7
M16	130	133.9	163
M20	203	209.1	255
M22	252	259.6	315
M24	293	301.8	367
M27	381	392.4	477
M30	466	480.0	583
M33	576	593.3	722
M36	678	698.3	850
M39	810	834.3	1020

Reference – AS 4291.1 – Table 5 – Proof loads – ISO metric coarse pitch thread

Reference – AS 4291.1 – Table 4 – Minimum ultimate tensile loads – ISO metric coarse pitch thread