SAE Aerospace
An SAE International Group

AEROSPACE INFORMATION REPORT

SAE AIR4923

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Bolts and Screws, Aerospace Engine - Materials, Procurement Specifications and Properties

RATIONALE

This document has been reaffirmed to comply with the SAE 5-year Review policy.

1. SCOPE:

1.1 Type:

This SAE Aerospace Information Report (AIR) provides a tabular listing of materials, procurement specifications, and mechanical properties for bolts and screws developed for use on aerospace propulsion systems designed using the U.S. customary system or the SI system.

1.2 Purpose:

The list is intended to give a brief overview of the various kinds of SAE aerospace procurement specifications available when developing bolt and screw part standards. Table 1 covers specifications based on the U.S. customary system and Table 2 covers specifications based on the SI system.

1.2.1 Information Covered: Tables 1 and 2 include the following information

a. AMS material specification number
b. Material type (trade designation)
c. Procurement specification number
d. Maximum test temperature
e. Ultimate tensile strength at room temperature, minimum
f. Hardness
g. Ultimate tensile strength at test temperature, minimum
h. Yield strength at room temperature, minimum
i. Yield strength at test temperature, minimum
j. Stress rupture strength at test temperature, minimum 23 h test
k. Fatigue test loads, maximum and minimum
l. Double shear strength at room temperature, minimum
m. Process sequence for rolling thread and working underhead fillet radius

Table 3 provides material density (ρ) values for the bolt materials listed.

TABLE 1 - Aerospace Engine Bolts
Materials, Procurement Specifications, and Properties - Inch

Matl Spec AMS	Matl Type and UNS No.	Prcmt Spec	Max Duty Temp °F	Rm Temp Ftu min and Hardness	Ftu min at °F	Stress Rupture at °F	Rm Temp Fty min and at °F	Fatigue Test Load at Rm Temp	Rm Temp Fsu min	Process
4967	6Al-4V R56400	AS7460	600	165 ksi up to 0.5 in dia thd	—	—	—	—	—	Head hot formed or machined. Blanks soln and precip heat treated. Cold work fillet (when specified) and roll thread on heat treated blank.
4967	6Al-4V R56400	AS7461	600	165 ksi up to 0.5 in dia thd	—	—	—	77 ksi max 19.2 ksi min	—	Head hot formed. Blanks soln and precip heat treated. Cold work fillet and roll thread on heat treated blank.
5061	C steel K00802	AS7473-1	450	—	—	—	—	—	—	Head formed by forging or machining. Cold work fillet (when specified) and roll thread on blank after oxide and decarb removal.
5616	Greek Ascoloy S41800	AS7470	900	140 ksi 30-38 HRC	—	—	—	—	—	Head formed by forging or machining. Harden and temper blanks. Cold work fillet (when specified) and roll thread on heat treated and finished blank.
5624	HI-Exp K91505	AS7473-2	600	27-38 HRC	—	—	—	—	—	Head formed by forging or machining. Cold work fillet (when specified) and roll thread on blank after oxide and decarb removal.
5625	HI-Exp K91456	AS7473-3	600	125 ksi	—	—	100 ksi	—	—	Head formed by forging or machining. Cold work fillet (when specified) and roll thread on blank after oxide and decarb removal.
5637	302 S30200	AS7472	800	125 ksi	70 ksi Proof Load at rm temp	—	—	—	—	Head formed by forging or machining. Cold work fillet (when specified) and roll thread on blank after oxide removal.
5643	17-4PH S17400	AS7474	600	140 ksi 32-38 HRC	—	—	120 ksi	72 ksi max 7.2 ksi min	88 ksi	Head formed by forging. Soln and precip heat treat (H1100). Cold work fillet and roll thread on heat treated blank.

TABLE 1 (Continued)

Matl Spec AMS	Matl Type and UNS No.	Prcmt Spec	Max Duty Temp °F	Rm Temp Ftu min and Hardness	Ftu min at °F	Stress Rupture at °F	Rm Temp Fty min and at °F	Fatigue Test Load at Rm Temp	Rm Temp Fsu min	Process
5645	321 S32100	AS7473-4	1000	—	—	—	—	—	—	Head formed by forging or machining. Cold work fillet (when specified) and roll thread on blank after oxide and decarb removal.
5646	347 S34700	AS7473-5	1000	—	—	—	—	—	—	Head formed by forging or machining. Cold work fillet (when specified) and roll thread on blank after oxide and decarb removal.
5662	Inco 718 N07718	AS7466	800	185 ksi 40-46 HRC	155 ksi at 800 °F	—	150 ksi at rm temp 130 ksi at 800 °F	105 ksi max 10.5 ksi min	—	Head formed by forging; soln and precip heat treat. Cold work fillet and roll thread on heat treated blank after oxide removal.
5662	Inco 718 N07718	AS7467	1200	185 ksi 36-45 HRC	145 ksi at 1200 °F	100 ksi at 1200 °F	150 ksi at rm temp 125 ksi at 1200 °F	—	111 ksi	Head formed by forging; soln heat treat, remove oxide, cold work fillet and roll thread. Precip heat treat after cold working fillet and rolling thread.
5662	Inco 718 N07718	AS4877	1200	185 ksi 40-46 HRC	145 ksi at 1200 °F	100 ksi at 1200 °F	150 ksi at rm temp 125 ksi at 1200 °F	105 ksi max 10.5 ksi min	111 ksi	Head formed by forging; soln and precip heat treat. Cold work fillet and roll thread on heat treated blank after oxide removal.
5708	Waspaloy N07001	AS7471	1500	165 ksi	—	75 ksi at 1350 °F	115 ksi	—	99 ksi	Head formed by forging. Blanks soln and stabilization heat treated. Oxide removed; cold work fillet and roll thread prior to precip heat treat.
5712	Rene 41 S07041	AS7469	1600	155 ksi 30 HRC min	126 ksi at 1400 °F	85 ksi at 1350 °F	—	—	—	Head formed by forging. Blanks soln heat treated, oxide removed. Cold work fillet and roll thread prior to precip heat treat.
5731	A286 S66286	AS7477	1200	130 ksi 24-35 HRC	—	70 ksi at 1200 °F	85 ksi	—	—	Head formed by forging. 1800 °F soln HT then precip heat treat, oxide removed, cold work fillet and roll thread.

TABLE 1 (Continued)

Matl Spec AMS	Matl Type and UNS No.	Prcmt Spec	Max Duty Temp °F	Rm Temp Ftu min and Hardness	Ftu min at °F	Stress Rupture at °F	Rm Temp Fty min and at °F	Fatigue Test Load at Rm Temp	Rm Temp Fsu min	Process
5731	A286 S66286	AS7478	1200	130 ksi 24-35 HRC	—	65 ksi at 1200 °F	85 ksi	—	85 ksi	Head formed by forging or machining. 1800 °F soln HT; oxide removed, cold work fillet (when specified), roll thread, then precip heat treat.
5731	A286 S66286	AS7479	1200	130 ksi 24-35 HRC	—	65 ksi at 1200 °F	85 ksi	—	—	Head formed by forging or machining. 1650 °F soln HT; precip HT and oxide removed. Cold work fillet (when specified) and roll thread.
5842	MP159 R30159	AS7475	1100	260 ksi	205 ksi at 1100 °F	140 ksi at 1100 °F	250 ksi at rm temp 190 ksi at 1100 °F	135 ksi max 13.5 ksi min	—	Head formed by forging. Blanks aged by heating to 1200 °F for 4 h, air cool. Oxide removed, cold work fillet, and roll thread.
5844	MP-35N R30035	AS7468	700	260 ksi 44 HRC min	—	—	230 ksi at rm temp	135 ksi max 13.5 ksi min	—	Head formed by forging. Blanks aged by heating to 1200 °F for 4 h, air cool. Oxide removed, cold work fillet, and roll thread.
5853	A286 K66286	AS4506	1000	160 ksi 32 HRC	—	—	120 ksi	—	—	Head formed by forging. Blanks precip heat treated. Oxide removed, cold work fillet and roll thread.
6304	17-22A K14675	AS7454 AS7454-1 for plate NI-CAD	900	135 ksi 30-38 HRC	—	—	115 ksi	—	—	Head formed by forging or machining. Normalize and temper to 1100 °F min. Oxide and decarb removal. Cold work fillet and roll thread.
6304	17-22A K14675	AS7455 AS7455-1 for plate NI-CAD	900	190 ksi 42-46 HRC	—	—	—	—	—	Head formed by forging. Harden and temper to 1000 °F min. Oxide and and decarb removal. Cold work fillet and roll thread.

TABLE 1 (Continued)

Mat Spec AMS	Mat Type and UNS No.	Prcmt Spec	Max Duty Temp °F	Rm Temp Ftu min and Hardness	Ftu min at °F	Stress Rupture at °F	Rm Temp Fty min and at °F	Fatigue Test Load at Rm Temp	Rm Temp Fsu min	Process
6304	17-22A K14675	AS7459 AS7459-1 for plate Ni-CAD	900	195 ksi 42-46 HRC	145 ksi at 900 °F	105 ksi at 900 °F	—	100 ksi max 10 ksi min	117 ksi	Head formed by forging. Harden and temper to 1000 °F min. Oxide and decarb removal. Cold work fillet and roll thread on heat treated blank after oxide removal.
6322	AISI 8740 G87400	AS7452	450	125 ksi 26-32 HRC	—	—	—	—	—	Head formed by forging or machining. Harden and temper, oxide and decarb removal, cold work fillet (when specified), roll thread.
6485	H-11 T20811	AS7464	1000	220 ksi 48-50 HRC	170 ksi at 900 °F	130 ksi at 900 °F	—	115 ksi max 11.5 ksi min	—	Head formed by forging. Anneal, harden, temper, oxide and decarb removal, stress relief, cold work fillet, roll thread.

TABLE 2 - Aerospace Engine Bolts
Materials, Procurement Specifications, and Properties - Metric

Matl Spec AMS	Matl Type and UNS No.	Prcmt Spec	Max Duty Temp °C	Rm Temp Ftu min and Hardness	Fsu min at °C	Stress Rupture at °C	Rm Temp Fty min and at °C	Fatigue Test Load at Rm Temp	Rm Temp Fsu min	Process
5662	Inco 718 N07718	MA3377	650 °C	1275 MPa 40-46 HRC	1000 MPa at 650 °C	690 MPa at 650 °C	1035 MPa at rm temp 860 MPa at 650 °C	663 MPa max 68.3 MPa min	765 MPa	Head formed by forging. Soln and precip heat treat, oxide removal, cold work fillet and roll thread.
5708	Waspaloy N07001	MA3378	730 °C	1210 MPa 34-44 HRC	—	520 MPa at 730 °C	790 MPa at rm temp	—	726 MPa	Head formed by forging. Soln and stbln heat treat, oxide removal, cold work fillet, roll thread, precip heat treat.
5731	A286 S66286	MA3374	650 °C	900 MPa 24-36 HRC	—	480 MPa at 650 °C	590 MPa at rm temp	—	590 MPa	Head formed by forging. Soln and precip heat treat, oxide removal, cold work fillet and roll thread.
6322	AISI 8740 G87400	MA3376	235 °C	860 MPa 26-32 HRC	—	—	—	—	See Note 1	Head formed by forging or machining. Harden and temper, oxide and decarb removal, cold work fillet and roll thread.

NOTES:

1. Fsu min at room temperature 516 MPa at 26 min HRC.
   Fsu min at room temperature 600 MPa at 32 min HRC.

TABLE 3 - Density (ρ) of Bolt Materials

Material Spec AMS	Density (ρ) lb/in^3	Density (ρ) g/cm^3
4967	0.160	4.429
5061	0.284	7.861
5616	0.285	7.889
5624	0.284	7.861
5625	0.284	7.861
5637	0.286	7.916
5643	0.282	7.806
5645	0.285	7.889
5646	0.286	7.916
5662	0.297	8.221
5708	0.298	8.249
5712	0.298	8.249
5731	0.287	7.944
5734	0.287	7.944
5842	0.302	8.359
5844	0.304	8.415
5853	0.287	7.944
6304	0.283	7.833
6322	0.283	7.833
6485	0.283	7.833

2. REFERENCES:

There are no referenced publications specified herein.

2.1 Symbols and Abbreviations:

AISI	American Iron and Steel Institute
AS	Aerospace Standard
AMS	Aerospace Material Specification
C steel	carbon steel
decarb	decarburization
dia	diameter
Fsu	ultimate shear stress
Ftu	ultimate tensile stress