AERONAUTICAL
MATERIAL SPECIFICATIONS

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AMS 7481

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Revised

STUDS, STEEL, CORROSION AND HEAT RESISTANT
Heat Treated - Roll Threaded

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

2. APPLICATION: High quality studs for use up to 1200 F.

3. MATERIAL: Shall be AMS 5736 steel.

4. FABRICATION:

4.1 Blanks: Shall be machined from bar stock and shall be machined sufficiently to remove surface defects. The smaller diameter or nut end of blanks may be reduced as necessary but the larger diameter or stud end shall not be upset.

4.2 Thread Rolling: Threads shall be formed on the finished blanks, before precipitation heat treatment, by a single rolling for each end.

4.3 Heat Treatment:

4.3.1 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.

4.3.2 Precipitation Heat Treatment: The parts shall be precipitation heat treated by heating to 1325 F ± 15, holding at heat for 16 hr, and cooling in air.

5. TECHNICAL REQUIREMENTS:

5.1 Threads: Screw Thread Standards for Federal Services 1944 (National Bureau of Standards Handbook H28) and the 1950 supplement thereto shall be a part of this specification and shall be the basis for all screw thread requirements. Tolerances for pitch diameter of the stud end shall be as shown on the drawing. Tolerances for lead and thread form, and for accuracy of thread angle, of the stud end shall be in accordance with Class 4 Fit screw threads in the above referenced Handbook H28; any error in lead shall be in the same relative direction on the lead thread of the stud end as on the full thread of the stud end (see Figure 10).

5.1.1 Flow lines at threads shall be continuous, shall follow the general thread contour, and shall be of maximum density at root of thread (see Figure 2).

5.1.2 Root defects such as notches, slivers, folds, roughness, or oxide scale are not permitted (see Figure 3).

5.1.3 Multiple laps on the sides of threads are not permissible regardless of location. Single laps on the sides of threads that extend toward the root are not permissible (see Figures 4 and 5).

5.1.4 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 closer than 20% of the basic thread height from the root and extends toward the crest and generally parallel to the side (see Figure 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 Figure 7). Basic thread height is defined as being equivalent to 0.650 times the pitch (see Table II).

5.1.5 Crest craters, crest laps, or a crest lap in combination with a crest crater are permissible, provided the imperfection does not extend deeper than 20% of the basic thread height (see Table II) as measured from the thread crest when the thread major diameter is at minimum size (see Figure 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 II may be increased by 1/2 the difference between the minimum major diameter and the actual major diameter as measured on the part.

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

5.1.7 The pitch diameter of all full threads on the stud end, Figure 10, shall not taper more than 0.0005 in. per in. and, if tapered, the smaller diameter shall be at the entering end of the stud. Taper variations shall fall within pitch diameter tolerances specified on the drawing.

5.1.8 The pitch diameter of the lead threads on the stud end shall originate from the stud pitch diameter and continue, decreasing for a distance B specified in the following Table I and illustrated in Figure 1.

Table I

Pitch	32	24	20	18	16	14	13	12	11	10	9	8
B, Inch, max	0.09	0.13	0.15	0.17	0.19	0.21	0.23	0.25	0.27	0.30	0.33	0.38

5.1.9 Circularity (out-of-roundness) of the pitch diameter of the stud end shall not exceed 0.0005 in. full indicator reading. Circularity shall fall within pitch diameter tolerances specified on the drawing.

5.1.10 The minimum lead thread length on the stud end is controlled by the number of threads that the stud will enter a lead thread ring gage or gage of equivalent accuracy made to the maximum pitch diameter of the lead threads specified on the drawing; the number of such threads shall be not less than one nor more than two.

5.1.11 Studs without necks that are made in accordance with this specification will have a minimum full thread length shown on the drawing. A maximum full thread length will also be shown and this will include the imperfect threads due to the lead. Parts shall have a minimum thread run-out of one thread and a maximum of three threads. The run-out shall fair onto the shank eliminating any abrupt change in cross-sectional area. Bottom and sides of threads contained in run-out shall be filleted, smooth, devoid of abrupt tool stop marks, and shall not be cut or mutilated in any way by the threading operation, unless so indicated on the drawing.

5.1.12 The general "break edge" note on drawing does not apply to the crest of the thread; sharp edges (without burrs and feather edges) at this location are permissible. Any operation to remove burrs from the thread should not break the edge more than approximately 0.003 in. radius.

5.1.13 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.

5.1.14 Threads on the nut end and the lead threads on the stud end may be 0.001 in. under the specified limits before plating but shall conform to the gage requirements after plating.

5.1.15 All thread elements on the nut thread end 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.

5.2 Structure: Parts shall have microstructure of completely recrystallized material except in the area of the threads. Grain size shall be 5 or finer, ASTM E112-58T. Up to 25%, by area, of abnormally large grains will be permitted in any specific area of 100 or more adjacent grains; abnormally large grains are defined as grains more than 3 ASTM numbers coarser than the average grain size of the part.

5.3 Hardness: Shall be uniform and within the range of Brinell 248 - 321 or equivalent, but hardness of the threaded portion may be higher as a result of the thread rolling.

5.4 Tensile Properties:

5.4.1 Finished Parts: Shall be capable of showing tensile strength not lower than 130,000 psi when aligned in fixtures so that at least 3 full threads of each end 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.

5.4.2 Tensile Test Specimens: Tensile test specimens machined from finished parts shall conform to the following requirements:

Tensile Strength, psi	130,000 min
Yield Strength at 0.2% Offset or at 0.0098 in. in 2 in. Extension Under Load (E = 29,100,000), psi	85,000 min
Elongation, % in 4D	15 min
Reduction of Area, %	20 min

5.5 Stress Rupture Test at 1200 F: Parts shall be capable of meeting the following requirements:

5.5.1 A part, maintained at 1200 F ± 3 while an axial stress of 65,000 psi is applied continuously, shall not rupture in less than 23 hours. The diameter 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.

5.5.2 If the geometry of the thread is substantially different from that of the notched portion of the specimen described in AMS 5736, or if the size or shape of a part is such that the part cannot be tested satisfactorily, a test may be made on a specimen machined from the stock to the dimensions of the notched portion of the specimen described in AMS 5736, heat treated in the same manner as the parts and tested under the conditions specified in 5.5.1.

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 Shoulders: A maximum of 3 surface indications 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 II), whichever is less.

6.1.2.2 Unthreaded Sections Other Than Sides of Shoulders: A maximum of 5 indications is permitted. The length of any 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. If parts have positioning shoulders within the total unthreaded section, these requirements apply to each such unthreaded section between thread and shoulder or between shoulders.

6.1.2.3 Threads: Shall not reveal indications of cracks, seams, pipes, or rolling laps as shown by Figures 3, 4, and 5 except that indications of slight laps as shown by Figures 6, 7, and 8 will be permitted.

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

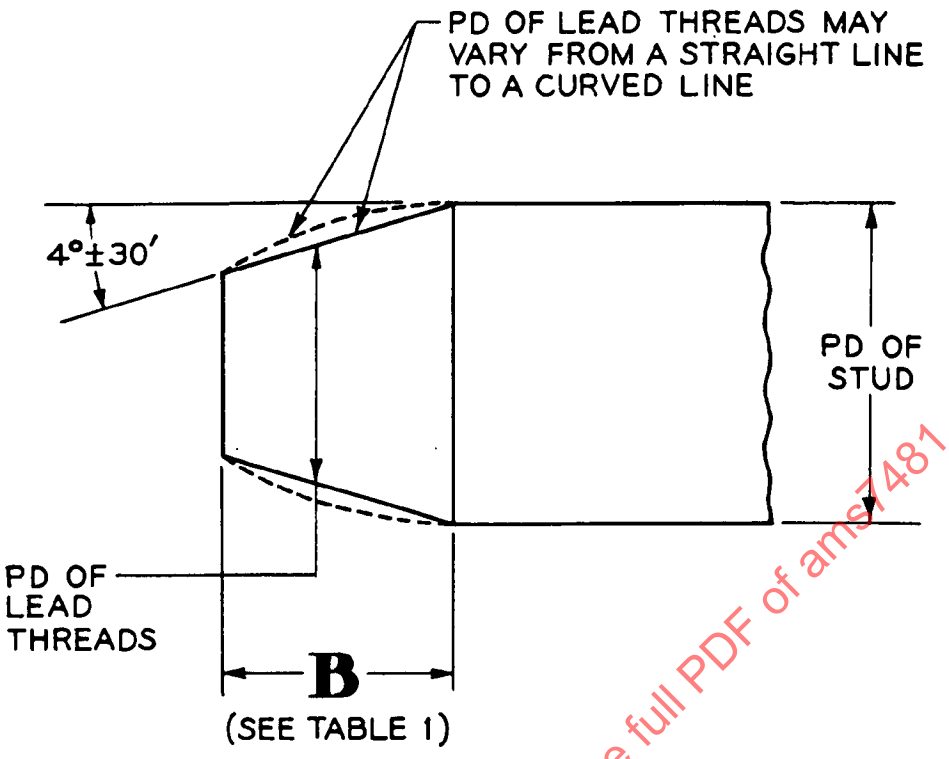
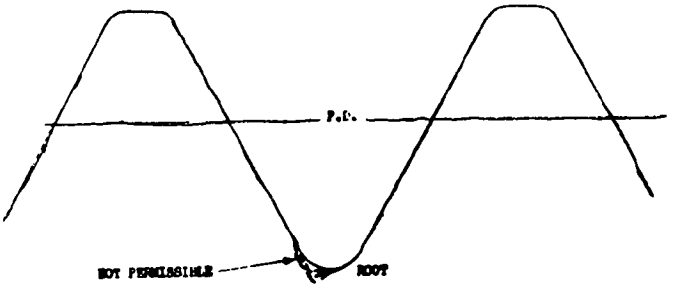
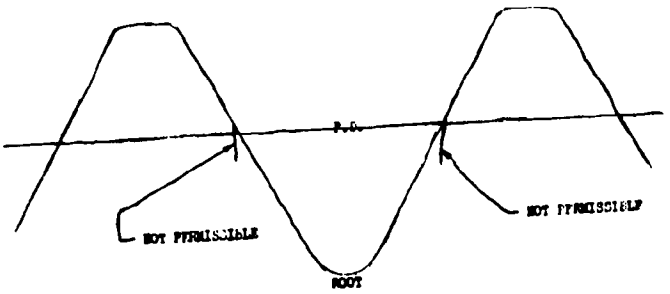


FIGURE 1
For Illustrative Purposes Only





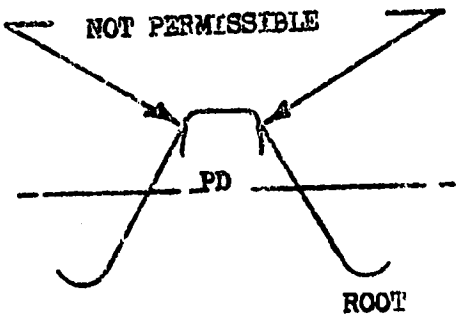
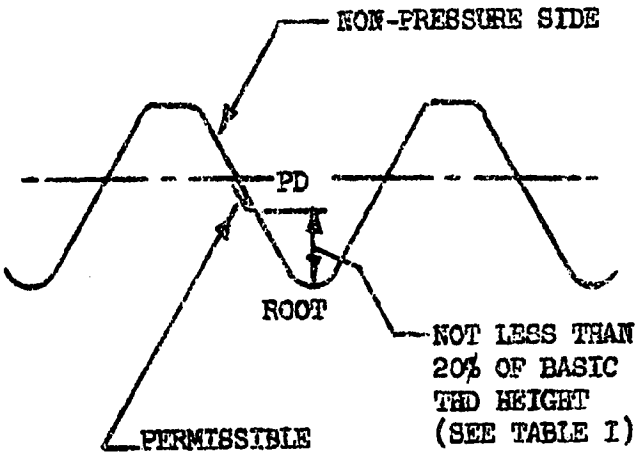
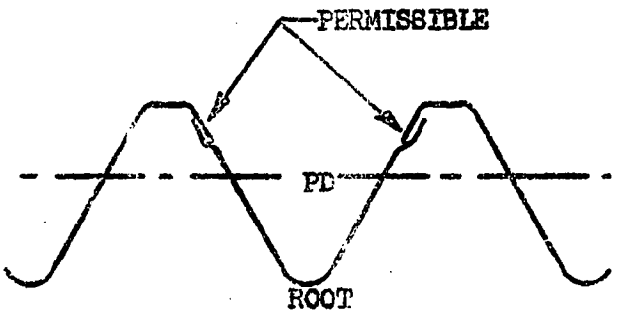


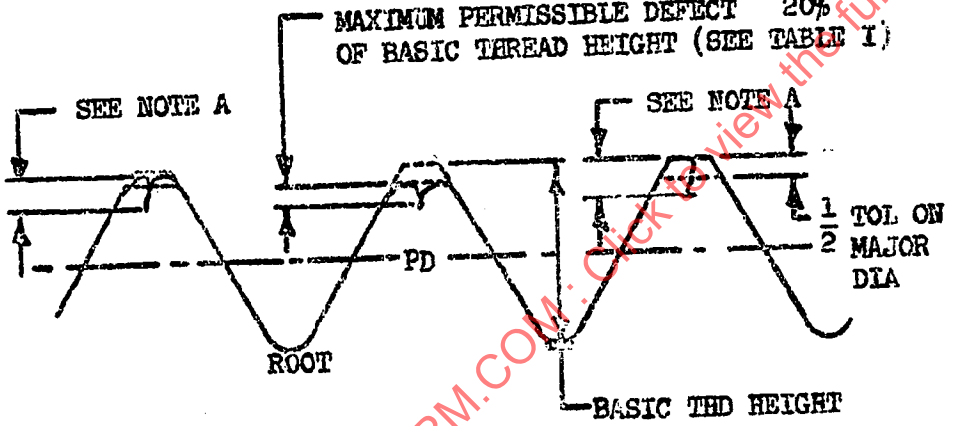
FIGURE 5
ROLLED THREAD



Ø FIGURE 6
ROLLED THREAD



Ø FIGURE 7
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.

Ø FIGURE 8
ROLLED THREAD

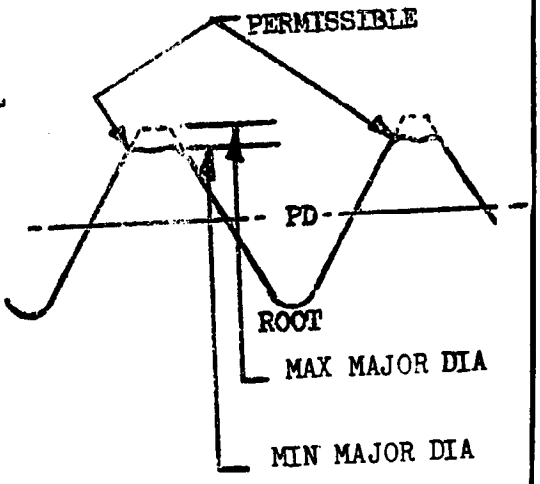


FIGURE 9
ROLLED THREAD