

Specification for

Procurement of alloy steel protruding head bolts with strength classification 1 250 MPa and MJ threads

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Aerospace Standards Policy Committee (ACE/-) to Technical Committee ACE/12 upon which the following bodies were represented:

- Civil Aviation Authority (Airworthiness Division)
- Electronic Engineering Association
- Ministry of Defence
- Society of British Aerospace Companies Limited

This British Standard, having been prepared under the direction of the Aerospace Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 31 October 1989

© BSI 01-2000

The following BSI references relate to the work on this standard:
Committee reference ACE/12
Draft for comment 79/80725 DC

ISBN 0 580 17460 3

Amendments issued since publication

Amd. No.	Date of issue	Comments

Contents

	Page
Committees responsible	Inside front cover
National foreword	ii
1 Scope and field of application	1
2 References	1
3 Definitions	1
4 Quality assurance	2
5 Requirements	3
Figure 1 — Head structure and grain flow	14
Figure 2 — Distortion in fillet area	15
Figure 3 — Grain flow in thread	15
Figure 4 — Non-permissible laps, seams and surface irregularities	16
Figure 5 — Permissible laps, seams and surface irregularities	16
Figure 6 — Metallurgical specimens	17
Table 1 — Technical requirements and test methods	4
Table 2 — Qualification testing requirements for bolt samples	8
Table 3 — Summary of qualification and acceptance tests	9
Table 4 — Surface discontinuities and contamination	9
Table 5 — Minimum tensile, double shear and stress durability loads for qualification and acceptance tests	10
Table 6 — Qualification and acceptance values for tension fatigue test	10
Table 7 — Thread discontinuities — Maximum depth of permissible faults	10
Table 8 — Classification of defects	11
Table 9 — Sampling plans for visual inspection and inspection of dimensional characteristics	12
Table 10 — Sampling plans for the inspection of mechanical and metallurgical characteristics	12
Table 11 — Variable sampling for tensile test (alternative method)	13
Publications referred to	Inside back cover

National foreword

This British Standard, which has been prepared under the direction of the Aerospace Standards Policy Committee, is identical with ISO 5857:1988 “*Aerospace — Alloy steel protruding head bolts with strength classification 1 250 MPa and MJ threads — Procurement specification*” published by the International Organization for Standardization (ISO).

Cross-references

International Standard	Corresponding British Standard
ISO 2859-1:1974	BS 6001 <i>Sampling procedures for inspection by attributes</i> Part 1:1972 <i>Specification for sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection</i> (Technically equivalent)
ISO 3534:1977	BS 5532 <i>Statistical terminology</i> Part 1:1978 <i>Glossary of terms relating to probability and general terms relating to statistics</i> (Identical)
ISO 5855-2:1981	BS 6293 <i>MJ threads for aerospace construction</i> Part 2:1982 <i>Specification for dimensions for bolts and nuts</i> (Identical)
ISO 6508:1986	BS 891 <i>Method for Rockwell hardness test</i> Part 1:1962 <i>Testing of metals</i> (Technically equivalent)

The Technical Committee has reviewed the provisions of ISO 6507-1, to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard. A related British Standard to ISO 6507-1:1982 is BS 427 “*Method for Vickers hardness test*” Part 1:1961 “*Testing of metals*”. It is envisaged that a British Standard corresponding to ISO 7961 will be published. A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 18, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope and field of application

This International Standard specifies the characteristics and quality assurance requirements for bolts with protruding heads, made of alloy steel, having a tensile strength classification of 1 250 MPa and MJ threads, and intended for use in aerospace construction.

This International Standard applies to bolts as defined above, provided that reference is made to this International Standard in the product standard or definition document.

2 References

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection*¹⁾.

ISO 3534, *Statistics — Vocabulary and symbols*.

ISO 5855-2, *Aerospace construction — MJ threads — Part 2: Dimensions for bolts and nuts*.

ISO 6507-1, *Metallic materials — Hardness test — Vickers test — Part 1: HV 5 to HV 100*.

ISO 6508, *Metallic materials — Hardness test — Rockwell test (scales A – B – C – D – E – F – G – H – K)*.

ISO 7961, *Aerospace — Bolts — Test methods*²⁾.

3 Definitions

3.1

production batch

quantity of finished bolts manufactured, using the same process, from a single material cast (single heat of alloy), having the same basic part number and diameter, heat-treated together to the same specified condition and produced as one continuous run

3.2

inspection lot

quantity of bolts from a single production batch with the same part number which completely defines the bolt

3.3 Discontinuities

3.3.1

crack

rupture in the material which may extend in any direction and which may be intercrystalline or transcrystalline in character

3.3.2

seam

open surface defect resulting from extension of the material

3.3.3

lap

surface defect caused by folding over metal fins or sharp corners and then rolling or forging them into the surface

3.3.4

inclusions

non-metallic particles originating from the material manufacturing process. These particles may be isolated or arranged in strings

3.4

simple random sampling

the taking of n items from a population of N items in such a way that all possible combinations of n items have the same probability of being chosen³⁾

3.5

critical defect

a defect that, according to judgement and experience, is likely to result in hazardous or unsafe conditions for individuals using, maintaining or depending upon the considered product, or that is likely to prevent performance of the function of a major end item³⁾

3.6

major defect

a defect, other than critical, that is likely to result in a failure or to reduce materially the usability of the considered product for its intended purpose³⁾

3.7

minor defect

a defect that is not likely to reduce materially the usability of the considered product for its intended purpose, or that is a departure from established specification having little bearing on the effective use or operation of this product³⁾

3.8

sampling plan

a plan according to which one or more samples are taken in order to obtain information and possibly to reach a decision³⁾

¹⁾ At present at the stage of draft. (Revision, in part, of ISO 2859:1974.)

²⁾ At present at the stage of draft.

³⁾ Definition taken from ISO 3534:1977. (ISO 3534 is currently being revised by ISO/TC 69, *Applications of statistical methods*.)

3.9**limiting quality (LQ)**

in a sampling plan, a quality level which corresponds to a specified and relatively low probability of acceptance: for the purposes of this International Standard, a 10 % probability of acceptance (LQ_{10}). It is the limiting lot quality characteristic that the consumer is willing to accept with a low probability that a lot of this quality would occur⁴⁾

3.10**acceptable quality level (AQL)**

a quality level which in a sampling plan corresponds to a specified but relatively high probability of acceptance

it is the maximum per cent defective (or the maximum number of defects per hundred units) that, for purposes of sampling inspection, can be considered satisfactory as a process average⁴⁾

4 Quality assurance**4.1 General****4.1.1 Approval of manufacturers**

The manufacturer shall conform to the quality assurance and approval procedures in effect in the purchaser's country: the purpose of these procedures is to ensure that a manufacturer has a quality system and the capability for continuous production of bolts complying with the specified quality requirements.

The granting of an approval of the manufacturer is a function of the Certification Authorities, or their appointed representative, who may be the prime contractor.

4.1.2 Qualification of bolts

The purpose of qualification inspections and tests of bolts is to check that the design and manufacturing conditions of a bolt allow it to satisfy the requirements of this International Standard.

The granting of qualification of a bolt is a function of the Certification Authorities in the purchaser's country, or their appointed representative, who may be the prime contractor.

4.1.3 Acceptance of bolts

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

Acceptance inspections and tests shall be carried out by the manufacturer, or under his responsibility. The manufacturer is responsible for the quality of the bolts manufactured.

4.2 Qualification inspection and test conditions

Qualification inspections and tests (requirements, methods, numbers of bolts) are specified in Table 1. They shall be carried out on

- each type and diameter of bolt,
- 25 bolts selected from a single inspection lot by simple random sampling.

The test programme may possibly be reduced, or the qualification of a bolt be granted, without inspection or testing: any such decision shall be based on the results obtained on similar types and diameters of bolts provided that the design and manufacturing conditions are identical.

The inspections and tests shall be repeated on any bolt if the manufacturing conditions have changed. Table 2 indicates the allocation of bolt specimens for the inspections and tests.

Qualification inspections and tests are summarized in Table 3.

4.3 Acceptance inspection and test conditions

Acceptance inspections and tests (requirements, methods, numbers of bolts) are specified in Table 1; they shall be carried out on each production batch or inspection lot. Bolts from the batch or lot to be tested shall be selected by simple random sampling.

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.

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

Production batches or inspection lots declared unacceptable after the acceptance inspections and tests shall be submitted for re-inspection or re-testing only after all defective units have been removed and/or defects have been corrected.

⁴⁾ Definition taken from ISO 3534:1977. (ISO 3534 is currently being revised by ISO/TC 69, *Applications of statistical methods*.)

Twice the normal sample size shall be used for re-inspecting or re-testing the attributes causing initial rejection; the same acceptance level shall be used.

Acceptance inspections and tests are summarized in Table 3.

5 Requirements

The requirements of this International Standard are given in Table 1 and, unless otherwise specified, they apply to bolts ready for use. Unless otherwise specified, the test temperature shall be the ambient temperature. These requirements complement the requirements of all other standards or specifications referenced in the product standard or in the definition document of the bolt.

Table 1 — Technical requirements and test methods

Clause No.	Characteristic	Technical requirement	Inspection and test method	Q/A ^a	Sample size
5.1	Materials	In accordance with the product standard or definition document.	As stated in the material specification.		
5.2	Dimensions	In accordance with the requirements of the product standard or definition document.	Standard gauging.	Q A	22 Table 8 and Table 9
5.3	Manufacturing				
5.3.1	Forging	The heads of the bolts shall be formed by a hot or cold forging process before heat treatment. In the case of hot forging, the equipment shall be such that an adequate temperature is guaranteed throughout the production batch.	The equipment used shall be approved.		
5.3.2	Heat treatment	The forged blanks shall be heat treated to produce the properties required by the product standard or definition document. Blanks shall not be hardened more than twice.			
5.3.3	Machining	The amount of material removed from the bearing surface of the head and the shank of the heat-treated blanks shall be as little as practicable consistent with the removal of surface contamination, production of a smooth surface and maintenance of optimum grain flow around the under-head fillet radius as shown in Figure 1.	See 5.5.1.		
5.3.4	Stress-relieving	After grinding and before thread and fillet rolling, bolts shall be stress-relieved at a temperature higher than 190 °C and 20 to 30 °C below the final tempering temperature for at least 2 h.			
5.3.5	Cold rolling	The fillet radius shall be cold rolled after heat treatment and machining so as to remove all visual signs of machining and to create superficial cold working; this may cause distortion which shall not exceed the values shown in Figure 2; this requirement is not applicable to fully threaded screws or bolts with a nominal diameter less than MJ5.	See 5.5.1.		
5.3.6	Threads	To be formed by a single rolling process after all heat treatment (e.g. after hardening, tempering, stress-relieving, etc.).			

^a Q = qualification inspection and test conditions (4.2)
A = acceptance inspection and test conditions (4.3)