SAE The Engineering Society For Advancing Mobility Land Sea Air and Space

400 Commonwealth Drive, Warrendale, PA 15096

METRIC AEROSPACE STANDARD

MA 3377

Issued 8-86
Revised

FSC 5305 & 5306

BOLTS & SCREWS, UNS N07718, Stress-Rupture and Fatigue Resistant, Procurement Specification For, Metric

1. SCOPE:

1.1 Type: This procurement specification covers aircraft quality metric bolts and screws made from a corrosion and heat resistant nickel alloy of the type identified under the Unified Numbering System as UNS N07718.

1.2 Application: Primarily for use in aerospace propulsion systems as follows:

a. For use up to 650°C where elevated temperature tensile strength, stress-rupture strength, and resistance to relaxation are required.

b. For use up to 425°C where impact resistance, fatigue resistance, and tensile strength are required; and suitable for use at higher temperature where degradation of these mechanical properties is acceptable.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications and Aerospace Standards shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2645 - Fluorescent Penetrant Inspection
AMS 5662 - Alloy Bars, Forgings, and Rings, Corrosion and Heat Resistant, 52.5Ni - 19Cr - 3.0 Mo - 5.1(Cb + Ta) - 0.90Ti - 0.50Al - 18Fe, Consumable Electrode or Vacuum Induction Melted, 1775°F (970°C) Solution Heat Treated

2.1.2 Aerospace Standards:

AS 1370 - Metric Screw Threads - MJ Profile
MA 1518 - Bolts, Screws and Nuts - External Wrenching, Metric MJ Threads - Design Parameters For
MA 1520 - Areas for Calculating Stress or Load for Metric MJ Externally Threaded Fasteners
MA 1566 - Gaging Practice and Gage Requirements for MJ Screw Threads
AS 3062 - Bolts, Screws and Studs, Screw Thread Requirements
AS 3063 - Bolts, Screws and Studs, Geometric Control Requirements

REAFFIRMED
11-91, 5/95

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM E 8 - Tension Testing of Metallic Materials
ASTM E 21 - Elevated Temperature Tension Tests of Metallic Materials
ASTM E 112 - Determining the Average Grain Size
ASTM E 139 - Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials

2.3 ANSI Publications: Available from American National Standards Institute, 1430 Broadway, New York, NY 10018.

ANSI B46.1 - Surface Texture

2.4 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Ave., Philadelphia, PA 19120.

2.4.1 Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage
DOD-STD-1312 - Fasteners, Test Methods

3. TECHNICAL REQUIREMENTS:

3.1 Material: Shall be AMS 5662 alloy heading stock, except material composition shall limit carbon content to 0.02 - 0.08 %.

3.2 Design: Finished (completely manufactured) parts shall conform to the following requirements:

3.2.1 Dimensions: The dimensions of finished parts, after all processing including plating, shall conform to the part drawing. Dimensions shall apply before coating with dry film lubricants.

3.2.2 Surface Texture: Surface texture of finished parts, prior to plating or coating, shall conform to the requirements as specified on the part drawing, determined in accordance with ANSI B46.1.

3.2.3 Threads: Metric screw thread MJ profile and dimensions per AS 1370, unless otherwise specified on the part drawing.

3.2.3.1 Incomplete Threads: Incomplete threads are permissible at the chamfered end and the juncture of the unthreaded portion of the shank or adjacent to the head as specified in AS 3062.

3.2.3.2 Chamfer: The entering point of the thread shall be chamfered as specified on the part drawing.

3.2.4 Geometric Tolerances: Part features shall be within the geometric tolerances specified on the part drawing and, where applicable, controlled per AS 3063.

3.3 Fabrication:

3.3.1 Blanks: Heads shall be formed by hot forging or cold forging; machined heads are not permitted, except lightening holes may be produced by any suitable method. Wrenching recesses may be forged or machined. Flash or chip clearance in machined recesses shall not cause recess dimensions to exceed the specified limits.

3.3.2 Heat Treatment: Headed blanks shall, before finishing the shank and bearing surface of the head, be solution and precipitation heat treated as follows:

3.3.2.1 Heating Equipment: Furnaces may be any type ensuring uniform temperature throughout the parts and shall be equipped with, and operated by, automatic temperature controllers. The heating medium shall not cause surface hardening by carburizing or nitriding.

3.3.2.2 Solution Heat Treatment: Blanks shall be solution heat treated by heating to a temperature within the range 955 - 990°C, holding at the selected temperature within ± 15°C for 1 hr ± 0.1, and quenching in oil or water.

3.3.2.3 Precipitation Heat Treatment: After solution heat treatment as in 3.3.2.2, blanks shall be precipitation heat treated by heating to 718°C ± 8, holding at heat for 8 hr ± 0.25, furnace cooling at 56°C per hr to 620°C ± 8, holding at 620°C ± 8 for 8 hr ± 0.25, and cooling in air. Instead of the 56°C per hr cooling rate to 620°C ± 8, blanks may be furnace cooled at any rate provided the time at 620°C ± 8 is adjusted to give a total precipitation heat treatment time of approximately 18 hours.

3.3.3 Oxide Removal: Surface oxide and oxide penetration resulting from prior heat treatment shall be removed from the full body diameter and the bearing surface of the head of the solution and precipitation heat treated blanks prior to cold working the fillet radius and rolling the threads. The oxide removal process shall produce no intergranular attack or corrosion of the blanks. The metal removed from the bearing surface of the head and full body diameter of the shank shall be as little as practicable to obtain a clean, smooth surface and in no case shall be so great as to produce more cutting of flow lines in the head-to-shank junction than shown in Fig. 1B.

3.3.4 Cold Working of Fillet Radius: After removal of oxide as in 3.3.3, the head-to-shank fillet radius of headed parts having the radius complete throughout the circumference of the part shall be cold worked sufficiently to remove all visual evidence of grinding or tool marks. Distortion due to cold working shall conform to Fig. 2 unless otherwise specified on the part drawing. It shall not raise metal more than 0.05 mm above the contour at "A" or depress metal more than 0.05 mm below the contour at "B" as shown in Fig. 2; distorted areas shall not extend beyond "C" as shown in Fig. 2. In configurations having an undercut associated with the fillet radius, cold working will be required only for 90 deg of fillet arc, starting at the point of tangency of the fillet radius and the bearing surface of the head. For shouldered bolts, having an unthreaded shank diameter larger than the thread major diameter and having an undercut associated with a fillet between the threaded shank and the shoulder of the unthreaded shank, the cold working will be required only for 90 deg of fillet arc, starting at the point of tangency of the fillet radius and the shouldered surface of the unthreaded shank. For parts with compound radii between head and shank, cold work only the radius that blends with the head.

3.3.5 Thread Rolling: Threads shall be formed on the heat treated and finished blanks by a single rolling process after removal of oxide as in 3.3.3.

3.3.6 Cleaning: Parts, after finishing, shall be degreased and then immersed in one of the following solutions for the time and the temperature shown:

a. One volume of nitric acid (sp gr 1.42) and 9 volumes of water for not less than 20 min. at room temperature.

b. One volume of nitric acid (sp gr 1.42) and 4 volumes of water for 30 - 40 min. at room temperature.

c. One volume of nitric acid (sp gr 1.42) and 4 volumes of water for 10 - 15 min. at 60 - 70°C.

3.4 Product Marking: Each part shall be identification marked as specified by the part drawing. Unless otherwise specified, the markings may be formed by forging or stamping, raised or depressed 0.25 mm max, with rounded root form on depressed characters.

3.5 Plating: Where required, all surfaces shall be plated as specified by the part drawing.

3.6 Mechanical Properties: Parts shall conform to the requirements of 3.6.1, 3.6.2, 3.6.3, 3.6.4, 3.6.5 and 3.6.6. Threaded members of gripping fixtures for tensile, fatigue and stress-rupture tests shall be of sufficient size and strength to develop the full strength of the part without stripping the thread. The loaded portion of the shank shall have three

3.6 Mechanical Properties (continued):

full thread turns from the thread runout exposed between the loading fixtures during tensile, fatigue and stress-rupture tests. Finished parts shall be tested in accordance with the following applicable test methods of DOD-STD-1312:

Requirement	Test Method
Hardness	No. 6
Room Temperature Tensile Strength	No. 8
Stress-Rupture	No. 10
Fatigue Strength	No. 11
Elevated Temperature Tensile Strength	No. 18

3.6.1 Tensile Strength at Room Temperature:

3.6.1.1 Finished Parts: Parts shall withstand the minimum tensile load specified in Table II and shall be tested to failure for thread sizes MJ8 x 1 and smaller. If the size or shape of the part is such that failure would occur outside the threaded section but the part can be tested satisfactorily, such as parts having a shank diameter equal to or less than the thread root diameter or having an undercut, parts shall conform to only the tensile strength requirements of 3.6.1.2; for such parts, the diameter on which stress is based shall be the actual measured minimum diameter of the part. Tension fasteners with either standard spline drive or hexagon-type heads having a minimum metal condition in the head equal to the design parameters specified in MA 1518 shall not fracture in the head-to-shank fillet radius except when this radius is associated with an undercut or with a shank diameter less than the minimum pitch diameter of the thread.

3.6.1.2 Machined Test Specimens: If the size or shape of the part is such that a tensile test cannot be made on the part, tensile tests shall be conducted in accordance with ASTM E 8 on specimens prepared as in 4.3.4. Such specimens shall meet the following requirements:

Tensile Strength, min	1275 MPa
Yield Strength at 0.2 % Offset, min	1035 MPa
Elongation in 5D, min	12 %
Reduction of Area, min	15 %

3.6.2 Tensile Strength at 650°C:

3.6.2.1 Finished Parts: Finished parts, heated to 650°C ± 3, held at heat for 30 min. before testing, and tested at 650°C ± 3, shall withstand the minimum tensile load specified in Table II. If the size or shape of the part is such that failure would occur outside the threaded section but the part can be tested satisfactorily, such as parts having a shank diameter equal to or less than the thread root diameter or having an undercut, parts shall conform to only the tensile strength requirements of 3.6.2.2; for such parts, the diameter on which stress is based shall be the actual measured minimum diameter of the part. Tension fasteners with either standard spline drive or hexagon-type heads having a minimum metal condition in the head equal to the design parameters specified in MA 1518 shall not fracture in the head-to-shank fillet radius except when this radius is associated with an undercut or with a shank diameter less than the minimum pitch diameter of the thread.

3.6.2.2 Machined Test Specimens: If the size or shape of the part is such that a tensile test cannot be made on the part, specimens prepared as in 4.3.4 shall meet the following requirements when heated to 650°C ± 3, held at heat for not less than 30 min. before testing, and tested in accordance with ASTM E 21 at 650°C ± 3:

Tensile Strength, min	1000 MPa
Yield Strength at 0.2 % Offset, min	860 MPa
Elongation in 5D, min	12 %
Reduction of Area, min	15 %

3.6.3 Hardness: Shall be uniform and within the range 40 - 46 HRC or equivalent, but hardness of the threaded section and of the head-to-shank fillet area may be higher as a result of the cold working operations.

3.6.4 Fatigue Strength: Finished parts tested in tension-tension fatigue at room temperature with maximum load as specified in Table II and minimum load equal to 10 % of maximum load shall have average life of not less than 65,000 cycles with no part having life less than 45,000 cycles. Tests need not be run beyond 130,000 cycles. Life of parts which do not fail in less than 130,000 cycles shall be taken as 130,000 cycles for purposes of computing average life. If the shank diameter of the part is less than the minimum pitch diameter of the thread, parts shall withstand fatigue testing as above using loads sufficient to produce a maximum stress of 663 MPa and a minimum stress of 66.3 MPa. The above requirements apply only to parts 4 mm and larger in nominal thread size with round, square, hexagonal, or spline drive heads designed for tension applications and not having an undercut and having a head-to-shank fillet radius equal to or larger than that specified in MA 1518; for all parts to which the above requirements do not apply, fatigue test requirements shall be as specified on the part drawing.

3.6.5 Stress-Rupture Properties at 650°C: Shall be as follows:

3.6.5.1 Finished Parts: Parts, maintained at 650°C ± 2 while the load specified in Table II is applied continuously, shall not rupture in less than 23 hours. If the shank diameter of the part is less than the minimum pitch diameter of the thread but the part can be tested satisfactorily, parts shall conform to the requirements of 3.6.5.1.1.

3.6.5.1.1 Parts having a shank diameter less than the minimum pitch diameter of the thread shall be tested as in 3.6.5.1 except that the load shall be as specified in 3.6.5.2. The diameter on which stress is based shall be the actual measured minimum diameter of the part.

3.6.5.2 Machined Test Specimens: If the size or shape of the part is such that a stress-rupture test cannot be made on the part, a test specimen prepared as in 4.3.4, maintained at 650°C ± 2 while a load sufficient to produce an initial axial stress of 690 MPa is applied continuously, shall not rupture in less than 23 hours. Tests shall be conducted in accordance with ASTM E 139.

3.7 Quality: Parts shall be uniform in quality and condition, clean, sound, smooth, and free from burrs and foreign materials and from imperfections detrimental to their performance.

3.7.1 Macroscopic Examination: Parts or sections of parts as applicable, etched in a solution consisting of approximately 40 % hydrochloric acid (sp gr 1.19), 10 % of a 30 % solution of hydrogen peroxide, and 50 % water, or other suitable etchant, for sufficient time to reveal flow lines but not longer than 30 min., shall be examined at a magnification of approximately 20X to determine conformance to the following requirements, except that examination for thread imperfections as specified in 3.7.1.3 may be made by microscopic examination of specimens polished and etched as in 3.7.2.

3.7.1.1 Flow Lines:

3.7.1.1.1 Head-to-Shank: Examination of a longitudinal section through the part shall show flow lines in the shank, head-to-shank fillet, and bearing surface which follow the contour of the part as shown in Fig. 1A, except that slight cutting of flow lines by oxide removal process of 3.3.3 is permissible, as shown in Fig. 1B; excessive cutting of flow lines in the shank, head-to-shank fillet, and bearing surface, as shown in Fig. 1C, is not permissible except when an undercut is associated with the fillet radius. The head style shown in Figs. 1A through 1C is for illustrative purposes only but other symmetrical head styles shall conform to the above requirements. Flow lines in heads on parts having special heads, such as Dee- or Tee-shaped heads or thinner than MA 1518 standard heads, shall be as agreed upon by purchaser and vendor.

3.7.1.1.2 Threads: Flow lines in threads shall be continuous, shall follow the general thread contour, and shall be of maximum density at root of thread (See Fig. 3).

3.7.1.2 Internal Defects: Examination of longitudinal sections of the head and shank and of the threads shall reveal no cracks, laps, or porosity except laps in threads as permitted in 3.7.1.3.3 and 3.7.1.3.4. The head and shank section shall extend not less than D/2 from the bearing surface of the head and the threaded section shall extend not less than D/2 beyond the thread runout where "D" is the nominal diameter of the shank after heading. If the two sections would overlap, the entire length of the part shall be sectioned and examined as a whole.

3.7.1.3 Threads:

3.7.1.3.1 Root defects such as laps, seams, notches, slivers, folds, roughness, and oxide scale are not permissible (See Fig. 4).

3.7.1.3.2 Multiple laps on the flanks of threads are not permissible regardless of location. Single laps on the flanks of threads that extend toward the root are not permissible (See Figs. 5 and 6).

3.7.1.3.3 There shall be no laps along the flank of the thread below the pitch diameter (See Fig. 7). A single lap is permissible along the flank of the thread above the pitch diameter on either the pressure or non-pressure flank (one lap at any cross-section through the thread) provided it extends toward the crest and generally parallel to the flank (See Fig. 7).

3.7.1.3.4 Crest craters, crest laps, or a crest lap in combination with a crest crater are permissible provided that the imperfections do not extend deeper than 20 % of the basic thread height (See Table I) as measured from the thread crest when the thread major diameter is at minimum size (See Fig. 8). The major diameter of the thread shall be measured prior to sectioning. As the major diameter of the thread approaches maximum size, values for depth of crest crater and crest lap imperfections listed in Table I may be increased by one-half of the difference between the minimum major diameter and actual major diameter as measured on the part.

3.7.2 Microscopic Examination: Specimens cut from parts shall be polished, etched in Kalling's reagent (100 cm^3 of absolute ethyl alcohol, 100 cm^3 of hydrochloric acid (sp gr 1.19), and 5 g of cupric chloride), Marble's reagent (20 cm^3 of hydrochloric acid (sp gr 1.19), 20 cm^3 of water, and 4 g of cupric sulfate pentahydrate), or other suitable etchant, and examined at not lower than 100X magnification to determine conformance to the requirements of 3.7.1.3, 3.7.2.1, 3.7.2.2, and 3.7.2.3.

3.7.2.1 Microstructure: Parts shall have a microstructure of completely recrystallized material, except in the area of the threads and the head-to-shank fillet radius.

3.7.2.2 Grain Size: Shall be predominantly 3 or finer with occasional grains as large as 2 permissible, determined by comparison of the specimen with the chart in ASTM E 112; grain size shall be substantially uniform without pronounced segregation of fine and coarse grain areas conforming to standards agreed by purchaser and vendor. In case of disagreement on grain size by the comparison method, the intercept (Heyn) procedure shall be used.

3.7.2.3 Surface Hardening: Parts shall have no change in hardness from core to surface except as produced during rolling of threads. There shall be no evidence of carburization or nitriding. In case of dispute over results of microscopic examination, microhardness testing shall be used as a referee method; a Vickers hardness reading within 0.08 mm of an unrolled surface which exceeds the reading in the core by more than 30 points shall be evidence of nonconformance to this requirement.

3.7.3 Fluorescent Penetrant Inspection: Parts shall be subject to fluorescent penetrant inspection in accordance with AMS 2645.

3.7.3.1 The following conditions shall be cause for rejection of parts inspected:

3.7.3.1.1 Discontinuities transverse to grain flow (i.e., at an angle of more than 10 degrees to the axis of the shank), such as grinding checks and quench cracks.

3.7.3.1.2 Longitudinal indications (i.e., at an angle of 10 degrees or less to the axis of the shank) due to imperfections other than seams, forming laps, and nonmetallic inclusions.

3.7.3.2 The following conditions shall be considered acceptable on parts inspected:

3.7.3.2.1 Parts having longitudinal indications (i.e., at an angle of 10 degrees or less to the axis of the shank) of seams and forming laps parallel to the grain flow that are within the limits specified in 3.7.3.2.2 thru 3.7.3.2.5 provided the separation between indications is not less than 1.6 mm in all directions.

3.7.3.2.2 Sides of Head: There shall be not more than three indications per head. The length of each indication may be the full height of the surface but no indication shall break over either edge to a depth greater than 0.8 mm or the equivalent of the basic thread height (See Table I), whichever is less.

3.7.3.2.3 Shank or Stem: There shall be not more than five indications. The length of any indication may be 5 mm with a depth not exceeding 0.05 mm but the total length of all indications shall not exceed twice the length of the surface. No indication shall break into a fillet or over an edge.

3.7.3.2.4 Threads: There shall be no indications, except as permitted in 3.7.1.3.

3.7.3.2.5 Top of Head and End of Stem: The number of indications is not restricted but the depth of any individual indication shall not exceed 0.25 mm, as shown by sectioning representative samples. No indication, except those of 3.7.3.2.2 shall break over an edge

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of parts shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that parts conform to the requirements of this specification.

4.2 Production Inspection Lot: A production inspection lot shall be all finished parts of the same part number, made from a single heat of alloy, heat treated at the same time to the same specified condition, produced as one continuous run, and submitted for vendor's inspection at the same time.

4.3 Classification of Tests: The inspection and testing of parts are classified as follows:

a. Acceptance tests as in 4.3.1 which are to be performed on each production inspection lot.

b. Periodic tests which are to be performed periodically on production lots at the direction of the vendor or purchaser. Tensile strength test at 650°C in 3.6.2 is classified as periodic test and shall be performed when requested by the purchaser.

4.3.1 Acceptance Tests: The acceptance tests shall be performed on each production inspection lot. The acceptance tests consist of all the tests specified in Table III.

4.3.2 Acceptance Test Sampling:

4.3.2.1 Non-Destructive Test - Visual and Dimensional: A random sample will be selected from each production inspection lot; the size of the sample to be as specified in Table IV. The classification of defects for parts shall be as specified in Table V. Defects not classified in Table V shall be classified as Minor B defects. All dimensional characteristics are considered defective when out of tolerance.

4.3.2.2 Hardness Test: A random sample shall be selected from each production inspection lot; the size of the sample shall be as specified in Table VI, column B. The sample units may be selected from those that have been subjected to and passed the visual and dimensional inspection, with additional units selected at random from the production inspection lot as necessary.

4.3.2.3 Non-Destructive Inspection: Parts shall be subject to fluorescent penetrant inspection.

4.3.2.4 Destructive Tests: A random sample shall be selected from each production inspection lot; the size of the sample shall be as specified in Table VI, column B. The sample units may be selected from those that have been subjected to and passed the non-destructive tests with additional units selected at random from the production inspection lot as necessary.

4.3.3 Periodic Test Sampling: As agreed by purchaser and vendor.

4.3.4 Test Specimens: Specimens for tensile, fatigue, and stress-rupture testing of machined test specimens shall be of standard proportions in accordance with ASTM E8 with either 6 mm diameter at the reduced parallel gage section or smaller specimens proportional to the standard when required. Specimens shall be machined from finished parts or coupons of the same lot of alloy and be processed together with the parts they represent. Specimens shall be machined from the center of parts 18 mm and under in diameter, from the center of coupons 20 mm and under in nominal diameter or distance between parallel sides, and from mid-radius of larger parts or coupons.

4.3.5 Acceptance Quality: The acceptance quality level and acceptance number of defectives for the acceptance tests shall be as specified in Tables IV and VI.

4.4 Reports: The vendor of parts shall furnish with each shipment a report stating that the chemical composition of the parts conforms to the applicable material specification, showing the results of tests to determine conformance to the room temperature tensile property, hardness, fatigue, and stress-rupture requirements, and stating that the parts conform to the other technical requirements of this specification. This report shall include the purchase order number, lot number, this specification number, contractor or direct supplier of material, part number, nominal size, and quantity.

4.5 Resampling and Retesting: If any part or specimen used in the above tests fails to meet the specified requirements for mechanical properties and quality in 3.6 and 3.7, disposition of the parts may be based on the results of testing three additional parts or specimens for each original nonconforming part or specimen. Failure of any retest part or specimen to meet the specified requirements shall be cause for rejection of the parts represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

5.1.1 Parts having different part numbers shall be packed in separate containers.

5.1.2 Each container of parts shall be marked with not less than the following information:

METRIC BOLTS & SCREWS, UNS N07718, STRESS-RUPTURE & FATIGUE RESISTANT
MA 3377
PART NUMBER _____
PURCHASE ORDER NUMBER _____
QUANTITY _____
MANUFACTURER'S IDENTIFICATION _____

5.1.3 Threaded fasteners shall be suitably protected from abrasion and chafing during handling, transportation and storage.

5.1.4 Containers of parts shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the product to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.1.5 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-163, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.1.4 will be acceptable if it meets the requirements of Level C.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Parts not conforming to this specification or to modifications authorized by the purchaser will be subject to rejection.

8. NOTES:

8.1 For direct U.S. Military procurement, purchase documents should specify not less than the following:

Title, number, and date of this specification.
Part number or size of parts desired.
Quantity of parts desired.
Applicable level of packaging (See 5.1.5).

PREPARED BY SAE COMMITTEE E-25, GENERAL STANDARDS FOR AEROSPACE PROPULSION SYSTEMS.

TABLE I

Thread Pitch, mm	Basic Thread Height mm, Ref (See Note 1)	20 % Basic Thread Height
0.5	0.30	0.06
0.6	0.36	0.07
0.7	0.42	0.08
0.8	0.48	0.10
1	0.60	0.12
1.25	0.75	0.15
1.5	0.90	0.18
1.75	1.05	0.21
2	1.20	0.24
2.5	1.50	0.30
3	1.80	0.36

Note 1. Basic thread height is defined as being equivalent to 0.6 times the pitch.

TABLE II

Thread Size	Tensile Strength Load Standard MJ Threads kN min		Fatigue Strength Tension-Tension Max Test Load kN	Stress-Rupture Tensile Test Load kN
	Room Temp.	At 650 °C		
MJ3 x 0.5-4h6h	6.935	5.439	-	3.182
MJ3.5 x 0.6-4h6h	9.352	7.335	-	4.270
MJ4 x 0.7-4h6h	12.13	9.517	6.308	5.521
MJ5 x 0.8-4h6h	19.51	15.30	10.15	9.004
MJ6 x 1-4h6h	27.73	21.75	14.42	12.72
MJ7 x 1-4h6h	39.44	30.93	20.51	18.51
MJ8 x 1-4h6h	53.14	41.68	27.63	25.39
MJ10 x 1.25-4h6h	83.05	65.14	43.19	39.68
MJ12 x 1.25-4h6h	123.8	97.13	64.38	60.40
MJ14 x 1.5-4h6h	167.8	131.6	87.26	81.56
MJ16 x 1.5-4h6h	223.9	175.6	116.4	110.3
MJ18 x 1.5-4h6h	288.0	225.9	149.8	143.5
MJ20 x 1.5-4h6h	360.3	282.6	187.4	180.8
MJ22 x 1.5-4h6h	440.5	345.5	229.1	222.6
MJ24 x 2-4h6h	512.2	401.7	266.3	255.0

Note 1. Area upon which stress is based for tensile and fatigue strength load requirements is the tensile stress area as defined in MA 1520, for threads rolled after heat treatment, and calculated from equation:

$$A = 0.7854(d_3)^2\left[2 - \left(\frac{d_3}{d_2}\right)^2\right]$$

where, A = tensile stress area
d_2 = max pitch diameter
d_3 = max minor (root) diameter

Max fatigue tension load is based on 52 % of the room temperature min tensile load requirement. Min fatigue tension load is 10 % of the max fatigue tension load.

Area upon which stress-rupture tensile load requirements is based is the area at the max minor (root) diameter for MJ threads as defined in MA 1520, and calculated from the equation:

$$A = 0.7854(d_3)^2$$

where, A = area at max minor (root) diameter
d_3 = max minor (root) diameter

Load requirements are based on:
1275 MPa for tensile strength load at room temperature
1000 MPa for tensile strength load at 650°C
663 MPa for fatigue strength max tension load
690 MPa for stress-rupture test load

Note 2. For sizes not shown, tensile strength loads, fatigue strength tension test loads, and stress-rupture test loads for parts tested as parts, not as specimens from parts or coupons of the stock, shall be based upon the areas and stresses given above.

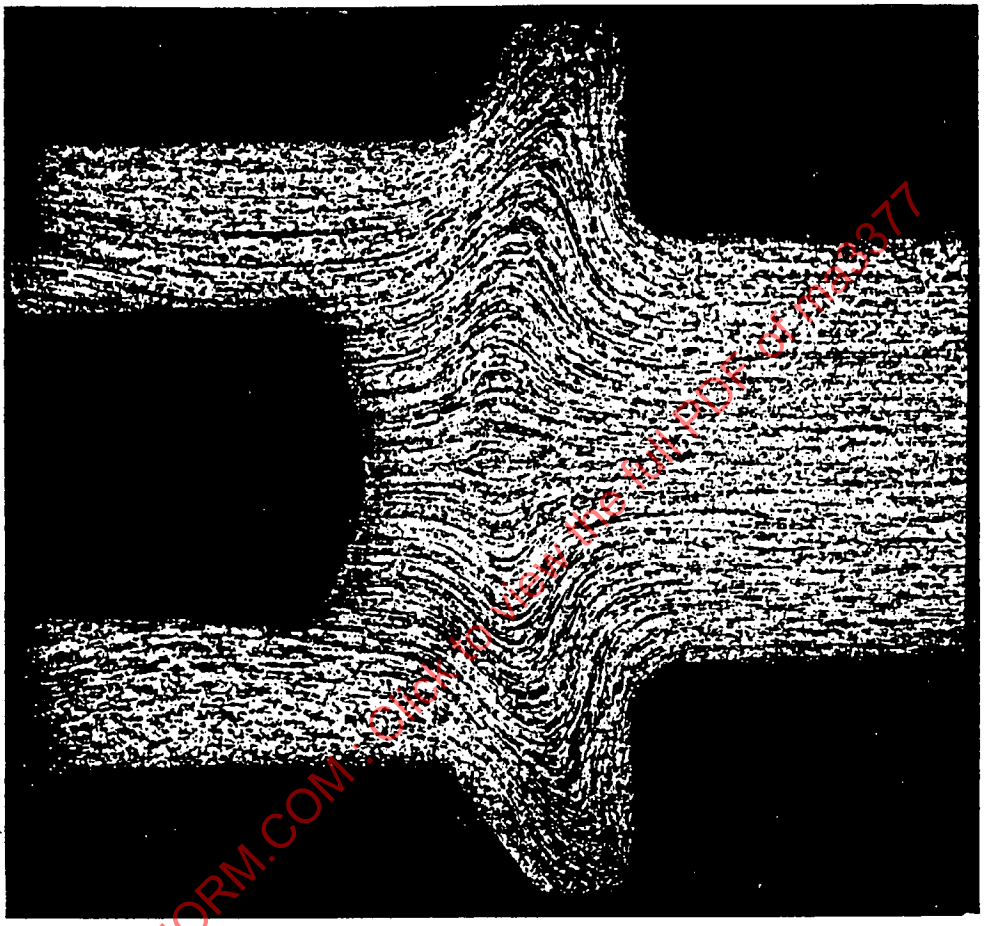


FIGURE 1A - SATISFACTORY GRAIN FLOW

Showing a smooth well formed grain flow following the contour of the under head fillet radius.

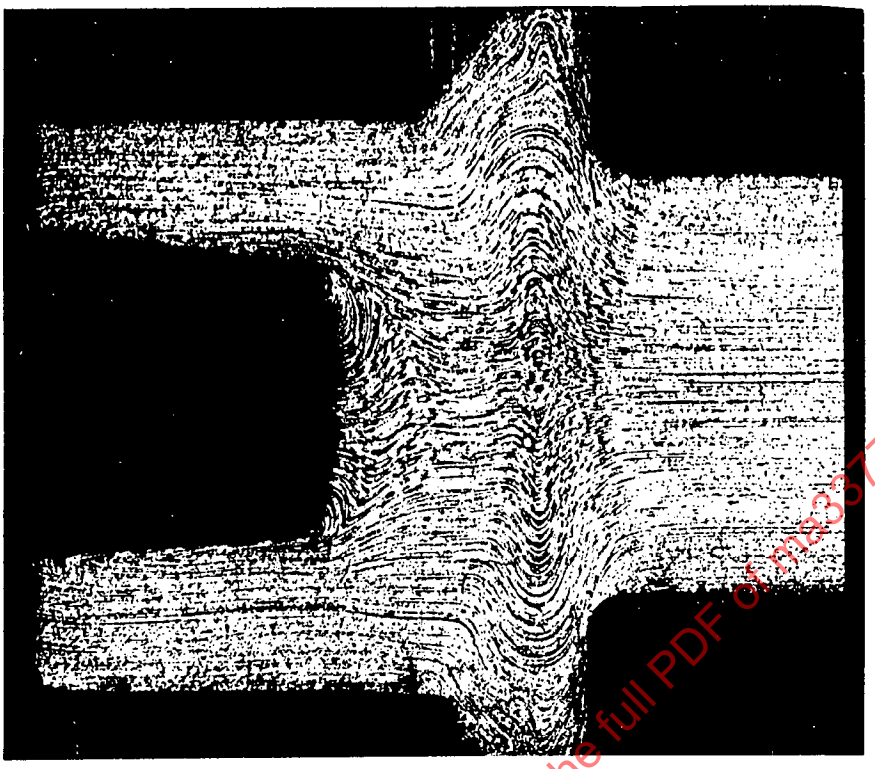


FIGURE 1B - MINIMUM ACCEPTABLE STANDARD

Showing maximum permissible cutting of grain flow after machining to remove contamination oxide.

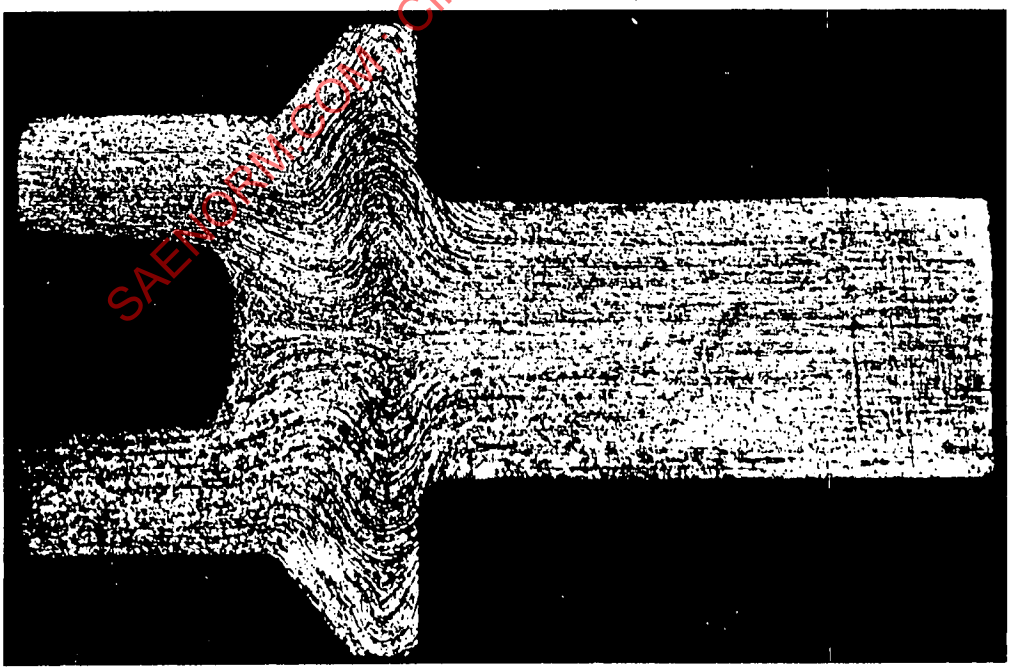
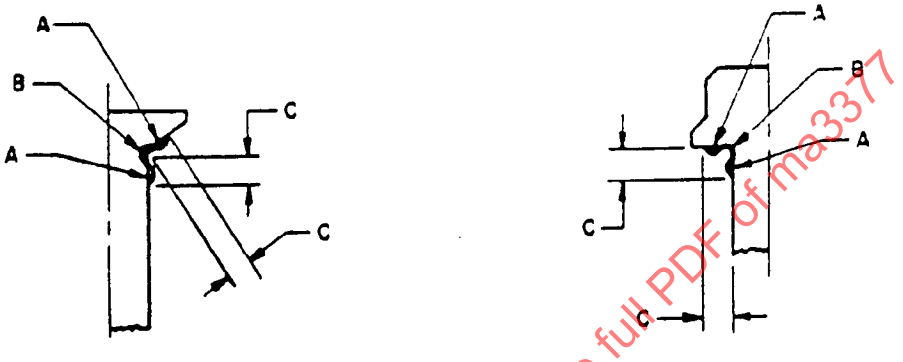


FIGURE 1C - UNACCEPTABLE GRAIN FLOW

Showing excessive cutting of grain flow in the shank, fillet and bearing surface which is not permissible.

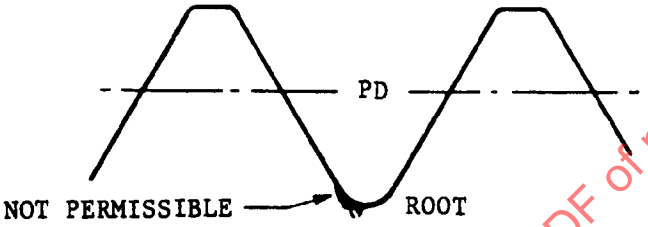


Nominal Bolt Diameter, mm	C, max mm
Up to 8, excl	1.6
8 & 10	2.4
12 - 16 incl	3.2
18 - 24 incl	4.0
Over 24	4.8

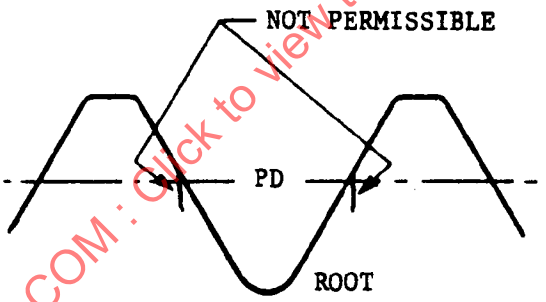
PERMISSIBLE DISTORTION FROM FILLET WORKING

FIGURE 2

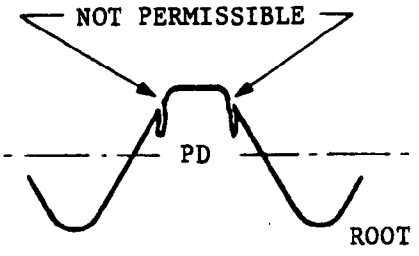
FLOW LINES, ROLLED THREAD
FIGURE 3



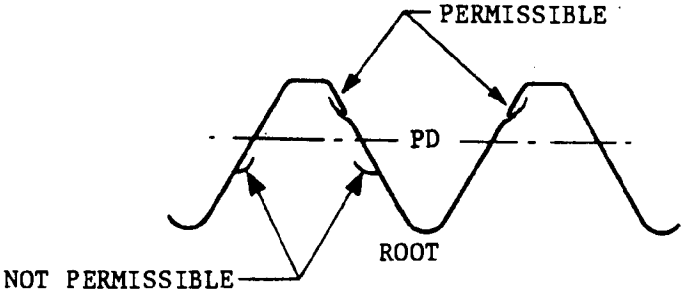
ROOT DEFECTS, ROLLED THREAD
FIGURE 4



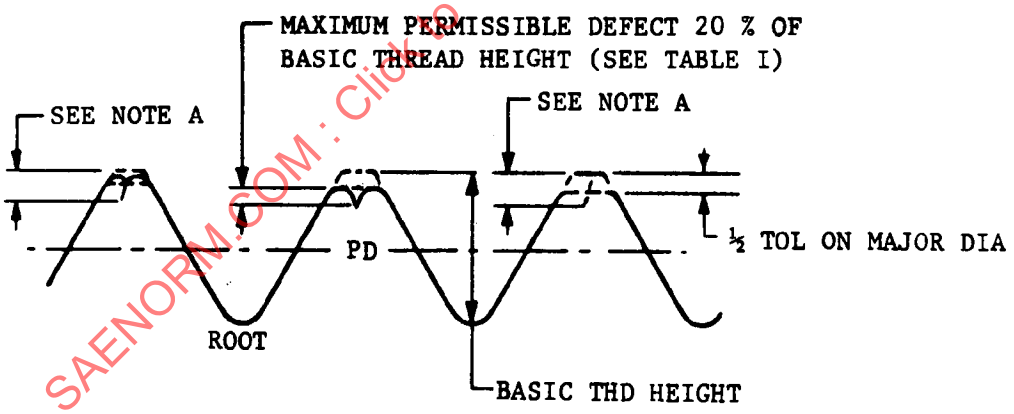
MULTIPLE LAPS BELOW PD EXTENDING TOWARD ROOT, ROLLED THREAD
FIGURE 5



MULTIPLE LAPS ABOVE PD EXTENDING TOWARD ROOT, ROLLED THREAD
FIGURE 6



LAPS EXTENDING TOWARDS CREST, ROLLED THREAD
FIGURE 7



Note A: Depth of defect equals 20 % of basic thread height plus ½ the difference of the actual major diameter and minimum major diameter.

CREST CRATERS & CREST LAPS, ROLLED THREAD
FIGURE 8