TECHNICAL SPECIFICATION

No. TS24™

MANUFACTURING SPECIFICATION FOR BOLTS

1275 MPa (185,000 lbf/in^2) TENSILE STRENGTH AT ROOM TEMPERATURE
1000 MPa (145,000 lbf/in^2) TENSILE STRENGTH AT 650°C

ASPQP™

Aerospace Standards Part Qualification Program

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RATIONALE	
7th issue of Technical Spec. AQL sampling replaced with AS9138 sampling and Appendix A added For full details of changes, refer to supplementary SAE ITC Amendment Record document TS24-AR.	
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SAE INDUSTRY TECHNOLOGIES CONSORTIA
AEROSPACE STANDARDS AND PART QUALIFICATION PROGRAM

FOREWORD

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Documents
Document Sharing Hub

Full document details: SAE TS24-7

CONTENTS

Title Page

Foreword

Contents

SECTIONS

1. Scope

2. Normative References

3. Definitions

4. Quality Assurance

5. Manufacturing and Test Requirements

Appendix A – Implementation Period For AS9138 Sampling

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Full document details: SAE TS24-7

1. SCOPE

1.1 This specification covers the requirements for forged bolts in DTD5638, EN2952, EN3219 or AMS5662 material with rolled underhead radii. The bolts will develop a minimum tensile strength of 1275 MPa (185,000 lbf/in^2) at room temperature and 1000 MPa (145,000 lbf/in^2) at 650°C.

2. NORMATIVE REFERENCES

2.1 The following documents, in whole or in part, are normatively referenced in this Technical Specification and are indispensable for its application. For dated / revision listed references, only the issue cited applies. For undated / revision listed references, the latest issue of the referenced document (including any amendments) applies.

2.1.1 SAE Industry Technologies Consortia (ITC)

RS610	Identification Marking of Parts and Assemblies.
RS678	Fasteners, Rolled Threads, Chamfers, Lead Threads and Runouts.
TS 200	Qualified Manufacturers for SAE ITC Aerospace Industry Standard Parts.
TS 201	Method Change Approval for Qualified Parts listed in TS200.
TS 202	Qualification Test Requirements and Procedures for Aerospace Industry Standard Parts.

2.1.1 British Standards Institution (bsi.)

BS M 39	Method for Penetrant Inspection of Aerospace Materials and Components.
BS 1134	Assessment of Surface Texture - Guidance and General Information.
BS 1580	Unified Screw Threads.
BS A346	Unified Screw Threads of UNJ Profile.
(BS) EN 2002-1	Metallic Materials - Test Methods - Part 1 : Tensile Testing at Ambient Temperature.
(BS) EN 2952	Heat Resisting Nickel Base Alloy (Ni-P100HT) – Solution Treated and Cold Worked – Bar.
(BS) EN 3219	Heat Resisting Nickel Base Alloy (Ni-P100HT) –Cold Worked and Softened – Bar and Wire.

(BS) EN ISO 6506-1 Metallic Materials - Brinell Hardness Test - Part 1 : Test Method.

(BS) EN ISO 6507-1 Metallic Materials - Vickers Hardness Test - Part 1 : Test Method.

(BS) EN ISO 6508-1 Metallic materials - Rockwell Hardness Test - Part 1 : Test Method.

2.1.2 International Standards Organisation (ISO)

ISO 3161 (BS A 346) UNJ threads - General Requirements and Limit Dimensions.

2.1.3 American Society for Testing and Materials (ASTM)

ASTM E112	Standard Method for Determining Average Grain Size.
ASTM E1417	Standard Practice for Liquid Penetrant Testing.

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2.1.2 **SAE International**

SAE AS8879 Screw Threads, UNJ Profile, Inch, Controlled Root Radius with Increased Minor Diameter.

SAE AS9138 Statistical Product Acceptance Requirements.

2.1.4 **UK Ministry of Defence**

DTD5638 Iron – 52.5 Nickel – Chromium – Molybdenum – Niobium – Titanium – Aluminium – Heat Resisting Alloy.

3. DEFINITIONS

For the purposes of this specification, the following definitions apply: -

3.1 **Authorities**

3.1.1 **Design Authority**

The Design Authority is the SAE ITC Technical Standards Committee (TSC).

3.1.2 **Qualification Testing Authority**

The qualification testing authority shall be the SAE ITC Technical Standards Committee or other body nominated by the TSC to carry out the testing

3.1.3 **Quality Assurance Authority**

The Quality Assurance Authority shall be as agreed by the Design Authority, but generally it will be that of the design activity.

3.2 **Production Batch**

A batch shall consist of bolts which are of the same type and thread diameter. They shall be fabricated by the same process from material of the same cast, heat-treated as one lot, and produced as one continuous run. Production shall be free from any interruptions or changes, such as might be expected to result in a significant variation in the quality of the finished product.

3.3 **Inspection Lot**

An inspection lot consists of fasteners from a single production batch of the same part number which completely defines the lot.

3.4 **Discontinuities**

3.4.1 **Crack** : A rupture in the material which may extend in any direction and which may be intercrystalline or transcrystalline in character.

3.4.2 **Seam** : Open surface defect.

3.4.3 **Lap** : Surface defect caused by folding over metal fins or sharp corners and then rolling or forging them into the surface. To be considered rateable, will be a fold having its length equal to or greater than three times its width with a depth of 0.0005 inch when viewed at 200X magnification.

3.4.4 **Inclusion** : Non-metallic particles originating from the material making process. They may exist as discrete particles or strings of particles extending longitudinally.

3.5 **Test Temperature**

The ambient temperature, unless otherwise specified.

3.6 **Finished Fastener**

A fastener ready for use, inclusive of any possible treatments and/or surface coatings, as specified on the relevant fastener's SAE ITC drawing standard.

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4. QUALITY ASSURANCE

4.1 General

4.1.1 Material and Surface Treatment

4.1.1.1 The fastener Manufacturer shall provide evidence to the Quality Assurance Authority that the controls for the bolt material and surface treatment process complies with the relevant specifications. They shall also show the identity of the fastener material has been maintained throughout all stages of manufacture.

4.1.2 Records

4.1.2.1 The Manufacturer shall establish a batch record chart (or card) to the satisfaction of the Quality Assurance Authority. The record shall show the batch quantity and the serial numbers of certificates covering approval of the material. The results of the inspections and tests made to the requirements of this specification, shall be recorded and correlated with the batch numbers and the batch chart (or card) shall show the serial numbers of those records to the satisfaction of the Quality Assurance Authority.

4.1.3 Dimensional Control during Manufacture

4.1.3.1 The Manufacturer shall satisfy the Quality Assurance Authority that the frequency and results of inspections made at each operation during manufacture of each bolt, are adequate.

4.1.4 Dimensions and Gauging

4.1.4.1 All dimensions shall be controlled by a system of gauging which, with the type and quality of all gauges, projection apparatus, diagrams and inspection techniques, shall be to the satisfaction of the quality assurance authority. In cases of dispute :-

a. The full threads shall be checked with fixed limit gauges.

b. Notwithstanding the reaction of the threads to the gauges, the overall profile must be acceptable when checked with an optical projector and line limit diagrams.

4.1.4.2 Each gauge and projection diagram shall be marked with its reference number (serial number) and in the case of non-adjustable gauges, marked with the gauging dimensions. Each gauge shall further be certified initially, and thereafter the standard of accuracy of each gauge shall be maintained by regular certification, either at an approved gauge test house or if agreed with the Quality Assurance Authority, at the Manufacturer's own test room. The accuracy of each projection diagram shall be to the satisfaction of the Quality Assurance Authority.

4.1.4.3 A record card shall be maintained for each gauge, showing the initial dimensions of each gauging element, the frequency of the maintenance checks and the gauge dimensions resulting therefrom, to the satisfaction of the Quality Assurance Authority.

4.2 Qualification

4.2.1 A minimum of 25 finished bolts of each diameter for which qualification is required, manufactured in accordance with the requirements of this specification and by a technique which is to be used for future deliveries, shall be supplied by the bolt manufacturer for evaluation in accordance with TS202 " SAE ITC qualification test requirements and procedures for aerospace industry standard parts ".

4.2.2 The qualification inspections and tests (requirements, methods and numbers of bolts) are specified in Table 1.

4.2.3 Table 2 indicates the allocation of bolt specimens for the inspections and tests.

4.2.4 Re-qualification may be called for from time to time at the discretion of the Design Authority.

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4.2.5 If there is any proposed change in manufacturing source or method, the procedures specified in TS201 " Method change approval for qualified parts " shall be initiated

4.3 **Acceptance**

4.3.1 The purpose of acceptance inspections and tests is to check as simply as possible using a method representative of actual conditions of use, with the uncertainty inherent in statistical sampling, that the bolts satisfy the requirements of this specification.

4.3.2 Acceptance inspections and tests are specified in Table 1. They shall be carried out on each production batch or inspection lot. Table 1 specifies the test methods and sampling tables to be used for each test. Bolts from the batch to be tested shall be selected by sampling in accordance with AS9138.

4.3.3 Each bolt may be submitted to several inspections or tests. The bolts to be subjected to destructive inspections or tests may be those on which non-destructive inspections or tests have been carried out.

4.3.4 If a more stringent inspection (see 4.3.2) is deemed necessary, all or part of the qualification inspections or tests may be performed during the acceptance inspection and testing. In this case, the number of bolts submitted to these inspections or tests is the same as that submitted for qualification inspections and tests.

4.3.5 Acceptance inspections and tests shall be carried out by the Manufacturer, or under their responsibility.

4.4 **Inspection and Test Report**

4.4.1 A test report showing actual numerical values for the mechanical test results shall be provided.

4.4.2 The test report shall include a statement that dimensional inspection has been carried out to the latest issue of SAE ITC TS24 (this specification), and that all results conform to the fastener's SAE ITC drawing standard.

4.5 Manufacturers of DTD5638, EN2952, EN3219 or AMS5662 Forged Bolts

4.5.1 A list of qualified manufacturers of DTD5638, EN2952, EN3219 or AMS5662 forged bolts is contained in TS200.

https://ts200.sae-itc.org/

Note : Qualified manufacturers shall hold a certificate of qualification as evidence of their qualified status for a part.

5. MANUFACTURING and TEST REQUIREMENTS

See Table 1.

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TABLE 1 - MANUFACTURING AND TEST REQUIREMENTS

Clause	Characteristic	Requirement	Inspection and test method	Q/A 1)	Sample size
5.1	Material	In accordance with DTD5638, EN2952, EN3219 or AMS5662.	Chemical analysis or certificate issued by the material manufacturer.		
5.2	Dimensions, tolerances of form and position	In accordance with the relevant bolt's SAE ITC drawing standard.	Standard gauging.	Q	25
				A	Tables 3, 5, 6 and 7
5.3	Manufacturing				
5.3.1	Forging	The heads of bolts shall be formed by forging at a temperature agreed between the fastener manufacturer and the Design Authority. If hot formed, the temperature of the fastener shall not exceed +1150°C. The heating equipment, if applicable, shall be approved by the Design Authority and shall be of a type which ensures a consistent temperature throughout the batch. The temperature shall be automatically controlled. Any coating applied to the bar or wire shall be completely removed prior to final heat treatment. Any lightening hole in the head may be machined or forged.	The method of forging shall be declared to and approved by the Design Authority.		
1) Q = Qualification, A = Acceptance					

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