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

AMS 7455A

Issued 9-15-57
Revised 1-15-58

BOLTS AND SCREWS, STEEL, LOW ALLOY HEAT RESISTANT
Hardened and Tempered - Roll Threaded

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

2. APPLICATION: Bolts and screws made primarily from AMS 6304 steel for use up to 900 F.

3. FABRICATION: Heads may be formed by hot or cold upsetting. Threads shall be formed, and the head-to-shank fillet radius shall be cold worked, on the heat treated and finished blanks by a single rolling.

4. TECHNICAL REQUIREMENTS:

4.1 Hardenability: Material shall have hardenability of J50 = 20 min when austenitized at 1725 F ± 10.

4.2 Flow Lines: Flow lines of upset heads shall conform to the general arrangement shown in Figure 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 bolts and screws and not less than D/7 in. from the bearing surface for 12 point head bolts and screws where D is the nominal diameter of the shank after heading.

4.2.1 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 equal volumes of hydrochloric acid (sp gr 1.19) and water at 160 - 180 F for 10 - 15 min., shall reveal no cracks, laps, or porosity.

4.3 Machining: The metal removed from the bearing surface of the head shall be as little as practicable to obtain a clean, smooth surface.

4.4 Heat Treatment: Before finishing the shank and the bearing surface of the head and rolling the threads, blanks shall be heat treated as follows:

4.4.1 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 neither surface hardening nor decarburization other than that permitted in 4.7 and 4.8.

4.4.2 Austenitizing: Blanks of AMS 6304 shall be uniformly heated to 1750 F ± 25, held at heat for 1 - 1.5 hr, and quenched in oil or water. For other steels, the temperature shall be as agreed upon by purchaser and vendor. Elapsed time between quenching and tempering shall not be excessive.

4.4.3 Tempering: Hardened blanks shall be tempered by heating uniformly to the temperature necessary to produce the specified hardness and microstructure but not lower than 1000 F, holding at heat for 6 hr, and cooling in air.

4.5 Threads:

4.5.1 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).

4.5.2 Threads shall have no multiple or single laps at the root or on the sides (see Figures 3, 4, and 5), except that slight laps are permissible at the crest, on the non-pressure side inside the pitch diameter, and on the sides outside the pitch diameter (see Figures 6, 7, and 8). Slight deviation from thread contour is permissible at the crest of the thread as shown in Figure 9; the incomplete thread at each end of the threaded section may also deviate slightly from contour.

4.5.3 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.

4.5.4 Threads may be 0.001 in. under the specified limits before plating but shall conform to the gage requirements after plating.

4.6 Structure: Parts shall have microstructure of tempered martensite. Structure of the head-to-shank fillet area shall show evidence of cold work.

4.7 Surface Hardening: Parts shall have no surface hardening except as produced during rolling of threads and head-to-shank fillet radius. Determinations of surface hardening may be made by microscopic method or by a sensitive hardness testing instrument.

4.7.1 This requirement prevents heat treating procedures such as uncontrolled atmosphere for heating, bath heating medium, carbon restoration, and other similar processes.

4.8 Decarburization:

4.8.1 The bearing surface of the head, the fillet between head and shank, the shank, and threads shall be free from decarburization.

4.8.2 Depth of decarburization on those surfaces of the head which are the original surfaces of the bar shall be not greater than that permitted by the applicable material specification, except as noted in 4.8.1.

4.8.3 Depth of decarburization on the OD of the head of cylindrical head bolts and screws is not restricted.

4.8.4 Depth of decarburization at any point on any surface not covered in 4.8.1, 4.8.2, or 4.8.3 shall not exceed 0.002 inch.

4.9 Hardness: Hardness shall be uniform and as specified on the drawing, but hardness of the threaded portion and the head-to-shank fillet area may be higher as a result of the rolling.

4.10 Straightness, Concentricity, and Squareness: For purposes of these inspections, shank and threads shall be included but shall be considered as separate elements of the bolt.

4.10.1 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 bolt under the head (see Figure 10). Visibly abrupt changes in diameter or shape of the shank and threads which might cause stress concentrations are not permissible.

4.10.2 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 bolt diameter away from the last full thread along the shank (see Figure 11). For bolts having a shank length less than 1.5 times the nominal bolt 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.

4.10.3 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 bolt diameter away from the washer face along the shank (see Figure 12). For bolts threaded to the head and for bolts having shank length less than 1.5 times the nominal bolt diameter, concentricity of head shall be measured in relation to thread pitch diameter in lieu of shank diameter.

4.10.4 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 bolt diameter away from the washer face along the shank (see Figure 12). For bolts threaded to the head and for bolts having a shank length less than 1.5 times the nominal bolt diameter, squareness of washer face shall be measured in relation to thread pitch diameter in lieu of shank diameter.

5. 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.

5.1 Parts subject to magnetic particle inspection shall conform to the following standards:

5.1.1 Pipes, grinding checks, rolling laps, cracks, and indications transverse to the grain flow shall be cause for rejection.

5.1.2 Longitudinal indications of seams and nonmetallic inclusions are acceptable within the following limits:

5.1.2.1 Sides of Heads: Six or fewer surface or subsurface indications; the length of each indication may be the full height of the surface. The separation between parallel indications shall be not less than 1/16 inch. No indication shall break over either edge to a depth greater than 1/32 inch.

5.1.2.2 Shank or Stem: Ten or fewer subsurface and hairline surface indications; the length of any indication may run the full length of the surface but the total length of all indications shall not exceed twice the length of the shank. The separation between parallel indications shall be not less than 1/16 inch. No indication shall break into a fillet or over an edge to a depth greater than 1/64 inch.

5.1.2.3 Threads: On the profile or crest, three or fewer interrupted hairline indications are acceptable the full length of the thread if they do not extend more than 1/64 in. into the profile. The separation between parallel indications shall be not less than 1/16 inch.

5.2 Any method of magnetic particle inspection may be used to determine conformance of the parts to the above requirements, but resolution of disputed rejections shall be based upon the wet, residual, black oxide suspension method using amperages shown in 5.2.1 and 5.2.2.

5.2.1 Circular Magnetization: 800 - 1000 amp per sq in. of contact area passed through the part longitudinally.

5.2.2 Longitudinal Magnetization: Sufficient to produce 5000 amp-turns per inch of shank diameter with the part placed in a standard solenoid of appropriate size.

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

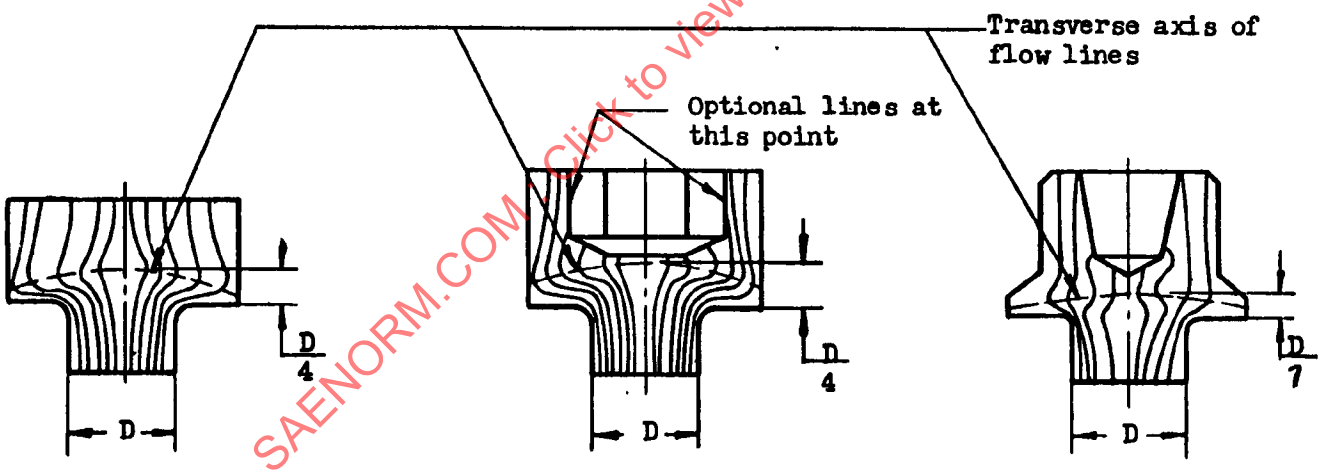

Figure 1A Figure 1B Figure 1C

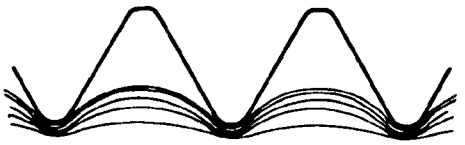

FIGURE 2
FLOW LINES
ROLLED THREAD

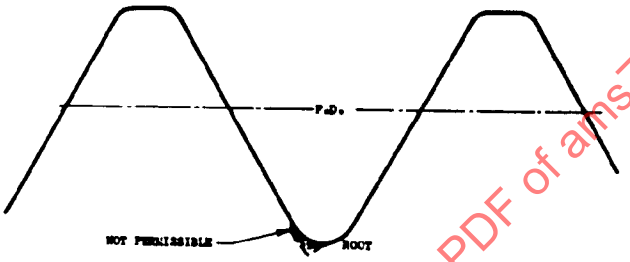

FIGURE 3
ROLLED THREAD

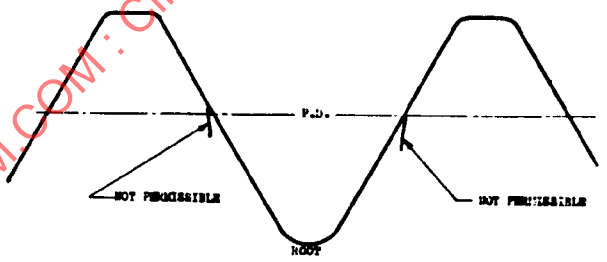

FIGURE 4
ROLLED THREAD

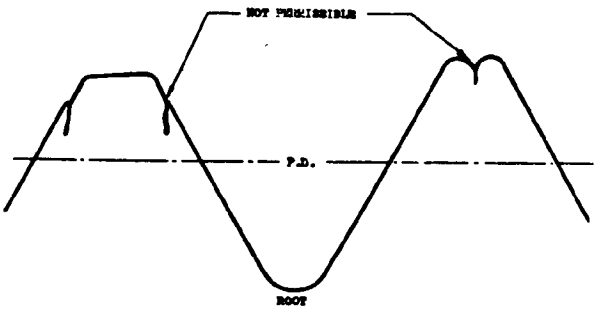

FIGURE 5
ROLLED THREAD