



AEROSPACE INFORMATION REPORT

AIR6151™**REV. C**

Issued 2011-05
Reaffirmed 2019-03
Revised 2024-01

Superseding AIR6151B

Torque, Threaded Application, Electrical Connector,
Accessory and Terminal Board Installation

RATIONALE

Revision required to clarify torque values, update references, and provide minor editorial errors as need.

1. SCOPE

This SAE Aerospace Information Report (AIR) is intended to provide guidelines to tightening methods and torque values as applied to electrical connectors, related hardware and switches, relays, circuit breakers, and A-A-59125 type terminal boards. The connectors and associated hardware discussed herein are typically manufactured from aluminum alloy, high-grade engineering thermoplastics, or corrosion-resistant steel, and typically plated with a protective/conductive coating. These guidelines may be used where no rules have been mandated either contractually or otherwise.

1.1 Purpose

To aid in the proper assembly of electrical connectors, related hardware and switches, relays, circuit breakers, and terminal boards in order to avoid damage by over torque or the loosening of parts while in service.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AS50151 Connectors, Electrical, Circular Threaded, AN Type, General Specification for

AS81511 Connectors, Electrical, Circular, High Density, Quick Disconnect, Environment Resisting and Accessories, General Specification for

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SAE WEB ADDRESS:

For more information on this standard, visit
<https://www.sae.org/standards/content/AIR6151C/>

AS81703	Connectors, Electric, Circular, Miniature, Rack and Panel or Push-Pull Coupling, Environment Resisting
AS85049	Connector Accessories, Electrical, General Specification for
AS85049/1	Connector Accessories, Electrical, Backshell, Environmental, Cable Sealing, Straight, Grounding (without Strain Relief), Category 1C (for AS50151 Solder Type, V Thread of AS310XX Classes A, B, C, or K Connectors, AS95234 Connectors)
AS85049/2	Connector Accessories, Electrical, Backshell, Environmental, Cable Sealing, Straight, Category 1C (for AS50151 Solder Type, V Thread of AS310XX Classes A, B, C, or K Connectors, AS95234 Connectors)
AS85049/4	Connector Accessories, Electrical, Backshell, Cable Sealing, Straight, Set-up, Category 1A (for MIL-DTL-22992 Connectors, Classes C, J, and R)
AS85049/42	Connector Accessories, Electrical, Nonenvironmental, Strain Relief, Straight, Category 4A (for AS50151 Solder Type, V Thread of MS310X Classes A, B, C, or K Connectors)

2.1.2 U.S. Government Publications

Copies of these documents are available online at <https://quicksearch.dla.mil>.

MIL-DTL-22992	Connectors, Plugs and Receptacles, Electrical, Waterproof, Quick Disconnect, Heavy Duty Type, General Specification for
MIL-DTL-26482	Connectors, Electrical (Circular, Miniature, Quick Disconnect, Environment Resisting) Receptacles and Plugs
MIL-DTL-26500	Connectors, General Purpose, Electrical, Miniature, Circular, Environment Resisting, General Specification for
MIL-DTL-27599	Connector, Electrical, Miniature, Quick Disconnect (for Weapons Systems), Established Reliability
MIL-DTL-28840	Connectors, Electrical, Circular, Threaded, High Density, High Shock, Shipboard, Class D, General specification for
MIL-DTL-38999	Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect (Bayonet, Threaded, and Breech Coupling), Environment Resistant, Removable Crimp and Hermetic Solder Contacts
MIL-DTL-83723	Connectors, Electrical, Circular (Environment resisting) Receptacles and Plugs
MIL-PRF-28876	Connectors, Fiber Optics, Circular, Plug And Receptacle Style, Multiple Removable Termini, General Specification For

2.2 Definitions

2.2.1 APPLIED TORQUE

The torque transmitted to the thread by the installation tool.

2.2.2 ASSEMBLY SEQUENCE

A method indicating sequence of assembling fasteners in a prescribed pattern. Also called installation sequence, tightening sequence, or torquing sequence.

2.2.3 ASSEMBLY TORQUE

This shall be the design torque applied at final assembly. It shall include the net effect of the following:

- a. The torque required to overcome kinetic friction between mating bearing faces and between mating threads.
- b. The torque required to overcome the self-locking feature (if any).
- c. The torque required to apply the desired axial load to a fastener assembly.

2.2.4 BREAKAWAY TORQUE

This is the torque required to initiate relative motion between male and female threads. Breakaway torque can be prefixed with the words maximum or minimum and shall only be measured in the loosening direction.

2.2.5 OVER TORQUE

This shall be the torque required to initially move the wrench thread from the installed condition. Over torque is always measured in the tightening direction and exceeds the maximum limit of the desired installation torque. Also called over tightening torque.

2.2.6 PREVAILING TORQUE

This shall be the torque required to overcome kinetic friction of mating threads plus the torque required to overcome the locking feature when 100% of the locking feature is engaged and the threads are unseated. The word "prevailing" shall be understood as the average torque when it is not prefixed by the words maximum or minimum. The prevailing torque can be measured in either a loosening or tightening direction. Also called run down torque/running torque.

2.2.7 SINGLE TORQUE

This shall be the installation torque applied once per assembly, usually applied to freely fitting parts, where no interference fits to hinder the seating of mating parts.

2.2.8 TORQUE

Torque is the result of force times radius. Typically measured in units of inch-ounces, inch-pounds, foot-pounds, Newton-meters, kilogram-centimeters, etc. (see 3.1 and Table 6).

2.2.9 TORQUE OUT

This term refers to a general type of torsional failure where any fastener component reacting to the applied torque disengages or fails. This term is also used when referring to other types of torquing elements such as interference fits.

2.2.10 UNSEATING TORQUE

This shall be the torque required to initially move the fastener from the installation torque condition. The unseating torque shall always be measured in a loosening direction. Also called breakaway torque.

3. REQUIREMENTS

3.1 General

Torque is the force or turning moment tending to produce rotation. It is expressed in terms of applied load and the length of the moment arm applying it in inch-pounds (in-lb). The torques specified herein are those commonly used in the aerospace industry and do not represent thread strength values for qualification testing. It is the responsibility of the user/installer to determine the best torque for the application and to select the appropriate tools and holding devices for the work and the user conditions.

It should be noted that the included torque definitions apply equally to both internal and external threaded parts that may or may not have a locking feature. For all the following torque definitions, the threaded components shall be considered:

- a. Seated when its bearing surface contacts the material being joined and any additional applied torque will produce a residual axial stress in either the male or female component.
- b. Unseated when the application of removal torque disengages the bearing surface of the threaded component from the material being joined, reducing the axial stress to zero.

3.2 Material

Torque requirements specified herein shall apply to threaded components such as couplings, nuts, screws, bolts, studs, and inserts. These items may be separate hardware or integral parts of such components as connectors, backshells, or clamps. They will usually be made of corrosion-resistant steel, high-grade engineering thermoplastic, or aluminum alloy coated with a protective coating. Threads may be locked by lockwashers, self-locking inserts, anti-decoupling devices, or liquid locking compounds. Threads that are locked by deformed metal threads in inserts or contain a material compound that provides a locking feature may be coated with a thread lubricant.

3.3 Temperature Effects

For ambient temperatures outside the range of -1 to 93 °C (30 to 200 °F) allowance must be made for mechanical property differences from tabulated room temperature values. These properties include tensile strength, yield strength, modulus of elasticity, etc. Where bolts and flange materials are generically dissimilar, such as aluminum and corrosion-resistant steel or steel and brass, differences in thermal expansion may cause preload increase or decrease with temperature. Allowance must be made for these changes.

4. TORQUE REQUIREMENTS

4.1 Screw Torque

Recommended torque for corrosion-resistant or plated steel screws is listed in Table 1. Column 1 is for standard installation into aluminum or corrosion-resistant steel. Column 2 is for installation into composite material regardless of thread length or aluminum material with less than three full threads of engagement. Column 3 is for installation in high vibration (engine) areas, clinch nuts, and ground straps.

Table 1 - Corrosion-resistant/plated steel screw torque, inch-pounds

Screw Size	Column 1 Min/Max	Column 2 Min/Max	Column 3 Min/Max
2-56	1.5/ 2.5	1.2/ 2.0	2.0/ 2.5
4-40	3.5/ 4.5	2.8/ 3.6	3.5/ 4.5
6-32	5.0/ 7.0	4.0/ 5.6	5.5/ 6.5
8-32	7.0/ 9.0	5.6/ 7.2	7.5/ 8.5
10-32	9.0/11.0	7.2/ 8.8	8.5/10.5
.250-20	11.0/13.0	8.8/10.4	10.5/15.5

4.2 Connector Receptacle Jam Nut Torque

Recommended torque for aluminum, composite, and corrosion-resistant steel connector jam nuts is listed in Table 2.

Table 2 - Connector receptacle jam nut torque, inch-pounds

Thread Size	Torque Min/Max	Connector Shell Size Reference			
		AS50151 AS95234	MIL-DTL-26482	MIL-DTL-26500	MIL-DTL-83723 Series I
.500-28UNEF-2B	24/ 30	8S			
.562-24UNEF-2B	26/ 32		8		8
.625-24UNEF-2B	28/ 34	10S - 10SL			
.625-20UN-2B	28/ 34			8	
.687-24UNEF-2B	30/ 36		10		10
.750-20UNEF-2B	34/ 40	12 - 12S		10	
.875-20UNEF-2B	46/ 50	14 - 14S	12		12
.937-20UNEF-2B	50/ 55			12	
1.000-20UNEF-2B	55/ 60	16 - 16S	14	14	14
1.125-20UN-2B	70/ 75			16	
1.125-18UNEF-2B	70/ 75	18	16		16
1.250-20UN-2B	80/ 85			18	18
1.250-18UNEF-2B	80/ 85	20	18		
1.375-18UNEF-2B	90/ 95	22	20	20	20
1.500-20UN-2B	105/115			22	
1.500-18UNEF-2B	105/115	24	22		22
1.625-18UNEF-2B	110/120		24	24	24
1.750-18UNS-2B	120/130	28			
2.000-18UNS-2B	150/160	32			
2.250-16UN-2B	170/180	36			
2.500-16UN-2B	200/210	40			
2.750-16UN-2B	220/230	44			
3.000-16UN-2B	240/250	48			

Table 2 - Connector receptacle jam nut torque, inch-pounds (continued)

Thread Size	Torque Min/Max	Connector Shell Size Reference		
		MIL-DTL-83723 Series III	MIL-DTL-38999 Series I	MIL-DTL-38999 Series II
.625-20UN-2B	28/ 34	8	9	
.750-20UNEF-2B	34/ 40	10	11	
.812-20UNEF-2B	40/ 46			8
.937-20UNEF-2B	50/ 55	12	13	10
1.000-20UNEF-2B	55/ 60	14		
1.125-18UNEF-2B	70/ 75	16		
1.125-20UN-2B	70/ 75		15	12
1.250-20UN-2B	80/ 85		17	14
1.250-18UNEF-2B	80/ 85	18	19	16
1.375-18UNEF-2B	90/ 95	20		
1.500-20UN-2B	105/115		21	18
1.500-18UNEF-2B	105/115	22	23	20
1.625-18UNEF-2B	110/120	24	25	22
1.750-18UNS-2B	120/130			24

Table 2 - Connector receptacle jam nut torque, inch-pounds (continued)

Thread Size	Torque Min/Max	Connector Shell Size Reference			
		MIL-DTL-28840 MIL-PRF-28876	MIL-DTL-27599	MIL-DTL-38999 Series III	MIL-DTL-38999 Series IV
.687-24UNEF-2B	30/ 36		9		
.750-20UNEF-2B	34/ 40				
.812-20UNEF-2B	40/ 46		11		
.875-20UNEF-2B	46/ 50	11	8		
.937-20UNEF-2B	50/ 55				
1.000-20UNEF-2B	55/ 60	13	10 & 13		
1.125-20UN-2B	70/ 75				
1.125-18UNEF-2B	70/ 75		12 & 15		
1.187-18UNEF-2B	75/ 80	15			
1.250-20UN-2B	80/ 85		14 & 17		
1.250-18UNEF-2B	80/ 85	17			
1.375-18UNEF-2B	90/ 95		16 & 19		
1.437-18UNEF-2B	100/110	19			
1.500-20UN-2B	105/115				
1.500-18UNEF-2B	105/115		18 & 21		
1.625-18UNEF-2B	110/120	23	20 & 23		
1.750-18UNS-2B	120/130	25	22 & 25		
1.875-16UN-2B	140/150		24		
1.937-16UN-2B	145/155	29			
2.000-18UNS-2B	150/160				
2.125-16UN-2B	170/180	33			

Table 2 - Connector receptacle jam nut torque, inch-pounds (continued)

Thread Size	Torque Min/Max	Connector Shell Size Reference			
		MIL-DTL-28840 MIL-PRF-28876	MIL-DTL-27599	MIL-DTL-38999 Series III	MIL-DTL-38999 Series IV
M17 x 1-6H	30/ 36			09	
M20 x 1-6H	40/ 46			11	
M25 x 1-6H	55/ 60			13	11
M28 x 1-6H	70/ 75			15	13
M31 x 1-6H	70/ 75				15
M32 x 1-6H	80/ 85			17	
M34 x 1-6H	80/ 85				17
M35 x 1-6H	90/ 95			19	
M38 x 1-6H	100/110			21	19
M41 x 1-6H	110/120			23	21
M44 x 1-6H	120/130			25	23
M47 x 1-6H	120/130				25

4.3 Secondary Adapter and AS Cable Clamp Torque

Recommended torque for aluminum and corrosion-resistant steel secondary adapters and AS85049/41 and AS85049/42 type cable clamps is listed in Table 3. Cable clamps that utilize elastomeric sealing grommets such as AS85049/1 and AS85049/2 need adequate torque applied to assure proper cable sealing but not over torqued to the extent that the sealing grommet extrudes. For all assemblies where metal braided RFI/EMI shielding is terminated using conical metal ferrule(s), the minimum recommended torque is 35 in-lb.

Table 3 - Secondary and AS cable clamp torque, inch-pounds

AS Clamp Size	Torque Min/Max
3	30/ 40
4	30/ 40
6	35/ 55
8	35/ 55
10	35/ 55
12	40/ 60
16	40/ 60
20	40/ 60
24	80/100
28	80/100
32	80/100
40	80/100

4.4 Connector Accessory Recommended Torque

Recommended torque for accessories such as those defined in AS85049 to connector rear threads is listed in Table 4.

Column 1 is for aluminum medium- and light-duty accessories, including connector series:

- AS50151 (AS31001 Series)
- MIL-DTL-26482 Series 1
- MIL-DTL-26500
- MIL-DTL-27599
- MIL-DTL-38999 Series I and II
- AS81511 Series 1, 2, 3, 4
- AS81703 Series 1

Column 2 is for aluminum heavy-duty accessories, including connector series:

- AS50151 (AS34001 Series)
- MIL-DTL-22992
- MIL-DTL-26482 Series 2
- MIL-DTL-28840
- MIL-DTL-38999 Series III and IV

- AS81703 Series 3
- MIL-DTL-83723 Series I, II, III
- AS95234

Column 3 is for accessories with composite (high-grade engineering thermoplastic) material coupling threads.

Column 4 is for accessories with aluminum coupling threads used in high vibration (engine) applications.

Column 5 is for accessories with corrosion-resistant steel coupling threads used in high vibration (engine) applications.

Table 4 - Connector accessory torque, inch-pounds

Connector Shell Sizes	Column 1 Min/Max	Column 2 Min/Max	Column 3 Min/Max	Column 4 Min/Max	Column 5 Min/Max
8,9,A	30/ 40	51/ 61	20/ 25	66/ 77	91/101
3,10,10SL, 11, B	30/ 40	71/ 81	20/ 30	103/113	115/125
7,12,12S,13,C	35/ 45	103/113	25/ 35	115/125	115/125
14,14S,15,D	35/ 45	111/121	25/ 35	139/149	139/149
16,16S,17,E	35/ 45	111/121	30/ 40	139/149	139/149
18,19,27,F	35/ 45	111/121	30/ 40	139/149	175/185
20,21,37,G	75/ 85	131/141	35/ 45	175/185	199/209
22,23,H	75/ 85	131/141	35/ 45	175/185	223/233
24,25,61,J	75/ 85	131/141	35/ 45	175/185	259/269
28,29	115/125	143/153	115/125	187/197	307/317
32,33	115/125	143/153			
36	115/125	142/153			
40	155/165	159/169			
44	155/165	159/169			
48	155/165	159/169			

4.5 Connector to Connector (Plug to Receptacle) Coupling Torque

Recommended torques for coupling threaded plug and receptacle connectors are shown in Table 5.

Table 5 - Connector to connector torque, inch-pounds

Connector Series Shell Size					
Connector Torque Max/in-lb	MIL-DTL-28840 MIL-PRF-28876	MIL-DTL-38999 Series III	MIL-DTL-83723 Series II	MIL-DTL-83723 Series III	AS50151
8		A (9)			
11				8	
12	A (11)	B (11)	8S		8S
13				10	
14			10S & 10SL	12	10S & 10SL
16	B (13)	C (13)	12 & 12S		12 & 12S
18				14	
20	C (15)	D (15)	14 & 14S		14 & 14S
21				16	
24	D (17)	E (17)	16 & 16S		16 & 16S
27				18	
28	E (19)	F (19)			
30			18		18
31				20	
32		G (21)		22	
36	F (23)	H (23)			
40	G (25)	J (25)	20		20
46			22	24	22
47	H (29)				
53	J (33)				
55			24		24
66			28		28
78			32		32
93			36		36
106			40		40

4.6 Torque for Switches, Relays, Circuit Breakers, and Terminal Boards

Recommended application torques for switches, relays, circuit breakers, and terminal boards are as shown in Table 6.

Table 6 - Recommended application torque

Screw Size	Material	
	Steel (60000 psi Tensile Strength Min)	Brass/Aluminum (55000 psi Tensile Strength Min)
	Recommended Torque Values ⁽¹⁾	Recommended Torque Values ⁽¹⁾
#6 (0.138 inch) -32 UNC	8- 10	7- 9
#6 (0.138 inch) -40 UNF	8- 11	8- 10
#8 (0.164 inch) -32 UNC	11- 17	11- 17
#8 (0.164 inch) -36 UNF	11- 19	11- 18
#10 (0.190 inch) -24 UNC	20- 25	18- 23
#10 (0.190 inch) -32 UNF	20- 29	20- 25
1/4 inch -20 UNC	55- 62	50- 58
1/4 inch -28 UNF	60- 70	58- 66
5/16 inch -18 UNC	80- 105	70- 80
5/16 inch -24 UNF	90- 140	80- 90
3/8 inch -16 UNC	110- 145	85- 105
3/8 inch -24 UNF	115- 175	90- 110
7/16 inch -14 UNC	125- 160	100- 125
7/16 inch -20 UNF	130- 190	120- 150
1/2 inch -13 UNC	135- 175	115- 150
1/2 inch -20 UNF	150- 200	150- 200
9/16 inch -12 UNC	195- 215	195- 215
9/16 inch -18 UNF	210- 275	210- 275
5/8 inch -11 UNC	270- 300	230- 300
5/8 inch -18 UNF	300- 400	300- 400
3/4 inch -10 UNC	475- 530	400- 530
3/4 inch -16 UNF	525- 700	525- 700
7/8 inch -9 UNC	770- 850	650- 850
7/8 inch -14 UNF	835-1100	835-1100

⁽¹⁾ All values are in inch-pounds and believed to be applicable to switches, relays, circuit breakers, and terminal boards. This data was developed using 55 and 60 KSI fasteners only. If a different strength fastener is used, consult your engineer group for any changes required.

4.6.1 Purpose

The purpose of Table 6 is to provide recommended torque values for attaching electrical devices to receiving members by means of screws, bolts, studs, and nuts; i.e., standard mounting hardware.

The values provided in the table cover selected steel, brass, and aluminum materials used for standard mounting hardware. These values were based upon safe mechanical strengths as defined by general industry practices and existing aerospace requirements (SAE Grade 2 as a minimum).

These recommendations are general guidelines. Safety factors for any unusual mounting applications or operating conditions, such as vibration, impact, shear, and fatigue, should be given special consideration by the designer.

The specified values are not intended to be design criteria for the minimum torque values that switches, relays, circuit breakers, and terminal boards should be able to withstand without failure.

Also, these values are not intended to supersede those recommended by equipment/component manufacturers or required by the equipment designer.