AEROSPACE
MATERIAL SPECIFICATIONS
SOCIETY OF AUTOMOTIVE ENGINEERS, Inc. 485 Lexington Ave., New York 17, N.Y.

AMS 7471

Issued 7-15-63
Revised

BOLTS AND SCREWS, NICKEL ALLOY, CORROSION AND HEAT RESISTANT
Upset Headed, Heat Treated, Roll Threaded
1975 F (1079.4 C) Heat Treatment

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

2. APPLICATION: Premium quality bolts and screws requiring high strength at temperatures up to 1500 F (815 C) and oxidation resistance up to 1750 F (955 C).

3. MATERIAL: Shall be AMS 5708 alloy heading stock.

4. FABRICATION:

4.1 Blanks: Heads shall be formed by hot upsetting or cold upsetting.

4.2 Heat Treatment:

4.2.1 Heating Equipment: Furnaces may be any type ensuring uniform temperature throughout the parts being heated and shall be equipped with, and operated by, automatic temperature controllers. The heating medium or atmosphere shall cause no surface hardening by carburizing or nitriding.

4.2.2 Solution Heat Treatment: Blanks shall be solution heat treated by heating to 1975 F ± 25 (1079.4 C ± 14), holding at heat for 4 hr, and cooling in air.

4.2.3 Stabilization Heat Treatment: The solution heat treated blanks shall be stabilization heat treated by heating to 1550 F ± 15 (843.3 C ± 8.3), holding at heat for 4 hr, and cooling in air.

4.2.4 Precipitation Heat Treatment: After thread rolling as in 4.4, parts shall be precipitation heat treated by heating to 1400 F ± 15 (760 C ± 8.3), holding at heat for 16 hr, and cooling in air.

4.3 Oxide Removal: The solution and stabilization heat treated blanks, before rolling the threads, shall have the full body and the bearing surface of the head free from all surface oxide and oxide penetration caused by prior heat treatment. The metal removed from the bearing surface of the head shall be as little as practicable to obtain a clean, smooth surface and in no case shall be greater than 0.010 inch.

4.4 Thread Rolling: Threads shall be formed by a single rolling process after removal of oxide as in 4.3.

Printed in U. S. A.

5. TECHNICAL REQUIREMENTS:

5.1 Flow Lines: Flow lines of upset heads shall conform to the general arrangement shown in Fig. 1A, 1B, or 1C. The intersection of the longitudinal axis of the part and the approximate transverse axis of the flow lines shall be not less than D/4 in. from the bearing surface for hexagonal, round, and square head parts and not less than D/7 in. from the bearing surface for 12 point head parts where D is the nominal diameter of the shank after heading.

5.1.1 Examination for Internal Defects: Visual examination of a longitudinal section of a head and 1/4 in. or more of the shank, after etching in approximately 40% hydrochloric acid (sp gr 1.19), 10% of a 30% solution of hydrogen peroxide, and 50% water for not more than 30 min. at room temperature, shall reveal no cracks, laps, or porosity.

5.2 Threads:

5.2.1 Flow lines at threads shall be continuous, shall follow the general thread contour, and shall be of maximum density at root of thread (See Fig. 2).

5.2.2 Root defects such as notches, slivers, folds, roughness, or oxide scale are not permissible (See Fig. 3).

5.2.3 Multiple laps on the side of threads are not permissible regardless of location. Single laps on the sides of threads that extend toward the root are not permissible (See Figs. 4 and 5).

5.2.4 A single lap is permissible along the side of the thread below the pitch diameter on the non-pressure side provided the lap does not originate less than 20% of the basic thread height from the root and extends toward the crest and generally parallel to the side (See Fig. 6). A single lap is permissible along the side of the thread above the pitch diameter on either the pressure or non-pressure side (one lap per thread) provided it extends toward the crest and generally parallel to the side (See Fig. 7). Basic thread height is defined as being equivalent to 0.650 times the pitch (See Table I).

5.2.5 Crest craters, crest laps, or a crest lap in combination with a crest crater are permissible, provided 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 crest crater or crest lap imperfections listed in Table I may be increased by 1/2 the difference between the minimum major diameter and the actual major diameter as measured on the part.

5.2.6 Slight deviations from thread contour are permissible at the crest of the thread within the major diameter limits as shown in Fig. 9 and at the incomplete thread at each end of the threaded section.

5.2.7 Parts having holes for locking devices are permitted to have slight ovalization of the hole and the countersink and slight flattening of the crest of the thread at the countersink, provided the diameter of the hole is within specified tolerances.

5.2.8 Parts shall have a minimum thread run-out of one thread and a maximum of two threads. The run-out shall fair onto the shank eliminating any abrupt change in cross sectional area. Root and sides of threads contained in run-out shall be filleted, smooth, and devoid of abrupt tool stop marks.

5.2.9 All thread elements shall be within specified limits starting at a length 2 times the pitch from the end, including chamfer, and extending for the specified full thread length.

5.3 Straightness, Concentricity, and Squareness: For purpose of these inspections, shank and threads shall be included but shall be considered as separate elements of the part.

5.3.1 Straightness of Shank and Threads: Shank and threads shall be straight within the limits specified on the drawing for the total length (L) of the part under the head (See Fig. 10). Visibly abrupt changes in diameter or shape of the shank and threads which might cause stress concentrations are not permissible.

5.3.2 Concentricity of Thread Pitch Diameter: The concentricity of thread pitch diameter in relation to shank diameter shall be within the limits specified on the drawing for a distance of not less than 1.5 times the nominal part diameter away from the last full thread along the shank (See Fig. 11). For parts having a shank length less than 1.5 times the nominal part diameter, the concentricity of the shank diameter over its full length in relation to the thread pitch diameter shall be within the limits specified on the drawing.

5.3.3 Concentricity of Head: The concentricity of the head in relation to the shank diameter shall be within the limits specified on the drawing for a distance of not less than 1.5 times the nominal part diameter away from the washer face along the shank (See Fig. 12). For parts threaded to the head and for parts having shank length less than 1.5 times the nominal part diameter, concentricity of head shall be measured in relation to thread pitch diameter in lieu of shank diameter.

5.3.4 Squareness of Washer Face: The squareness of the washer face with the shank diameter shall be within the limits specified on the drawing for a distance of not less than 1.5 times the nominal part diameter away from the washer face along the shank (See Fig. 12). For parts threaded to the head and for parts having a shank length less than 1.5 times the nominal part diameter, squareness of washer face shall be measured in relation to thread pitch diameter in lieu of shank diameter.

5.4 Structure: Parts shall have microstructure of completely recrystallized material except in the area of the threads. Grain size shall be substantially uniform with no pronounced segregation of fine and coarse grain areas, in accordance with standards agreed upon by purchaser and vendor. Clusters of large germinated grains will be cause for rejection.

5.5 Hardness: Shall be uniform and within the range of Rockwell C 32 - 42 or equivalent, but hardness of the threaded portion may be higher as a result of the thread rolling.

5.6 Tensile Properties: Finished parts shall show tensile strength not lower than 160,000 psi when aligned in fixtures so that at least 3 full threads are exposed in the gage section. The diameter of the area on which stress is based shall be taken as the mean of the maximum minor (nominal minor) and basic pitch diameters of the part or the shank diameter, whichever is smaller.

5.7 Stress-Rupture Test at 1350 F (732.2 C): A finished part, maintained at 1350 F ± 5 (732.2 C ± 2.8) while an axial stress of 75,000 psi is applied continuously, shall not rupture in less than 23 hours. The diameter of the area on which stress is based shall be taken as the maximum minor (nominal minor) diameter of the part or the shank diameter, whichever is smaller.

5.8 If the size or shape of a part is such that the part cannot be tested satisfactorily, tensile and stress-rupture tests may be made on specimens machined from the same stock and processed in the same manner as the parts.

6. QUALITY: Parts shall be uniform in quality and condition, clean, sound, smooth, and free from burrs and foreign materials and from internal and external imperfections detrimental to their performance. Discoloration resulting from precipitation heat treatment will not be considered objectionable except when the drawing requires that parts be plated.

6.1 Parts subject to fluorescent penetrant inspection shall conform to the following standards:

6.1.1 Discontinuities transverse to grainflow, such as pipes, grinding checks, and quench cracks, shall be cause for rejection.

6.1.2 Longitudinal indications of surface seams and forming laps parallel to grainflow are acceptable within the following limits, provided the separation between indications is not less than 1/16 in. in all directions.

6.1.2.1 Sides of Head: A maximum of 3 surface indications per head is permitted and the length of each indication may be the full height of the surface. No indication shall break over either edge to a depth greater than 1/32 in. or the equivalent of the basic thread height (See Table I), whichever is less.

6.1.2.2 Top of Head and End of Stem: A maximum of 3 surface indications in each area is permitted provided the length or diameter of any individual indication does not exceed 1/32 in. or the equivalent of the basic thread height (See Table I), whichever is less.

6.1.2.3 Shank or Stem: A maximum of 5 indications is permitted. The length of any one indication may be the full length of the surface 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.

6.1.2.4 Threads: There shall be no indications of cracks, seams, pipes, or rolling laps in threads as shown by Figs. 3, 4, and 5 except that indications of slight laps as shown by Figs. 6, 7, and 8 will be permitted.

7. REPORTS: Unless otherwise specified, the vendor of parts shall furnish with each shipment three copies of a report stating that the chemical composition of the parts conforms to the requirements of the applicable material specification and showing the results of tests to determine conformance to the tensile and stress-rupture strength requirements of this specification. This report shall include the purchase order number, specification number, contractor or other direct supplier of material, part number, and quantity.

8. REJECTIONS: Parts not conforming to this specification or to authorized modifications will be subject to rejection.

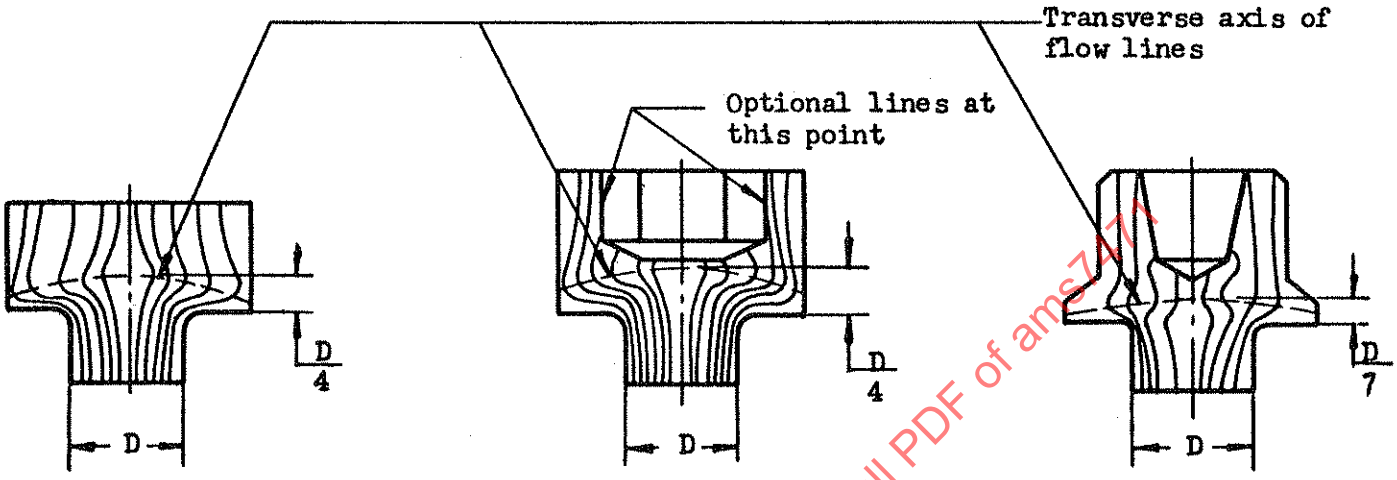


Figure 1A

Figure 1B

Figure 1C

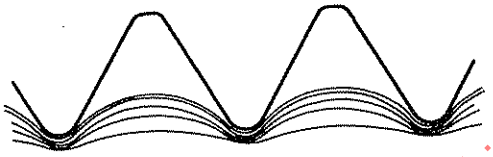


FIGURE 2
FLOW LINES
ROLLED THREAD

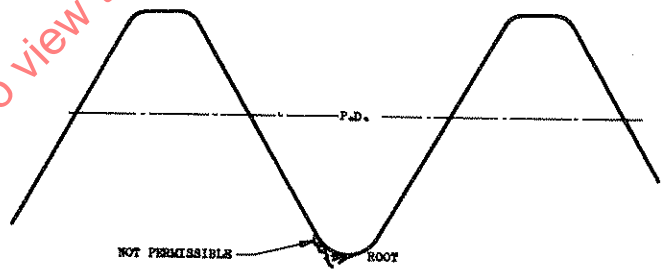


FIGURE 3
ROLLED THREAD

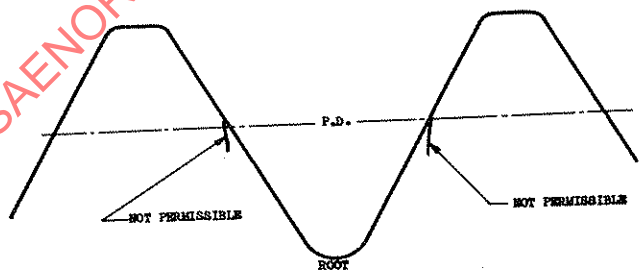


FIGURE 4
ROLLED THREAD

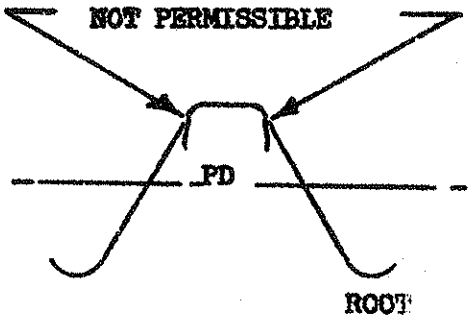


FIGURE 5
ROLLED THREAD

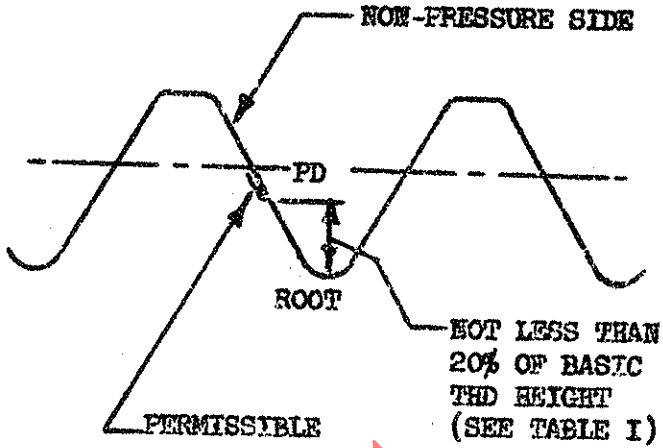


FIGURE 6
ROLLED THREAD

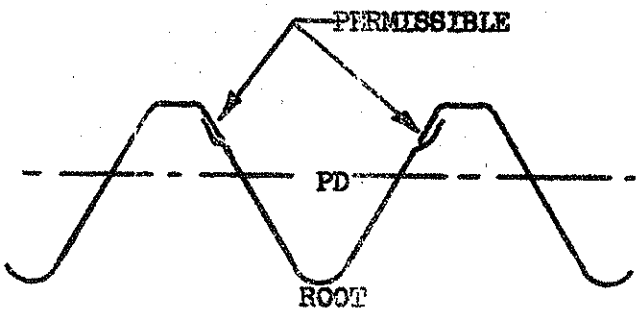


FIGURE 7
ROLLED THREAD

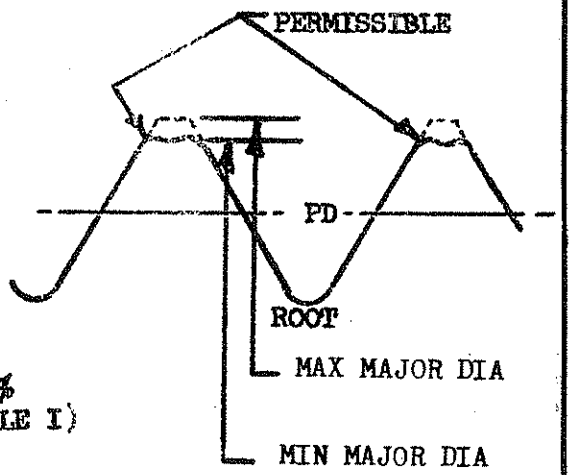
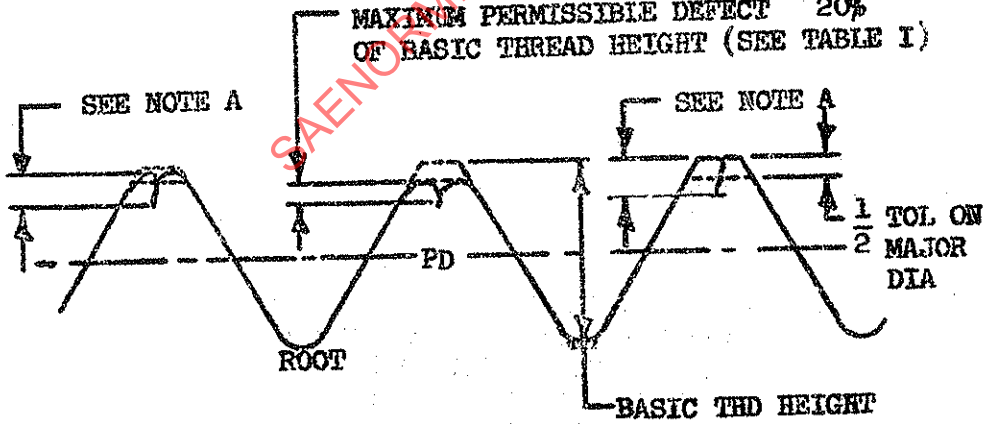


FIGURE 9
ROLLED THREAD



NOTE A: DEPTH OF DEFECT EQUALS 20% OF BASIC THREAD HEIGHT PLUS 1/2 THE DIFFERENCE OF THE ACTUAL MAJOR DIAMETER AND MINIMUM MAJOR DIAMETER.

FIGURE 8
ROLLED THREAD