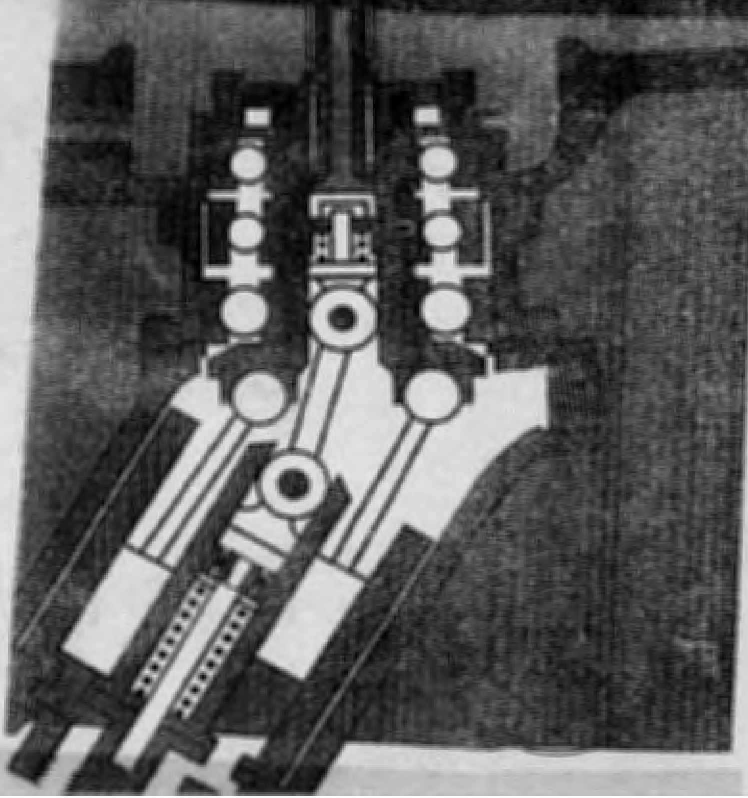
HANDBOOK



© Jeppesen
55 Inverness Dr. E.
Englewood, CO 80112-5498
Website: www.Jeppesen.com
Email: Captain@jeppesen.com

Printed in the United States of America

ISBN 0-88487-324-2

JS312624-002

U

V

W

A

B

C

Fig. 7-101

CHERRY RIVETS

CR9162-4-2 —— Rivet Grip Number (grip length)
Serrated stems are in 16ths of an inch
(-2 is 2/16" or 1/8")
Knob stems are in 32nds of an inch
(-4 is 4/32" or 1/8")

—— Rivet Diameter in 32nds of an inch (-4 is 4/32 or 1/8)

—— Example Series Number

Rivet Shank Diameter	Rivet Dia. Dash No.	Recomm'd Finish Drill	Inspection Limits Minimum	Maximum
3/32	-3	#40	.097	.101
1/8	-4	#30	.129	.132
5/32	-5	#20	.160	.164
3/16	-6	#10	.192	.196
7/32	-7	#2	.220	.225
1/4	-8	F	.256	.261
9/32	-9	L	.289	.295
1/18 Bulbed	-4	#27	.143	.146
5/32 Bulbed	-5	#16	.176	.180
3/16 Bulbed	-6	#5	.205	.209
1/4 Bulbed	-8	1	.271	.275

Material Thickness Range		Rivet Grip Number	
Minimum	Maximum	Knob Stems	Serrated Stems
1/32(.032)	1/16 (.062)	-2	-1
1/16(.062)	1/8 (.125)	-4	-2
1/8(.125)	3/16 (.187)	-6	-3
3/16(.187)	1/4 (.250)	-8	-4
1/4(.250)	5/16 (.312)	-10	-5
5/16(.312)	3/8 (.375)	-12	-6
3/8(.375)	7/16 (.437)	-14	-7
7/16(.437)	1/2 (.500)	-16	-8
1/2(.500)	9/16 (.562)	-18	-9
9/16(.562)	5/8 (.625)	-20	-10
5/8(.625)	11/16 (.687)	-22	-11
11/16 (.687)	3/4 (.750)	-24	-12
3/4(.750)	13/16 (.812)	-26	-13
13/16 (.812)	7/8 (.875)	-28	-14
7/8(.875)	15/16 (.937)	-30	-15
15/16 (.937)	1 (1.000)	-32	-16

Fig. 100 (cont.)

FLAT TYPE

Used to replace threaded nuts, lock washers and spanner washers; weigh less than other types of self-locking aircraft fasteners. Can be applied faster, easier, and are vibration resistant. Provide maximum holding power at minimum cost per fastener. Turned-up ends prevent scoring of surfaces.

Use these with Type B tapping screws:

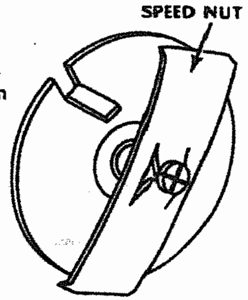
Part Number	Screw Size	A Length	B Width
A1776-4Z-1	4B	.50	.31
A1181-6Z-1	6B	.51	.31
A1777-6Z-1	6B	.63	.44
A1778-8Z-1	8B	.63	.44
A1779-10Z-1	10B	.88	.50

Use these with machine screws:

Part Number	Screw Size
AI05-440-1	4-40
A1322-632-1	6-32
A1322-832-1	8-32

Fig. 7-99

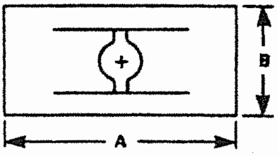
PATCH PLATES



Used as inspection hole covers and for sealing holes left after removal of equipment, design changes, etc. Installed from one side. Coined edge on washer prevents scratching of Alclad surfaces. Supplied with 82-degree flat-recessed head machine screw with end upset to prevent removal of Speed Nut.

Tinnerman Number	Screw Size	Dia. Of Hole In Skin	Washer Dia.
A6912-832-1	8-32	.906	1.062
A6914-1024-1	10-24	1.375	1.687

Fig. 7-100



TINNERMAN NUTS

MATERIAL: Special aircraft spring steel is generally used for all parts unless otherwise specified. Where Speed Nuts are available in stainless steel the part number will include SS — example: A6199SS-8Z-3. Speed Nuts with welding nibs are made of stainless steel only.

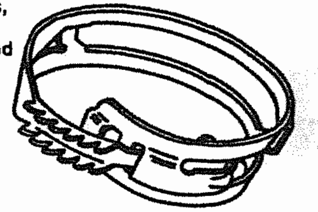
Finish: Tinnerman items are offered in the following finishes — (final dash number of the part number denotes the type finish):

-1	(Phosphate and three coats olive drab phenolic paint)
-24A	(Cadmium Electro-plate)
-24J	(Cadmium plate per QQ-P-416)
-27	(Soluble oil dipped)
-493	(Aluminum electroplate .0002 minimum, plus chromate to QQ-P-416A, Class 3, Type 2)
-495	(Cadmium electroplate .0002 minimum to QQ-P-416A, Class 3, Type 1)

Fig. 7-98

HOSE CLAMPS

Self-locking, ratchet-type hose clamps. One-piece construction — no bolts, nuts, or thumb screws. Fast, easy installation and removal on low- and medium-pressure connections. Approved for use on military aircraft. Clamps are made of special aircraft spring steel. Finish is phosphate and 3 coats of olive drab phenolic paint.

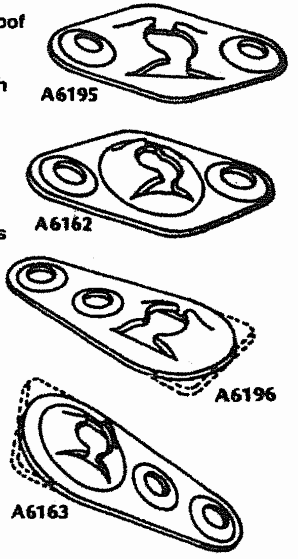


Tinnerman Number	NAS Number	Hose O.D. (inches) Minimum	Maximum
A3122-8-1J	397-8	15/32	1/2
A3122-10-1J	397-10	9/16	5/8
A3122-12-1J	397-12	11/16	3/4
A3122-14-1J	397-14	13/16	7/8
A312246-1J	397-16	15/16	1
A3122-18-1J	397-18	1-1/f16	1-1/8
A3122-20-1J	397-20	1-1/8	1-1/4
A3122-22-1J	397-22	1-1/4	1-3/8
A3122-24-1J	397-24	1-11/32	1-1/2
A3122-28-1J	397-28	1-19/32	1-3/4
A3499-30-1J	397-30	1-13/16	1-15/16
A3499-32-1J	397-32	1-15/16	2-1/16
A3499-34-1J	397-34	2-1/16	2-3/16

Fig. 7-97

ANCHOR TYPE SPEED NUTS

To attach access plates, doors, or any part that must be fastened securely, yet be easily removed with fasteners retained in blind location. Riveted in screw-receiving position, they make firm, vibration-proof attachments. Popular types shown in the table are all for 3/32" dia. rivets. All except the A6191's are for use with sheets dimpled for 100 degree flat head rivets.

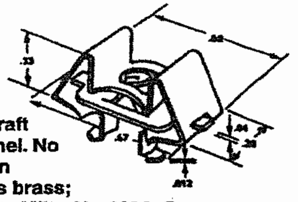


Tinnerman Part Number	Screw Size (B or Z)	Material Thickness
A6191-6Z-1	6	.025
A6191-8Z-1	8	.028
A6195-6Z-1	6	.025
A6195-8Z-1	8	.028
A6162-8Z-1	8	.028
A6196-6Z-1	6	.025
A6196-8Z-1	8	.028
A6163-8Z-1	8	.028

NOTE: Speed Nuts for aircraft are designed to fit standard AN530 type "B" or "Z" sheet metal screws only. Important—do not use pointed type "A" sheet metal screws with aircraft Speed Nuts. There is a difference in root diameter and thread pitch!

Fig.7-96

INSTRUMENT MOUNTING



Cage-type. Permits mounting of aircraft instruments from the front of the panel. No change in panel or instrument design required. Non-magnetic (speed nut is brass; cage is phosphor bronze). Conform to MIL—N—3336. Gauge is easily compressed with finger-pressure to allow insertion of legs into clearance holes. When fully inserted and pressure is released, legs spring apart and retain the SPEED NUT in the screw-receiving position. Turned-down corners hold firm against force of inserting screw and screw-tightening torque. All instrument mounting nuts listed below take a 6-32 machine screw.

Tinnerman Part Number	NAS Part No.	Panel Thickness
A8938-632-493	487-13	.062
A8939-632-493	487-14	.091
A6939-632-493	487-15	.125
A8940-632-493	487-16	.187
A8941-632-493	487-17	.250
A8942-632-493	487-18	.313
A8943-632-493	487-20	.375
A8944-632-493	487-21	over .375

Fig. 7-95 (cont.)

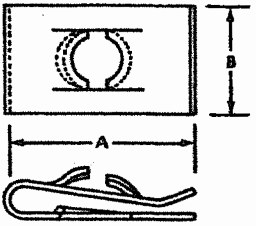
Tinnerman Part No.	-NAS P/N	Screw Size (B or Z)	Design Varia.	Panel Range	A (L)	B (W)
A6187-4Z-1	395-1	4	CD	.025-.032	.38	.31
A188-6Z-1	395-5	6	ACDH	.025-.032	.48	.75
A1784-6Z-1	395-6	6	E	.02S-.051	.61	.44
A1785-6Z-1	395-7	6	E	.025-.064	.84	.44
A6052-6Z-1	395-3	6	EH	.032-.040	.47	.50
A1932-6Z-1	396-1	6	BE	.032-.051	.59	.50
A1274-8Z4	395-14	8	DEH	.025-.032	.50	.50
A1348-8Z-1	39S-17	8	AE	.025-.064	.75	.50
A1786-8Z-1	395-12	8	CEH	.040-.051	.53	.50
A1787-8Z-1	395-18	8	E	.025-.064	.84	.44
A1788-8Z-1	——	8	AE	.025-.064	.84	.44
Al 789-8Z-1	395-16	8	E	.025-.051	.61	.44
A1932-8Z-1	396-4	8	BE	.032-.051	.59	.50
A1350-10Z-1	395-25	10	AE	.025-.064	.75	.50
A1758-10Z-1	39S-24	10	E	.081-.094	.62	.44
A1787-10Z-1	——	10	E	.025-.064	.84	.44
A1791-10Z-1	——	10	EH	.040-.064	.63	.63
A1794-10Z-1	395-23	10	E	.032-.064	.64	.44
A9031-10Z-1	39S-28	10	EH	.102-.125	.70	.63

Fig 7-95

"U" TYPE

Self-retaining; press easily into locked-on position over panel edges or in center panel locations. Hold themselves in a screw-receiving position and are ideal for blind assembly or hard-to-reach locations.

Eliminated arc welding, staking, riveting or other secondary fastening methods. Used where full bearing surface on the lower leg of the SPEED NUT is required.



DESIGNATIONS

A

No extrusion on lower leg

B

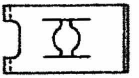
Full extrusion on lower leg

C

Straight upper leg

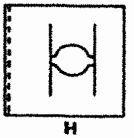
D

Corner turned up



E

Relief notch



H

Speed Nut impression turned 90 degrees

Fig 7-92

CAMLOC COWL FASTENERS STUD ASSEMBLIES 4002 Series

Part Number	Dimensions (inches) A	B	C	D
4002	.4	S±.02	.168	.42

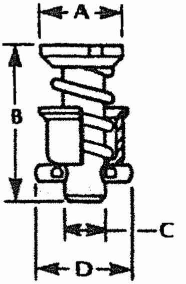


Fig 7-93

CAMLOC COWL FASTENERS GROMMETS Plus Flush, 4002 Series

Part Number	Dimensions (inches) E	F	G	H
4002-N	.621	.197	.026	.118
4002-0	.621	.197	.026	.147

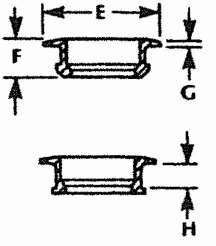


Fig 7-94

CAMLOC COWL FASTENERS RECEPTACLES 2600, 2700, 4002 Series

	2600	2700	4002
I	1.0	1.0	1.38
J	.75	.75	1.0
K	.5	.5	.69
L	.5	.5	.526
M	.072	.072	.09

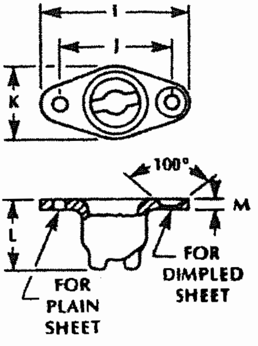


Fig 7-89

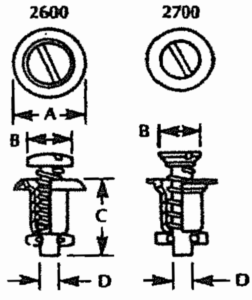
CAMLOC COWL FASTENERS

STUD ASSEMBLIES

2600, 2700 Series

Steel; slotted head;

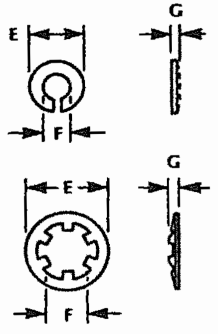
.030 stud increments



Part Number	Dimensions (inches) A	B	C	D
2600	.5	.303	S±.02	.128
2700	.39	.254	S± .02	.127

Fig 7-90

CAMLOC COWL FASTENERS RETAINING WASHERS 2600, 2700 Series



Part Number	Dimensions (inches) E	F	G
2600-SW 2 (Split)	.312	.156	.019
2600-LW (Solid)	.46	.232	.04

Fig 7-91

CAMLOC COWL FASTENERS PLIERS - 4P3

2600, 2700 Series

Compress stud with 4P3 pliers, insert stud into panel and release. DO NOT REMOVE THE STUD CROSS PIN.

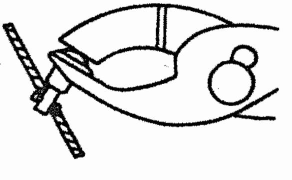
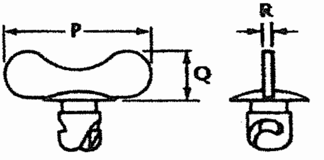


Fig. 7-88 (cont.)

WING TYPE FASTENERS

Dimensions A, B, and L are same as standard slotted. head fasteners. Example: AW4-25 dimensions are the same as those of A4-25. Wing in lock position usually aligns with the spring rivets. Use the same size grommets and springs for wing type as are specified for standard slotted head type.



TYPE AW and AJW

Part Number	Dimensions (inches) P	Q	R
AW4-25			
AW4-30	.875	.3125	.050
AW4-35			
AWS-30			
AW5-35			
AW5-40	1.125	.4375	.062
AW5-45			
AW5-50			

Fig. 7-87

TYPE S SPRINGS

Part Number	Dimensions (inches)	
	H	G
S4-200	.200	.750
S4-250	.250	
S5A-200	.200	
S5A-225	.225	1.000
S5A-300	.300	
S5A-325	.325	
S6A-250	.250	
S6A-275	.275	1.375
S6A400	.400	
S6A425	.425	

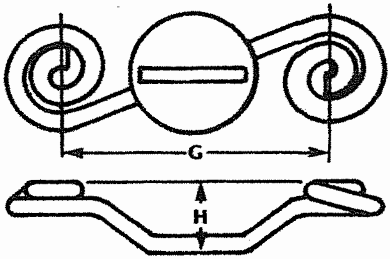
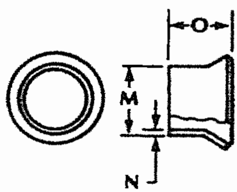


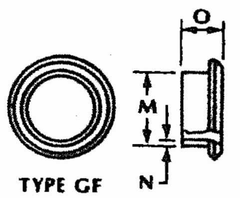
Fig. 7-88

TYPES GA AND GF GROMMETS

Part Number	Dimensions (inches)			Max. Depth Of Panel
	O	M	N	
GA3-175	.175	.2187	.015	.025
GA3-200	.200	.2187	.015	.050
GA4-250	.250	.3125	.025	.050
GA5-312	.312	.375	.028	.062
GA5-375	.375	.375	.028	.125
GA6-1/2-375	.375	.500	.035	.093
GA6-1/2-500	.500	.500	.035	.200
GF5-175	.175	.375	.028	.062
GF6-1/2-250	.250	.500	.035	.093



TYPE GA



TYPE GF

Fig. 7-86 (cont.)

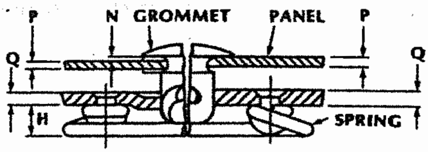
Part Number	Dimensions (inches) A	B	L	Uses Grommet	Uses Spring
A4-25			.250		
A4-30	.250	.080	.300	GA4-250 S4-200, S4-225	
A4-35			.350		
A5-30			.300		
A5-35			.350		
A5-40	.3125	.100	.400	GA5-312, GA5-375	S5A-250, S6A-275
A5-45			.450		
A5-50			.500		
A6-1/2-40	.4065	.125	.400	GA6-1/2-375, GA6-1/2-500	S6A-250, S6A-275
A6-1/2-50			.500		
AJ4-25		.075	.250		
AJ4-35	.250	.150	.350	GA4-250 S4-200, S4-225	
AJ4-50		.250	.500		
AJ5-30		.100	.300		
AJ5-35	.125	.350			
AJ5-40	.3125	.190	.400	GA5-312, GA5-375	S5A-200, S5A-225, S5A-250
AJ5-45		.190	.450		
AJ5-50		.250	.500		
AJ6-1/2-45		.188	.450		
AJ6-1/2-50		.250	.500		
	.4062			GA6-1/2-375, GA6-1/2-500	S6A-250, S6A-275
AJ6-1/2-80		.450	.800		
AJ6-1/2-90		.550	.900		
FA5-35			.350		
FA5-40	.3125	.188	.400	GF5-175	S5A-300, S5A-325
FA5-45			.450		
FA5-50			.500		
FA6-1/2-45			.450		
FA6-1/2-50			.500		
FA6-1/2-55	.4062	.250	.550	GF6-1/2-218, GF6-1/2-250	S6A-4OO, S6A-425
FA6-1/2-60			.600		

Fig. 7-86

DZUS FASTENERS

STANDARD LINE

Fastener studs are made of steel, heat treated and cadmium plated. Springs are made of music wire, cadmium plated. Grommets are made of aluminum or steel, cadmium plated. No special tools needed to operate the fasteners.



IN SELECTING LENGTH OF FASTENER-
Add N+P+Q+H — Subtract spring deflection.
For installation without grommet — omit "N".

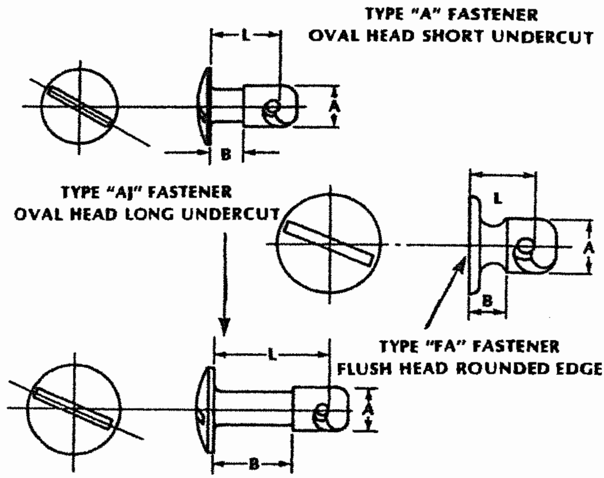
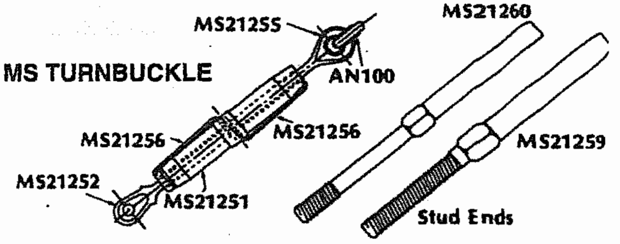


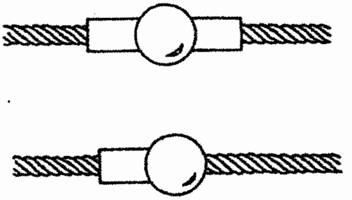
Fig. 7-85



Part Number	Thread	Cable Dia.	Description
MS21251-B2S	6-40	1/16	
-B3S	10-32	3/32	Barrel (Body), Brass
-B3L	10-32	3/32	
-B5S	1/4-28	5/32	
MS21252-3LS	10-32	3/32	
-3RS	10-32	3/32	Fork (Clevis End)
-5RS	1/4-28	5/32	
MS21254-2RS	6-40	1/16	
-3RS	10-32	3/32	Eye End (for pin)
-5LS	1/4-28	5/32	
-5RS	1/4-28	5/32	
MS21255-3LS	10-32	3/32	Eye End (for cable)
-3RS	10-32	3/32	
MS21259-2RH	6-40	1/16	
-2LH	6-40	1/16	Stud End
-4RH	1/4-28	1/8	
-4LH	1/4-28	1/8	
MS21260-S2RH	6-40	1/16	
(Short) -S2LH	6-40	1/16	
-S3RH	10-32	3/32	Stud End
-S3LH	10-32	3/32	
-S4RH	1/4-28	1/8	
-S4LH	1/4-28	1/8	
MS21256-1	----	-----	Clip (for short barrels)
-2	----	-----	Clip (for long barrels)

Fig. 7-83

SWAGED BALL & SHANK



Part Number	Cable Dia. (in.)	Pin Hole Dia. (in.)	Description
MS20663C-2	1/16	.073	
-3	3/32	.104	Ball & Double Shank
-4	1/8	.139	
MS20664C-2	1/16	.073	
-3	3/32	.104	
-4	1/8	.139	Ball & Single Shank
-5	5/32	.169	
-6	3/16	.201	

Fig. 7-84

AN TURNBUCKLE

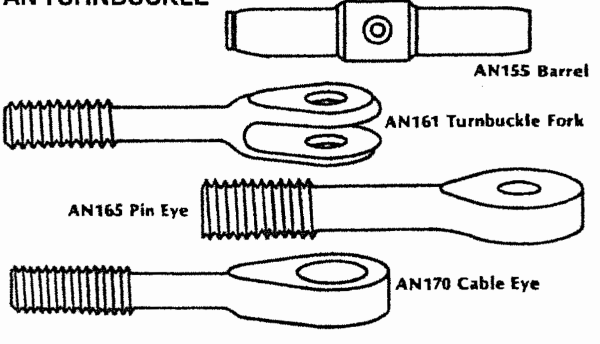
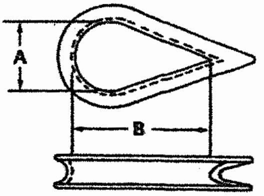


Fig. 7-81

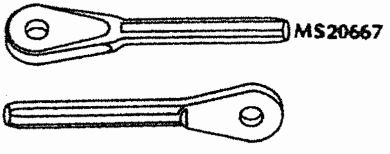
CABLE TERMINALS
AN100 CABLE THIMBLES



Dash Number Carbon Steel	Dash Number Cor. Res. Steel	Fits Cable Size	Dimensions (inches) A	Dimensions (inches) B
-3	-C3	1/16-5/64	.35	.70
-4	-C4	3/32-7/64-1/8	.35	.70
-5	-C5	5/32	.40	.80
-6	-C6	3/16	.50	1.00

Fig. 7-82

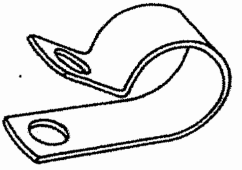
SWAGED FORK & EYE ENDS



Part Number	Cable Dia. (in.)	Pin Hole Dia. (in.)	Description
MS20667-2	1/16	.190	
-3	3/32	.190	Fork End
-4	1/8	.190	
-5	5/32	.250	
-6	3/16	.313	
MS20668-2	1/16	.190	
-3	3/32	.190	
-4	1/8	.190	Eye End
-5	5/32	.250	
-6	3/16	.313	

Fig. 7-79

AN742 PLAIN CLAMP



Dash No.	For Use With Rigid Tube O.D. (inches)
D3	3/16
D4	1/4
D5	5/16
D12	3/4
D16	1

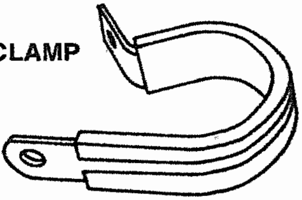
Fig. 7-80

SAFETY WIRE
MS20995 SAFETY WIRE

Material	Nominal Wire Diameter (inches) .020	.025	.032	.040	.041
	MS20995 Dash Number				
Monel	-NC20	-----	-NC32	-NC40	-----
Corrosion-Resistant Steel	-C20	-C25	-C32	------	-C41

Fig. 7-78

MS21919 CUSHIONED CLAMP

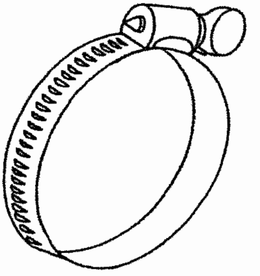


AN741 Equiv.	For Use With Tube O.D. (Inches)	Dash Number Aluminum	Steel
D4C	1/8	DG2	G2
D5C	3/16	DG3	G3
D6C	1/4	DG4	G4
D7C	5/16	DG5	G5
D8C	3/8	DG6	G6
D9C	7/16	DG7	
D10C	1/2	DG8	G8
D11C	9/16	DG9	G9
D12C	5/8	DG10	G10
D13C	11/16	DG11	
D14C	3/4	DG12	G12
D15C	13/16	DG13	
D16C	7/8	DG14	G14
D17C	15/16	DG15	
D18C	1	DG.16	
D19C	1-1/16	DG17	
D20C	1-1/8	DG18	
D21C	1-3/16	DG19	
D22C	1-1/4	DG20	
D23C	1-5/16	DG21	
D24C	1-3/8	DG22	
D25C	1-7/16	DG23	
D26C	1-1/2	DG24	
D27C	1-9/16	DG25	
D28C	1-5/8	DG26	

Fig. 7-77

CLAMPS

AN737 HOSE CLAMP



Dash Number	Min. I.D. Of Clamp (inches)	Max. I.D. Of Clamp (inches)	For Use With Hose I.D.	
			Non Self-Sealing	Self-Sealing
TW22	7/16	11/16	1/4	----
TW24	1/2	3/4	5/16	----
TW26	9/16	13/16	3/8	----
TW30	11/16	15/16	1/2	----
TW34	13/16	1-1/16	5/8	----
TW38	15/16	1-3/16	3/4	----
TW44	61/64	1-3/8	----	5/8
TW46	1	1-7/16	1	----
TW48	1-5/64	1-1/2	----	3/4
TW56	1-21/64	1-3/4	----	1-1/4
TW58	1-3/8	1-13/16	1-1/4	-----
TW66	1-5/8	2-1/16	1-1/2	1-1/4
TW74	1-7/8	2-5/16	1-3/4	1-1/2
TW82	2-1/8	2-9/16	2	-----
TW91	2-13/32	2-27/32	-----	-----
TW98	2-5/8	3-1/16	2-1/2	-----
TWI07	2-29/32	3-11/32	-----	2-1/2
TW114	3-1/8	3-9/16	3	-----

Fig 7-76 (cont.)

Part Number	Size (in.)	
	I.D.	O.D.
-16	3-1/2	3-3/4
-20	4	4-1/4
-22	4-1/4	4-1/2
-24	4-1/2	4-3/4
-29	5-1/8	5-3/8
-30	5-1/4	5-1/2
-36	6	6-1/4
-37	6-1/4	6-1/2
-38	6-1/2	6-3/4
-39	6-3/4	7
-44	8	8-1/4
-47	8-3/4	9
-49	9-1/4	9-1/2

Fig 7-76 (cont.)

Part Number	Size (in.)	
	I.D.	O.D.
-31	1-7/8	2-1/4
-32	2	2-3/8
-33	2-1/8	2-1/2
-34	2-1/4	2-5/8
-35	2-3/8	2-3/4
-36	2-1/2	2-7/8
-37	2-5/8	3
-38	2-3/4	3-1/8
-39	2-7/8	3-1/4
-40	3	3-3/8
-41	3-1/8	3-1/2
-42	3-1/4	3-5/8
-44	3-1/2	3-7/8
-46	3-3/4	4-1/8
-47	3-7/8	4-1/4
AN623OB-1	1-5/8	1-7/8
-2	1-3/4	2
-3	1-7/8	2-1/8
-4	2	2-1/4
-5	2-1/8	2-3/8
-6	2-1/4	2-1/2
-7	2-3/8	2-5/8
-8	2-1/2	2-3/4
-9	2-5/8	2-7/8
-10	2-3/4	3
-11	2-7/8	3-1/8
-12	3	3-1/4
-13	3-1/8	3-3/8
-14	3-1/4	3-1/2
-15	3-3/8	3-5/8

Fig. 7-76

AN6227 O-RING, PACKING

AN6230 O-RING, GASKET

Part Number	Size (in.) I.D.	Size (in.) O.D.
AN6227B-1	1/8	1/4
-2	5/32	9/32
-3	3/16	5/16
-4	7/32	11/32
-5	1/4	3/8
-6	5/16	7/16
-7	3/8	1/2
-8	3/8	9/16
-9	7/16	5/8
-10	1/2	11/16
-11	9/16	3/4
-12	5/8	13/16
-13	11/16	7/8
-14	3/4	15/16
-15	3/4	1
-16	13/16	1-1/16
-17	7/8	1-1/8
-18	15/16	1-3/16
-19	1	1-1/4
-20	1-1/16	1-5/16
-21	1-1/8	1-3/8
-22	1-3/16	1-7/16
-23	1-1/4	1-1/2
-24	1-5/16	1-9/16
-25	1-3/8	1-5/8
-26	1-7/16	1-11/16
-27	1-1/2	1-3/4
-28	1-1/2	1-7/8
-29	1-5/8	2
-30	1-3/4	2-1/8

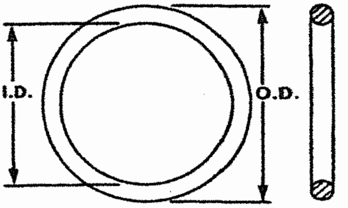


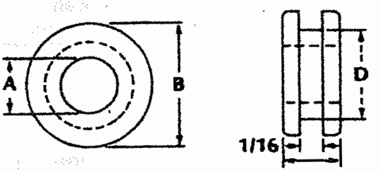
Fig 7-75 (cont.)

MS35489 GROMMET, ELASTIC (cont.)

MS35489 Dash Number	AN931 Dash Number	Dimensions (Inches)			
		A	B	D	T
-22	-14-20	7/8	1-5/8	1-1/4	7/16
-121	-14-26	7/8	2	1-5/8	7/16
-23	-16-22	1	1-3/4	1-3/8	7/16
-24	-16	1	2-1/4	1-7/8	7/16

Fig. 7-75

MS35489 GROMMET, ELASTIC



MS35489 Dash Number	AN931 Dash Number	Dimensions (Inches)			
		A	B	D	T
-2	-2-9	1/8	3/4	9/16	3/16
-3	-2-16	1/8	1-1/4	1	1/4
-134	-3-9	3/16	3/4	9/16	3/16
-4	-3-5	3/16	7/16	5/16	3/16
-5	-3-10	3/16	7/8	5/8	3/16
-6	-4-7	1/4	5/8	7/16	3/16
-7	-4-12	1/4	1	3/4	1/4
-8	-4-16	1/4	1-1/4	1	1/4
-9	-5-9	5/16	13/16	9/16	5/16
-10	-5-12	5/16	1	3/4	5/16
-118	-5-13	5/16	1-1/16	13/16	5/16
-11	-6-10	3/8	7/8	5/8	5/16
-12	-6-16	3/8	1-1/4	1	1/4
-13	-7-11	7/16	15/16	11/16	5/16
-14	-8-13	1/2	1-1/16	13/16	5/16
-15	-8-20	1/2	1-1/2	1-1/4	1/4
-16	-9-13	9/16	1-1/16	13/16	5/16
-17	-10-14	5/8	1-1/8	7/8	5/16
-18	-10-20	5/8	1-1/2	1-1/4	1/4
-19	-11-16	11/16	1-5/16	1	3/8
-135	-12-20	3/4	1-5/8	1-1/4	1/4
-20	-12-17	3/4	1-3/8	1-1/16	3/8
-21	-12-23	3/4	1-13/16	1-7/16	3/8
-120	-12-26	3/4	2	1-5/8	3/8

Fig. 7-74

AN901 GASKET, TUBE CONNECTION SEAL

Dash Number	Tube O.D. (Inches)
-4A	1/4
-5A	5/16
-6A	3/8
-8A	1/2
-10A	5/8
-12A	3/4
-16A	1

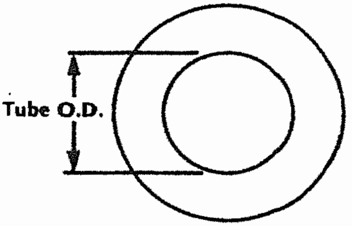


Fig. 7-72

AN900 GASKET, ANNULAR COPPER-ASBESTOS

Part Number	I.D. (inches)
AN900-4	1/4
-6	3/8
-7	7/16
-8	1/2
-10	5/8
-11	11/16
-12	3/4
-14	7/8
-16	1
-17	1-1/16
-18	1-1/8
-22	1-3/8
-28	1-3/4
-29	1-13/16

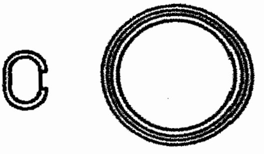


Fig. 7-73

MS28778 GASKET, TUBE FITTING BOSS

Part Number	Tube O.D. (in.)
MS28778-2	1/8
-3	3/16
-4	1/4
-5	5/16
-6	3/8
-8	1/2
-10	5/8
-12	3/4

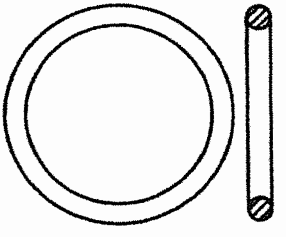


Fig. 7-70

MS20913 PLUG, SQUARE HEAD

MS20913 Dash No.			Pipe Thread
Brass	Alum.	Stainless Steel	
-1	-1D	-1S	1/8"
-2	-2D	-2 S	1/4"
-3	-3D	-3 S	3/8"
-4	-4D	-4 S	1/2"
-6	-6D	-6 S	3/4"
-8	-8D	-8 S	1"
-10	-10D	-10 S	1-1/4"

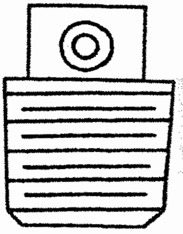


Fig. 7-71

AIRCRAFT NAILS
Flat, Bonderized, cement coated

AN Number	Length	Gauge
AN301-2	1/4"	20
AN301-516	5/16"	20
AN301-3	3/8"	20
AN301-4	1/2"	20
AN301-5	5/8"	20
AN301-6	3/4"	20
AN301-8	1"	20
AN301B18-5	5/8"	18 Brass
AN301B18-7	7/8"	18 Brass

AN301 NAIL, AIRCRAFT

Fig. 7-68

MS20825 TEE, FLARED TUBE WITH PIPE THREAD ON SIDE

MS20825 Dash No.		Tube	Pipe
Steel	Alum.	O.D.	Thread
-2	-2D	1/8"	1/8"
-3	-3D	3/16"	1/8"
-4	-4D	1/4"	1/8"
-5	-5D	5/16"	1/8"
-6	-6D	3/8"	1/4"
-8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-12	-12D	3/4"	3/4"
-16	-16D	1"	1"

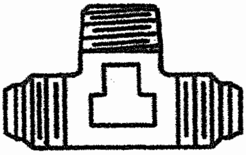


Fig. 7-69

MS20826 TEE, FLARED TUBE WITH PIPE THREAD ON RUN

MS20826 Dash No.		Tube	Pipe
Steel	Alum.	O.D.	Thread
-2	-2D	1/8"	1/8"
-3	-3D	3/16"	1/8"
-4	-4D	1/4"	1/8"
-5	-5D	5/16"	1/8"
-6	-6D	3/8"	1/4"
-8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-12	-12D	3/4"	3/4"
-16	-16D	1"	1"

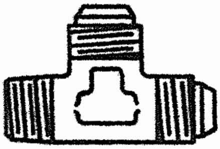


Fig. 7-66

MS20822 ELBOW/90° FLARED TUBE AND PIPE THREAD

MS20822 Dash No. Steel	Alum.	Tube O.D.	Pipe Thread
-2	-2D	1/8"	1/8"
-3	-3D	3/16"	1/8"
-4	-4D	1/4"	1/8"
-5	-5D	5/16"	1/8"
-6	-6D	3/8"	1/4"
-8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-12	-12D	3/4"	3/4"
-16	-16D	1"	1"

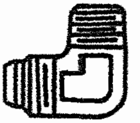


Fig. 7-67

MS20823 ELBOW, 45° FLARED TUBE AND PIPE THREAD

MS20823 Dash No. Steel	Alum.	Tube O.D.	Pipe Thread
-2	-2D	1/8"	1/8"
-3	-3D	3/16"	1/8"
-4	-4D	1/4"	1/8"
-5	-5D	5/16"	1/8"
-6	-6D	3/8"	1/4"
-8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-12	-12D	3/4"	3/4"
-16	-16D	1"	1"

Fig. 7-64

AN6289 NUT, FLARED TUBE, UNIVERSAL FITTING

AN6289 Dash No. Steel	Alum. Alloy	Tube O.D.
-2	D2	1/8"
-3	D3	3/16"
-4	D4	1/4"
-5	D5	5/16"
-6	D6	3/8"
-8	D8	1/2"
-10	D10	5/8"
-12	D12	3/4"
-16	D16	1"

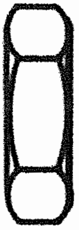


Fig. 7-65

MS20819 SLEEVE, COUPLING

MS20819 Dash No. Steel	Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

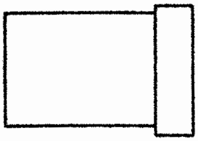


Fig. 7-62

AN932 PLUG, COUNTERSINK HEX,HEAD

Steel	Alum.	Pipe Thread
-2	-2D	1/8"
	-3D	1/4"
	-4D	3/8"

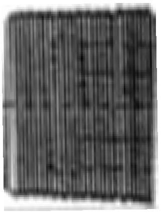


Fig. 7-63

AN938 TEE, INTERNAL SCREW THREAD

AN938 Dash No.		Tube
Steel	Alum. Alloy	O.D.
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"
-20	-20D	1-1/4"

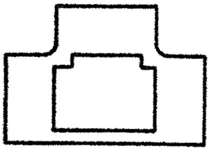


Fig. 7-60

AN924 NUT, FLARED TUBE, BULKHEAD AND UNIVERSAL FITTING

AN924 Dash No.		Tube
Steel	Alum. Alloy	O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

Fig. 7-61

AN929 CAP (ASSEMBLY) PRESSURE SEAL FLARED TUBE FITTING

AN929 Dash Number.	Tube O.D.
-2	1/8"
-3	3/16"
-4	1/4"
-5	5/16"
-6	3/8"
-8	1/2"
-10	5/8"
-12	3/4"
-16	1"

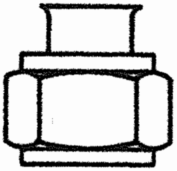


Fig. 7-58

AN918 CROSS, INTERNAL THREAD

AN918 Dash No.		Pipe
Brass	Alum. Alloy	Size
-1	-1D	1/8"
-2	-2D	1/4"
-3	-3D	3/8"
-4	-4D	1/2"
-6	-6D	3/4"
-8	-8D	1"

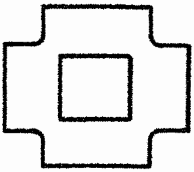


Fig. 7-59

TUBE FITTINGS
AN919 REDUCER, EXTERNAL THREAD, FLARED TUBE

AN919 Dash Number		Tube O.D.	
Steel	Alum. Alloy	Small End	Large End
-2	-2D	1/4"	3/16"
-3	-3D	5/16"	1/4"
-6	-6D	3/8"	1/4"
-7	-7D	3/8"	5/16"
-11	-11D	1/2"	5/16"
-12	-12D	1/2"	3/8"
-14	-14D	5/8"	3/8"
-15	-15D	5/8"	1/2"
-19	-19D	3/4"	1/2"

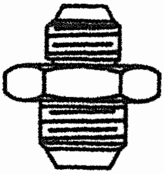


Fig. 7-56

AN916 ELBOW, 90°, INTERNAL THREAD

AN916 Dash No. Brass	Alum. Alloy	Pipe Size
-1	-1D	1/8"
-2	-2D	1/4"
-3	-3D	3/8"
-4	-4D	1/2"
-6	-6D	3/4"
-8	-8D	1"

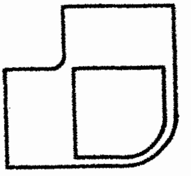


Fig. 7-57

AN917 TEE, INTERNAL THREAD

AN917 Dash No. Brass	Alum. Alloy	Pipe Size
-1	-1D	1/8"
-2	-2D	1/4"
-3	-3D	3/8"
-4	-4D	1/2"
-6	-6D	3/4"

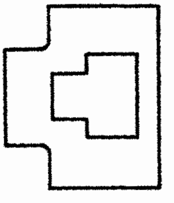


Fig. 7-54

AN914 ELBOW, 45°, INTERNAL AND EXTERNAL THREAD

AN914 Dash No. Brass	Alum. Alloy	Pipe Size
-1	-1D	1/8"
-2	-2D	1/4"
-3	-3D	3/8"
-4	-4D	1/2"
-6	-6D	3/4"
-8	-8D	1"

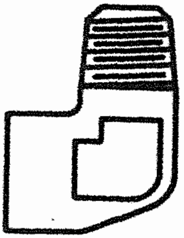


Fig. 7-55

AN915 ELBOW, 45°, INTERNAL AND EXTERNAL THREAD

AN915 Dash No. Brass	Alum. Alloy	Pipe Size
-1	-1D	1/8"
-2	-2D	1/4"
-3	-3D	3/8"
-4	-4D	1/2"
-6	-6D	3/4"
-8	-8D	1"

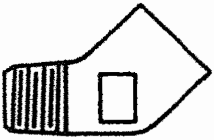


Fig. 7-52

AN911 HEX, SHOULDER NIPPLE

AN911 Dash No. Brass	Alum. Alloy	Pipe Size
-1	-1D	1/8"
-2	-2D	1/4"
-3	-3D	3/8"
-4	-4D	1/2"
-6	-6D	3/4"
-8	-8D	1"

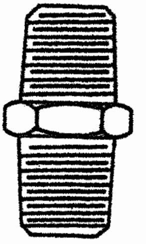


Fig. 7-53

AN912 BUSHING, REDUCER

AN912 Dash No. Brass	Alum. Alloy	Pipe Size
-1	-1D	1/4" x 1/8"
-	-2D	3/8" x 1/4"
-3	-3D	3/8" x 1/8"
-4	-4D	1/2" x 3/8"
-5	-5D	1/2" x 1/4"
-7	-7D	3/4" x 1/2"
-8	-8D	3/4" x 3/8"
-10	-10D	1" x 3/4"

Fig 7-50

TUBE FITTINGS
AN894 BUSHING, SCREW THREAD EXPANDER

AN893 Dash Number		Tube O.D.	
Steel	Alum. Alloy	Small End	Large End
-3-2	D3-2	3/16"	1/8"
-4-3	D4-3	1/4"	3/16"
-5-4	D5-4	5/16"	1/4"
-6-5	D6-5	3/8"	5/16"
-8-5	D5-5	1/2"	5/16"
-8-6	D8-6	1/2"	3/8"
-10-6	D10-6	5/8"	3/8"
-10-8	D10-8	5/8"	1/2"
-12-8	D12-8	3/4"	1/2"

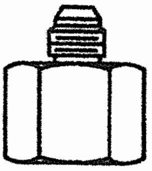


Fig. 7-51

PIPE FITTINGS

AN910 COUPLING

AN910 Dash No.		Pipe
Brass	Alum. Alloy	Size
-1	-1D	1/8"
-2	-2D	1/4"
-3	-3D	3/8"
-4	-4D	1/2"
-6	-6D	3/4"
-8	-8D	1"

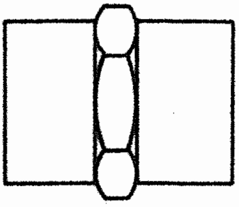


Fig. 7-48

HOSE FITTINGS
AN844 HOSE ELBOW, 45°, PIPE THREAD

AN844 Dash Number Steel	Alum. Alloy	Tube O.D.	Pipe Thread
-4	-4D	1/4"	1/8"
-6	-6D	3/8"	1/4"
-8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-12	-12D	3/4"	3/4"
-16	-16D	1"	3/4"
-17	-17D	1"	1"
-20	-20D	1-1/4"	1-1/4"

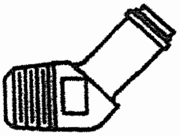


Fig. 7-49

TUBE FITTINGS
AN893 BUSHING, SCREW THREAD REDUCER

AN893 Dash Number		Tube O.D.	
Steel	Alum. Alloy	Small End	Large End
-2	-2D	1/4"	3/8"
-3	-3D	1/4"	1/2"
-7	-7D	5/16"	3/8"
-8	-8D	5/16"	1/2"
-12	-12D	3/8"	1/2"
-121	-121D	3/8"	5/8"
-151	-151D	1/2"	5/8"
-16	-16D	1/2"	3/4"
-17	-17D	1/2"	1"

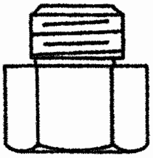


Fig. 7-46

AN840 HOSE NIPPLE, PIPE THREAD

AN840 Steel	Dash Number Alum. Alloy	Tube O.D.	Pipe Thread
-4	-4D	1/4"	1/8"
-6	-6D	3/8"	1/4"
-8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-11	-11D	3/4"	5/8"
-12	-12D	3/4"	3/4"
-16	-16D	1"	3/4"
-17	-17D	1"	1"

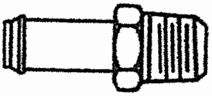


Fig.7-47

AN842 HOSE ELBOW, PIPE THREAD

AN842 Steel	Dash Number Alum. Alloy	Tube O.D.	Pipe Thread
-4	-4D	1/4"	1/8"
-6	-6D	3/8"	1/4"
-8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-12	-12D	3/4"	3/4"
-16	-16D	1"	3/4"
-17	-17D	1"	1"
-20	-20D	1-1/4"	1-1/4"

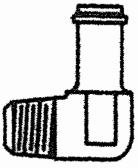


Fig. 7-44

AN834 TEE, FLARED TUBE, BULKHEAD AND UNIVERSAL

AN834 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

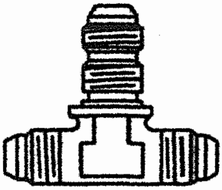


Fig.7-45

AN837 ELBOW, 45° FLARED TUBE, BULKHEAD AND UNIVERSAL

AN837 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

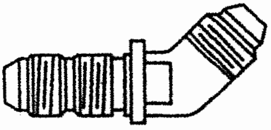


Fig. 7-42

AN832 UNION, FLARED TUBE, 3/8 BULKHEAD AND UNIVERSAL

AN832 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

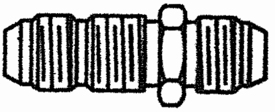


Fig. 7-43

AN833 ELBOW, 90° FLARED TUBE, BULKHEAD AND UNIVERSAL

AN833 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

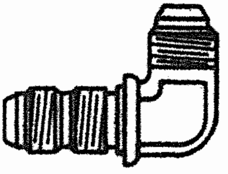


Fig. 7-40

AN824 TEE, FLARED TUBE

AN824 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

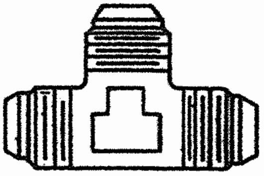


Fig. 7-41

AN827 CROSS, FLARED TUBE

AN827 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

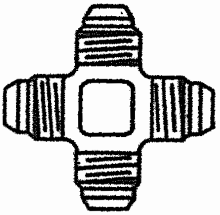


Fig. 7-38

AN820 CAP, FLARED TUBE FITTING

AN820 Steel	Dash Number Alum. Alloy	Tube O.D.	Pipe Thread
-2		1/8	5/16-24
	-3D	3/16	3/8-24
-4		1/4	7/16-20
-5		5/16	1/2-20
-6		3/8	9/16-18
-8		1/2	3/4-16
-10		5/8	7/8-14
-12		3/4	1-5/16-12

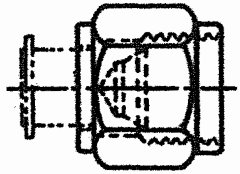


Fig. 7-39

AN821 ELBOW, 90° FLARED TUBE

AN821 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

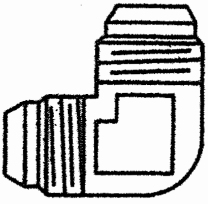


Fig. 7-36

AN816 NIPPLE, FLARED TUBE AND PIPE THREAD

AN816 Steel	Dash Number Alum. Alloy	Tube O.D.	Pipe Thread
-2	-2D	1/8"	1/8"
-3	-3D	3/16"	1/8"
-4	-4D	1/4"	1/8"
-5	-5D	5/16"	1/8"
-6	-6D	3/8"	1/4"
8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-12	-12D	3/4"	3/4"
-16	-16D	1"	1"

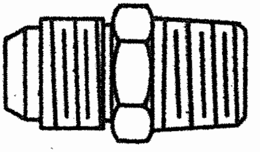


Fig. 7-37

AN818 NUT, COUPLING

AN818 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

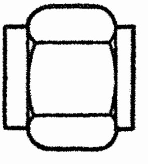


Fig. 7-34

AN814 PLUG AND BLEEDER, SCREW THREAD

AN814 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

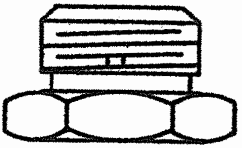


Fig. 7-35

AN815 UNION, FLARED TUBE

AN815 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/8"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

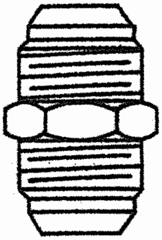


Fig. 7-32

AN804 TEE, FLARED TUBE WITH BULKHEAD ON RUN

AN804 Dash Number Steel	Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

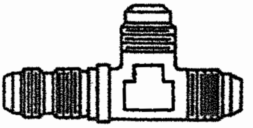


Fig. 7-33

AN806 PLUG, FLARED TUBE

AN806 Dash Number Steel	Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

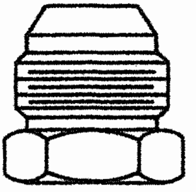


Fig 7-31 (cont.)

AN470, 430, 456, 426, 442 RIVETS

Dash Number	Diameter (Inches)	Length (Inches)	Quantity Per Pound MS20470	MS20426
-5-4		1/4	888	1440
-5-5		5/16	802	1226
-5-6		3/8	721	1079
-5-7		7/16	672	946
-5-6	5/32	1/2	621	849
-5-9		9/16	578	770
-5-10		5/8	507	649
-5-12		3/4	407	494
-5-16		1	366	340
-6-5		5/16	515	846
-6-6		3/8	472	738
-6-7		7/16	436	654
-6-8	3/16	1/2	406	588
-6-9		9/16	379	534
-6-10		5/8	334	451
-6-12		3/4	271	343
-6-16		1	221	241

Fig. 7-31 (cont.)

AN470, 430, 456, 426, 442 RIVETS

Dash Number	Diameter (Inches)	Length (Inches)	Quantity Per Pound MS20470	MS20426
-3-2	3/32	1/8	4107	6406
-3-3		3/16	3485	5003
-3-4		1/4	3027	4103
-3-5		5/16	2675	3478
-3-6		3/8	2397	3018
-3-7		7/16	2171	2666
-3-8		1/2	1826	2161
-3-10		5/8	1576	1817
-3-12		3/4	2003	1515
-4-3	1/8	3/16	1734	2810
-4-4		1/4	1529	2308
-4-5		5/16	1367	1958
-4-6		3/8	1236	1700
-4-7		7/16	1128	1502
-4-8		1/2	1037	1346
-4-9		9/16	960	1219
-4-10		5/8	836	1025
-4-12		3/4	740	885
-4-14		7/8	664	775
-4-16		1	590	731

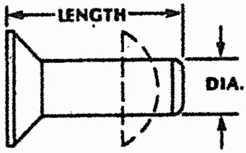
Table Continued on Next Page

Fig. 7-31

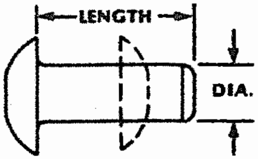
SOLID RIVETS

AN470, 430, 456, 426, 442 RIVETS

MS20426 100º countersunk head



M520470 UNIVERSAL HEAD



Application:

Solid shank rivets are the most universally used device for the construction of sheet metal aircraft.

Material:

1100-H14 Aluminum alloy: Designated A – no mark on head
2117-T4 Aluminum alloy: Designated-AD – dimple in head
2017-T4 Aluminum alloy: Designated-D – raised teat on head
2024-T4 Aluminum alloy: Designated-DD – two raised dashes on head
5056-H12 Aluminum alloy: Designated-B – raised cross on head

Head shape.

Designated by the AN number:
AN-426 - 100° countersunk head
AN430 – round head
AN456 – braizier head
AN470 – universal head

Diameter:

The first dash number is the diameter in 1/32" increments.
Example: AN470AD4 is a universal head rivet made of 2117 -T4 aluminum alloy, 4/32" of 1/8" diameter.

Length:

The second dash number is the length of the rivet in sixteenth inch increments.
Example: AN426DD3 -5. This is a 100° countersunk head 2024 -T4 aluminum alloy rivet, 3/32" diameter, 5/16" long.

Fig. 7-30 (cont.)

MS20392, AN392-AN406 CLEVIS PINS (FLATHEAD PINS)

MS20392 Dash Number	"AN" Part Number	Dia. & Length (Inches)
-3C43	-43	1/4 x 1 11/32
-3C45	-45	1/4 x 1 13/32
-3C47	-47	1/4 x 1 15/32
-3C49	-49	1/4 x 1 17/32
-3C51	-51	1/4 x 1 19/32
-3C53	-53	1/4 x 1 21/32
-3C55	-55	1/4 x 1 23/32
-3C57	-57	1/4 x 1 25/32

Application:

These pins are used as hinge pins for aircraft controls and other applications where only a shear load is applied.

Material:

Alloy steel, heat treated and cadmium plated.

Diameter:

The last digit of the AN number indicates the diameter of the pin in 1/16ths of an inch.
Example: AN396-15 is 6/16" or 3/8" diameter.

Length:

All clevis pin grip lengths are in odd thirty-seconds of an inch.
Example: AN402-33 is a 12/16" or 3/4" diameter clevis pin with a grip length of 1-1/32".

Fig7-30 (cont.)

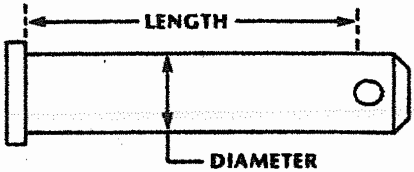
MS20392, AN392-AN406 CLEVIS PINS (FLATHEAD PINS)

MS20392 Dash Number	"AN" Part Number	Dia. & Length (Inches)
-2C15	-15	3/16 x 15/32
-2C17	-17	3/16 x 17/32
-2C19	-19	3/16 x 19/32
-2C21	-21	3/16 x 21/32
-2C23	-23	3/16 x 23/32
-2C25	-25	3/16 x 25/32
-2C27	-27	3/16 x 27/32
-2C29	-29	3/16 x 29/32
-2C31	-31	3/16 x 31/32
-2C33	-33	3/16 x 1-1/32
-2C35	-35	3/16 x 1-3/32
-2C37	-37	3/16 x-1-5/32
-2C39	-39	3/16 x-1-7/32
-2C41	-41	3/16 x-1-9/32
-2C43	-43	3/16 x-1-11/32
-3C11	AN394-11	1/4 x 11/32
-3C13	-13	1/4 x 13/32
-3C15	-15	1/4 x 15/32
-3C17	-17	1/4 x 17/32
-3C19	-19	1/4 x 19/32
-3C21	-21	1/4 x 21/32
-3C23	-23	1/4 x 23/32
-3C25	-25	1/4 x 25/32
-3C27	-27	1/4 x 27/32
-3C29	-29	1/4 x 29/32
-3C31	-31	1/4 x 31/32
-3C33	-33	1/4 x 1-1/32
-3C35	-35	1/4 x 1-3/32
-3C37	-37	1/4 x 1-5/32
-3C39	-39	1/4 x 1-7/32
-3C41	-41	1/4 x 1-9/32

Table Continued on Next Page

Fig. 7-30

MS20392, AN392-AN406 CLEVIS PINS (FLATHEAD PINS)

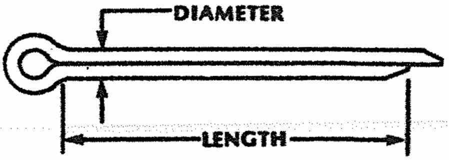


MS20392 Dash Number	"AN" Part Number	Dia. & Length (Inches)
-107	AN392-7	1/8-x-7/32
-109	-9	1/8-x-9/32
-1C11	-11	1/8-x-11/32
-1C13	-13	1/8-x-13/32
-1C15	-15	1/8-x-15/32
-1C17	-17	1/8-x-17/32
-1C19	-19	1/8-x-19/32
-1C21	-21	1/8-x-21/32
-1C23	-23	1/8-x-23/32
-1C2S	-25	1/8-x-25/32
-1C27	-27	1/8-x-27/32
-1C29	-29	1/8-x-29/32
-1C33	-33	1/8-x-31/32
-1C35	-35	1/8-x-1-3/32
-1C37	-37	1/8-x-1-5/32
-1C39	-39	1/8-x-1-7/32
-1C41	-41	1/8-x-1-9/32
-1C45	-45	1/8-x-1-11/32
-1C53	-53	1/8-x-1-13/32
-1C57	-57	1/8-x-1-15/32
-2C7	AN393-7	3/16-x-7/32
-2C9	-9	3/16-x-9/32
-2C11	-11	3/16-x-11/32
-2C13	-13	3/16-x-13/32

Table Continued on Next Page

Fig. 7-29

MS24665 COTTER PINS
AN380 AND AN381 COTTER PINS



Application:

Used to lock castellated nuts onto drilled shank bolts.

Material:

Low carbon steel, cadmium plated: AN380
Corrosion resistant steel: AN381

Diameter:

The first dash number denotes the diameter of the pin in thirty-seconds of an inch.
Example: AN380-4-is a 4/32" or 1/8" diameter pin.

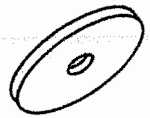
Length:

The second dash number gives the length of the pin in one quarter inch increments.
Example: AN381-2-4 is a corrosion resistant steel cotter pin, 1/16" in diameter, 1" long.

AN380 and MS24665 carbon steel pins of the same diameter and length are interchangeable, as are the AN381 and MS24665 corrosion resistant pins.

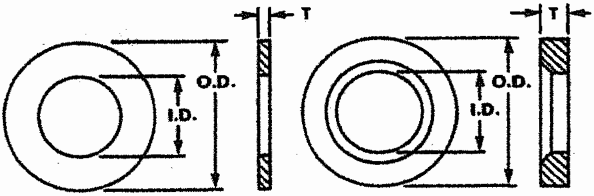
Fig. 7-28

AN970 LARGE AREA WASHER



AN Dash No.	Bolt Size	I.D. Inch	O.D. Inch	Thick-ness (inches)
-3	No. 10	.1935	7/8	.063
-4	1/4"	17/64	1-1/8	.063
-5	5/16"	21/64	1-3/8	.063
-6	3/8"	25/64	1-5/8	.063
-7	7/16"	29/64	1-13/16	.109
-8	1/2"	33/64	2	.109

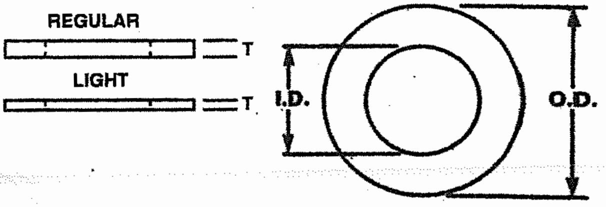
MS20002 HIGH-STRENGTH STEEL WASHER



DASH NO. Countersunk	Plain	Bolt Size	O.D.	I.D. Max.	Min.	Thickness
-C4	-4	1/4	17/32	.260	.252	5/64
-C5	-5	5/16	19/32	.324	.315	5/64
-C6	-6	3/8	11/16	.388	.378	5/64
-C7	-7	7/16	25/32	.451	.441	5/64
-C8	-8	1/2	7/8	.515	.504	5/64

Fig. 7-27

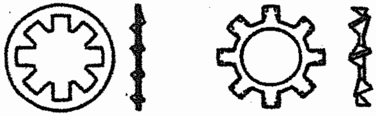
AN960 FLAT WASHER



I.D. (inches)	O.D. (inches)	Screw or Bolt Size	LIGHT Dash No.	LIGHT T (inches)	REGULAR Dash No.	REGULAR T (inches)
.099	.250	#2	-2L	.016	-2	.032
.109	.250	#3	-3L	.016	-3	.032
.125	.312	#4	-4L	.016	-4	.032
.149	.375	#6	-6L	.016	-6	.032
.174	.375	#8	-8L	.016	-8	.032
.203	.438	#10	-10L	.032	-10	.064
.265	.500	1/4"	-416L	.032	-416	.064
.326	.562	5/16"	-516L	.032	-516	.064
.390	.625	3/8"	-614L	.032	-616	.064
.453	.750	7/16"	-716L	.032	-716	.064
.515	.875	1/2"	-816L	.032	-816	.064
.578	1.062	9/6"	-916L	.032	-916	.064
.640	1.188	5/8"	-1016L	.032	-1016	.091

Fig. 7-26

MS35333 and MS35335 AN936 SHAKEPROOF LOCK WASHERS



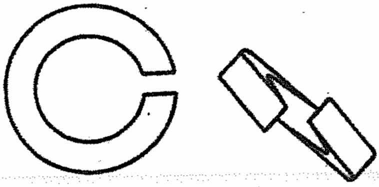
	TYPE A		TYPE B	
Screw/ Bolt Size	MS35333 Dash #	Old AN936 Dash #	MS35333 Dash #	Old AN936 Dash #
#4	-36	A4	-29	B4
#6	-37	A6	-30	B6
#8	-38	A8	-31	B8
#10	-39	A10	-32	B10
1/4	-40	A416	-33	B416
5/16	-41	A516	-34	B516
3/8	-42	A616	-35	B616
7/16	-43	A716	-36	B716
1/2	-44	A816	37	B816
9/16	-45	A916	-38	B916
5/8	-46	A1016	-39	B1016
3/4	-47	A1216	-40	B1216
7/8	-48	A1416	-41	B1416
1	-49	A1616	-42	B1616

PHOSPHOR BRONZE

#4	-104	A4B
#6	-105	A6B
#8	-106	A8B
#10	-107	AI0B

Fig. 7-25

MS35338 (AN935) SPLIT LOCK WASHERS



MS3538 Dash Number	AN935 Dash Number	Screw or Bolt Size	O.D. (inches)	Thickness. (inches)
-40	-4	#4	.212	.025
-41	-6	#6	.253	.031
-42	-8	#8	.296	.040
-43	-10	#10	.337	.047
-44	-416	1/4"	.493	.062
-45	-516	5/16"	.591	.078
-46	-616	3/8"	.688	.094
-47	-716	7/16"	.784	109
-48	-816	1/2"	.879	.125
-49	-916	9/16"	979	.141
-50	-1016	5/8"	1.086	.156

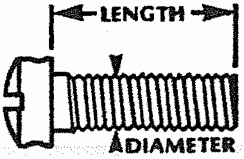
Fig. 7-24 (cont.)

MS3S265 (AN5OOA SLOTTED DRILLED) FILLISTER HEAD MACHINE SCREW (cont.)

AN500A	Part Number	Thread Size	Length (inches)
-10-4	-59	#10-24	1/4
-10-5	-60		5/16
-10-6	-61		3/8
-10-8	-63		1/2
-10-10	-64		5/8
-10-12	-65		3/4
-10-14	-66		7/8
-10-16	-67		1
-10-32	-71		2
-416-6	-77	1/4-20	3/8
-416-8	-79		1/2
-416-10	-80		5/8
-416-17	-81		3/4

Fig. 7-24

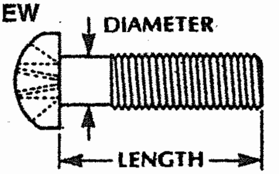
MS3S265 (AN5OOA SLOTTED DRILLED) FILLISTER HEAD MACHINE SCREW



AN500A	Part Number	Thread Size	Length (inches)
-4-3	MS35265-12		3/16
-4-4	-13		1/4
-4-5	-14		5/16
-4-6	-15		3/8
-4-7	-16	#4-40	7/16
-4-8	-17		1/2
-4-10	-18		5/8
-4-12	-19		3/4
-6-3	-25		3/16
-6-4	-26		1/4
-6-5	-27		5/16
-6-6	-28		3/8
-6-7	-29	#6-32	7/16
-6-8	-30		1/2
-6-10	-31		5/8
-6-12	-32		3/4
-8-4	-41		1/4
-8-5	-42		5/16
-8-6	-43		3/8
-8-7	-44		7/16
-8-8	-45	#8-32	1/2
-8-10	-46		5/8
-8-12	-47		3/4
-8-14	-48		7/8
-8-16	-49		1

Fig 7-22

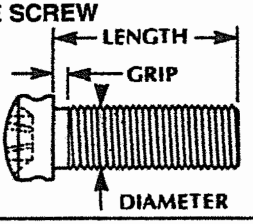
MS35215 (AN520B CROSS RECESSED) PAN HEAD, MACHINE SCREW



AN520B	Part Number	Thread Size	Length (inches)
-10R6*	MS3S215-53		3/8
-10R8*	-55		1/2
-10R10*	-56		5/8
-10R12*	-57	#10-32	3/4
-10R14*	-58		7/16
-10R16	-59		1
-10R20*	-60		1-1/4
-10R24*	-61		1-1/2

Fig. 7-23

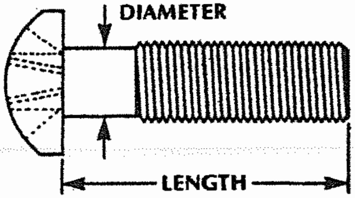
MS35266 (AN501A CROSS RECESSED) FILLISTER HEAD MACHINE SCREW



AN501A	Part Number	Thread Size	Length (inches)
-10-4	MS35266-59		1/4
-10-5	-60		5/16
-10-6	-61		3/8
-10-7	-62	#10-32	7/16
-10-8	-63		1/2
-10-10	-64		5/8
-10-12	-65		3/4
-10-16	-67		1
-416-10	-80	1/4-28	5/8

Fig. 7-21

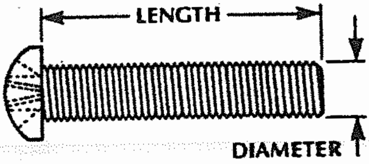
MS35214 (AN515B CROSSED RECESSED) PAN HEAD, MACHINE SCREW



AN515B	Part Number	Thread Size	Length (Inches)
-4R4	MS35214-12	#4-40	1/4
-4R6	-14		3/8
-4R8	-16		1/2
-4R10	-17		5/8
-4R12	-18		5/8
-6R4	-23	#6-32	1/4
-6R6	-25		3/8
-6R7	-26		7/16
-6R8	-27		1/2
-6R10	-28		5/8
-6R12	-29		3/4
-6R14	-30		7/8
-6R16	-31		1
-6R20	-32		1-1/4
-6R24	-33		1-1/2
-8R6	-40	#8-32	3/8
-8R8	-42		1/2
-8R10	-43		5/8
-8R12	-44		3/4
-8R14	-45		7/8
-8R16	-46		1
-8R20	-47		1-1/4
-8R24	-48		1-1/2

Fig. 7-20

MS35207 (AN520R CROSS RECESSED) PAN HEAD MACHINE SCREW



AN520R	Part Number	Thread Size	Length (inches)
-10R5	MS35207-260	#10-32	5/16
-10R6	-261		3/8
-10R7	-262		7/16
-10R8	-263		1/2
-10R10	-264		5/8
-10R12	-265		3/4
-10R14	-266		7/8
-10R16	-267		1
-10R20	-268		1-1/4
-10R24	-269		1-1/2
-10R28	-270		1-3/4
-10R32	-271		2

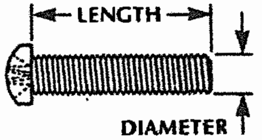
Fig 7-19 (cont.)

MS35206 (AN515R CROSS RECESSED) PAN HEAD MACHINE SCREW (cont.)

AN515R	Part Number	Thread Size	Length (inches)
-8R4	-241		1/4
-8R5	-242		5/16
-8R6	-243		3/8
-8R7	-244		7/16
-8R8	-245		1/2
-8R10	-246		5/8
-8R12	-247	8-32	3/4
-8R14	-248		7/8
-8R16	-249		1
-8R20	-250		1-1/4
-8R24	-251		1-1/2
-8R28	-252		1-3/4
-8R32	-253		2
-10R6	-261		3/8
-10R7	-262		7/16
-10R8	-263	10-24	1/2
-16R10	-264		5/8
-10R12	-265		3/4
-10R14	-266		7/8
-10R16	-267		1

Fig. 7-19

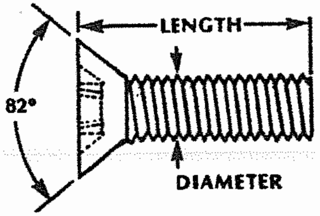
MS35206 (AN515R CROSS RECESSED) PAN HEAD MACHINE SCREW



AN515R	Part Number	Thread Size	Length (inches)
-2R4	MS35206-203		1/4
-2R5	-204		5/16
-2R6	-205		3/8
-2R7	-206	2-56	7/16
-2R8	-207		1/2
-2R10	-208		5/8
-2R12	-209		3/4
-4R 3	-212		3/16
-4R4	-213		1/4
-4R5	-214		5/16
-4R6	-215		3/8
-4R7	-216		7/16
-4R8	-217	4-40	1/2
-4R10	-218		5/8
-4R12	-219		3/4
-4R14	-220		7/8
-4R16	-221		1
-4R20	-222		1-1/14
-4R24	-223		1-1/2
-6R4	-226		1/4
-6R5	-227		5/16
-6R6	-228		3/8
-6R7	-229		7/16
-6R8	-230		1/2
-6R10	-231	6-32	5/8
-6R12	-232		3/4
-6R14	-233		7/8
-6R16	-234		1
-6R 20	-235		1-1/4
-6R24	-236		1-1/2
-6R32	-238		2

Fig. 7-18

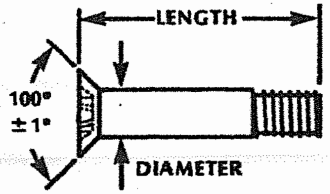
MS35190 (AN505R CROSS RECESSED) 82º FLAT HEAD MACHINE SCREW



AN505R	Part Number	Thread Size	Length (inches)
-4R4	MS35190-221	4-40	1/4
-4R5	-222		5/16
-4R8	-225		1/2
-4R10	-226		5/8
-6R4	-234	6-32	1/4
-6R6	-236		3/8
-6R8	-238		1/2
-6R10	-239		5/8
-6R12	-240		3/4
-8R5	-250	8-32	5/16
-8R8	-253		1/2
-8R10	-254		5/8

Fig. 7-16

MS24694 (AN509R CROSS RECESSED) 100º FLAT HEAD STRUCTURAL MACHINE SCREW



(An "S" in place of the MS24694 dash indicates alloy steel, Cadmium II plated. A "C" indicates 300 series stainless steel, unplated.)

AN509R	Part Number	Thread Size	Length (inch)
-8R4	MS24694-1		9/32
-8R5	-2		11/32
-8R6	-3		13/32
-8R7	-4		15/32
-8R8	-S5		17/32
-8R9	-S6		19/32
-8R10	-S7		21/32
-8R11	-S8		23/32
-8R12	-S9	8-32	25/32
-8R13	-S10		27/32
-8R14	-S11		29/32
-8R15	-S12		31/32
-8R16	-S13		1-1/32
-8R24	-S21		1-17/32
-10R4	-S46		9/32
-10R5	-S47		11/32
-10R6	-S48		13/32
-10R7	-S49		15/32
-10R8	-S50		17/32
-10R9	-S51	10-32	19/32
-10R10	-S52		21/32
-10R11	-S53		23/32

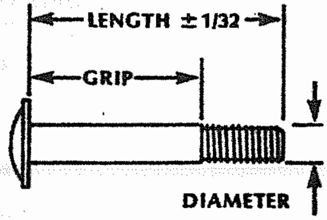
Fig 7-15 (cont.)

MS24693 (AN507R) 100° FLAT HEAD MACHINE SCREW (cont.)

AN507R	Part Number	Thread No.	Length (inch)
-832R4	-46		1/4
-832R5	-47		5/16
-832R6	-48		3/8
-832R7	-49		7/16
-832R8	-S50		1/2
-832R10	-S51		5/8
-832R12	-SS2	8-32	3/4
-832R14	-S53		7/8
-832R16	-S54		1
-832R18	-S55		1-1/8
-832R20	-S56		1-1/4
-832R24	-S58		1-1/2
-832R32	-S62		2
-1032R4	-S268		1/4
-1032R5	-S269		5/16
-1032R6	-S270		3/8
-1032R7	-S271		7/16
-1032R8	-S272		1/2
-1032R10	-S273	10-32	5/8
-1032R12	-S274		3/4
-1032R14	-S275		7/8
-1032R16	-S276		1
-1032R18	-S277		1-1/8
-1032R20	-S278		1-1/4
-1032R24	-S280		1-1/2
-428R8	-S294		1/2
-428R10	-S295	1/4-28	5/8
-428R12	-S296		3/4

Fig. 7-17

AN525 WASHER HEAD STRUCTURAL MACHINE SCREW



DASH NUMBERS				GRIP	LENGTH
8-32	8-36	10-32	1/4-28		
832-6	8-6	10-6	416-6	1/32	3/8
832-7	8-7	10-7	416-7	106	7/16
832-8	8-8	10-8	416-8	1/8	1/2
832-9	8-9	10-9	416-9	5/32	9/16
832-10	8-10	10-10	416-10	7/32	5/8
832-11	8-11	10-11	416-11	9/32	11/16
832-12	8-12	10-12	416-12	11/32	3/4
832-14	8-14	10-14	416-14	15/32	7/8
832-16	8-16	10-16	416-16	19/32	1
832-18	8-18	10-18	416-18	23/32	1-1/8
832-20	8-20	10-20	416-20	27/32	1-1/4
832-22	8-22	10-22	416-22	31/32	1-3/8
832-24	8-24	10-24	416-24	1-3/32	1-1/2
832-26	8-26	10-26	416-26	1-7/32	1-5/8
832-28	8-28	10-28	416-28	1-11/32	1-3/4
832-30	8-30	10-30	416-30	1-15/32	1-7/8
832-32	8-32	10-32	416-32	1-19/32	2

Part Numbers:
Add "R" between first and second dash numbers: for recessed head screws.
Add "D" before first dash number for AL alloy screws: Size 8 available with NC thread only.

Example:
AN525-10-6 = .190-32 slotted head steel screw, 3/8 long with 1/32 grip.
AN5D10-6 = .190-32 slotted head AL alloy screw, 3/8 long with 1/32 grip.
AN525-10R6 = .190-32 recessed head steel screw, 3/8 long with 1/32 grip.

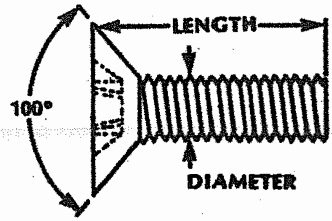
Fig 7-16 (cont.)

MS24694 (AN509R CROSS RECESSED) 100º FLAT HEAD STRUCTURAL MACHINE SCREW (cont.)

AN509R	Part Number	Thread Size	Length (inch)
-10R12	-54		25/32
-10R13	-55		27/32
-10R14	-56		29/32
-10R15	-57	10-32	31/32
-10R16	-S58		1-1/32
-10R17	-S59		1-3/32
-10R18	-S60		1-5/32
-10R19	-S61		1-7/32
-10R20	-S62		1-9/32
-10R21	-S63		1-11/32
-10R22	-S64		1-13/32
-10R23	-S65		1-15/32
-10R24	-S66		1-17/32
-10R28	-S70		1-25/32
-10R32	-S74		2-1/32
-416R7	-S94		15/32
-416RS	-S95		17/32
-416R9	-S96		19/32
-416R10	-S97	1/4-28	21/32
-416R12	-S98		25/32
-416R13	-S100		27/32
-416R14	-S101		29/32
-4161115	-S102		31/32
-416R16	-S103		1-1/32
-4161118	-S105		1-5/32
-416R28	-S115		1-25/32

Fig. 7-15

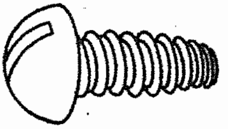
MS24693 (AN507R CROSS RECESSED) 100º FLAT HEAD MACHINESCREW



AN507R	Part Number	Thread Size	Length (inch)
-440R4	MS24693-2		1/4
-440R5	-3		5/16
-440R6	-4		3/8
-440R7	-5		7/16
-44OR8	-6	4-40	1/2
-44ORIO	-7		5/8
-440R12	-8		3/4
-44OR14	-9		7/8
-44OR16	-10		1
-632114	-24		1/4
-632R5	-25		5/16
-632116	-26		3/8
-632R7	-27		7/16
-632RO	-28		1/2
-632R10	-29		5/8
-632R12	-30	6-32	3/4
-632R14	-31		7/8
-632R16	-32		1
-632R18	-33		1-1/8
-632R20	-34		1-1/4
-632R24	-36		1-1/2
-632R32	-40		2

Fig. 7-14

ROUND AND FLAT HEAD TAPPING SCREWS



AN530 BLUNT POINT, ROUND HEAD, SELF-TAPPING SCREW
AN531 BLUNT POINT, FLAT HEAD, SELF-TAPPING SCREW

DIA.	LENGTH (Inches)	AN530 ROUND Phillips Dash No.	AN530 ROUND Slotted Dash No.	AN531 FLAT Phillips Dash No.	AN531 FLAT Slotted Dash No.
4	1/4	-4R4	-4-4	-4R4	-4-4
	3/8	-4R6	-4-6	-4R6	-4-6
	1/2	-4R8	-4-8	-4R8	-4-8
6	1/4	-6R4	-6-4	-6R4	-6-4
	3/8	-6R6	-6-6	-6R6	-6-6
	1/2	-6R8	-6-8	-6R8	-6-8
	5/8	-6R10	-6-10	-6R10	-6-10
	3/4	-6R12	-6-12	-6R12	-6-12
8	1/4	-8R4	-8-4	-8R4	-8-4
	3/8	-8R6	-8-6	-8R6	-8-6
	1/2	-8R8	-8-8	-8R8	-8-8
	5/8	-8R10	-8-10	-8R10	-8-10
	3/4	-8R12	-8-12	-8R12	-8-12
10	3/8	-10R6	-10-6	-10R6	-10-6
	1/2	-10R8	-10-8	-10R8	-10-8
	5/8	-10R10	-10-10	-10R10	-10-10
	3/4	-10R12	-10-12	-10R12	-10-12
	1	-10R16	-10-16	-10R16	-10-16

Fig. 7-13 (cont.)

MACHINE SCREWS
FOR "AN" MACHINE SCREWS ONLY

Thread Size

Dia. or No.	Coarse	Fine
2	56	64
3	48	56
4	40	48
5	40	44
6	32	40
8	32	36
10	24	32
1/4	20	28
5/16	18	24
3/8	16	24

First Dash No. (Diameter)		Second Dash No. (Length)	
Dash No.	Dia. & Thread	Dash No.	Length
		2	1/8
440	4-40	3	3/16
632	6-32	4	1/4
8	8-36	5	5/16
832	8-32	6	3/8
1024	10-24	7	7/16
1032	10-32	8	1/2
416	1/4-20	10	5/8
		12	3/4

Fig. 7-13

MACHINE SCREWS

Head Style	Material	Finish	Thread Coarse	Thread Fine	Screw No.
Fillister, slotted, drilled	Carbon steel	Cadmium, type 1, class C		X	AN502
			X		AN503
		Cadmium, type 2, class 3	X		MS35265
				X	MS35266
Flat, 82°, cross-recessed	Carbon steel	Cadmium, type 2, class 3	X		MS35190
Flat, 100°, cross-recessed	Carbon steel	Cadmium, type 2, class 3	X	X	MS24693
	Alloy steel	Cadmium, type 1, class 3	X	X	NAS514P
		Cadmium, type 2, class 3	X	X	MS24694
		Cadmium, type 2, class 3 (spcl.)		X	NAS517
	Brass	Black Oxide	X	X	MS24693
Pan, cross-recessed	Carbon steel	Cadmium, type 2, class 3	X		MS35206
				X	M535207
	Alloy steel	Cadmium, type 1, class 3	X	X	NAS600-603
		Cadmium, type 2, class 3	X	X	MS27039
	Brass	Black oxide	X		MS35214
				X	MS35215
Round, slotted	Carbon steel	Cadmium, type 1, class 3	X		AN515
				X	AN520
Truss, slotted	Carbon steel	Cadmium, type 1, class 3	X	X	AN526
Truss, cross-recessed	Carbon steel	Cadmium, type 1, class 3	X	X	AN526R
Washer, cross-recessed	Carbon steel	Cadmium, AN-P-61 (cr-zinc)	X	X	AN525R

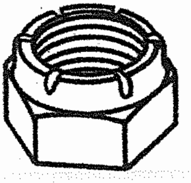
Fig. 7-12 (cont.)

MS20365 SELF-LOCKING NUT

MILITARY NUMBER	THREAD SIZE
CADMIUM PLATED STEEL:	
MS20365-440	4-40
-632	6-32
-640	6-40
-832	8-32
-1032	10-32
-420	1/4-20
-428	1/4-28
-518	5/16-18
-524	5/16-24
-616	3/8-16
-624	3/8-24
-720	7/16-20
-820	1/2-20
-918	9/16-18
-1018	5/8-18
-1216	3/4-16
BRASS:	
MS20365B-1032	8-32
ALUMINUM ALLOY	
MS20365D-832	8-32
-1032	10-32

Fig. 7-12

MS20365 SELF-LOCKING NUT



Material:

Cadmium plated alloy steel: No letter designation
Aluminum alloy (2024-T4): D in place of dash
Brass: B in place of dash

Size:

These nuts are available in both National Fine and National Coarse threads. The size and number of threads is denoted by the dash number.

Other dash numbers denote the diameter in sixteenth-inch increments and the number of threads per inch:

Example
AN365C428 = High temperature self-locking nut, 1/4 -inch diameter, with 28 threads per inch. inch.
AN365B632 - Low temperature regular hex self-locking nut made of brass that fits a 6-32 machine screw.

Fig. 7-10

HIGH TEMPERATURE SELF-LOCKING NUT

MILITARY NUMBER	THREAD SIZE
AN363C-832	8-32
.AN363C-1032	10-32
AN363C-428	1/4-28
AN363C-524	5/16-24
AN363C-624	3/8-24

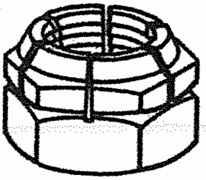
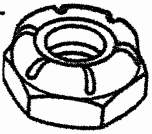


Fig. 7-11

MS20364 THIN SELF-LOCKING NUT

MILITARY NUMBER	THREAD SIZE
MS20364-632	6-32
MS20364-832	8-32
MS20364-1032	10-32
MS20364-428	1/4-28
MS20364-524	5/16-24
MS20364-624	3/8-24



MS27151 PAL NUT

PART NUMBER	OLD "AC" PART NO.	SIZE & THREAD
MS27151-6	AC356-832	8-32
-7	-1032	10-32
-13	-428	1/4-28
-16	-524	5/16-24
-19	-624	3/8-24
-21	-720	7/16-20
-24	-820	1/2-20

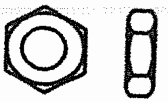
Fig. 7-8

AN315-316 PLAIN AND CHECK NUTS

DASH NUMBER	DIAMETER & SIZE
-3	No. 10-32
-4	1/4-28
-5	5/16-24
-6	3/8-24

Add "L" after dash for left-hand thread.

AN315



AN316

MS20341 ELECTRICAL NUT

PART NUMBER	THREAD SIZE
MS20341-6	6-32
MS20341-8	8-32
MS20341-10	10-32

Fig. 7-9

NAF213790 BRASS MANIFOLD NUT

PART NUMBER	"AC" NUMBER	SIZE & THREAD
NAF213790-4	AC36A6203-4	1/4-28
NAF213790-5	AC36A6203-5	5/16-24

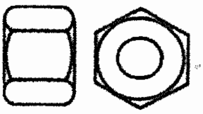
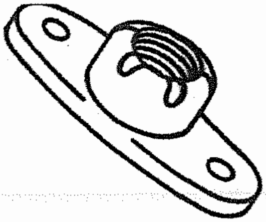


Fig. 7-7

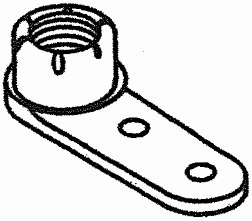
MS21078 TWO LUG ANCHOR NUT

MILITARY NUMBERS	THREAD SIZE
MS21078-06	6-32
-08	8-32
-3	10-32
-4	1/4-28
-5	5/16-24



MS21080 ONE LUG ANCHOR NUT

MILITARY NUMBERS	THREAD SIZE
MS21080-06	6-32
-08	8-32
-3	10-32
-4	1/4-28



MS21081 CORNER ANCHOR NUT

MILITARY NUMBERS	THREAD SIZE
MS21081-06	6-32
-08	8-32
-3	10-32

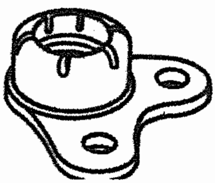


Fig 7-6 (cont.)

CASTLE NUTS

DASH NUMBER	DIAMETER & THREAD	COTTER PINS USED WITH AN310 & AN320
-3	No. 10-32	AN380-2-2
-4	1/4-28	AN380-2-2
-5	5/16-24	AN380-2-2
-6	3/8-24	AN380-3-3
-7	7/16-20	AN380-3-3
-8	1/2-20	AN380-3-3
-9	9/16-18	AN380-4-4
-10	5/8-18	AN380-4-4
-12	3/4-16	AN380-4-5

—AN320 SHEAR CASTLE NUT—

Application:

These nuts are used on drilled shank clevis bolts for shear loads, and safetied with a cotter pin.

Material:

Cadmium plated alloy steel: No letter designation
Aluminum alloy (2024-T4): D in place of dash
Corrosion resistant steel: C in place of dash

Size:

The size is indicated by the dash number. -1 fits a 6-40 machine screw, -2 fits an 8-36 screw. Other dash numbers indicate the diameter in sixteenths of an inch of the fine thread bolt the nut fits.
Ex: AN320-6 fits a 3/8" clevis bolt (AN26).

Thread:

Class 3NF

D

E

F

A

B

C

Fig. 7-101

CHERRY RIVETS

CR9162-4-2

- Rivet Grip Number (grip length)
  Serrated stems are in 16ths of an inch
  (-2 is 2/16" or 1/8")
  Knob stems are in 32nds of an inch
  (-4 is 4/32" or 1/8")
- Rivet Diameter in 32nds of an inch (-4 is 4/32 or 1/8)
- Example Series Number

Rivet Shank Diameter	Rivet Dia. Dash No.	Recomm'd Finish Drill	Inspection Limits Minimum	Maximum
3/32	-3	#40	.097	.101
1/8	-4	#30	.129	.132
5/32	-5	#20	.160	.164
3/16	-6	#10	.192	.196
7/32	-7	#2	.220	.225
1/4	-8	F	.256	.261
9/32	-9	L	.289	.295
1/18 Bulbed	-4	#27	.143	.146
5/32 Bulbed	-5	#16	.176	.180
3/16 Bulbed	-6	#5	.205	.209
1/4 Bulbed	-8	1	.271	.275

Material Thickness Range		Rivet Grip Number	
Minimum	Maximum	Knob Stems	Serrated Stems
1/32(.032)	1/16 (.062)	-2	-1
1/16(.062)	1/8 (.125)	-4	-2
1/8(.125)	3/16 (.187)	-6	-3
3/16(.187)	1/4 (.250)	-8	-4
1/4(.250)	5/16 (.312)	-10	-5
5/16(.312)	3/8 (.375)	-12	-6
3/8(.375)	7/16 (.437)	-14	-7
7/16(.437)	1/2 (.500)	-16	-8
1/2(.500)	9/16 (.562)	-18	-9
9/16(.562)	5/8 (.625)	-20	-10
5/8(.625)	11/16 (.687)	-22	-11
11/16 (.687)	3/4 (.750)	-24	-12
3/4(.750)	13/16 (.812)	-26	-13
13/16 (.812)	7/8 (.875)	-28	-14
7/8(.875)	15/16 (.937)	-30	-15
15/16 (.937)	1 (1.000)	-32	-16

Fig. 100 (cont.)

FLAT TYPE

Used to replace threaded nuts, lock washers and spanner washers; weigh less than other types of self-locking aircraft fasteners. Can be applied faster, easier, and are vibration resistant. Provide maximum holding power at minimum cost per fastener. Turned-up ends prevent scoring of surfaces.

Use these with Type B tapping screws:

Part Number	Screw Size	A Length	B Width
A1776-4Z-1	4B	.50	.31
A1181-6Z-1	6B	.51	.31
A1777-6Z-1	6B	.63	.44
A1778-8Z-1	8B	.63	.44
A1779-10Z-1	10B	.88	.50

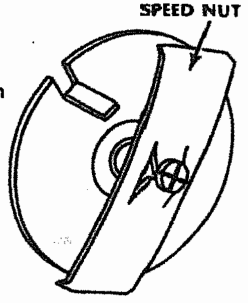
Use these with machine screws:

Part Number	Screw Size
Al05-440-1	4-40
A1322-632-1	6-32
A1322-832-1	8-32

Fig. 7-99

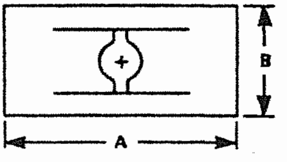
PATCH PLATES

Used as inspection hole covers and for sealing holes left after removal of equipment, design changes, etc. Installed from one side. Coined edge on washer prevents scratching of Alclad surfaces. Supplied with 82-degree flat-recessed head machine screw with end upset to prevent removal of Speed Nut.



Tinnerman Number	Screw Size	Dia. Of Hole In Skin	Washer Dia.
A6912-832-1	8-32	.906	1.062
A6914-1024-1	10-24	1.375	1.687

Fig. 7-100



TINNERMAN NUTS

MATERIAL: Special aircraft spring steel is generally used for all parts unless otherwise specified. Where Speed Nuts are available in stainless steel the part number will include SS — example: A6199SS-8Z-3. Speed Nuts with welding nibs are made of stainless steel only.

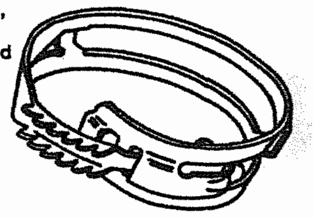
Finish: Tinnerman items are offered in the following finishes — (final dash number of the part number denotes the type finish):

-1	(Phosphate and three coats olive drab phenolic paint)
-24A	(Cadmium Electro-plate)
-24J	(Cadmium plate per QQ-P-416)
-27	(Soluble oil dipped)
-493	(Aluminum electroplate .0002 minimum, plus chromate to QQ-P-416A, Class 3, Type 2)
-495	(Cadmium electroplate .0002 minimum to QQ-P-416A, Class 3, Type 1)

Fig. 7-98

HOSE CLAMPS

Self-locking, ratchet-type hose clamps. One-piece construction — no bolts, nuts, or thumb screws. Fast, easy installation and removal on low- and medium-pressure connections. Approved for use on military aircraft. Clamps are made of special aircraft spring steel. Finish is phosphate and 3 coats of olive drab phenolic paint.

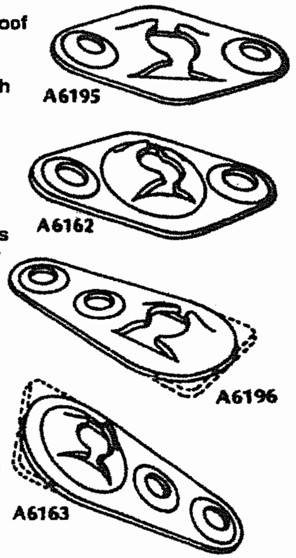


Tinnerman Number	NAS Number	Hose O.D. (inches) Minimum	Maximum
A3122-8-1J	397-8	15/32	1/2
A3122-10-1J	397-10	9/16	5/8
A3122-12-1J	397-12	11/16	3/4
A3122-14-1J	397-14	13/16	7/8
A312246-1J	397-16	15/16	1
A3122-18-1J	397-18	1-1/f16	1-1/8
A3122-20-1J	397-20	1-1/8	1-1/4
A3122-22-1J	397-22	1-1/4	1-3/8
A3122-24-1J	397-24	1-11/32	1-1/2
A3122-28-1J	397-28	1-19/32	1-3/4
A3499-30-1J	397-30	1-13/16	1-15/16
A3499-32-1J	397-32	1-15/16	2-1/16
A3499-34-1J	397-34	2-1/16	2-3/16

Fig. 7-97

ANCHOR TYPE SPEED NUTS

To attach access plates, doors, or any part that must be fastened securely, yet be easily removed with fasteners retained in blind location. Riveted in screw-receiving position, they make firm, vibration-proof attachments. Popular types shown in the table are all for 3/32" dia. rivets. All except the A6191's are for use with sheets dimpled for 100 degree flat head rivets.

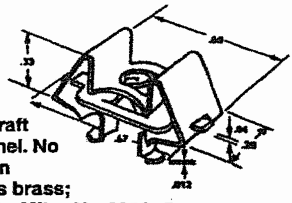


Tinnerman Part Number	Screw Size (B or Z)	Material Thickness
A6191-6Z-1	6	.025
A6191-8Z-1	8	.028
A6195-6Z-1	6	.025
A6195-8Z-1	8	.028
A6162-8Z-1	8	.028
A6196-6Z-1	6	.025
A6196-8Z-1	8	.028
A6163-8Z-1	8	.028

NOTE: Speed Nuts for aircraft are designed to fit standard AN530 type "B" or "Z" sheet metal screws only. Important—do not use pointed type "A" sheet metal screws with aircraft Speed Nuts. There is a difference in root diameter and thread pitch!

Fig.7-96

INSTRUMENT MOUNTING



Cage-type. Permits mounting of aircraft instruments from the front of the panel. No change in panel or instrument design required. Non-magnetic (speed nut is brass; cage is phosphor bronze). Conform to MIL—N—3336. Gauge is easily compressed with finger-pressure to allow insertion of legs into clearance holes. When fully inserted and pressure is released, legs spring apart and retain the SPEED NUT in the screw-receiving position. Turned-down corners hold firm against force of inserting screw and screw-tightening torque. All instrument mounting nuts listed below take a 6-32 machine screw.

Tinnerman Part Number	NAS Part No.	Panel Thickness
A8938-632-493	487-13	.062
A8939-632-493	487-14	.091
A6939-632-493	487-15	.125
A8940-632-493	487-16	.187
A8941-632-493	487-17	.250
A8942-632-493	487-18	.313
A8943-632-493	487-20	.375
A8944-632-493	487-21	over .375

Fig. 7-95 (cont.)

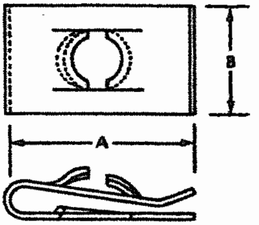
Tinnerman Part No.	-NAS P/N	Screw Size (B or Z)	Design Varia.	Panel Range	A (L)	B (W)
A6187-4Z-1	395-1	4	CD	.025-.032	.38	.31
A188-6Z-1	395-5	6	ACDH	.025-.032	.48	.75
A1784-6Z-1	395-6	6	E	.02S-.051	.61	.44
A1785-6Z-1	395-7	6	E	.025-.064	.84	.44
A6052-6Z-1	395-3	6	EH	.032-.040	.47	.50
A1932-6Z-1	396-1	6	BE	.032-.051	.59	.50
A1274-8Z4	395-14	8	DEH	.025-.032	.50	.50
A1348-8Z-1	39S-17	8	AE	.025-.064	.75	.50
A1786-8Z-1	395-12	8	CEH	.040-.051	.53	.50
A1787-8Z-1	395-18	8	E	.025-.064	.84	.44
A1788-8Z-1	——	8	AE	.025-.064	.84	.44
Al 789-8Z-1	395-16	8	E	.025-.051	.61	.44
A1932-8Z-1	396-4	8	BE	.032-.051	.59	.50
A1350-10Z-1	395-25	10	AE	.025-.064	.75	.50
A1758-10Z-1	39S-24	10	E	.081-.094	.62	.44
A1787-10Z-1	——	10	E	.025-.064	.84	.44
A1791-10Z-1	——	10	EH	.040-.064	.63	.63
A1794-10Z-1	395-23	10	E	.032-.064	.64	.44
A9031-10Z-1	39S-28	10	EH	.102-.125	.70	.63

Fig 7-95

"U" TYPE

Self-retaining; press easily into locked-on position over panel edges or in center panel locations. Hold themselves in a screw-receiving position and are ideal for blind assembly or hard-to-reach locations.

Eliminated arc welding, staking, riveting or other secondary fastening methods. Used where full bearing surface on the lower leg of the SPEED NUT is required.



DESIGNATIONS

A

No extrusion on lower leg

B

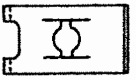
Full extrusion on lower leg

C

Straight upper leg

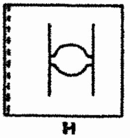
D

Corner turned up



E

Relief notch



H

Speed Nut impression turned 90 degrees

Fig 7-92

CAMLOC COWL FASTENERS STUD ASSEMBLIES 4002 Series

Part Number	Dimensions (inches) A	B	C	D
4002	.4	S±.02	.168	.42

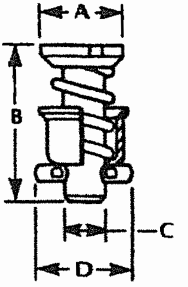


Fig 7-93

CAMLOC COWL FASTENERS GROMMETS Plus Flush, 4002 Series

Part Number	Dimensions (inches) E	F	G	H
4002-N	.621	.197	.026	.118
4002-0	.621	.197	.026	.147

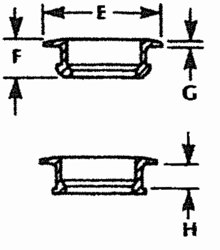


Fig 7-94

CAMLOC COWL FASTENERS RECEPTACLES 2600, 2700, 4002 Series

	2600	2700	4002
I	1.0	1.0	1.38
J	.75	.75	1.0
K	.5	.5	.69
L	.5	.5	.526
M	.072	.072	.09

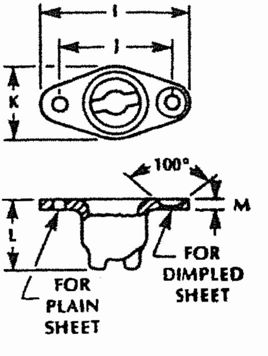


Fig 7-89

CAMLOC COWL FASTENERS

STUD ASSEMBLIES

2600, 2700 Series

Steel; slotted head;

.030 stud increments

Part Number	Dimensions (inches) A	B	C	D
2600	.5	.303	S±.02	.128
2700	.39	.254	S± .02	.127

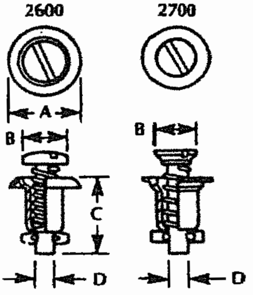


Fig 7-90

CAMLOC COWL FASTENERS RETAINING WASHERS 2600, 2700 Series

Part Number	Dimensions (inches) E	F	G
2600-SW 2 (Split)	.312	.156	.019
2600-LW (Solid)	.46	.232	.04

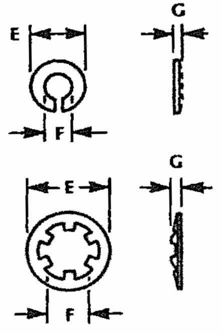


Fig 7-91

CAMLOC COWL FASTENERS PLIERS - 4P3

2600, 2700 Series

Compress stud with 4P3 pliers, insert stud into panel and release. DO NOT REMOVE THE STUD CROSS PIN.

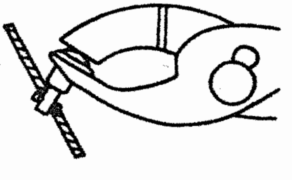
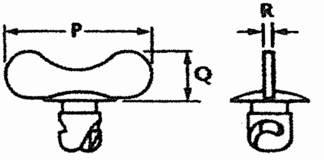


Fig. 7-88 (cont.)

WING TYPE FASTENERS

Dimensions A, B, and L are same as standard slotted. head fasteners. Example: AW4-25 dimensions are the same as those of A4-25. Wing in lock position usually aligns with the spring rivets. Use the same size grommets and springs for wing type as are specified for standard slotted head type.



TYPE AW and AJW

Part Number	Dimensions (inches) P	Q	R
AW4-25			
AW4-30	.875	.3125	.050
AW4-35			
AWS-30			
AW5-35			
AW5-40	1.125	.4375	.062
AW5-45			
AW5-50			

Fig. 7-87

TYPE S SPRINGS

Part Number	Dimensions (inches)	
	H	G
S4-200	.200	.750
S4-250	.250	
S5A-200	.200	
SSA-225	.225	1.000
S5A-300	.300	
SSA-325	.325	
S6A-250	.250	
S6A-275	.275	1.375
S6A400	.400	
S6A425	.425	

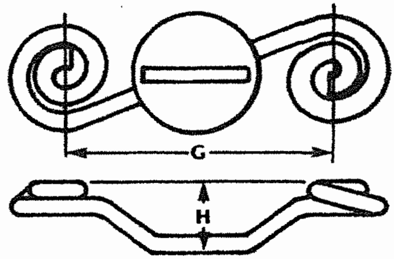
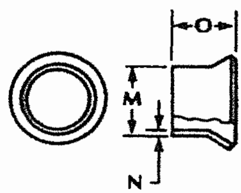


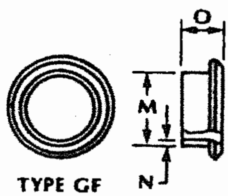
Fig. 7-88

TYPES GA AND GF GROMMETS

Part Number	Dimensions (inches) O	M	N	Max. Depth Of Panel
GA3-175	.175	.2187	.015	.025
GA3-200	.200	.2187	.015	.050
GA4-250	.250	.3125	.025	.050
GAS-312	.312	.375	.028	.062
GAS-375	.375	.375	.028	.125
GA6-1/2-375	.375	.500	.035	.093
GA6-1/2-500	.500	.500	.035	.200
GFS-175	.17S	.375	.028	.062
GF6-1/2-250	.250	.500	.035	.093



TYPE GA



TYPE GF

Fig. 7-86 (cont.)

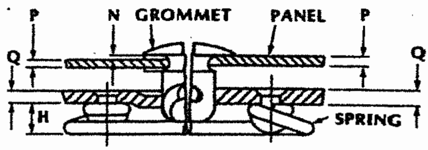
Part Number	Dimensions (Inches) A	B	L	Uses Grommet	Uses Spring
A4-25			.250		
A4-30	.250	.080	.300	GA4-250 S4-200, S4-225	
A4-35			.350		
A5-30			.300		
A5-35			.350		
A5-40	.3125	.100	.400	GA5-312, GA5-375	S5A-250, S6A-275
A5-45			.450		
A5-50			.500		
A6-1/2-40	.4065	.125	.400	GA6-1/2-375, GA6-1/2-500	S6A-250, S6A-275
A6-1/2-50			.500		
AJ4-25		.075	.250		
AJ4-35	.250	.150	.350	GA4-250 S4-200, S4-225	
AJ4-50		.250	.500		
AJ5-30		.100	.300		
AJ5-35	.125	.350			
AJ5-40	.3125	.190	.400	GA5-312, GA5-375	S5A-200, S5A-225, S5A-250
AJ5-45		.190	.450		
AJ5-50		.250	.500		
AJ6-1/2-45		.188	.450		
AJ6-1/2-50		.250	.500		
	.4062			GA6-1/2-375, GA6-1/2-500	S6A-250, S6A-275
AJ6-1/2-80		.450	.800		
AJ6-1/2-90		.550	.900		
FA5-35			.350		
FA5-40	.3125	.188	.400	GF5-175	S5A-300, S5A-325
FA5-45			.450		
FA5-50			.500		
FA6-1/2-45			.450		
FA6-1/2-50			.500		
FA6-1/2-55	.4062	.250	.550	GF6-1/2-218, GF6-1/2-250	S6A-4OO, S6A-425
FA6-1/2-60			.600		

Fig. 7-86

DZUS FASTENERS

STANDARD LINE

Fastener studs are made of steel, heat treated and cadmium plated. Springs are made of music wire, cadmium plated. Grommets are made of aluminum or steel, cadmium plated. No special tools needed to operate the fasteners.



IN SELECTING LENGTH OF FASTENER-
Add N+P+Q+H — Subtract spring deflection.
For installation without grommet — omit "N".

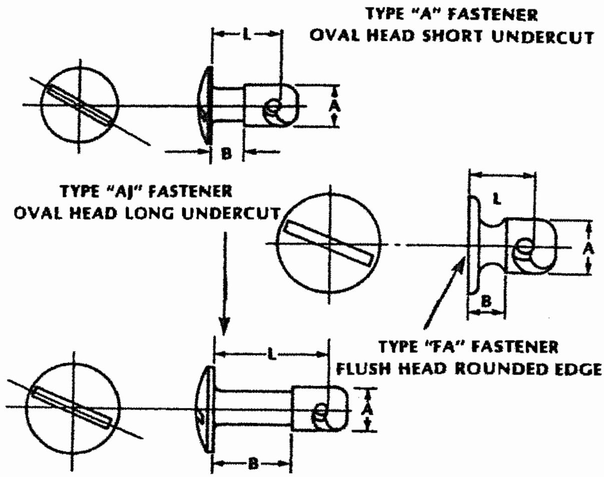
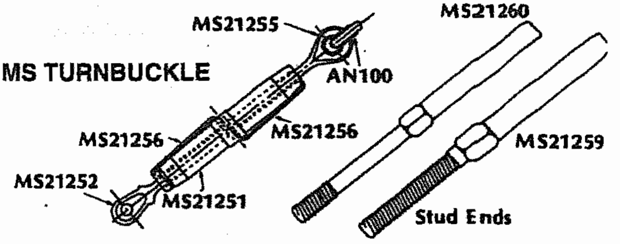


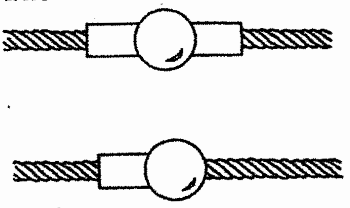
Fig. 7-85



Part Number	Thread	Cable Dia.	Description
MS21251-B2S	6-40	1/16	
-B3S	10-32	3/32	Barrel (Body), Brass
-B3L	10-32	3/32	
-B5S	1/4-28	5/32	
MS21252-3LS	10-32	3/32	
-3RS	10-32	3/32	Fork (Clevis End)
-5RS	1/4-28	5/32	
MS21254-2RS	6-40	1/16	
-3RS	10-32	3/32	Eye End (for pin)
-5LS	1/4-28	5/32	
-5RS	1/4-28	5/32	
MS21255-3LS	10-32	3/32	Eye End (for cable)
-3RS	10-32	3/32	
MS21259-2RH	6-40	1/16	
-2LH	6-40	1/16	Stud End
-4RH	1/4-28	1/8	
-4LH	1/4-28	1/8	
MS21260-S2RH	6-40	1/16	
(Short) -S2LH	6-40	1/16	
-S3RH	10-32	3/32	Stud End
-S3LH	10-32	3/32	
-S4RH	1/4-28	1/8	
-S4LH	1/4-28	1/8	
MS21256-1	----	-----	Clip (for short barrels)
-2	----	-----	Clip (for long barrels)

Fig. 7-83

SWAGED BALL & SHANK



Part Number	Cable Dia. (in.)	Pin Hole Dia. (in.)	Description
MS20663C-2	1/16	.073	
-3	3/32	.104	Ball & Double Shank
-4	1/8	.139	
MS20664C-2	1/16	.073	
-3	3/32	.104	
-4	1/8	.139	Ball & Single Shank
-5	5/32	.169	
-6	3/16	.201	

Fig. 7-84

AN TURNBUCKLE

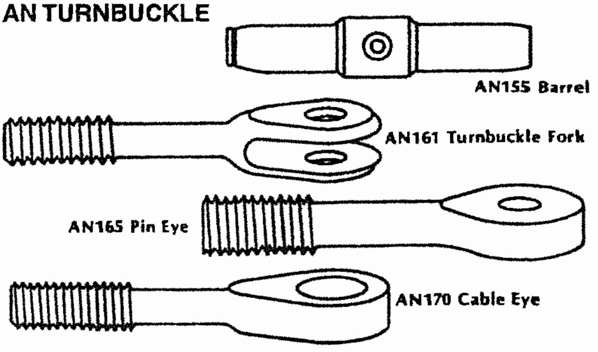
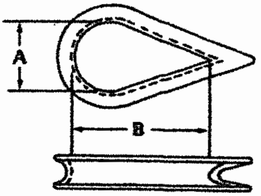


Fig. 7-81

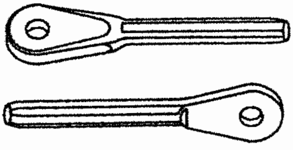
CABLE TERMINALS
AN100 CABLE THIMBLES



Dash Number Carbon Steel	Dash Number Cor. Res. Steel	Fits Cable Size	Dimensions (Inches) A	Dimensions (Inches) B
-3	-C3	1/16-5/64	.35	.70
-4	-C4	3/32-7/64-1/8	.35	.70
-5	-C5	5/32	.40	.80
-6	-C6	3/16	.50	1.00

Fig. 7-82

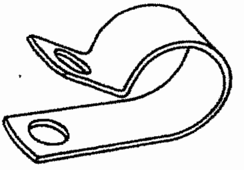
SWAGED FORK & EYE ENDS



Part Number	Cable Dia. (in.)	Pin Hole Dia. (in.)	Description
MS20667-2	1/16	.190	
-3	3/32	.190	Fork End
-4	1/8	.190	
-5	5/32	.250	
-6	3/16	.313	
MS20668-2	1/16	.190	
-3	3/32	.190	
-4	1/8	.190	Eye End
-5	5/32	.250	
-6	3/16	.313	

Fig. 7-79

AN742 PLAIN CLAMP



Dash No.	For Use With Rigid Tube O.D. (inches)
D3	3/16
D4	1/4
D5	5/16
D12	3/4
D16	1

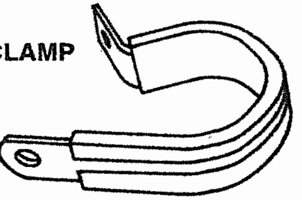
Fig. 7-80

SAFETY WIRE
MS20995 SAFETY WIRE

Material	Nominal Wire Diameter (inches) .020	.025	.032	.040	.041
	MS20995 Dash Number				
Monel	-NC20	-----	-NC32	-NC40	-----
Corrosion-Resistant Steel	-C20	-C25	-C32	------	-C41

Fig. 7-78

MS21919 CUSHIONED CLAMP

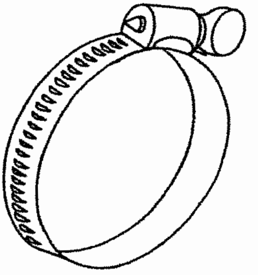


AN741 Equiv.	For Use With Tube O.D. (Inches)	Dash Number Aluminum	Steel
D4C	1/8	DG2	G2
D5C	3/16	DG3	G3
D6C	1/4	DG4	G4
D7C	5/16	DG5	G5
D8C	3/8	DG6	G6
D9C	7/16	DG7	
D10C	1/2	DG8	G8
D11C	9/16	DG9	G9
D12C	5/8	DG10	G10
D13C	11/16	DG11	
D14C	3/4	DG12	G12
D15C	13/16	DG13	
D16C	7/8	DG14	G14
D17C	15/16	DG15	
D18C	1	DG.16	
D19C	1-1/16	DG17	
D20C	1-1/8	DG18	
D21C	1-3/16	DG19	
D22C	1-1/4	DG20	
D23C	1-5/16	DG21	
D24C	1-3/8	DG22	
D25C	1-7/16	DG23	
D26C	1-1/2	DG24	
D27C	1-9/16	DG25	
D28C	1-5/8	DG26	

Fig. 7-77

CLAMPS

AN737 HOSE CLAMP



Dash Number	Min. I.D. Of Clamp (inches)	Max. I.D. Of Clamp (inches)	For Use With Hose I.D. Non Self-Sealing	Self-Sealing
TW22	7/16	11/16	1/4	----
TW24	1/2	3/4	5/16	----
TW26	9/16	13/16	3/8	----
TW30	11/16	15/16	1/2	----
TW34	13/16	1-1/16	5/8	----
TW38	15/16	1-3/16	3/4	----
TW44	61/64	1-3/8	----	5/8
TW46	1	1-7/16	1	----
TW48	1-5/64	1-1/2	----	3/4
TW56	1-21/64	1-3/4	----	1-1/4
TW58	1-3/8	1-13/16	1-1/4	-----
TW66	1-5/8	2-1/16	1-1/2	1-1/4
TW74	1-7/8	2-5/16	1-3/4	1-1/2
TW82	2-1/8	2-9/16	2	-----
TW91	2-13/32	2-27/32	-----	-----
TW98	2-5/8	3-1/16	2-1/2	-----
TWI07	2-29/32	3-11/32	-----	2-1/2
TW114	3-1/8	3-9/16	3	-----

Fig 7-76 (cont.)

Part Number	Size (in.)	
	I.D.	O.D.
-16	3-1/2	3-3/4
-20	4	4-1/4
-22	4-1/4	4-1/2
-24	4-1/2	4-3/4
-29	5-1/8	5-3/8
-30	5-1/4	5-1/2
-36	6	6-1/4
-37	6-1/4	6-1/2
-38	6-1/2	6-3/4
-39	6-3/4	7
-44	8	8-1/4
-47	8-3/4	9
-49	9-1/4	9-1/2

Fig 7-76 (cont.)

Part Number	Size (In.) I.D.	O.D.
-31	1-7/8	2-1/4
-32	2	2-3/8
-33	2-1/8	2-1/2
-34	2-1/4	2-5/8
-35	2-3/8	2-3/4
-36	2-1/2	2-7/8
-37	2-5/8	3
-38	2-3/4	3-1/8
-39	2-7/8	3-1/4
-40	3	3-3/8
-41	3-1/8	3-1/2
-42	3-1/4	3-5/8
-44	3-1/2	3-7/8
-46	3-3/4	4-1/8
-47	3-7/8	4-1/4
AN623OB-1	1-5/8	1-7/8
-2	1-3/4	2
-3	1-7/8	2-1/8
-4	2	2-1/4
-5	2-1/8	2-3/8
-6	2-1/4	2-1/2
-7	2-3/8	2-5/8
-8	2-1/2	2-3/4
-9	2-5/8	2-7/8
-10	2-3/4	3
-11	2-7/8	3-1/8
-12	3	3-1/4
-13	3-1/8	3-3/8
-14	3-1/4	3-1/2
-15	3-3/8	3-5/8

Fig. 7-76

AN6227 O-RING, PACKING

AN6230 O-RING, GASKET

Part Number	Size (in.) I.D.	Size (in.) O.D.
AN6227B-1	1/8	1/4
-2	5/32	9/32
-3	3/16	5/16
-4	7/32	11/32
-5	1/4	3/8
-6	5/16	7/16
-7	3/8	1/2
-8	3/8	9/16
-9	7/16	5/8
-10	1/2	11/16
-11	9/16	3/4
-12	5/8	13/16
-13	11/16	7/8
-14	3/4	15/16
-15	3/4	1
-16	13/16	1-1/16
-17	7/8	1-1/8
-18	15/16	1-3/16
-19	1	1-1/4
-20	1-1/16	1-5/16
-21	1-1/8	1-3/8
-22	1-3/16	1-7/16
-23	1-1/4	1-1/2
-24	1-5/16	1-9/16
-25	1-3/8	1-5/8
-26	1-7/16	1-11/16
-27	1-1/2	1-3/4
-28	1-1/2	1-7/8
-29	1-5/8	2
-30	1-3/4	2-1/8

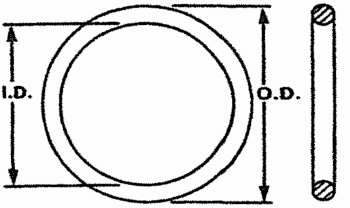


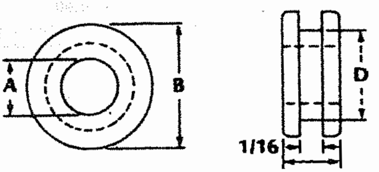
Fig 7-75 (cont.)

MS35489 GROMMET, ELASTIC (cont.)

MS35489 Dash Number	AN931 Dash Number	Dimensions (Inches)			
		A	B	D	T
-22	-14-20	7/8	1-5/8	1-1/4	7/16
-121	-14-26	7/8	2	1-5/8	7/16
-23	-16-22	1	1-3/4	1-3/8	7/16
-24	-16	1	2-1/4	1-7/8	7/16

Fig. 7-75

MS35489 GROMMET, ELASTIC



MS35489 Dash Number	AN931 Dash Number	Dimensions (Inches)			
		A	B	D	T
-2	-2-9	1/8	3/4	9/16	3/16
-3	-2-16	1/8	1-1/4	1	1/4
-134	-3-9	3/16	3/4	9/16	3/16
-4	-3-5	3/16	7/16	5/16	3/16
-5	-3-10	3/16	7/8	5/8	3/16
-6	-4-7	1/4	5/8	7/16	3/16
-7	-4-12	1/4	1	3/4	1/4
-8	-4-16	1/4	1-1/4	1	1/4
-9	-5-9	5/16	13/16	9/16	5/16
-10	-5-12	5/16	1	3/4	5/16
-118	-5-13	5/16	1-1/16	13/16	5/16
-11	-6-10	3/8	7/8	5/8	5/16
-12	-6-16	3/8	1-1/4	1	1/4
-13	-7-11	7/16	15/16	11/16	5/16
-14	-8-13	1/2	1-1/16	13/16	5/16
-15	-8-20	1/2	1-1/2	1-1/4	1/4
-16	-9-13	9/16	1-1/16	13/16	5/16
-17	-10-14	5/8	1-1/8	7/8	5/16
-18	-10-20	5/8	1-1/2	1-1/4	1/4
-19	-11-16	11/16	1-5/16	1	3/8
-135	-12-20	3/4	1-5/8	1-1/4	1/4
-20	-12-17	3/4	1-3/8	1-1/16	3/8
-21	-12-23	3/4	1-13/16	1-7/16	3/8
-120	-12-26	3/4	2	1-5/8	3/8

Fig. 7-74

AN901 GASKET, TUBE CONNECTION SEAL

Dash Number	Tube O.D. (Inches)
-4A	1/4
-5A	5/16
-6A	3/8
-8A	1/2
-10A	5/8
-12A	3/4
-16A	1

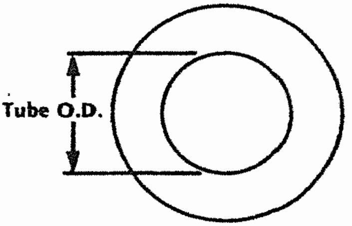


Fig. 7-72

AN900 GASKET, ANNULAR COPPER-ASBESTOS

Part Number	I.D. (inches)
AN900-4	1/4
-6	3/8
-7	7/16
-8	1/2
-10	5/8
-11	11/16
-12	3/4
-14	7/8
-16	1
-17	1-1/16
-18	1-1/8
-22	1-3/8
-28	1-3/4
-29	1-13/16

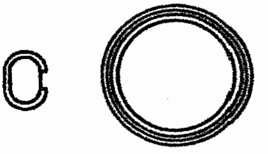


Fig. 7-73

MS28778 GASKET, TUBE FITTING BOSS

Part Number	Tube O.D. (in.)
MS28778-2	1/8
-3	3/16
-4	1/4
-5	5/16
-6	3/8
-8	1/2
-10	5/8
-12	3/4

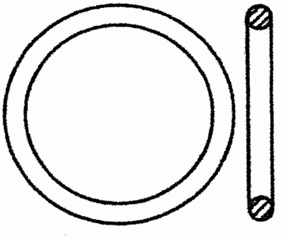


Fig. 7-70

MS20913 PLUG, SQUARE HEAD

MS20913 Dash No.			Pipe Thread
Brass	Alum.	Stainless Steel	
-1	-1D	-1S	1/8"
-2	-2D	-2 S	1/4"
-3	-3D	-3 S	3/8"
-4	-4D	-4 S	1/2"
-6	-6D	-6 S	3/4"
-8	-8D	-8 S	1"
-10	-10D	-10 S	1-1/4"

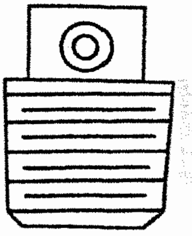


Fig. 7-71

AIRCRAFT NAILS
Flat, Bonderized, cement coated

AN Number	Length	Gauge
AN301-2	1/4"	20
AN301-516	5/16"	20
AN301-3	3/8"	20
AN301-4	1/2"	20
AN301-5	5/8"	20
AN301-6	3/4"	20
AN301-8	1"	20
AN301B18-5	5/8"	18 Brass
AN301B18-7	7/8"	18 Brass

AN301 NAIL, AIRCRAFT

Fig. 7-68

MS20825 TEE, FLARED TUBE WITH PIPE THREAD ON SIDE

MS20825 Dash No.		Tube	Pipe
Steel	Alum.	O.D.	Thread
-2	-2D	1/8"	1/8"
-3	-3D	3/16"	1/8"
-4	-4D	1/4"	1/8"
-5	-5D	5/16"	1/8"
-6	-6D	3/8"	1/4"
-8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-12	-12D	3/4"	3/4"
-16	-16D	1"	1"

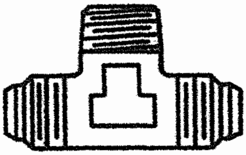


Fig. 7-69

MS20826 TEE, FLARED TUBE WITH PIPE THREAD ON RUN

MS20826 Dash No.		Tube	Pipe
Steel	Alum.	O.D.	Thread
-2	-2D	1/8"	1/8"
-3	-3D	3/16"	1/8"
-4	-4D	1/4"	1/8"
-5	-5D	5/16"	1/8"
-6	-6D	3/8"	1/4"
-8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-12	-12D	3/4"	3/4"
-16	-16D	1"	1"

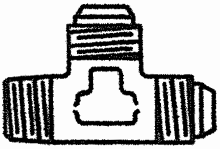


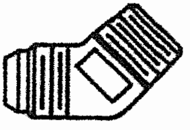
Fig. 7-66

MS20822 ELBOW/90° FLARED TUBE AND PIPE THREAD

MS20822 Dash No. Steel	Alum.	Tube O.D.	Pipe Thread
-2	-2D	1/8"	1/8"
-3	-3D	3/16"	1/8"
-4	-4D	1/4"	1/8"
-5	-5D	5/16"	1/8"
-6	-6D	3/8"	1/4"
-8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-12	-12D	3/4"	3/4"
-16	-16D	1"	1"

Fig. 7-67

MS20823 ELBOW, 45° FLARED TUBE AND PIPE THREAD



MS20823 Dash No. Steel	Alum.	Tube O.D.	Pipe Thread
-2	-2D	1/8"	1/8"
-3	-3D	3/16"	1/8"
-4	-4D	1/4"	1/8"
-5	-5D	5/16"	1/8"
-6	-6D	3/8"	1/4"
-8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-12	-12D	3/4"	3/4"
-16	-16D	1"	1"

Fig. 7-64

AN6289 NUT, FLARED TUBE, UNIVERSAL FITTING

AN6289 Dash No. Steel	Alum. Alloy	Tube O.D.
-2	D2	1/8"
-3	D3	3/16"
-4	D4	1/4"
-5	D5	5/16"
-6	D6	3/8"
-8	D8	1/2"
-10	D10	5/8"
-12	D12	3/4"
-16	D16	1"

Fig. 7-65

MS20819 SLEEVE, COUPLING

MS20819 Dash No. Steel	Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

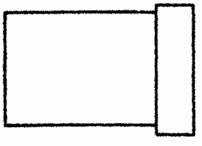


Fig. 7-62

AN932 PLUG, COUNTERSINK HEX,HEAD

Steel	Alum.	Pipe Thread
-2	-2D	1/8"
	-3D	1/4"
	-4D	3/8"

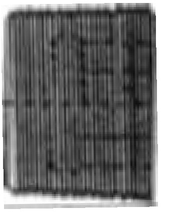


Fig. 7-63

AN938 TEE, INTERNAL SCREW THREAD

AN938 Dash No. Steel	Alum. Alloy	Tube O.D.
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"
-20	-20D	1-1/4"

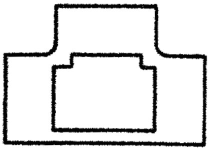


Fig. 7-60

AN924 NUT, FLARED TUBE, BULKHEAD AND UNIVERSAL FITTING

AN924 Dash No.		Tube
Steel	Alum. Alloy	O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

Fig. 7-61

AN929 CAP (ASSEMBLY) PRESSURE SEAL FLARED TUBE FITTING

AN929 Dash Number.	Tube O.D.
-2	1/8"
-3	3/16"
-4	1/4"
-5	5/16"
-6	3/8"
-8	1/2"
-10	5/8"
-12	3/4"
-16	1"

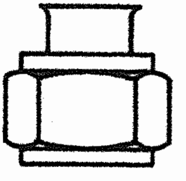


Fig. 7-58

AN918 CROSS, INTERNAL THREAD

AN918 Dash No. Brass	Alum. Alloy	Pipe Size
-1	-1D	1/8"
-2	-2D	1/4"
-3	-3D	3/8"
-4	-4D	1/2"
-6	-6D	3/4"
-8	-8D	1"

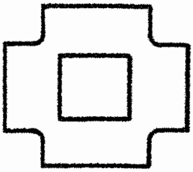


Fig. 7-59

TUBE FITTINGS
AN919 REDUCER, EXTERNAL THREAD, FLARED TUBE

AN919 Dash Number Steel	Alum. Alloy	Tube O.D. Small End	Large End
-2	-2D	1/4"	3/16"
-3	-3D	5/16"	1/4"
-6	-6D	3/8"	1/4"
-7	-7D	3/8"	5/16"
-11	-11D	1/2"	5/16"
-12	-12D	1/2"	3/8"
-14	-14D	5/8"	3/8"
-15	-15D	5/8"	1/2"
-19	-19D	3/4"	1/2"

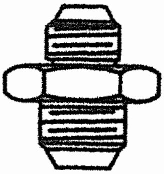


Fig. 7-56

AN916 ELBOW, 90°, INTERNAL THREAD

AN916 Dash No. Brass	Alum. Alloy	Pipe Size
-1	-1D	1/8"
-2	-2D	1/4"
-3	-3D	3/8"
-4	-4D	1/2"
-6	-6D	3/4"
-8	-8D	1"

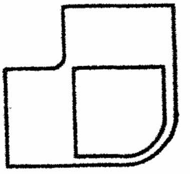


Fig. 7-57

AN917 TEE, INTERNAL THREAD

AN917 Dash No. Brass	Alum. Alloy	Pipe Size
-1	-1D	1/8"
-2	-2D	1/4"
-3	-3D	3/8"
-4	-4D	1/2"
-6	-6D	3/4"

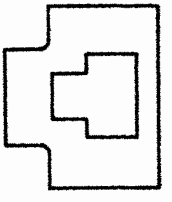


Fig. 7-54

AN914 ELBOW, 45°, INTERNAL AND EXTERNAL THREAD

AN914 Dash No. Brass	Alum. Alloy	Pipe Size
-1	-1D	1/8"
-2	-2D	1/4"
-3	-3D	3/8"
-4	-4D	1/2"
-6	-6D	3/4"
-8	-8D	1"

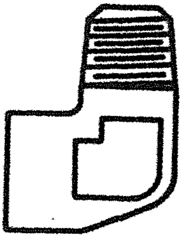


Fig. 7-55

AN915 ELBOW, 45°, INTERNAL AND EXTERNAL THREAD

AN915 Dash No. Brass	Alum. Alloy	Pipe Size
-1	-1D	1/8"
-2	-2D	1/4"
-3	-3D	3/8"
-4	-4D	1/2"
-6	-6D	3/4"
-8	-8D	1"

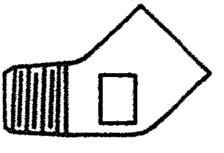


Fig. 7-52

AN911 HEX, SHOULDER NIPPLE

AN911 Dash No. Brass	Alum. Alloy	Pipe Size
-1	-1D	1/8"
-2	-2D	1/4"
-3	-3D	3/8"
-4	-4D	1/2"
-6	-6D	3/4"
-8	-8D	1"

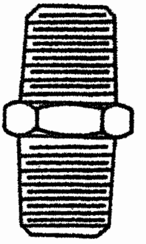


Fig. 7-53

AN912 BUSHING, REDUCER

AN912 Dash No. Brass	Alum. Alloy	Pipe Size
-1	-1D	1/4" x 1/8"
-	-2D	3/8" x 1/4"
-3	-3D	3/8" x 1/8"
-4	-4D	1/2" x 3/8"
-5	-5D	1/2" x 1/4"
-7	-7D	3/4" x 1/2"
-8	-8D	3/4" x 3/8"
-10	-10D	1" x 3/4"

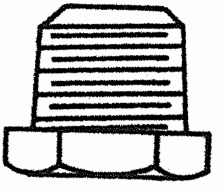


Fig 7-50

TUBE FITTINGS
AN894 BUSHING, SCREW THREAD EXPANDER

AN893 Dash Number		Tube O.D.	
Steel	Alum. Alloy	Small End	Large End
-3-2	D3-2	3/16"	1/8"
-4-3	D4-3	1/4"	3/16"
-5-4	D5-4	5/16"	1/4"
-6-5	D6-5	3/8"	5/16"
-8-5	D5-5	1/2"	5/16"
-8-6	D8-6	1/2"	3/8"
-10-6	D10-6	5/8"	3/8"
-10-8	D10-8	5/8"	1/2"
-12-8	D12-8	3/4"	1/2"

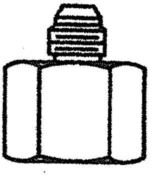


Fig. 7-51

PIPE FITTINGS
AN910 COUPLING

AN910 Dash No.		Pipe
Brass	Alum. Alloy	Size
-1	-1D	1/8"
-2	-2D	1/4"
-3	-3D	3/8"
-4	-4D	1/2"
-6	-6D	3/4"
-8	-8D	1"

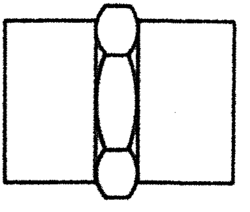


Fig. 7-48

HOSE FITTINGS
AN844 HOSE ELBOW, 45°, PIPE THREAD

AN844 Dash Number Steel	Alum. Alloy	Tube O.D.	Pipe Thread
-4	-4D	1/4"	1/8"
-6	-6D	3/8"	1/4"
-8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-12	-12D	3/4"	3/4"
-16	-16D	1"	3/4"
-17	-17D	1"	1"
-20	-20D	1-1/4"	1-1/4"

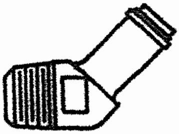


Fig. 7-49

TUBE FITTINGS
AN893 BUSHING, SCREW THREAD REDUCER

AN893 Dash Number Steel	Alum. Alloy	Tube O.D. Small End	Large End
-2	-2D	1/4"	3/8"
-3	-3D	1/4"	1/2"
-7	-7D	5/16"	3/8"
-8	-8D	5/16"	1/2"
-12	-12D	3/8"	1/2"
-121	-121D	3/8"	5/8"
-151	-151D	1/2"	5/8"
-16	-16D	1/2"	3/4"
-17	-17D	1/2"	1"

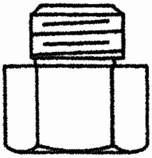


Fig. 7-46

AN840 HOSE NIPPLE, PIPE THREAD

AN840 Steel	Dash Number Alum. Alloy	Tube O.D.	Pipe Thread
-4	-4D	1/4"	1/8"
-6	-6D	3/8"	1/4"
-8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-11	-11D	3/4"	5/8"
-12	-12D	3/4"	3/4"
-16	-16D	1"	3/4"
-17	-17D	1"	1"

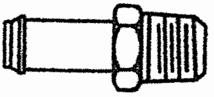


Fig.7-47

AN842 HOSE ELBOW, PIPE THREAD

AN842 Steel	Dash Number Alum. Alloy	Tube O.D.	Pipe Thread
-4	-4D	1/4"	1/8"
-6	-6D	3/8"	1/4"
-8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-12	-12D	3/4"	3/4"
-16	-16D	1"	3/4"
-17	-17D	1"	1"
-20	-20D	1-1/4"	1-1/4"

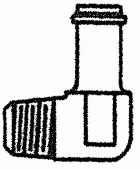


Fig. 7-44

AN834 TEE, FLARED TUBE, BULKHEAD AND UNIVERSAL

AN834 Dash Number Steel	Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

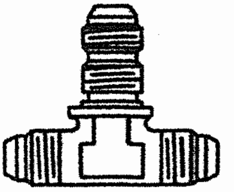


Fig.7-45

AN837 ELBOW, 45° FLARED TUBE, BULKHEAD AND UNIVERSAL

AN837 Dash Number Steel	Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

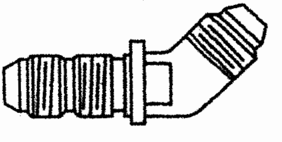


Fig. 7-42

AN832 UNION, FLARED TUBE, 3/8 BULKHEAD AND UNIVERSAL

AN832 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

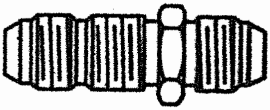


Fig. 7-43

AN833 ELBOW, 90° FLARED TUBE, BULKHEAD AND UNIVERSAL

AN833 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

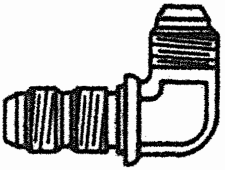


Fig. 7-40

AN824 TEE, FLARED TUBE

AN824 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

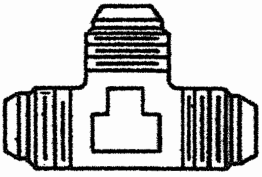


Fig. 7-41

AN827 CROSS, FLARED TUBE

AN827 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

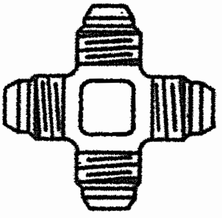


Fig. 7-38

AN820 CAP, FLARED TUBE FITTING

AN820 Steel	Dash Number Alum. Alloy	Tube O.D.	Pipe Thread
-2		1/8	5/16-24
	-3D	3/16	3/8-24
-4		1/4	7/16-20
-5		5/16	1/2-20
-6		3/8	9/16-18
-8		1/2	3/4-16
-10		5/8	7/8-14
-12		3/4	1-5/16-12

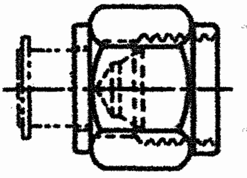


Fig. 7-39

AN821 ELBOW, 90° FLARED TUBE

AN821 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

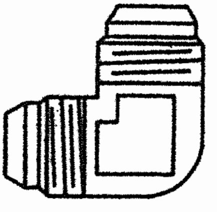


Fig. 7-36

AN816 NIPPLE, FLARED TUBE AND PIPE THREAD

AN816 Steel	Dash Number Alum. Alloy	Tube O.D.	Pipe Thread
-2	-2D	1/8"	1/8"
-3	-3D	3/16"	1/8"
-4	-4D	1/4"	1/8"
-5	-5D	5/16"	1/8"
-6	-6D	3/8"	1/4"
8	-8D	1/2"	3/8"
-10	-10D	5/8"	1/2"
-12	-12D	3/4"	3/4"
-16	-16D	1"	1"

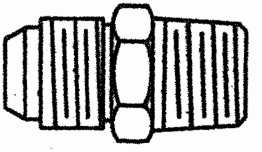


Fig. 7-37

AN818 NUT, COUPLING

AN818 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

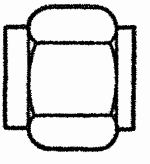


Fig. 7-34

AN814 PLUG AND BLEEDER, SCREW THREAD

AN814 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

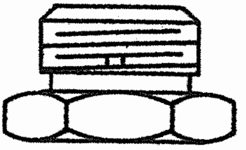


Fig. 7-35

AN815 UNION, FLARED TUBE

AN815 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/8"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

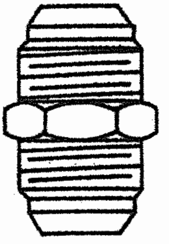


Fig. 7-32

AN804 TEE, FLARED TUBE WITH BULKHEAD ON RUN

AN804 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

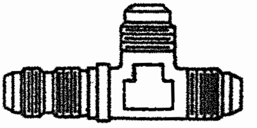


Fig. 7-33

AN806 PLUG, FLARED TUBE

AN806 Steel	Dash Number Alum. Alloy	Tube O.D.
-2	-2D	1/8"
-3	-3D	3/16"
-4	-4D	1/4"
-5	-5D	5/16"
-6	-6D	3/8"
-8	-8D	1/2"
-10	-10D	5/8"
-12	-12D	3/4"
-16	-16D	1"

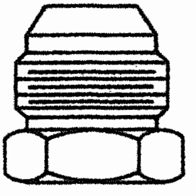


Fig 7-31 (cont.)

AN470, 430, 456, 426, 442 RIVETS

Dash Number	Diameter (Inches)	Length (Inches)	Quantity Per Pound MS20470	MS20426
-5-4		1/4	888	1440
-5-5		5/16	802	1226
-5-6		3/8	721	1079
-5-7		7/16	672	946
-5-6	5/32	1/2	621	849
-5-9		9/16	578	770
-5-10		5/8	507	649
-5-12		3/4	407	494
-5-16		1	366	340
-6-5		5/16	515	846
-6-6		3/8	472	738
-6-7		7/16	436	654
-6-8	3/16	1/2	406	588
-6-9		9/16	379	534
-6-10		5/8	334	451
-6-12		3/4	271	343
-6-16		1	221	241

Fig. 7-31 (cont.)

AN470, 430, 456, 426, 442 RIVETS

Dash Number	Diameter (Inches)	Length (Inches)	Quantity Per Pound MS20470	MS20426
-3-2	3/32	1/8	4107	6406
-3-3		3/16	3485	5003
-3-4		1/4	3027	4103
-3-5		5/16	2675	3478
-3-6		3/8	2397	3018
-3-7		7/16	2171	2666
-3-8		1/2	1826	2161
-3-10		5/8	1576	1817
-3-12		3/4	2003	1515
-4-3	1/8	3/16	1734	2810
-4-4		1/4	1529	2308
-4-5		5/16	1367	1958
-4-6		3/8	1236	1700
-4-7		7/16	1128	1502
-4-8		1/2	1037	1346
-4-9		9/16	960	1219
-4-10		5/8	836	1025
-4-12		3/4	740	885
-4-14		7/8	664	775
-4-16		1	590	731

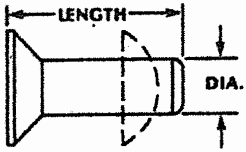
Table Continued on Next Page

Fig. 7-31

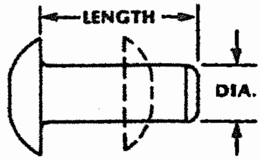
SOLID RIVETS

AN470, 430, 456, 426, 442 RIVETS

MS20426 100º countersunk head



M520470 UNIVERSAL HEAD



Application:

Solid shank rivets are the most universally used device for the construction of sheet metal aircraft.

Material:

1100-H14 Aluminum alloy: Designated A – no mark on head
2117-T4 Aluminum alloy: Designated-AD – dimple in head
2017-T4 Aluminum alloy: Designated-D – raised teat on head
2024-T4 Aluminum alloy: Designated-DD – two raised dashes on head
5056-H12 Aluminum alloy: Designated-B – raised cross on head

Head shape.

Designated by the AN number:
AN-426 - 100° countersunk head
AN430 – round head
AN456 – braizier head
AN470 – universal head

Diameter:

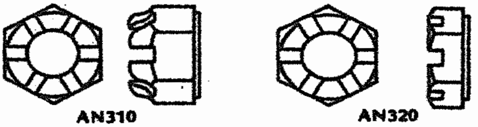
The first dash number is the diameter in 1/32" increments.
Example: AN470AD4 is a universal head rivet made of 2117 -T4 aluminum alloy, 4/32" of 1/8" diameter.

Length:

The second dash number is the length of the rivet in sixteenth inch increments.
Example: AN426DD3 -5. This is a 100° countersunk head 2024 -T4 aluminum alloy rivet, 3/32" diameter, 5/16" long.

Fig. 7-6

CASTLE NUTS



- AN310 CASTLE NUT -

Application:

These nuts are used for tension loads on drilled-shank bolts and are safetied with a cotter pin.

Material:

Cadmium plated alloy steel: No letter designation
Aluminum alloy (2024-T4): D in place of dash
Corrosion resistant steel: C in place of dash

Size:

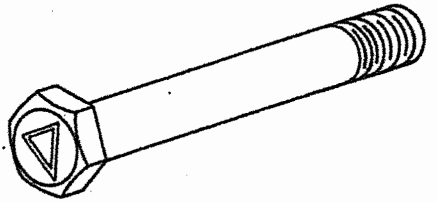
These nuts all have National Fine threads and the dash number denotes the diameter of the bolt they fit, in 1/16ths of an inch.
Ex. AN310C12 = Corrosion resistant steel castle nut to fit a 3/4-16 bolt.

Thread:

Class 3NF

Fig. 7-5

AN173-AN186 CLOSE TOLERANCE BOLT



Application:

Any time a bolted joint is subject to pounding loads or if bolts and rivets are used in the same joint, the bolts should fit the hole with a tight fit. These bolts are ground to a tolerance of + 0.0005" and are protected from rust by greasing instead of plating.

Material:

SAE 2330 nickel alloy steal.

Diameter:

The last digit in the AN number denotes the diameter in sixteenth-inch increments added to the basic 17.

Ex. AN176 is 6/16- or 3/8-inch diameter, AN182 is 12/16- or 3/4-inch diameter.

Length:

The dash number denotes the length in eighths of an inch. Bolts longer than one inch use two digits— the first indicating the number of inches, and the second, the number of eighths of an inch.

Ex. AN175-22 = 5/16 diameter close tolerance bolt 2-1/4 inches long.

Thread:

Thread is NF.

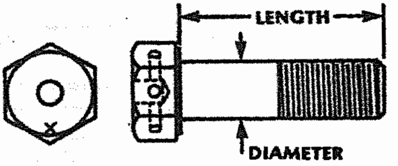
Safety provisions:

The standard bolt is drilled for a cotter pin, but if it is desired that the shank be undrilled so a self-locking nut may be used, the letter A is added to the end of the number: AN174-12A. If it is desired that the head be drilled to accept safety wire, the letter H is inserted in place of the dash.

Ex: AN173H4A

Fig. 7-4

MS20073 - MS20074 DRILLED HEAD BOLTS



Application:

Primarily in high stress areas where the bolt is screwed into a blind hole and safetied with lock wire. An example of the use of this bolt is to attach a propeller to a flanged shaft.

Materials:

SAE 2330 nickel alloy steel.

Diameter:

-03 through -12
MS20073 has from 10-32 to 3/4-16 threads
MS20074 has from 10-24 to 3/4-10 threads

Length:

The dash number denotes the length in eighths of an inch up through 7/8-inch. For lengths greater than one inch, the first digit is the number of inches and the second digit is the number of eighths.
Example: MS20073-7-7 is 3/8-inch diameter, 7/8-inch long.
MS20073-5-33 is 5/16-inch diameter, 3-3/8 inches long.

Thread:

The MS20073 has a national fine thread and is designed to be used with nuts or screwed into a steel part. MS20074 is national course threaded and is principally used in aluminum or magnesium castings.

Safety provisions:

All of these bolts have their heads drilled for safety wire with no hole in the shank for a cotter pin.

Fig 7-3 (cont.)

NUT AND COTTER PIN SIZES
To Use With Each Clevis Bolt Size

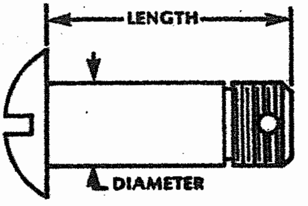
AN Number	Diameter & Threads Per Inch	Self-Locking Nut	Castle Shear Nut	Cotter Pin
AN21	6-40	-----------	AN320-1	MS24665-3
AN22	8-36	-----------	AN320-2	MS24665-132
AN23	10-32	MS20364-1032	AN320-3	MS24665-132
AN24	1/4-28	MS20364-428	AN320-4	MS24665-132

DASH NUMBER - NOMINAL LENGTH

-8 1/2	-14 7/8	-20 1-1/4
-9 9/16	-15 15/16	-21 1-5/16
-10 5/8	-16 1	-22 1-3/8
-11 11/16	-17 1-1/16	-23 1-7/16
-12 3/4	-18 1-1/8	-24 1-1/2
-13 13/16	-19 1-3/16	-25 1-9/16

Fig. 7-3

AN21 - AN36 CLEVIS BOLTS



Application:

These bolts are used for shear loads only.

Material:

Nickel steel alloy, SAE 2330.

Diameter:

AN21 - AN23 - the second digit denotes the fine thread machine screw size.

Example: 21 is 6-40, 22 is 8-36; 23 is 10-32.

AN24- AN36 - the second digit denotes the diameter in 1/16th -inch increments

Example: AN25 has a diameter of 5/16th -inch.

Length:

The dash number indicates the length in 1/16th-inch increments.

Ex: -9 = 9/16-inch, -26 = 26/16 or 1-5/8 inches long.

Thread:

Class 3NF

Safety provisions:

This bolt is designed to be used with a shear castle nut, safetied with a cotter pin. In the event a self-locking nut is used, the bolt should not be drilled. This is designated by the letter A following the dash number.

Ex: AN24-16A

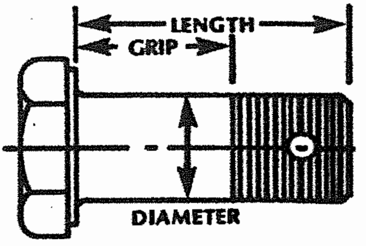
Fig 7-2 (cont.)

3. If the bolt is used in a blind hole and safetied with wire through the head, the head is drilled and designated by the letter H used in place of the dash.
EXAMPLE AN4H6A

NUT AND COTTER PIN SIZES

AN Number	Diameter	Plain Nut AN Number	Castle Nut AN Number	Cotter Pin MS Number
AN3	3/16	AN315-3R	AN310-3	MS24665-132
AN4	1/4	AN315-4R	AN310-4	MS24665-132
AN5	5/16	AN315-5R	AN310-5	MS24665-132
AN6	3/8	AN315-6R	AN310-6	MS24665-283
AN7	7/16	AN315-7R	AN310-7	MS24665-283
AN8	1/2	AN315-8R	AN310-8	MS24665-283

Fig. 7-2



Application:

These bolts may be used for either tensile or shear loads

Material:

Cadmium plated nickel alloy steel: No letter designation- Head marked with cross or asterisk.
Corrosion resistant steel (CRES): C -Head marked with single dash.
Aluminum alloy (2024-T4): DD -Head marked with two dashes.

Diameter:

The AN number denotes the diameter of the shank in 1/16-inch increments:
Example 3 = 3/16"

Length:

The dash number denotes the length in eighths of an inch up through7/8. For lengths greater than one inch, the first digit is the number of inches and the second digit is the number of eighths.
Example: 12 = 1 inch + 2/8 or 1-1/4 inch long

Thread:

Class 3NF

Safety provisions:

1. This bolt was originally designed to be used with a castle nut and cotter pin wherein the shank is drilled for the pin.

2. If a self-locking nut is to be used, the shank should be undrilled. This is designated by the letter A following the dash number.
Example AN4-6A

Aircraft Hardware

Fig.7-1

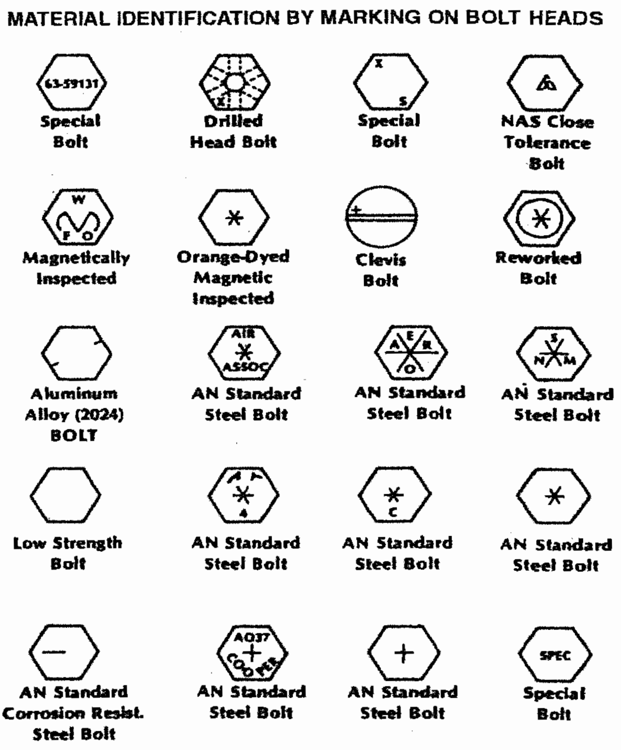
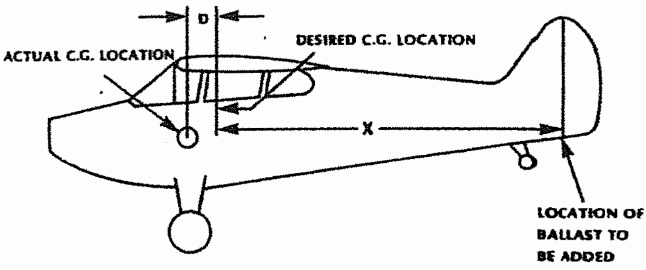


Fig. 6-30

PERMANENT BALLAST COMPUTATION FORMULA



D = Distance in inches desired to move C.G. of airplane

W = Weight of airplane as loaded

X = Distance in inches from point where ballast is to be installed, to the desired location of the new C.G.

B = Weight of ballast required in pounds.

$$B = \frac{D \times W}{X}$$

Compute the new C.G. of the aircraft with ballast installed.

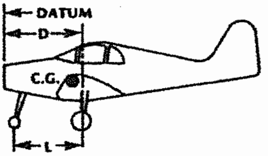
NOTE: If greater accuracy is desired, repeat the entire formula using the NEW aircraft weight and the NEW C.G. in the second operation.

Weight and Balance

Although the scope and detail of aircraft weight and balance computations are too involved to fully detail here, Figs. 6-29 and 6-30, provide a quick reference to the formulas used in these computations.

Fig. 6-29

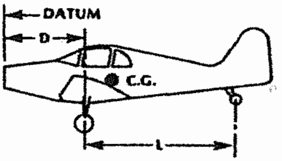
EMPTY WEIGHT CENTER OF GRAVITY FORMULAS



NOSE WHEEL TYPE AIRCRAFT

DATUM LOCATED FORWARD OF THE MAIN WHEELS

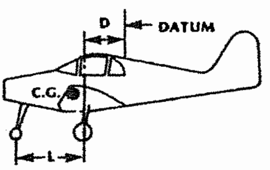
$$C.G. = D - \frac{F \times L}{W}$$



TAIL WHEEL TYPE AIRCRAFT

DATUM LOCATED FORWARD OF THE MAIN WHEELS

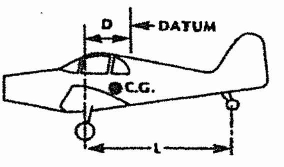
$$C.G. = D + \frac{R \times L}{W}$$



NOSE WHEEL TYPE AIRCRAFT

DATUM LOCATED AFT OF THE MAIN WHEELS

$$C.G. = -D + \frac{F \times L}{W}$$



TAIL WHEEL TYPE AIRCRAFT

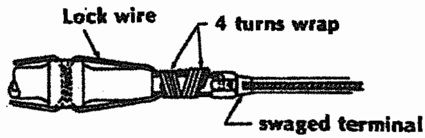
DATUM LOCATED AFT OF THE MAIN WHEELS

$$C.G. = -D + \frac{R \times L}{W}$$

C.G. = Distance from datum to center of gravity of the aircraft
W = The weight of the aircraft at the time of weighing
D = The horizontal distance measured from the datum to the main wheel weighing point
L = The horizontal distance measured from the main wheel weighing point to the nose or tail weighing point
F = The weight at the nose weighing point
R = The weight at the tail weighing point

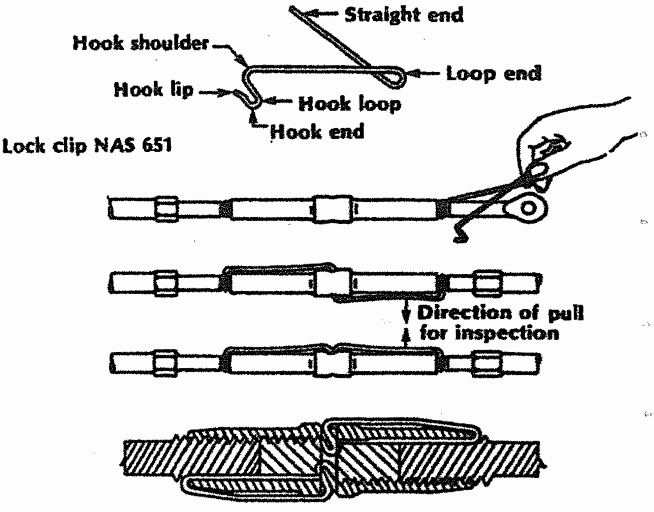
Fig. 6-28 (cont.)

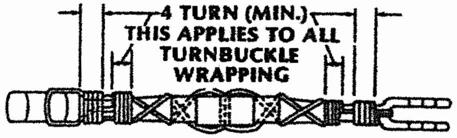
(D) SINGLE WRAP



The end of a turnbuckle having left hand threads is identified by the groove.

Fig. 6-28 (cont.)





(A) DOUBLE WRAP (SPIRAL)

(B) DOUBLE WRAP

(C) SINGLE WRAP (SPIRAL)

Tension in cable installations is normally adjusted using turnbuckles. When the proper tension has been obtained, safety the turnbuckle using one of the methods shown in Fig 6-28. Most modern aircraft will use the clip-lock style turnbuckle, while older airrcraft will use the wire wrap method.

Fig. 6-28

TURNBUCKLE SAFETYING GUIDE

Cable size	Type of wrap	Diameter of safety wire	Material (annealed condition)
1/16	Single	0.040	Copper, brass.[1]
3/32	Single	0.040	Copper, brass.[1]
1/8	Single	0.040	Stainless steel, Monel and "K" Monel.
1/8	Double	0.040	Copper, brass.[1]
1/8	Single	0.057 min.	Copper, brass.[1]
5/32 and greater.	Double	0.040	Stainless steel, Monel and "K" Monel.[1]
5/32 and greater.	Single	0.057 min.	Stainless steel, Monel or "K" Monel.[1]
5/32 and greater.	Double	0.051[2]	Copper, brass.

1 Galvanized or tinned steel, or soft iron wires are also acceptable.
2 The safety wire holes in 5/32-inch diameter and larger turnbuckle terminals for swaging may be drilled sufficiently to accommodate the double 0.051-inch diameter copper or brass wires when used.

It is important to the ultimate strength that the installation be properly made. Fig. 6-26 illustrates the sequence for swaging a Nicopress sleeve. The completed swage should be chocked with a *go, no-go* gauge provided by the manufacturer.

Fig. 6-26

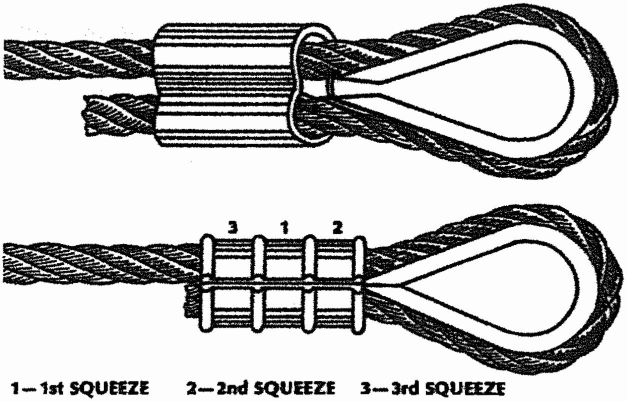
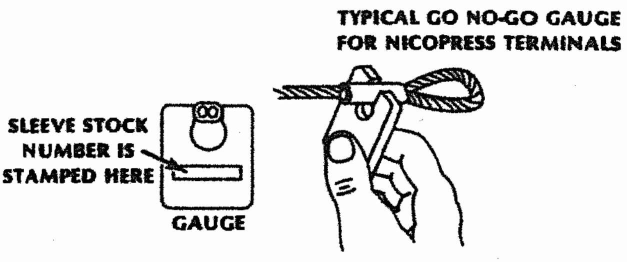


Fig. 6-27



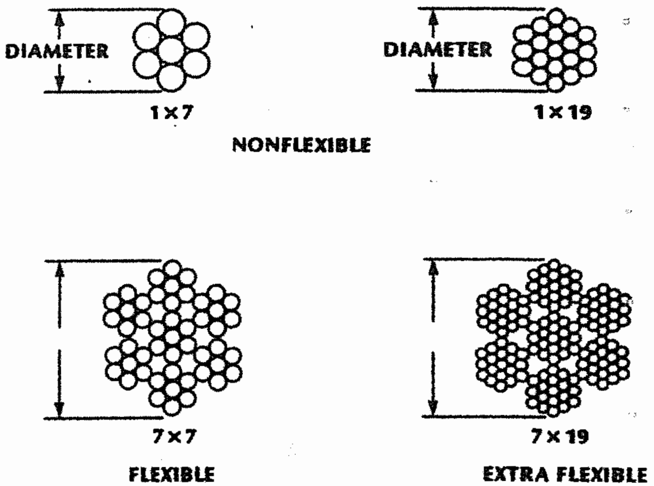
COPPER OVAL SLEEVE TERMINAL (MS51844)

Cable Size	Copper Oval Sleeve Nicopress Stock No: Plain	Zinc Plated*	Manual Tool No.	Sleeve length before compression (approx.) (inches)	Sleeve length after compression (approx.) (inches)	Number of Presses	Teste (p
3/64	18-11-B4	28-11-B4	51-B4-887	3/8	7/16	1	
1/16	18-1-C	28-1-C	51-C-887	3/8	7/16	1	
3/32	18-2-G	28-2-G	51-G-887	7/16	1/2	1	
1/8	18-3-M	28-3-M	51-M-850	9/16	3/4	3	
5/32	18-4-P	28-4-P	51-P-850	5/8	7/8	3	
3/16	18-6-X	28-6-X	51-X-850	1	1-1/4	4	
7/32	18-8-F2	28-8-F2	51-F2-850	1-1/16	1-3/16	4	
1/4	18-10-F6	28-10-F6	3-F6-950	1-1/8	1-1/2	3	
5/16	18-13-G9	29-13-G9	3-G9-950	1-1/4	1-5/8	3	
			No. 635 Hydraulic tool dies				
3/8	18-23-H5	28-23-H5	Oval H5	1-1/2	1-7/8	1	
7/16	18-24-J8	28-24-J8	Oval J8	1-3/4	2-1/8	2	
1/2	18-25-K8	28-25-K8	Oval K8	1-7/8	2-1/2	2	
9/16	18-27-M1	28-27-M1	Oval M1	2	2-5/8	3	
5/8	18-28-N5	28-28-N5	Oval N5	2-3/8	3-1/8	3	

*Required on stainless cables due to electrolysis caused by different types of metals.

Fig. 6-24

CABLE CROSS SECTION



Field repairs to cables are commonly made using a patented process (Nicopress) that incorporates a thimble and a swaged copper sleeve. Before beginning an installation using these fittings, determine the proper size tool and sleeve for the cable being used. A chart is provided in Fig. 6-25 to help select the proper size.

Fig. 6-23

STRENGTH OF STEEL CONTROL CABLE

7x7, 7x19, and 6x19 (1WRC)

	Flexible, carbon MIL-W-1511		Flexible, corrosion resisting MIL-C-5424	
Dia., inches	Weight, pounds per 100 feet	Breaking strength, pounds	Weight, pounds per 100 feet	Breaking strength, pounds
1/16	0.75	480	0.75	480
3/32	1.60	920	1.60	920
1/8	2.90	2,000	2.90	1,760
5/32	4.50	2,800	4.50	2,400
3/16	6.50	4,200	6.50	3,700
7/32	8.60	5,600	8.60	5,000
1/4	11.00	7,000	11.00	6,400
9/32	13.90	8,000	13.90	7,800
5/16	17.30	9,800	17.30	9,000

Cable use in aircraft may be classified according to the number of wires and their arrangement. The basic classifications are nonflexible, flexible, and extra-flexible. Cross-sectional diagrams of these types may be seen in Fig. 6-24.

Fig. 6-22

RECOMMENDED TORQUE VALUES FOR FLARED AND FLEX TUBING B-NUTS

Torque In Inch-Pounds*

Nominal tube O.D. (in.)	6061-0 & 5052-0 aluminum alloy tubing		Flex hose assembly and 6061-T6 aluminum alloy tubing		Specification MIL-T-6845 stainless (corrosion resistant) steel tubing	
	Min	Max	Min	Max	Min	Max
1/8	20	25			35	40
3/16	25	35	30	70	90	140
1/4	40	65	70	120	135	185
5/16	60	80	70	120	180	230
3/8	75	125	130	180	270	345
1/2	150	250	300	400	450	525
5/8	200	350	430	550	650	750
3/4	300	500	650	800	900	1,100
1	500	700	900	1,100	1,200	1,400
1-1/4	600	900	1,200	1,450	1,500	1,800
1-1/2	600	900	1,550	1,850	2,000	2,300
1-3/4	700	1,000	2,000	2,300	2,600	2,900
2	800	1,100	2,500	2,900	3,200	3,600

*For combinations of materials or tempers, use the applicable values shown for the material of the tubing flare.

Control Systems

Many aircraft control systems incorporate the use of cables to move the flight or engine controls. Cables provide a simple, reliable method of operating controls.

RECOMMENDED TORQUE VALUES FOR FITTINGS

Torque in Inch-Pounds

Nominal Tube OD (in.)	Fitting Thread Size	For Gasketed Aluminum or Steel Fittings*						For Jam nuts and Fittings Without Gaskets**		
		AN924 nut AN815 union		AN814 plug		AN6289 nut		Aluminum		
		Min	Max	Min	Max	Min	Max	Min	Max	Mi
1/8	5/16-24	25	35	10	16	25	35	35	50	
3/16	3/8-24	50	75	30	40	50	75	65	80	70
1/4	7/16-20	55	80	40	65	75	100	90	105	11
5/16	1/2-20	75	100	60	80	90	120	105	125	14
3/8	9/16-18	100	150	80	120	150	200	125	145	22
1/2	3/4-16	180	230	150	200	200	250	240	260	40
5/8	7/8-14	250	350	200	350	275	400	330	370	55
3/4	1-1/16-12	420	600	300	500	450	650	540	660	80
1	1-5/16-12	600	840	450	600	650	900	840	960	1,0
1-1/4	1-5/8-12	720	960	600	720	800	1,000	960	1,200	
1-1/2	1-7/8-12	840	1,080	600	800	900	1,100	1,200	1,400	

*For use with O-rings and aluminum, asbestos, leather, Teflon, gaskets, or washers.

**For combinations of materials (either jam nut, fittings, or boss), use the lowest applicable values shown.

Fig. 6-21 (cont)

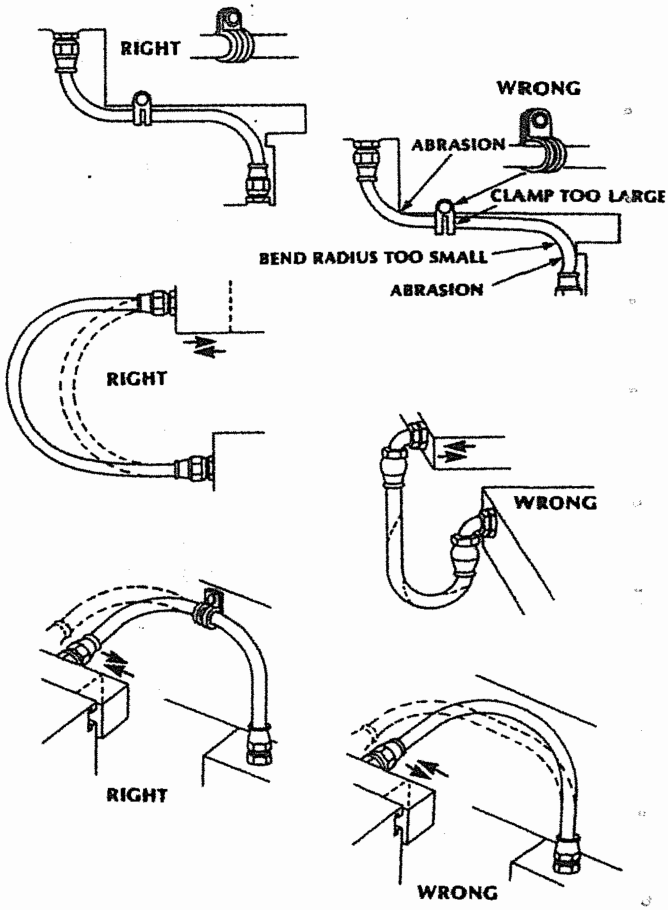
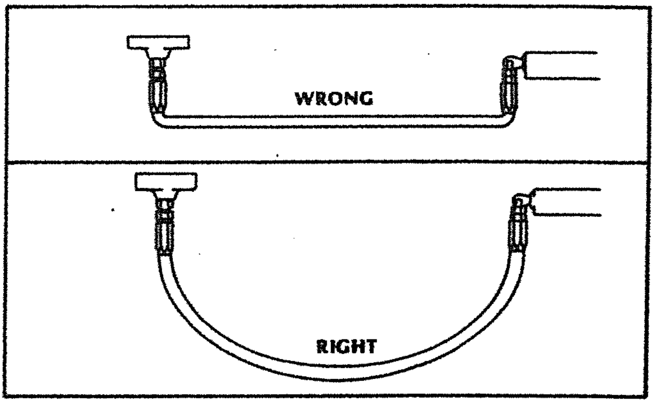

RIGHT
WRONG
ABRASION
CLAMP TOO LARGE
BEND RADIUS TOO SMALL
ABRASION
RIGHT
WRONG
RIGHT
WRONG

Fig. 6-20 (cont.)



5. Keep the Bend Radii of the hose as large as necessary to avoid kinking of line and restriction of flow.

Fig. 6-21

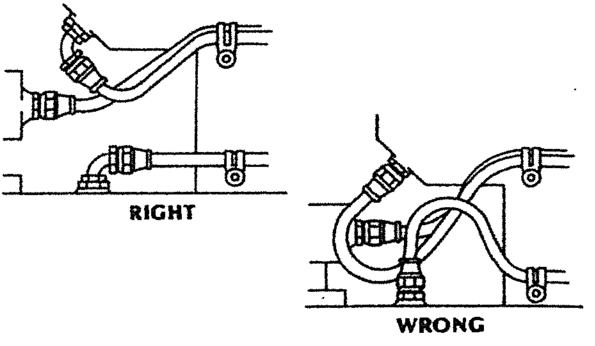
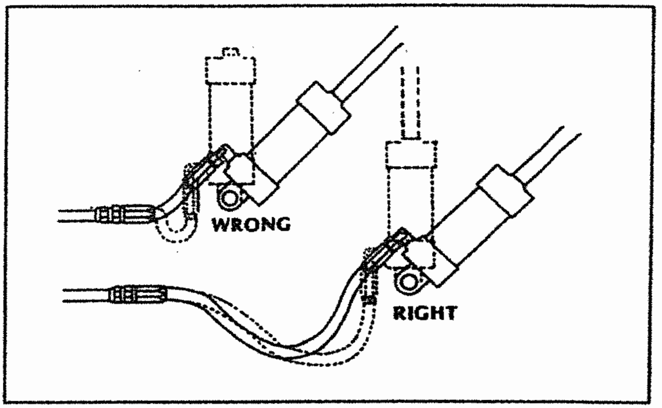
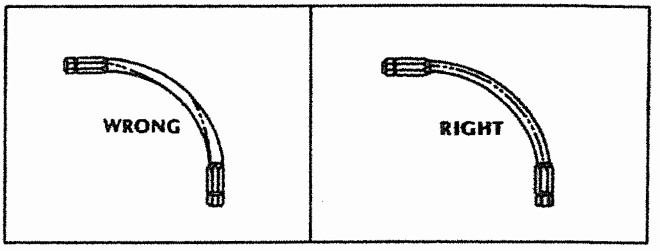


Fig. 6-20 (cont.)

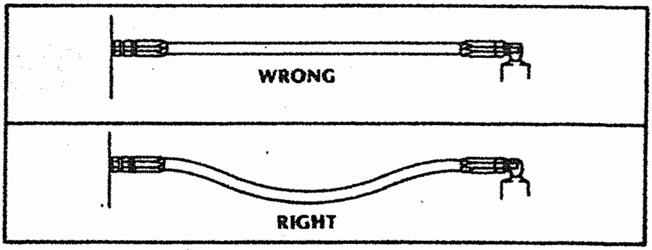


3. When a hose assembly is to be subjected to considerable flexing or vibration, remember that the metal hose fittings are not part of the flexible portion.

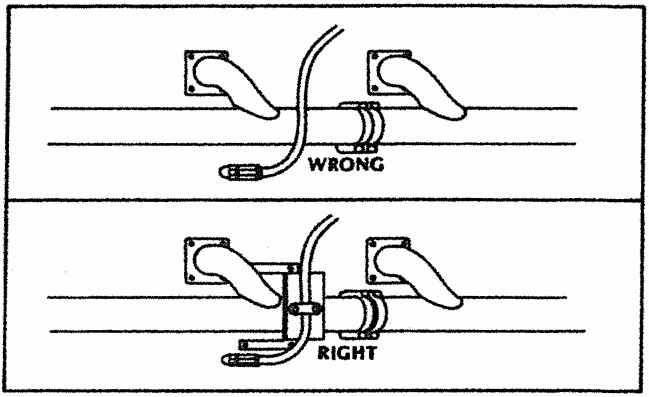


4. If high operating pressures are applied to a twisted hose, the hose may fail or the attaching nut become loose.

Fig. 6-20



1. Remember that the hose will change in length from +2% to −4% when pressurized. Provide slack or bend in the hose to compensate for any changes in length which might occur.



2. When hose lines pass close to a hot exhaust manifold, protect the hose with fireproof boot or metal baffle.

Fig. 6-18

MAXIMUM DISTANCE BETWEEN SUPPORTS FOR FLUID TUBING

Tubing outside diameter (in.)	Distance between supports (in.) Aluminum Alloy	Steel
1/8	9-1/2	11-1/2
3/16	12	14
1/4	13-1/2	16
5/16	15	18
3/8	16-1/2	20
1/2	19	23
5/8	22	25-1/2
3/4	24	27-1/2
1	26-1/2	30-1/2
1-1/4	28-1/2	31-1/2
1-1/2	29-1/2	32-1/2

Fig. 6-19

EQUIVALENT STRAIGHT TUBE LINE DROPS FOR 90° ELBOWS

Tubing size			Pressure drop in a 90° elbow in terms of length of straight tube equivalent to a 90° elbow
O.D. inch	Wall thickness inch		Feet
1/4	X	.035	0.28
3/8	X	.035	0.46
1/2	X	.042	0.62
5/8	X	.042	0.81
3/4	X	.049	0.98
1	X	.049	1.35

Proper installation of both solid and flexible lines is important to their safety and serviceability. The following illustrations demonstrate common installation errors and the proper remedy.

Fig. 6-17

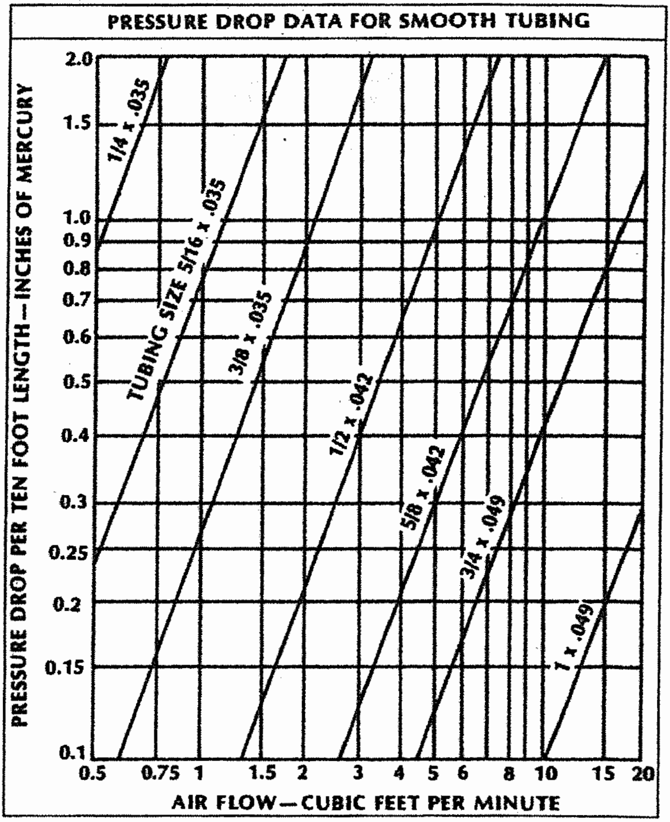

PRESSURE DROP DATA FOR SMOOTH TUBING
PRESSURE DROP PER TEN FOOT LENGTH—INCHES OF MERCURY
2.0
1.5
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.25
0.2
0.15
0.1
TUBING SIZE
1/4 x .035
5/16 x .035
3/8 x .035
1/2 x .042
5/8 x .042
3/4 x .049
1 x .049
0.5
0.75
1
1.5
2
3
4
5
6
8
10
15
20
AIR FLOW—CUBIC FEET PER MINUTE

Fig. 6-16

BEND RADII FOR CONDUIT AND FLUID LINES[1]

Minimum Bend Radii[2]			Steel Tubing	
Nominal tube OD (in.)	1100-1/2 H, 5052-O (in.)	Corrosion-resistant[3] (in.)	Desirable radius (in.)	Minimum radius[4] (in.)
1/8	3/8	---	---	--
3/16	7/16	21/32	3/4	3/8
1/4	9/16	7/8	1	3/8
5/16	11/16	---	1-1/4	3/8
3/8	15/16	1-5/16	1-1/2	3/8
1/2	1-1/4	1-3/4	2	1/2
5/8	1-1/2	2-3/16	2-1/2	5/8
3/4	1-3/4	2-5/8	3	3/4
7/8	2	---	3-1/2	7/8
1	3	3-1/2	4	1
1-1/8	3-1/2	---	4-1/2	1-1/4
1-1/4	3-3/4	4-3/8	5	1-1/2

NOTES:

1 Bend radii measured to inside of bend.

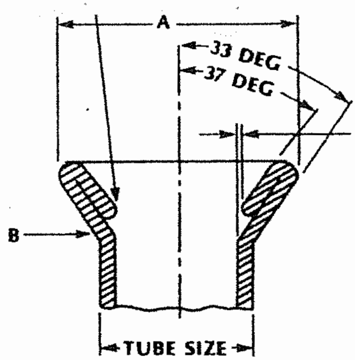
2 Increase bend radii when wall thickness is below standard.

3 Equal to 3–1/2 times tube diameter.

4 The minimum radius will be used only when the desirable radius cannot be used.

Fig. 6-15

DIMENSIONS FOR DOUBLE-FLARED TUBING



Tube Size Nominal Outside Diameter (in.)	A Diameter +0.010 -0.010 (in.)	B Radius ±0.010 (in.)	Wall Thickness (in.)	Minimum Inside Diameter (in.)
1/8	0.224	0.032		
3/16	0.302	0.032	0.028	0.114
			0.035	0.100
1/4	0.359	0.032	0.028	0.178
			0.035	0.159
5/16	0.421	0.032	0.035	0.224
			0.049	0.198
3/8	0.484	0.046	0.028	0.310
			0.035	0.288
			0.049	0.261

Fig. 6-14 (cont.)

DIMENSIONS FOR SINGLE-FLARED TUBING

Tube Size Outside Diameter (inch)	A Diameter		B Radius ±0.010 (Inch)
	Aluminum Alloy Tubing (inch)	Steel Tubing (inch)	
1-1/2	+0.000 1.721 -0.015	+0.000 1.721 -0.015	0.109
1-3/4	+0.000 2.106 -0.015	+0.000 2.106 -0.015	0.109
2	+0.000 2.356 -0.015	+0.000 2.356 -0.015	0.109
2- 1/2	+0.000 2.856 - 0.015	+0.000 2.856 -0.015	0.109
3	+0.000 3.356 -0.015	+0.000 3.356 -0.015	0.109

Fig. 6-14 (cont.)

DIMENSIONS FOR SINGLE-FLARED TUBING

Tube Size Outside Diameter (inch)	A Diameter		B Radius ±0.010 (Inch)
	Aluminum Alloy Tubing (inch)	Steel Tubing (inch)	
3/16	0.302 +0.000 -0.010	0.302 +0.000 -0.010	0.032
1/4	0.359 +0.000 -0.010	0.359 +0.000 -0.010	0.032
5/16	0.421 +0.000 -0.010	0.421 +0.000 -0.010	0.032
3/8	0.484 +0.000 -0.010	0.484 +0.000 -0.010	0.046
1/2	0.656 +0.000 -0.010	0.656 +0.000 -0.010	0.062
5/8	0.781 +0.000 -0.010	0.781 +0.010 -0.010	0.062
3/4	0.937 +0.000 -0.010	0.937 +0.000 -0.010	0.078
1	1.187 +0.000 -0.015	1.1 87 +0.000 -0.015	0.093
1-1/4	1.500 +0.000 -0.015	1.500 +0.000 -0.015	0.093

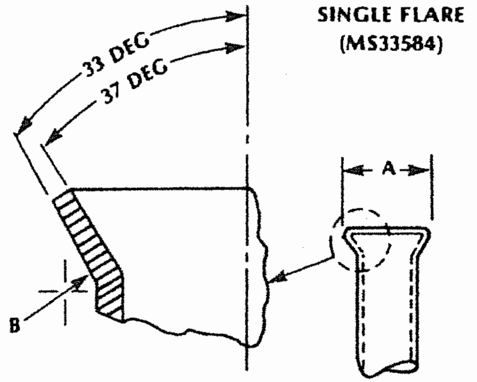
Fig. 6-13

COLOR CODE FOR HYDRAULIC SEALS

COLOR	USE
Blue dot or stripe	Air or MIL-H-5606 hydraulic fluid
Red dot or stripe	Fuel
Yellow dot	Synthetic engine oil
White stripe	Petroleum base engine oil or lubricant
White dot preceding Usage mark	Non-standard ring for use as coded
Green dash	Skydrol hydraulic fluid

Fig. 6-14

DIMENSIONS FOR SINGLE-FLARED TUBING



Tube Size Outside Diameter (inch)	A Diameter		B Radius ±0.010 (Inch)
	Aluminum Alloy Tubing (inch)	Steel Tubing (inch)	
1/8	0.200 +0.000 -0.010	0.200 +0.000 -0.010	0.032

Fluid Lines and Fittings

In this section we present several charts and illustrations to help the mechanic service and install fluid lines and their related fittings. Extreme care must be taken to identify the fluid carried by a particular line and that the system is depressurized before any repair is attempted.

Fig. 6-12

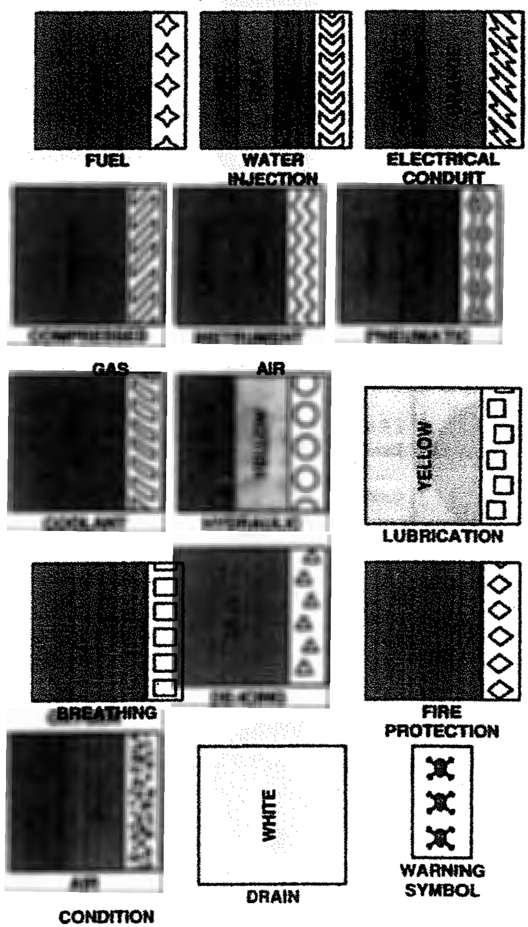
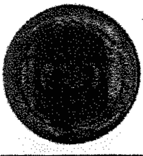
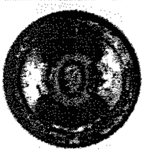
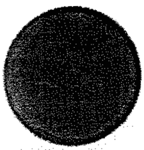
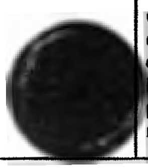


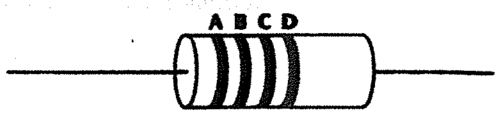
Fig. 6-11

	**NORMAL** Indicates short service time and correct heat range. Clean, regap and test before reinstalling.
	**WORN OUT - NORMAL** Indicates normal service life, electrodes show normal erosion, ground electrodes about half original thickness. Install new plugs.
	**WORN OUT - SEVERE** Excessively eroded center and ground electrodes indicate abnormal engine power operation. Check fuel metering. Install new plugs.
	**LEAD FOULED** Hard, cinder like deposits from poor fuel vaporization, high T.E.L. content in fuel or engine operating too cold. install new plugs.
	**CARBON FOULED** Black sooty deposits from excessive ground idling, idle mixture too rich or plug type too cold. If heat range is correct, clean, regap, test and reinstall.
	**OIL FOULED** Wet, oily deposits may be caused by broken or worn piston rings, excessive valve guide clearances, leaking impeller seal or engine still in break-in period. Repair engine as required. Clean, regap, test and reinstall plugs.

(Courtesy Champion Aviation Products)

The most common resistive device used today is the carbon resistor. These resistors may be identified by a code, consisting of color bands around the end of the resistor. Fig. 6-2 illustrates the relationship of these bands to the value of the resistor.

Fig. 6-10



Resistance is coded by color bands.
Power dissipation is rated by physical size.

RESISTOR COLOR CODES
Values in Ohms

Color A	1st Significant Figure	Color B	2nd Significant Figure	Color C	Decimal Multiplier	Color D	Tolerance
Black	0	Black	0	Black		None	± 20%
Brown	1	Brown	1	Brown	10	[illegible]	±10%
[illegible]	2	[illegible]	2	[illegible]	100	[illegible]	±5%
[illegible]	3	[illegible]	3	[illegible]	1,000		
Yellow	4	Yellow	4	Yellow	10,000		
[illegible]	5	[illegible]	5	[illegible]	100,000		
[illegible]	6	[illegible]	6	[illegible]	1,000,000		
[illegible]	7	[illegible]	7	[illegible]	10,000,000		
[illegible]	8	[illegible]	8	[illegible]	0.1		
White	9	White	9	[illegible]	0.01		

Spark Plug Installations

When installing spark plugs, always use new gasket washers and anti-seize compound. Apply anti-seize compound sparingly to the upper threads, preventing excess from contacting the electrode portion of the plug. Use the engine manufacturer's recommended torque values as prescribed in the engine Type Certificate Data Sheet or associated manufacturer's service information.

Before cleaning used plugs, inspect the electrode ends for condition and wear. Engine performance and malfunctions can often be identified by the plug's condition. The chart in figure 6-11 provides a guide for typical spark plug indications.

Electrical connectors may be identified by code letters and numbers marked on the coupling ring or shell. Fig. 6-9 explains the code found on connectors.

Fig. 6-9

AN CONNECTOR TERMINOLOGY

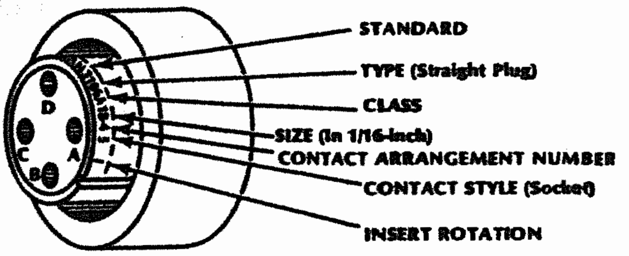
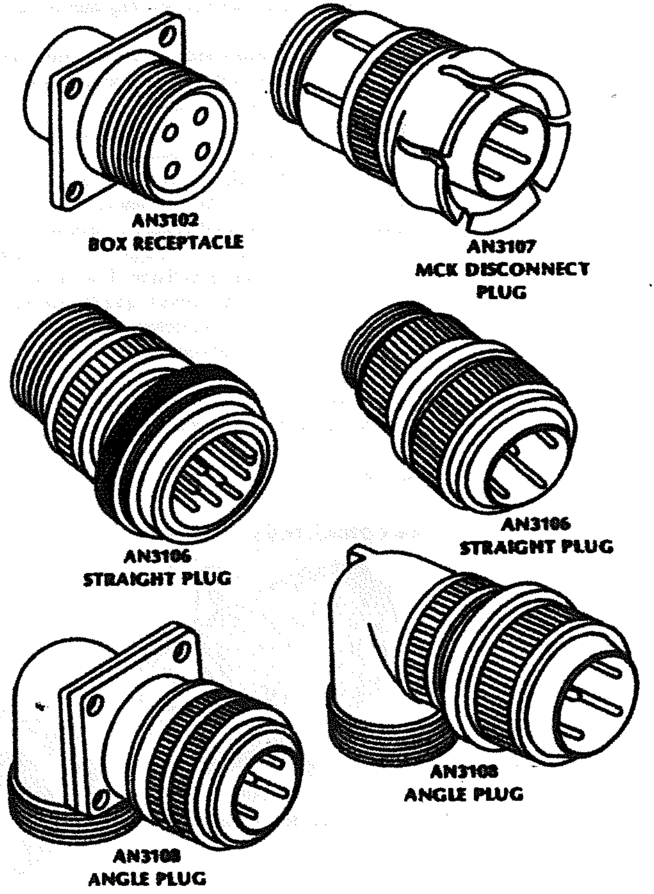


Fig. 6-8 (cont.)

AN CONNECTORS (cont.)



Class A	Solid, one piece back shell, general purpose connector.
Claw B	Connector back shell separates into two parts lengthwise. Used primarily where it is important that the soldered connections be readily accessible. The back shell is held together by screws or a threaded ring.
Class C	A pressurized connector with non-removable inserts. Similar in appearance to a Class A connector. It is used on pressurized aircraft.
Class D	Moisture- and vibration-resistant connector which has a sealing grommet in the back shell. Wires are threaded through tight fitting holes in the grommet, sealing them against moisture.
Class K	A fireproof connector that will not interrupt electrical current even though the connector is exposed to con tinuous open flame. The wires are crimped to the pins or socket contacts and the shell is made of steel. This class of connector is normally larger than the other classes of connectors.

Classes A, B, C, and D are made of aluminum and Class K is made of steel. Typical connectors may be seen in Fig. 6-8.

Fig. 6-8

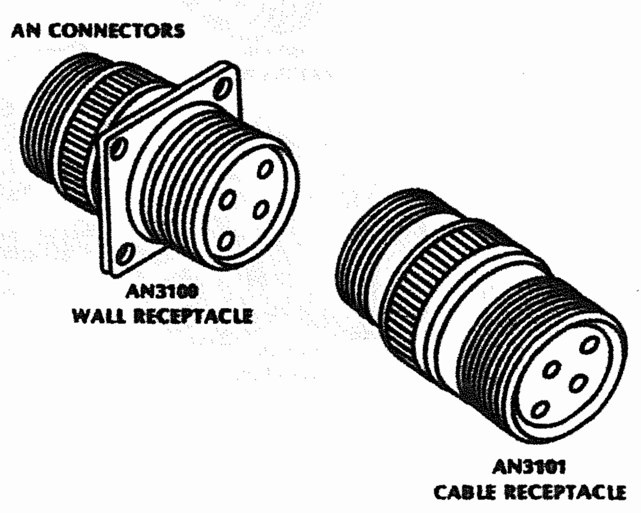


Fig. 6-7

SWITCH DERATING FACTORS

Nominal System Voltage	Type of Load	Derating Factor
24 V.D.C.	Lamp	8
24 V.D.C.	Inductive (Relay-Solenoid)	4
24 V.D.C.	Resistive (Heater)	2
24 V.D.C.	Motor	3
12 V.D.C.	Lamp	5
12 V.D.C.	Inductive (Relay-Solenoid)	2
12 V.D.C.	Resistive (Heater)	1
12 V.D.C.	Motor	2

1. To find the nominal rating of a switch required to operate a given device, multiply the continuous rating of the device by the derating factor corresponding to the voltage and type of load.

2. to find the continuous rating that a switch of a given nominal rating will handle efficiently, divide the switch nominal rating by the derating factor corresponding to the voltage and type of load.

CONNECTORS

In installations where frequent disconnection is required, maintenance may be facilitated by the use of connectors. A connector of the same basic type and design should be used when replacing a connector. When a connector is replaced, the socket type insert (the one without exposed pins) must be used on the half which is live or "hot" to prevent unintentional grounding.

Connectors may be identified by AN number and are divided into five basic classes. Each class of connector is of a slightly different construction.

All circuits in an aircraft electrical installation must be protected from overload. This is usually accomplished by the use of a fuse or circuit breaker. These devices are selected to open the circuit before the wire begins to smoke. Fig. 6-6 shows the size of fuse or circuit breaker that should be used for each wire size. Certain types of loads may require a circuit protector of a different value than the one shown here. Remember that the manufacturer's installation instructions provide more accurate information than tables designed for general use.

Fig. 6-6

WIRE AND CIRCUIT PROTECTOR CHART

Wire AN gauge copper	Circuit breaker amp.	Fuse amp.
22	5	5
20	7.5	5
15	10	10
16	15	10
14	20	15
12	25 (30)	20
Is	35 (40)	30
8	50	50
6	80	70
4	100	70
2	125	100
1		150
0		150

Figures in parentheses may be substituted where protectors of the indicated rating are not available.

Switch Derating

When installing switches in aircraft electrical systems, the voltage, as well as the type of load, must be considered. Certain types of loads may cause a sudden inrush of current that will be much higher than the normal operating load of the unit. Switches are rated for a simple resistive load and should be derated when switching other types of loads. A table listing derating factors is seen in Fig. 6-7.

Fig. 6-5

INTERMITTENT FLOW

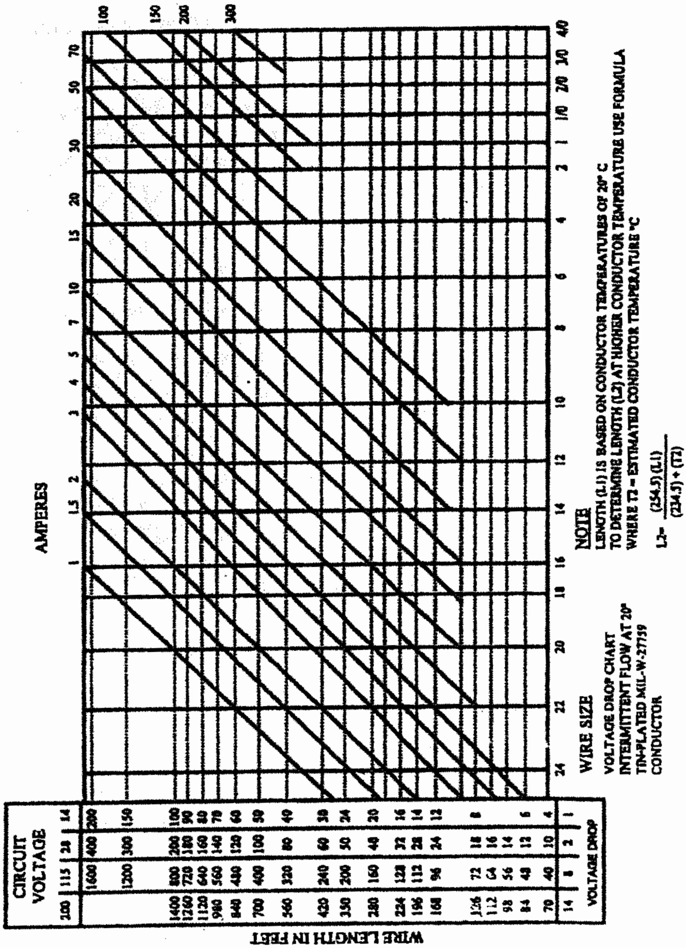
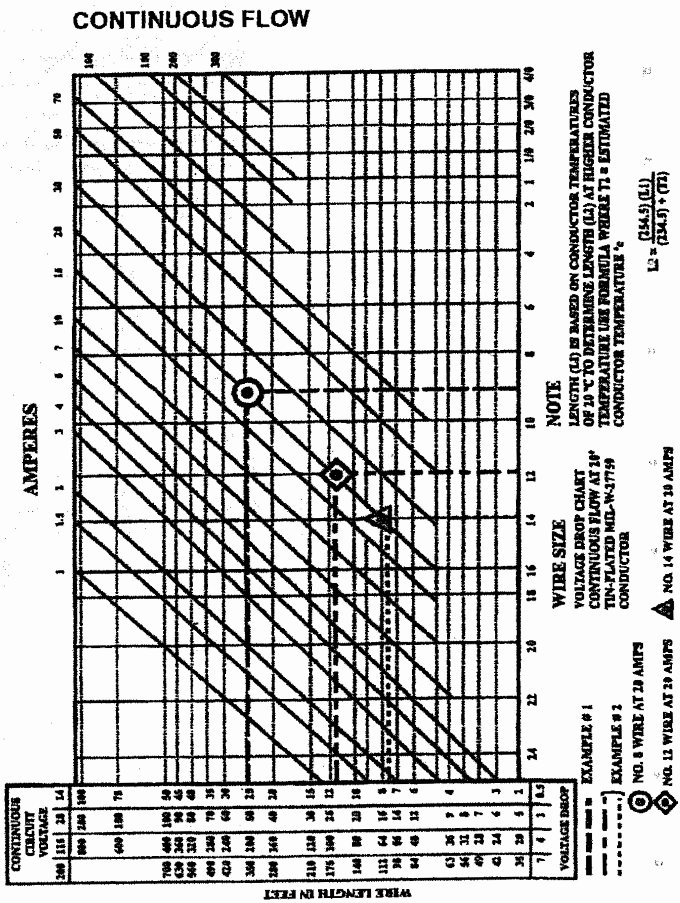


Fig. 6-4


CONTINUOUS FLOW
AMPERES
WIRE SIZE
VOLTAGE DROP CHART
CONTINUOUS FLOW AT 20°
TIN-PLATED MIL-W-27759
CONDUCTOR
NOTE
WIRE LENGTH IN FEET
CONTINUOUS CIRCUIT VOLTAGE
VOLTAGE DROP
EXAMPLE # 1
EXAMPLE # 2
NO. 8 WIRE AT 20 AMPS
NO. 12 WIRE AT 20 AMPS
NO. 14 WIRE AT 20 AMPS

ALUMINUM ELECTRIC WIRE CURRENT CARRYING CAPACITY

Wire size Specification MIL-W-7072	Single wire in free air-maximum amperes	Wire in conduit or bundled-maximum amperes	Maximum resistance-ohms/1,000 feet (20°C)	Nominal conductor area-circular mills	Finis weig per
AL-6	83	50	0.641	28,280	
AL-4	108	66	.427	42,420	
AL-2	152	90	.268	67,872	
AL-0	202	123	.169	107,464	
AL-00	235	145	.133	138,168	
AL-000	266	162	.109	168,872	
AL-0000	303	190	.085	214,928	

COPPER ELECTRIC WIRE CURRENT CARRYING CAPACITY

Wire size Specification MIL-W-5086	Single wire in free air-maximum amperes	Wire in conduit or bundled-maximum amperes	Maximum resistance-Ohms/1,000 feet (20°C)	Nominal conductor area-circular mils	Finis weight- 1,0
AN-24			25.7	475	
AN-22			16.20	755	
AN-20	11	7.5	10.25	1,119	
AN-18	16	10	6.44	1,779	
AN-16	22	13	4.76	2,409	
AN-14	32	17	2.99	3,830	
AN-12	41	23	1.88	6,088	
AN-10	55	33	1.10	10,443	
AN-8	73	46	.70	16,864	
AN-6	101	60	.436	26,813	
AN-4	135	80	.274	42,613	
AN-2	181	100	.179	66,832	
AN-1	211	125	.146	81,807	
AN-0	245	150	.114	104,118	
AN-00	283	175	.090	133,665	
AN-000	328	200	.072	167,332	
AN-0000	380	225	.057	211,954	

When installing electrical equipment in an aircraft, careful attention must be paid to assure that the wire used is of sufficient size for the current draw of the unit. Wire size will be determined by the length of the wire, the type of wire used (copper or aluminum), the type of installation (in free air or conduit), and the type of load (continuous or intermittent). The charts illustrated in Figs. 6-2 and 6-3 may be used for a quick reference to determine wire size. For a more accurate method, the wire charts shown in figures 6-4 and 6-5 may be used

Aircraft Assemblies and Installations

Modern aircraft must rely on their electrical system to power a host of electrical devices. These devices provide communication and navigation as well as operate aircraft systems. Proper installation, inspection, and maintenance of the electrical system is vital to the safe operation of the aircraft.

An understanding of electricity begins with an understanding of the relationship between voltage (E), current (I), resistance (R), and power (P). The relationship of these three values is expressed in Ohm's law and illustrated in Fig. 6-1.

Fig. 6-1

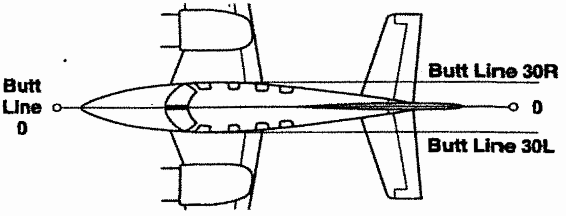
OHM'S LAW FORMULA

E=IR P=IE

TO FIND:	WHEN THESE ARE KNOWN	USE THE FORMULA:
E	I&P	$E = \frac{P}{I}$
E	I&R	$E = IR$
E	R&P	$E = \sqrt{PR}$
I	E&P	$I = \frac{P}{E}$
I	E&R	$I = \frac{E}{R}$
I	R&P	$I = \sqrt{\frac{P}{R}}$
R	E&P	$R = \frac{E^2}{P}$
R	I&E	$R = \frac{E}{I}$
R	I&E	$R = \frac{P}{I^2}$
P	E&I	$P = EI$
P	E&R	$P = \frac{E^2}{R}$
P	R&I	$P = I^2R$

Buttock lines are used to locate width measurements left or right of, and parallel to, the longitudinal axis of the aircraft. A centerline of the aircraft is established and labeled "buttock line 0." Lines are drawn parallel to this on both the left and right sides. These lines are called Butt 25L (BL 25L), Butt 25R (BL 25R), etc. This is illustrated in Fig. 5-6.

Fig. 5-6



Water and butt lines may be used in conjunction with the station lines to accurately locate any particular area on an aircraft. An example is shown in Fig. 5-7.

Fig 5-7

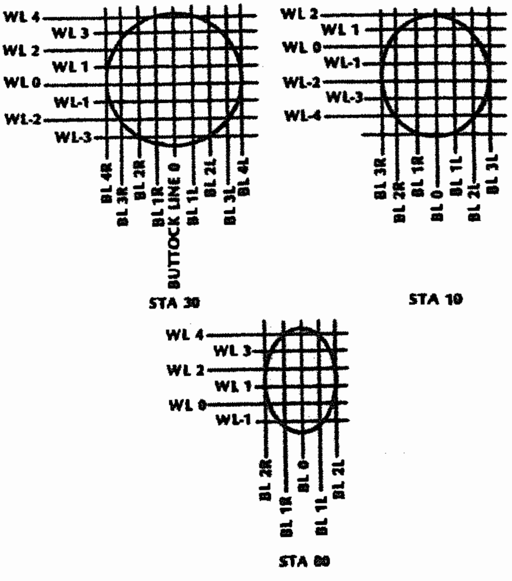


Fig. 2-11

TAP DRILL SIZES

National Coarse Thread Series Medium Fit, Class 3 (NC)

Size and Threads	Dia. of body	Body Drill	Preferred Dia. of Hole	Tap Drill
1-64	.073	47	.0575	No. 53
2-56	.086	42	.0682	No. 51
3-48	.099	37	.078	5/64 in.
4-40	.112	31	.0866	No. 44
5-40	.125	29	.0995	No. 39
6-32	.138	27	.1063	No. 36
8-32	.164	18	.1324	No. 29
10-24	.190	10	.1472	No. 26
12-24	.216	2	.1732	No. 17
1/4-20	.250	1/4	.1990	No. 8
5/16-18	.3125	5/16	.2559	F
3/8-16	.375	3/8	.3110	5/16 in.
7/16-14	.4375	7/16	.3642	U
1/2-13	.500	1/2	.4219	27/64 in.
9/16-12	.5625	9/16	.4776	31/64 in.
5/8-11	.625	5/8	.5315	17/32 in.
3/4-10	.750	3/4	.6480	41/64 in.
7/8-9	.875	7/8	.7307	49/64 in.
1-8	1.000	1	.8376	7/8 in.

National Fine Thread Series Medium Fit, Class 3 (NF)

Size and Threads	Dia. of body	Body Drill	Preferred Dia. of Hole	Tap Drill
0-80	.060	52	.0472	3/64 in.
1-72	.073	47	.0591	No. 53
2-64	.086	42	.0700	No. 50
3-56	.099	37	.0810	No. 46
4-48	.112	31	.0911	No. 42
5-44	.125	29	.1024	No. 38
6-40	.138	27	.113	No. 33
8-36	.164	18	.136	No. 29
10-32	.190	10	.159	No. 21
12-28	.216	2	.180	No. 15
1/4-28	.250	F	.213	No. 3
5/16-24	.3125	5/16	.2703	I
3/8-24	.375	3/8	.332	Q
7/16-20	.4375	7/16	.386	W
1/2-20	.500	1/2	.449	7/16 in.
9/16-18	.5625	9/16	.506	1/2 in.
5/8-18	.625	5/8	.568	9/16 in.
3/4-16	.750	3/4	.6688	11/16 in.
7/8-14	.875	7/8	.7822	51/64 in.
1-14	1.000	1	.9072	59/64 in.

Fig. 2-11 (cont.)

TAP DRILL SIZES

National Taper Pipe Thread

Size Pipe Thread, In.	No. of Threads Per Inch	Outside Dia. of Pipe for Threading: Decimal Inch	Outside Dia. of Pipe for Threading: Nearest Fraction of Inch	Size Pipe Reamer, In.	Size Tap Drill, In.
1/8	27	.405	13/32	1/8	21/64
1/4	18	.540	35/64	1/4	7/16
3/8	18	.675	43/64	3/8	9/16
1/2	14	.840	27/32	1/2	45/64
3/4	14	1.050	1 3/64	3/4	29/32

American Standard Pipe Thread and Tap Drill Sizes

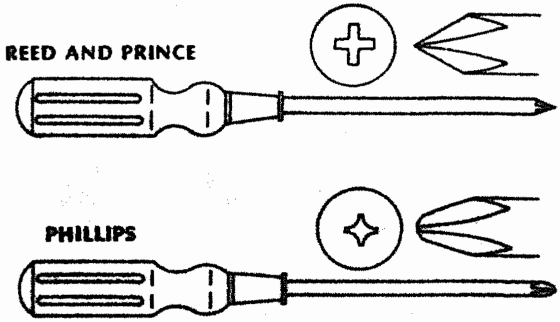
Size Pipe In.	Threads Per Inch	Root Diameter Small End of Pipe	Tap Drill	
			Size	Decimal Equivalent
1/8	27	.3339	R	.339
1/4	18	.4329	7/16	.437
3/8	18	.5676	37/64	.578
1/2	14	.7013	23/32	.719

Screwdrivers

Aircraft technicians must deal with many different sizes and type of screws used in aircraft construction. Use of the proper screwdriver wil assure the technician of a minimum amount of trouble during the remova and installation of screws.

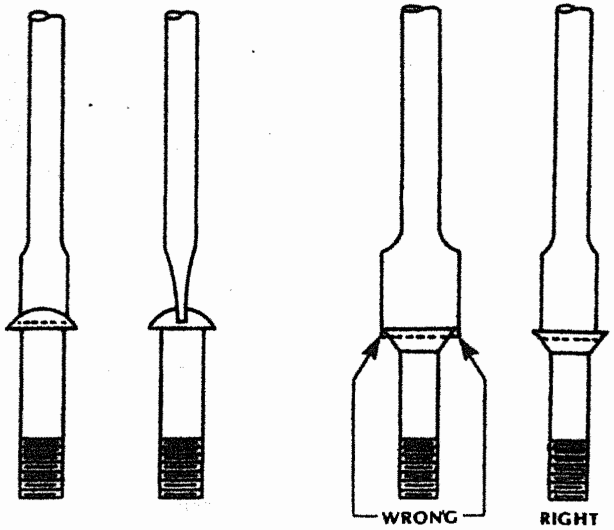
Two types of crosspoint screws likely to be encountered on ar airplane are: the Phillips and the Reed and Prince. The difference ir screw heads and screwdrivers may be seen in Fig. 2-12. The Phillip screwdriver may be identified by its blunt end and the Phillips screw by the radius between the slots. The Reed and Prince screwdriver has a sharp point and the slots are narrower than the Phillips, and there is no radius between the slots.

Fig. 2-12



If the screw has a slotted head, the screwdriver should fit the slot snugly. The sides of the screwdriver should be as nearly parallel to the screw slot sides as possible, as illustrated in Fig. 2-13.

Fig. 2-13

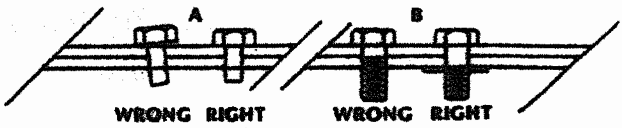


Bolting Practices

One of the most common methods of securely joining two objects together is the bolt-nut combination. This provides a unit which has a predictable strength, unless the bolt has been improperly installed. If this happens, strength is substantially reduced and failure may result.

Aircraft bolts are about .001 to .003 inch smaller than their nominal diameter, permitting easy installation in a properly drilled hole. The hole should be drilled such that the head of the bolt will lie solidly against the surface of the metal (Fig. 2-14A). Burrs around the edge of the hole should be removed before the bolt is inserted. Bolts are generally used in shear applications, therefore the smooth shank should extend entirely through the hole. No threads should be in contact with the bearing surface (Fig. 2-14B).

Fig. 2-14



Most applications using bolts require the use of a washer. The washer(s) specified by the application manufacturer should always be used and the installation is complete when the unit has been torqued to the specifications set down by the manufacturer.

Torquing

To assure proper service and prevent failures, most aircraft assemblies must be tightened to specifications designated by the aircraft manufacturer. A bolt that is too tight or too loose may create a hazardous situation and result in the untimely failure of a part.

Torque is the product of the force applied and the perpendicular distance from the force applied and the axis of rotation. It is expressed in inch-pound, foot-pounds or similar units. A chart showing the relationship of these units may be seen in Fig. 2-15.

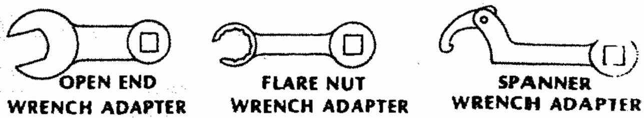
Fig. 2-15

TORQUE CONVERSION CHART

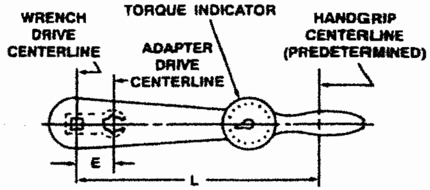
Inch Grams	Inch Ounces	Inch Pounds	Foot Pounds	Centimeter Kilogram	Meter-Kilogram
7.09	1/4				
14.17	1/2				
21.26	3/4				
28.35	1				
113.40	4	1/4			
226.80	8	1/2			
453.60	16	1		1.15	
	96	6	1/2	6.91	
	192	12	1	13.82	0.138
	384	24	2	27.65	0.276
	576	36	3	41.47	0.415
	768	48	4	55.30	0.553
	960	60	5	69.20	0.692
		72	6	82.95	0.829
		84	7	96.77	0.967
		96	8	110.60	1.106
		108	9	124.42	1.244
		120	10	138.25	1.382

Proper torque may be obtained by using an accurate, recently calibrated torque wrench. If a special adapter must be used in conjunction with the torque wrench, conversion formulas must be applied to assure accuracy (Fig. 2-16).

Fig. 2-16



NOTE:
When using a torque wrench adapter which changes the distance from the torque wrench drive to the adapter drive, apply the following formulas to obtain the corrected torque reading:



TORQUE WRENCH ADAPTERS

LEGEND

T	Actual (desired) torque
Y	Apparent (indicated) Torque
L	Effective length lever
E	Effective length of extension

Formula $\frac{T \times L}{L - E} = Y$

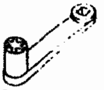
Example: (with "E" as minus dimension)

T = 135 lb. in. Y – 159 lb. in.
Y = Unknown
L = 10.0 in.
E = 1.5 in.

$$Y = \frac{135 \times 10}{10 - 1.5} = \frac{1350}{8.5} = 158.82$$

SHORT OPEN END ADAPTERS

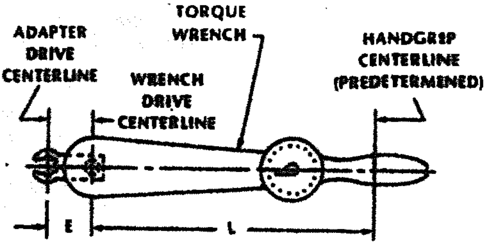
SET SCREW ADAPTER



HOSE CLAMP ADAPTER

Fig. 1-16 (cont.)

TORQUE WRENCH ADAPTERS



Formula $\frac{T \times L}{L + E} = Y$

Example: (with E as plus dimension)

T = 135 lb. in. $Y = \frac{135 \times 10}{10 + 1.5} = \frac{1350}{11.5} = 117.39$ **lb. in.**
Y = Unknown

L = 10.0 in.
E = l.5 in. **Y - 117 lb. in.**

NOTE: If the manufacturer does not specify torque values, the fastener should be installed using the charts in Fig. 2-17. Remember that these charts are to be used when the nut is being turned. If it is necessary to turn the bolt, the drag torque of the bolt-in-hole must be compensated for.

Fig. 2-17

RECOMMENDED TORQUE VALUES FOR OIL-FREE, CADMIUM-PLATED THREADS

Torque limits recommended for installation (Bolts loaded primarily in shear)

Maximum Allowable Tightening Torque Limits

Bolt Size	Tension-type nuts MS20365 and AN310 (40,000 PSI in bolts)	Shear-type nuts MS20364 and AN320 (24,000 PSI in bolts)	Nuts MS20365 and AN310 (90,000 PSI in bolts)	Nuts MS20364 and AN320 (54,000 PSI in bolts)
	Inch-pounds	Inch-pounds	Inch-pounds	Inch-pounds
8-36	12-15	7-9	20	12
8-32	12-15	7-9	20	12
10-32	20-25	12-15	40	25
10-24	20-25	12-15	35	21
1/4-28	50-70	30-40	100	60
1/4-20	40-50	25-30	75	45
5/16-24	100-140	60-85	225	140
5/16-18	80-90	48-55	160	100
3/8-24	160-190	95-110	390	240
3/8-16	160-185	95-100	275	170
7/16-20	450-500	270-300	840	500
7/16-14	235-255	140-155	475	280
1/2-20	480-690	290-410	1,100	660
1/2-13	400-480	240-290	880	520
9/16-18	800-1,000	480-600	1,600	960
9/16-12	500-700	300-420	1,100	650
5/8-18	1,100-1,300	600-780	2,400	1,400
5/8-11	700-900	420-540	1,500	900
3/4-16	2,300-2,500	1,300-1,500	5,000	3,000
3/4-10	1,150-1,600	700-950	2,500	1,500
7/8-14	2,500-3,000	1,500-1,800	7,000	4,200
7/8-9	2,200-3,000	1,300-1,800	4,600	2,700
1-14	3,700-5,500	2,200-3,300*	10,000	6,000
1 1/8-12	5,000-7,000	3,000-4,200*	15,000	9,000
1 1/4-12	9,000-11,000	5,400-6,600*	25,000	15,000

NOTE:
The above torque values may be used for all cadmium-plated nuts of the fine or coarse thread series which have approximately equal number of threads and face bearing areas.

***Estimated corresponding values**

Fig. 2-18

FOR USED SELF-LOCKING NUTS
MINIMUM PREVAILING TORQUE VALUES

Nut size	Minimum prevailing torque* (inch-pounds)
Fine Thread	
9/16-18	13
5/8-18	18
3/4-16	27
7/8-14	40
1-14	55
1 1/8-12	73
1 1/4-12	94
Coarse Thread	
9/16-12	14
5/8-11	18
3/4-10	27
7/8-9	38
1-8	51
1 1/8-8	68
1 1/4-8	88

Note: many manufacturers prohibit the reuse of self-locking nuts.

***Reading established when bolt or stud fully engages insert.**

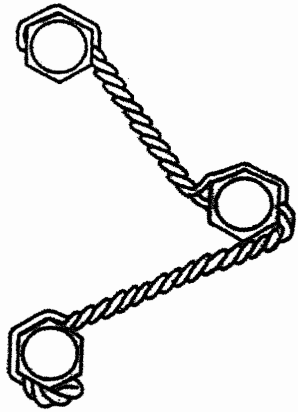
Safetying

Nearly all assemblies on an aircraft have some provision to allow the unit to be safetied. This is often in the form of lockwire or cotter pins. The drawings illustrate proper methods for installing lockwire and cotter pins.

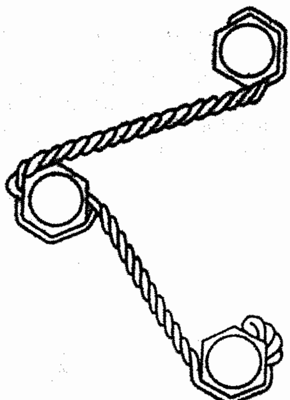
Examples 1, 2, 3, and 4 apply to all types of bolts, fillister head screws, square head plugs, and other similar parts which are wired together so that the loosening tendency of either part is counteracted by the tightening of the other part. The direction of twist from the second to the third unit is counterclockwise to keep the loop in position against the head of the bolt. The wire entering the hole in the third unit will be the lower wire and by making a counterclockwise twist after it leaves the hole, the loop will be secured in place around the head of that bolt.

Examples 1, 2,3,4

Example 1



Example 2

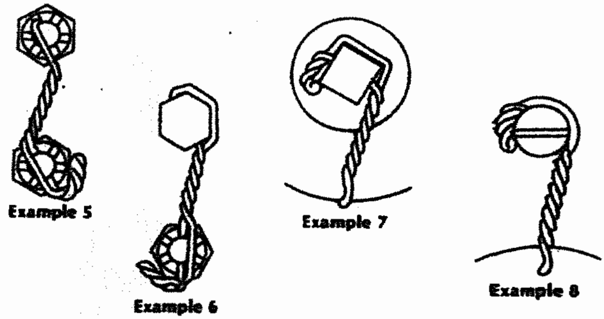


Example 3

Example 4

Examples 5, 6, 7, and 8 show methods for wiring various standard items. Note: The wire may be wrapped over the unit rather than around it when wiring castellated nuts or other items where there is a clearance problem.

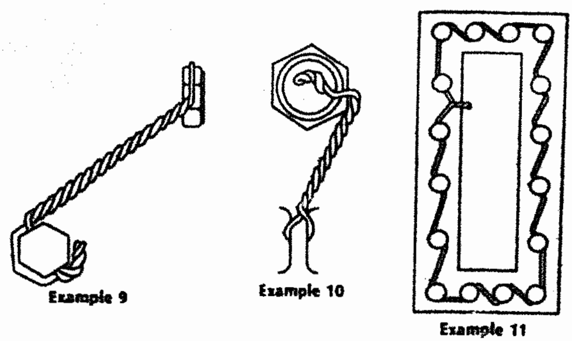
Examples 5, 6, 7, 8



Example 5 Example 6 Example 7 Example 8

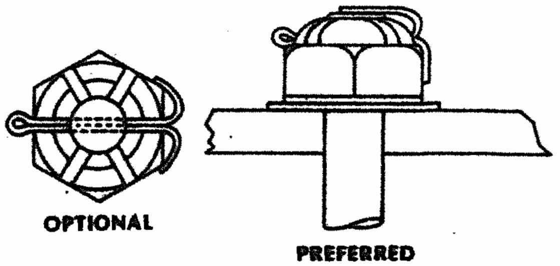
Example 9 shows the method for wiring bolts in different planes. The wire should always be applied so that the tension is in the tightening direction. Example 10 illustrates the method used for hollow head plugs. The tab (or pigtail) should be bent inside the hole to avoid snags and possible injury to personnel working on the aircraft. Groups of closely spaced screws or bolts may be wired together as shown in Example 11. The limit is the number of units that may be wired with a piece of wire 24 inches long. Example 12 illustrates the preferred and optional way of securing cotter pins.

Examples 9, 10, 11

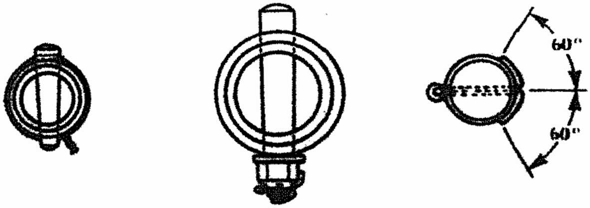


Example 9 Example 10 Example 11

Example 12



Examples 13,14, 15



Example 13 **Example 14** **Example 15**

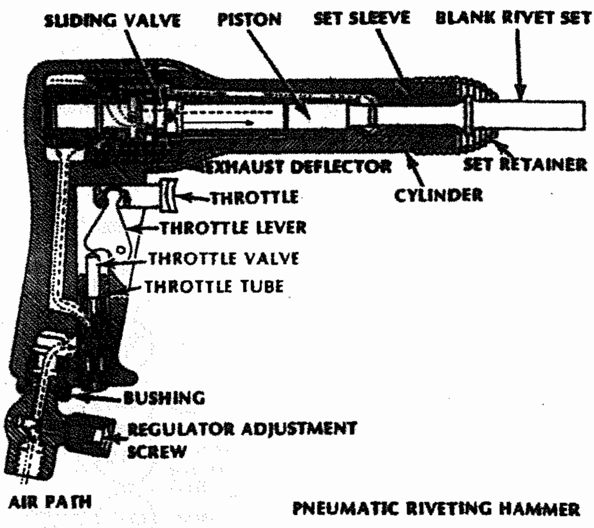
Examples 13 and 14 show taper pin installations using AN385 and AN386 taper pins. These pins, when properly installed, give the most serviceable splice method for torque tube and rod. Example 13 shows a wire wrap installation on an AN385 pin and example 14 shows an installation on an AN386 pin using nut and cotter pin. Example 15 is an end-view illustration of proper cotter pin placement on a clevis pin.

Riveting

Although methods of bonding one aircraft skin to another are coming into greater usage, the most common method of joining aircraft structures is still done by riveting. Proper riveting will produce a tight and effective joint.

The maintenance technician will probably perform the bulk of riveting with a pneumatic riveting hammer similar to the one illustrated in Fig. 3-1. This is a versatile tool with which most field repairs may be accomplished. The driving action of the gun is provided by air pressure driving a piston repeatedly against the rivet set. This set in turn applies the force to the head of the rivet. A heavy polished steel bucking bar is held solidly against the shank of the rivet while the rivet gun is being operated. This results in the upsetting of the rivet shank and the securing of the metal sheets.

Fig. 3-1



PNEUMATIC RIVETING HAMMER

Rivet Identification

Aircraft rivets are identified by *(1) head style, (2) alloy, (3) diameter,* and *(4) length.* There is a standard coding used to identify each of these terms. The method for identifying aluminum alloy rivets is shown in Fig. *3-2.*

Fig. 3-2

NOTE:
An example rivet number code is as follows:

MS 20470 AD 5 12

- 12 — Length in one-sixteenths of an inch
- 5 — Diameter in one thirty-seconds of an inch
- AD — Material Code
- 20470 — Head Style
- MS — Military Standard

Material	Head Marking	Ms Material Code	Heat-treat Before Using	Strength (PSI) Shear	Strength (PSI) Bearing
1100	Plain	A	No	10,000	25,000
2117	Dimpled	AD	No	30,000	100,000
2017	Raised Teat	D	Yes	34,000	113,000
2024	Raised Double Dash	DD	Yes	41,000	136,000
5056	Raised Cross	B	No	27,000	90,000
7075	Three Raised Dashes		No		
Carbon Steel	Recessed Triangle		No	35,000	90,000
Corrosion Resistant Steel	Recessed Dash	F	No	65,000	90,000
Monel	Recessed Double Dots	C	No	49,000	
Titanium	Recessed Large and Small Dots		No	95,000	

Rivet Installation

The rivet gun and proper rivet set must be selected before the riveting begins. These tools will vary with the size and material of the rivet being used. The table in Fig. 3-3 will help select the proper bucking bar.

Fig. 3-3

RECOMMENDED BUCKING BAR WEIGHTS

Rivet Diameter (in.)	Approximate Weight (lb.)
3/32	2 to 3
1/8	3 to 4
5/32	3 to 4-1/2
3/16	4 to 5
1/4	5 to 6-1/2

Most riveting is accomplished using two persons. One will drive the rivet while the other holds the bucking bar. Speed and efficiency can be obtained by a skilled team of riveters. Damage to the aircraft structure may result from careless or negligent behavior on the part of either person. This type of damage will result in many hours spent in removing bad rivets or replacement of a damaged skin.

Simplified instructions in riveting as well as illustrations of common riveting faults are given in Figs. 3-4 and 3-5.

Fig. 3-4

RIVETING PROCEDURE

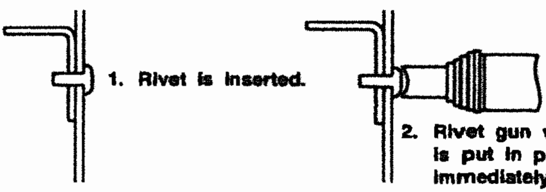


Fig. 3-4 (cont.)

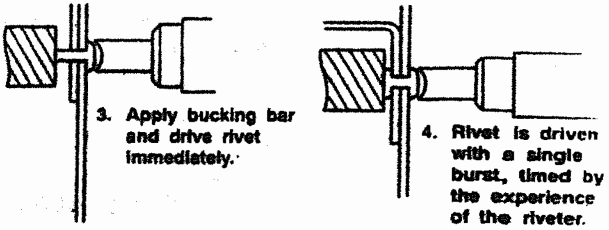


Fig. 3-5

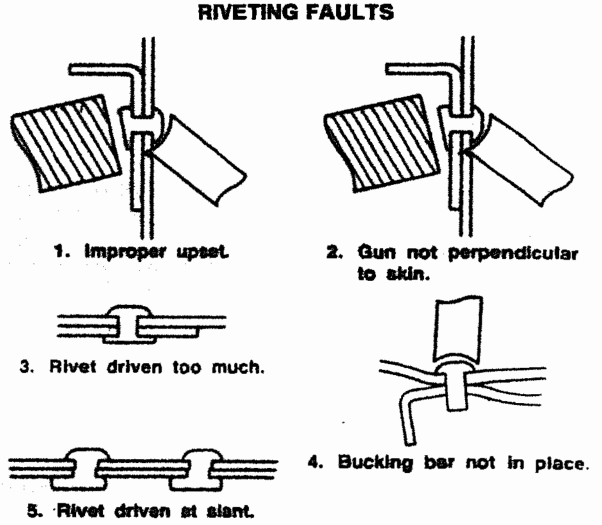


Fig. 3-6

RIVET HOLE DIAMETERS

Rivet Diameter	Pilot Size	Ream Size
3/32	3/32 (.0937)	41 (.096)
1/8	1/8 (.125)	30 (.1285)
5/32	5/32 (.1562)	21 (.159)
3/16	3/16 (.1875)	11 (.191)
1/4	1/4 (.250)	F (.257) *
5/16	5/16 (.3125)	O (.316)
3/8	3/8 (.375)	V (.377)

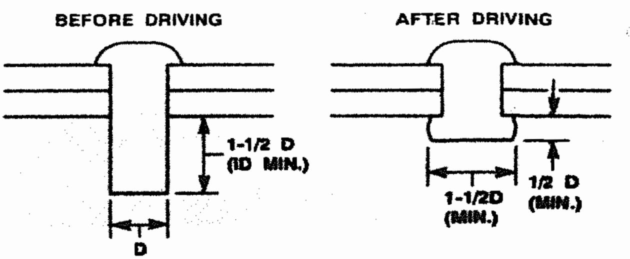
*Note that ream size exceeds the accepted maximum tolerance of .004 inch. This is permissible only if the next larger drill size happens to be larger than the tolerance of .004 inch.

Properly Driven Rivets

Whether installing rivets with the pneumatic rivet gun or another method, the upset rivets should be of uniform height and width. Fig. 3-7 shows the proper dimensions of rivets before and after driving.

Fig. 3-7

PROPER RIVET INSTALLATION

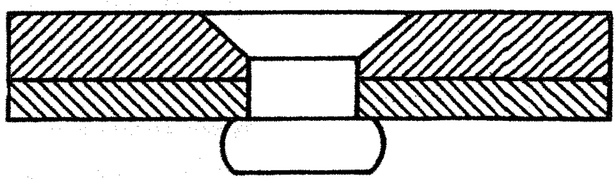


Flush Riveting

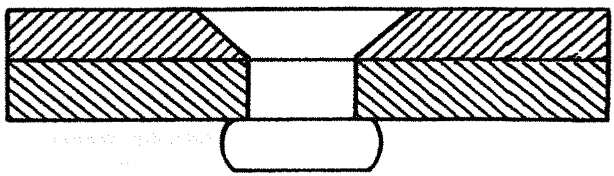
Many applications require that the surface of the skin be as smooth as possible. To accomplish this, flush rivets may be used.

In order to drive a flush rivet, the rivet hole must be either dimpled or countersunk. The choice of methods is largely dependant on the thickness of the skins involved. Fig. 3-8 lists the methods recommended for the various rivet sizes and skin thicknesses.

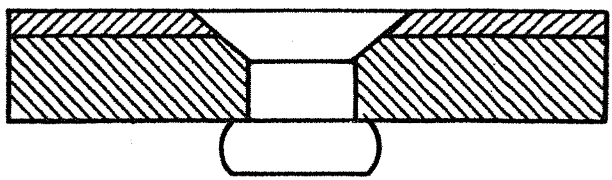
Fig. 3-8



COUNTERSINKING PREFERRED



COUNTERSINKING PERMISSABLE



NOT ACCEPTABLE
TOP SKIN SHOULD HAVE BEEN DIMPLED

Fig. 3-8 (cont.)

Diameter of Rivet (in.)	Top Sheet Thickness (in.)	Under Sheet Thickness (in.)	Use Countersink Method
3/32	0.032 or greater		a
	0.025 or less	0.051 or greater b	
	0.025 or less	0.040 or less c	
1/8	0.040 or greater		a
	0.032 or less	0.064 or greater	b
	0.032 or less	0.051 or less	c
5/32	0.051 or greater		a
	0.040 or less	0.072 or greater	b
	0.040 or less	0.064 or less	c
3/16	0.064 or greater		a
	0.051 or less	0.091 or greater	b
	0.051 or less	0.081 or less	c

a Countersink top sheet.
b Dimple top sheet and countersink under sheet(s).
c Dimple top and under sheets.

Flush rivets are driven with a large-faced, polished rivet set (Fig 3-9 (a). The head of the rivet must be absolutely flush with the skin when the shank has been properly driven. This may be checked by the use of a straightedge as shown in Fig. 3-9 (b).

Fig. 3-9 (a)

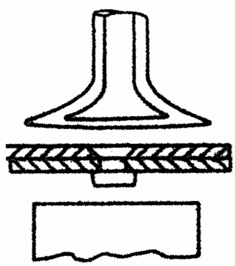
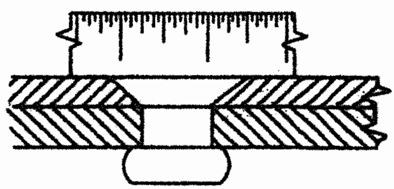


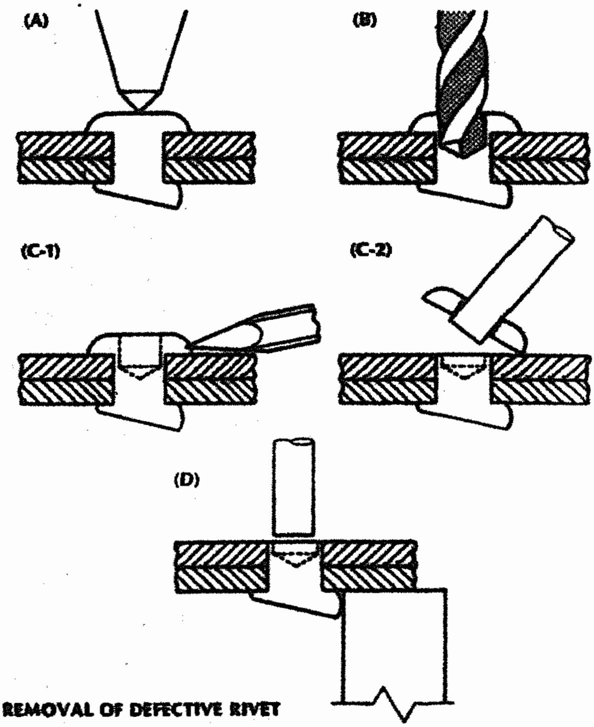
Fig. 3-9 (b)



Removal of Improperly Driven Rivets

Even the best riveters occasionally will ruin a rivet during installation. Proper removal of the defective rivet is important. An improperly removed rivet could result in an enlarged hole or damage to the aircraft's skin. Fig. 3-10 illustrates the proper method for removing defective rivets.

Fig. 3-10



REMOVAL OF DEFECTIVE RIVET

To remove the defective rivet (a) make a small center punch mark in the exact center of the manufactured head, (b) drill through the head with a drill slightly smaller than the diameter of the rivet shank, (c-1) using a small sharp chisel, knock the weakened head from the rivet, or (c-2) break the head off using a pin punch and a sideways motion, and (d) with the skin solidly supported by a bucking bar, drive the rivet shank from the skin with a pin punch slightly smaller than the rivet shank.

Riveted Repairs

The objective of a riveted repair is to restore to the structure at least the same strength that it had before being damaged. Any repair made must retain all of the required strength, rigidity, airflow characteristics and protection from the environment that the original aircraft did when it was certified. To help accomplish this, certain basic criteria have been set down and must be closely followed.

To assure proper strength, rivet spacing and edge distance must meet minimum standards shown here:

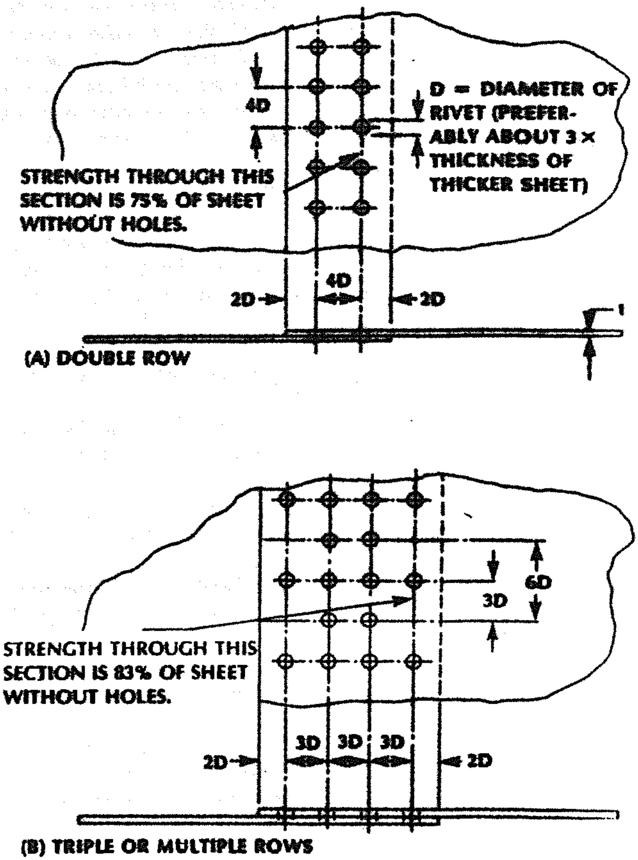
1. Single Row—edge distance not less than 2 times the diameter of the rivet and spacing not less than 3 times the diameter of the rivet.

2. Double Row—edge distance and spacing not less than the minimums shown in Fig. 3-11.

3. Triple or Multiple Rows—edge distance and spacing not less than the minimums shown in Fig. 3-11.

Specific repairs should be made In accordance with specifications shown in the aircraft manufacturers structural repair manual or the general instructions provided by AC 43.13-1B.

Fig. 3-11


4D
D = DIAMETER OF RIVET (PREFERABLY ABOUT 3 × THICKNESS OF THICKER SHEET)
STRENGTH THROUGH THIS SECTION IS 75% OF SHEET WITHOUT HOLES.
2D
4D
2D
t
(A) DOUBLE ROW
6D
3D
STRENGTH THROUGH THIS SECTION IS 83% OF SHEET WITHOUT HOLES.
2D
3D
3D
3D
2D
(B) TRIPLE OR MULTIPLE ROWS

Aircraft Materials

Metallurgy has played a key role in the development of aviation. As new materials have been compounded, new eras in aviation have unfolded. In order to understand metals it is important to examine the terms used to describe them:

Strength: The ability of a metal to withstand structural stresses without failing. For most metals, strength is thought of in terms of tensile strength. Tensile strength is expressed in thousands of pounds per square inch or KPSI.

Hardness: The ability of a metal to resist cutting, penetration or abrasion. A metal may be softened by annealing, and hardened by quenching-type heat treatments or by working (shaped by pounding or bending)

Malleability: The ability of a metal to be bent, formed or hammered without cracking or breaking. Normally the harder a metal, the less malleable.

Ductility: Similar to malleability, except it primarily refers to the ability of a metal to be permanently deformed by drawing or pulling it.

Brittleness: Opposite of ductility and malleability. It is the characteristic which causes the metal to shatter when it is bent or deformed.

Thermal expansion: The change in size with a change in temperature.

Ferrous Metal Identification

Most of the steel used in aircraft construction can be identified by a four digit numbering system adopted by the Society of Automotive Engineers (SAE). The SAE identification system for steel is explained in Fig. 4-1.

Fig. 4-1

SAE NUMERICAL SYSTEM FOR STEEL IDENTIFICATION

Type of Steels	Numerals and Digits
Carbon Steels	1XXX
Plain Carbon Steels	10XX
Free Cutting Steels	11XX
Manganese Steels (Manganese 1.60 to 1.90%)	13XX
Nickel Alloy Steels	2XXX
3.50% nickel	23XX
5.00% nickel	25XX
Nickel Chromium Steels	3XXX
9.70% nickel, 0.07% chromium	30XX
1.25% nickel, 0.60% chromium	31 XX
1.75% nickel, 1.00% chromium	32XX
3.50% nickel, 1.50% chromium	33XX
Corrosion and heat resisting	30XXX
Molybdenum Steels	4XXX
Chromium Molybdenum Steels	41XX
Nickel Chromium Molybdenum Steels	43XX
Nickel Molybdenum Steels	
1.75% nickel, 0.25% molybdenum	46XX
3.50% nickel, 1.50% chromium	48XX
Chromium Steels	5XXX
Low chromium	51XX
Medium chromium	52XX
High chromium	53XX
Chromium Vanadium Steels	6XXX
1.00% chromium	61XX
Nickel Chromium Molybdenum Alloy Steels	8XXX
Silicon Manganese Steels	9XXX
2.00% silicon	92XX

The four digit SAE code only explains the alloy of the steel. Further information about the steel may be found in the MIL Specifications and temper designations. Fig. 4-2 outlines the designations of many steels commonly used in aircraft

Fig. 4-2

IDENTIFICATION OF STEEL

Bars and Rods			
Commercial designation	**Current specification**		**Physical condition**
Carbon steels (general purpose). Specify type desired	QQ-S-633		Hot rolled and cold finish
1095	MIL-S-8559	A B C	(As forged) (As rolled) (Spheroidized) Furnished in C-4 condition 1' diameter or thickness and under, and C-2 condition over 1' diameter or thickness unless otherwise specified.
4037	MIL-S-8695	A B C D E F G H	(As forged) (As rolled) (Annealed) (Normalized) (Normalized and tempered) (Hardened and tempered) (Drawn and normalized) (Normalized and sphereoidize annealed) Furnished in condition C-4 1-1/2' diameter or thickness and under, and C-2 condition over 1-1/2' diameter or thickness unless otherwise specified.

Fig. 4-2 (cont.)

IDENTIFICATION OF STEEL (cont.)

Bars and Rods (cont.)

Commercial Designation	Current Specification		Physical condition
4130	MIL-S-6758	A B C D E F	(As forged) (As rolled) (Annealed) (Normalized) (Normalized and tempered) (Hardened and tempered)
4140	MIL-S-5626		Same as 4130
4340 or E4340	MIL-S-5000		Same as 4130
6150	MIL-S-8503		Same as 4130 (A through E)
8620	MIL-S-8690	A B C D E	(As forged) (As foiled) (Annealed) (Normalized) (Normalized and tempered) Furnished in C-4 condition 1-1/2' diameter or thickness and under, and C-2 condition over 1-1/2' diameter or thickness unless otherwise specified.
8630	MIL-S-6050		Same as 4130
8735	MIL-S-6098		Same as 4130
8740	MIL-S-6049		Same as 4130

Fig 4-2 (cont.)

IDENTIFICATION OF STEEL (cont.)

Bars and Rods (cont.)

Commercial Designation	Current Specification		Physical condition
18-8	MIL-S-7720 Comp G	A B C	(Annealed) (Annealed and cold finished) (Hot rolled or forged only)
304	QQ-S-763	A B	(Annealed) (cold finish) (High tensile)
321	QQ-S-763	A	(Annealed)
410	QQ.S-763	A	(Annealed)
430	QQ-S-763	A	(Annealed)
16CR-2NI 431 (Special Quality)	MIL-S-18732		Type A-Annealed Type HT 175 (175,000 psi) Type HT 115 (115,000 psi)

Fig. 4-2a

IDENTIFICATION OF STEEL

TUBING

Commercial Designation	Current Specification	Type	Shape	Conditions
1025	MIL-T-5056	I. Welded II. Seamless	Round and other shapes	Normalized, cold drawn or stress relieved
4130	MIL-T-6731	Welded	I. Round II. Rectangular and square III. Streamlined IV. Oval	A (Annealed) N (Normalized) HT-125 (125,000 psi minimum) HT-150 (150,000 psi minimum) HT-180 (180,000 psi minimum)
4130	MIL-T-6736	Seamless	Same as 4130 (MIL-T-6731)	A (Annealed) N (Normalized) HT-125 HT-150 HT-180
4135	MIL-T-6735	Seamless	Same as 4130 (MIL-T-6731)	A (Annealed) N (Normalized HT-125 HT-150 HT-180 HT-200
8630	MIL-T-6734	Seamless	Same as 4130 (MIL-T-6731)	A (Annealed) N (Normalized HT-125 HT-150 HT-180
8630	MIL-T-6732	Seamless	Same as 4130 (MIL-T-6731)	A (Annealed) N (Normalized HT-125 HT-150 HT-180
8735	MIL-T-6733	Seamless or welded	I. Round II. Rectangular and square III. Streamlined IV. Oval	A (Annealed) N (Normalized HT-125(125,000 psi minimum) HT-150(150,000 psi minimum) HT-180(180,000 psi minimum)

Fig 4-2a (cont.)

IDENTIFICATION OF STEEL

TUBING (cont.)

Commercial Designation	Current Specification	Type	Shape	Conditions
304	MIL-T-5695	Seamless or welded	As required	1/4 –Hard cold drawn 1/2 –Hard cold drawn
304	MIL-T-8506	Seamless or welded	As required	Annealed only
304 (Hydraulic)	MIL-T-6845	Seamless or welded	Round	1/8–Hard
18-8 (Hydraulic)	MIL-T-8504	Seamless or welded	Round	Annealed only
Inconel	MIL-T-7840	Seamless or welded	Round	Cold drawn
321 18-8	MIL-T-6737	Welded	As required	Annealed only
G 321 18-8	MIL-T-8606	Seamless or welded drawn	As required	Annealed only
X347	MIL-T-6737	Welded	As required	Annealed only
G347 18-8	MIL-T-8606	Seamless or welded drawn	As required	Annealed only

Fig 4-2b

SHEET, PLATE, AND STRIP

Commercial Designation	Current Specification	Condition Available
Low carbon	QQ-S-698	Hot rolled or cold rolled. See Specification for temper and finish.
Low carbon (High strength)	MIL-S-7809	Hot rolled, cold rolled, as rolled, or annealed.
1020	MIL-S-7952	Cold rolled and annealed

Fig 4-2b (cont.)

SHEET, PLATE, AND STRIP (cont.)

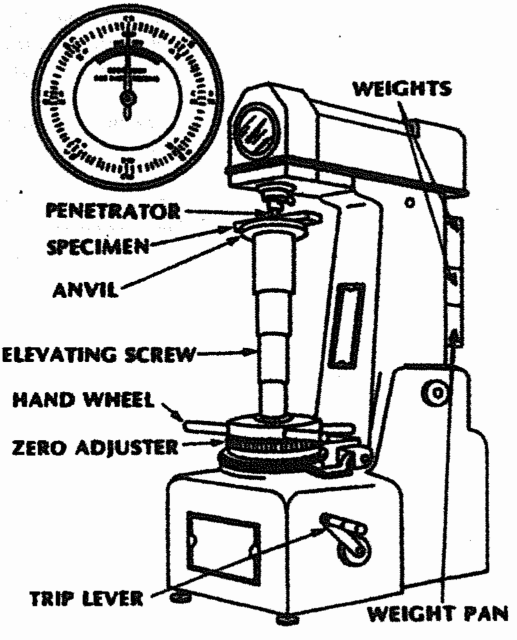
Commercial Designation	Current Specification		Condition Available
1025	MIL-S-7952		Same as 1020
1095	MIL-S-7947	A H	(Annealed) (Hard temper) (C47 to C52)
4130	MIL-S-18729	A MA N	(Annealed) (Modified annealed) (Normalized)
6150	MIL-S-18731		Annealed
8630	MIL-S-18718	A MA N	(Annealed) (Modified annealed) (Normalized)
8735	MIL-S-18730	A N	(Annealed) (Normalized)
18-8 301 (High ductility)	MIL-S-5059		Annealed 1/4-Hard 1/2-Hard 3/4-Hard Hard
18-8 302 (General use)	MIL-S-5059		Annealed 1/4-Hard
304 (Low carbon)	MIL-S-4043		Annealed and pickled only
18-8	MIL-S-5059		Annealed 1/4-Hard Sheet — Solution heat-treated, pickled, and cold rolled (No. 20 finish)
316 (Corrosion-resistant Comp. Ti, Cb, or Cb-ta.	MIL-S-6721		Strip — Cold rolled, solution heat-treated, pickled (No. 1 strip finish) Plate — hot rolled, solution heat-treated, and pickled

Hardness and Heat Treatment of Steel

To increase the hardness, and impart desirable physical characteristics, steel may be heat treated. To do this, steel is heated and cooled at controlled rates to obtain the desired results.

The hardness of the metal may be determined by measuring the depth that an object of known size and with a known force penetrates the surface of the metal. This is sometimes accomplished by the use of a Rockwell Hardness Tester. An alternative instrument used to determine hardness, especially in nonferrous materials is the Brinnel Hardness Tester. Although the objectives of both of these instruments are the same and the methods of operation are similar, the scales used are vastly different. A comparison of the scale readings may be seen in Fig. 4-3.

Fig. 4-3


WEIGHTS
PENETRATOR
SPECIMEN
ANVIL
ELEVATING SCREW
HAND WHEEL
ZERO ADJUSTER
TRIP LEVER
WEIGHT PAN

Notes for Fig. 4-4:

(A) Draw at 1150° (621°C) for tensile strength of 70,000 PSI.

(B) For spring temper, draw at 800° to 900°F (427° to 482° C) Rockwell hardness C-40-45.

(C) Bars or forgings may be quenched in water from 1500° to 1600° F (816° to 871° C).

(D) Air-cooling from the normalizing temperature will produce a tensile strength of approximately 90,000 PSI.

(E) For spring temper, draw at 850° to 950°F (454° to 510°C) Rockwell hardness C-40-45.

(F) Draw at 350° to 45O°F (177° to 232°C) to remove quenching stains. Rockwell hardness C-60-65.

(G) Anneal at 1600° to 1700°F (871° to 927°C) to remove residual stresses due to welding or cold work. May be applied only to steel containing titanium or columbium.

(H) Anneal at 1900° to 2100°F (1038° to 1149°C) to produce maximum softness and corrosion resistance. Cool in air or quench in water.

(I) Hardened by cold work only.

(J) Lower side of range for sheet 0.06-inch and under. Middle of range for sheet and wire 0.125-inch. Upper side of range for forgings.

(K) Not recommended for intermediate tensile strengths because of low impact.

(L) For steel, military specification Mil-SI8732. It is recommended that, prior to tempering, corrosion resisting (16 Cr - 2 NI) steel be quenched in oil from a temperature of 1875° to 1900°F (1024° to 1038°C)after a soaking period of 1/2-hour at this temperature.

(L) (cont.) To obtain a tensile strength at 115,000 PSI, the tempering temperature should be approximately 525°F (274°C). A holding time at these temperatures of about 2 hours is recommended. Tempering temperatures between 700° and 1100°F (371° to 593°C) will not be approved.

(M) Draw at approximately 800°F (427°C) and cool in air for Rockwell hardness of C-50.

(N) Water used for quenching shall not exceed 65°F (18°C). Oil used for quenching shall be within the temperature range of 80° to 150°F (27° to 66°C).

Fig. 4-5

COLOR CHART FOR OXIDES ON CARBON STEEL AT VARIOUS TEMPERING TEMPERATURES

	Temperature of Carbon Steel	
Color of Oxide	**(°F)**	**(°C)**
Pale yellow	428	220
Straw	446	230
Golden yellow	469	243
Brown	491	255
Brown dappled with purple	509	265
Purple	531	277
Dark blue	550	288
Bright blue	567	297
Pale blue	610	321

Fig. 4-3 (cont.)

ROCKWELL, BRINELL, AND VICKERS HARDNESS VALUES

Rockwell hardness number						
A Scale 60-kg Load, Brale Penetrator	B Scale 100-kg Load, 1/16-in (0.16 cm) Diam. Ball	C Scale 150-kg Load, Brale Penetrator	D Scale 100-kg Load, Brale Penetrator	Vickers Hardness Number Diamond-Pyramid Penetrator	Brinell Hardness Number, 3000-kg Load, 10-mm Standard Ball	Approx. Tensile Strength, 1000 psi
78.5		55	66.9	595		287
78.0		54	66.1	577		278
77.4		53	65.4	560		269
76.8		52	64.6	544	500	262
76.3		51	63.8	528	487	253
75.9		50	63.1	513	475	245
75.2		49	62.1	498	464	239
74.7		48	61.4	484	451	232
74.1		47	60.8	471	442	225
73.6		46	60.0	458	432	219
73.1		45	59.2	446	421	212
72.5		44	58.5	434	409	206
72.0		43	57.7	423	400	201
71.5		42	56.9	412	390	196
70.9		41	56.2	402	381	191
70.4		40	55.4	392	371	186
69.9		39	54.6	382	362	181
69.4		38	53.8	372	353	176
68.9		37	53.1	363	344	172
68.4	(109.0)*	36	52.3	354	336	168
67.9	(108.5)	35	51.5	345	327	163
67.4	(108.0)	34	50.8	336	319	159
66.8	(107.5)	33	50.0	327	311	154
66.3	(107.0)	32	49.2	318	301	150
65.8	(106.0)	31	48.4	310	294	146
65.3	(105.5)	30	47.7	302	286	142
64.7	(104.5)	29	47.0	294	279	138
64.3	(104.0)	28	46.1	286	271	134
63.8	(103.0)	27	45.2	279	264	131
63.3	(102.5)	26	44.6	272	258	127
62.8	(101.5)	25	43.8	266	253	124
62.4	(101.0)	24	43.1	260	247	121
62.0	100.0	23	42.1	254	243	118
61.5	99.0	22	41.6	248	237	115
61.0	98.5	21	40.9	243	231	113

*Values in ( )are beyond normal range and are given for information only. It is possible that steels of various compositions and processing histories will deviate in hardness-tensile strength relationship from data presented in this table. Above the level of Rockwell C43, deviation increases with increasing hardness and the table shall not be used above RC48 except in the absence of other data specifically approved by the procuring agency.

Fig. 4-4

HEAT TREATMENT PROCEDURES FOR STEELS

Steel No.	Temperature: Normalizing		Annealing		Hardening		Quenching Medium	Tempering (Drawing) Temperatures For Tensile Strength: 100,000		125,000		150,000		180,000		200,000	
	°F	°C	°F	°C	°F	°C	(N)	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C
1020	1650-1750	899-954	1600-1700	871-927	1575-1675	856-912	Water	—	—	—	—	—	—	—	—	—	—
1022 (X1020)	1650-1750	899-954	1600-1700	871-927	1575-1675	856-912	Water	—	—	—	—	—	—	—	—	—	—
1025	1600-1700	871-927	1575-1650	856-899	1575-1675	856-912	Water	(A)	(A)	—	—	—	—	—	—	—	—
1035	1575-1650	856-899	1575-1625	856-885	1525-1600	829-871	Water	875	468	—	—	—	—	—	—	—	—
1045	1550-1600	843-871	1500-1600	843-871	1475-1550	800-843	Oil or Water	1150	621	—	—	—	—	(N)	(N)	—	—
1095	1475-1550	800-843	1450-1600	788-816	1425-1500	773-816	Oil	(B)	(B)	—	—	1100	593	850	454	750	399
2330	1475-1525	800-829	1425-1475	773-800	1450-1500	788-816	Oil or Water	1100	593	950	510	800	427	—	—	—	—
3135	1600-1650	871-899	1500-1550	816-843	1475-1525	800-829	Oil	1250	677	1050	566	900	482	750	399	650	343
3140	1600-1650	871-899	1500-1550	816-843	1475-1525	800-829	Oil	1325	718	1075	579	925	496	775	413	700	371
4037	1600	871	1525-1575	829-856	1525-1575	829-856	Oil or Water	1225	662	1100	593	975	524	—	—	—	—
4130 (X4130)	1600-1700	871-927	1525-1575	829-856	1575-1625	856-885	Oil (C)	(D)	(D)	1050	566	900	482	700	371	575	301
4140	1600-1650	871-899	1525-1575	829-856	1525-1575	829-856	Oil	1350	732	1100	593	1025	551	825	440	675	357
4150	1550-1600	843-871	1475-1525	800-829	1500-1550	816-843	Oil	—	—	1275	690	1175	635	1050	566	950	510
4340 (X4340)	1550-1625	843-885	1525-1575	829-856	1475-1550	800-843	Oil	—	—	1200	649	1050	566	950	510	850	454
4640	1675-1700	912-927	1525-1575	829-856	1500-1550	816-843	Oil	—	—	1200	649	1050	566	750	399	625	329
6135	1600-1700	871-927	1550-1600	843-871	1575-1625	856-885	Oil	1300	704	1075	579	950	510	800	427	750	399
6150	1600-1650	871-899	1525-1575	829-856	1550-1625	843-885	Oil	(D)(E)	(D)(E)	1200	649	1000	538	900	482	800	427
6195	1600-1650	871-899	1525-1575	829-856	1500-1550	816-843	Oil	(F)	(F)	—	—	—	—	—	—	—	—
NE8620					1525-1575	829-856	Oil	—	—	1000	538	—	—	—	—	—	—
NE8630	1650	899	1525-1575	829-856	1525-1575	829-856	Oil	—	—	1125	607	975	524	775	413	675	357
NE8735	1650	899	1525-1575	829-856	1525-1575	829-856	Oil	—	—	1175	635	1025	551	875	468	775	413
NE8740	1625	885	1500-1550	816-843	1500-1550	816-843	Oil	—	—	1200	649	1075	579	925	496	850	454
30905	—	—	(G)(H)	(G)(H)	(I)	(I)			—	—	—	—	—	—	—	—	—
51210	1525-1575	829-856	1525-1575	829-856	1775-1825(J)	967-995	Oil	1200	649	1100	593	(K)	(K)	750	399	—	—
51335	—	—	1525-1575	829-856	1775-1850	967-1010	Oil	—	—	—	—	—	—	—	—	—	—
52100	1625-1700	885-927	1400-1450	760-788	1525-1550	829-843	Oil	(L)	(L)	—	—	—	—	—	—	—	—
Corrosion resisting (16-2)(I)	—	—	—	—	—	—	—	—	(M)	(M)	—	—	—	—	—	—	—
Silicon chromium (for springs)	—	—	—	—	1700-1725	927-941	Oil	—	—	—	—	—	—	—	—	—	—

Fig. 4-6

APPROXIMATE TEMPERATURE OF STEEL BY COLOR

COLOR OF METAL	DEGREES C	DEGREES F
Very Faint Yellow	215	420
Very Pale Yellow	221	430
Light Yellow	226	440
Pale Straw Yellow	232	450
Straw Yellow	237	460
Deep Straw Yellow	243	470
Dark Yellow	249	480
Yellow Brown	254	490
Brown Yellow	260	500
Spotted Red Brown	265	510
Brown Purple	271	520
Light Purple	276	530
Full Purple	282	540
Dark Purple	288	550
Full Blue	293	560
Dark Blue	299	570
Very Dark Blue	315	600
Blue Green	332	630
Black Red	537	1000
Blood Red	649	1200
Low Cherry Red	746	1375
Medium Cherry Red	774	1425
Full Cherry Red	815	1500
Bright Red	843	1550
Salmon	899	1650
Orange	940	1725
Lemon	996	1825

Aluminum Alloy Identification

Aluminum seems to be the king of metals for aircraft construction although in recent years some of its use has been given over to more modern superalloys. With its good strength to weight ratio, and relatively low cost, aluminum is still a prime material for the aircraft industry.

Aluminum alloys are identified by a four digit numbering system. The first digit identifies the alloy group and the others indicate the other alloys present. The composition of the major groups and some common alloys may be seen in Figs. 4-7 and 4-8.

Fig. 4-7

DESIGNATION FOR ALUMINUM ALLOY GROUPS

Aluminum	99.00% percent minimum and greater	1xxx
Alloys	Copper (Cu)	2xxx
grouped	Manganese (Mn)	3xxx
by	Silicon (Si)	4xxx
major	Magnesium (Mg)	5xxx
alloying	Magnesium and silicon (Mg and Si)	6xxx
elements	Zinc (Zn)	7xxx
	Other elements	8xxx

Fig. 4-8

NOMINAL COMPOSITION OF WROUGHT ALUMINUM ALLOYS

Percent of alloying elements - aluminum and normal impurities constitute remainder

Alloy	Copper	Silicon	Manganese	Magnesium	Zinc	Chromium
1100						
3003			1.2			
2017	4.0		0.5	0.5		
2117	2.5			0.3		

Fig. 4-8 (cont.)

NOMINAL COMPOSITION OF WROUGHT ALUMINUM ALLOYS

Percent of alloying elements - aluminum and normal impurities constitute remainder

Alloy	Copper	Silicon	Manganese	Magnesium	Zinc	Chromium
2024	4.5		0.6	1.5		
5052				2.5		0.25
6061	0.25	0.6		1.0		0.25
7075	1.6			2.5	5.6	0.3

Heat Treatment of Aluminum

When aluminum is alloyed with copper or zinc, its characteristics change to the extent that it can be hardened as well as softened by the use of heat. The temper designation of a piece of aluminum is indicated by an alpha-numeric code following the alloy designation. This code is explained in Fig. 4-9. Additional charts are provided to illustrate the temperatures and quenching mediums used to achieve various strengths and hardness of aluminum.

Fig. 4.9

BASIC TEMPER DESIGNATIONS AND SUBDIVISIONS FOR ALLUMINUM ALLOYS

Nonheat-treatable Alloys

Temper designation	Definition
-0	Annealed recrystallized (wrought products only) applies to softest temper of wrought products
-H12	Strain-hardened one-quarter-hard temper.
-H14	Strain-hardened half-hard temper.
-H16	Strain-hardened three-quarters-hard temper.

Fig. 4-9 (cont.)

BASIC TEMPER DESIGNATIONS AND SUBDIVISIONS FOR ALLUMINUM ALLOYS

Nonheat-treatable Alloys

Temper designation	Definition
-H18	Strain-hardened full-hard temper.
.-H22	Strain-hardened and partially annealed to one--quarter-hard temper.
-H24	Strain-hardened and partially annealed to half-hard temper.
-H26	Strain-hardened and partially annealed to three-quarters-hard temper.
- H28	Strain-hardened and partially annealed to full--hard temper.
-H32	Strain-hardened and then stabilized. Final temper is one-quarter-hard.
-H34	Strain-hardened and then stabilized. Final temper is three-quarters-hard.
-H36	Strain-hardened and then stabilized. Final tem-per is full-hard.
-H112	As fabricated; with specified mechanical\ property limits.
-F	For wrought alloys; as fabricated. No mechanical properties limits. For cast alloys; as cast

Fig. 4-9a

Heat-treatable Alloys

Temper designation	Definition
-0	Annealed recrystallized (wrought products only) applies to softest temper of wrought products.
-T2	Annealed (castings only)
-T3	Solution heat-treated and cold-worked by the flattening or straightening operation.
-T36	Solution heat-treated and cold-worked by reduction of 6 percent.
-T4	Solution heat-treated.

Fig 4-9a (cont.)

Temper designation	Heat-treatable Alloys Definition
-T42	Solution heat-treated by user regardless of prior temper (applicable only to 2014 and 2024 alloys).
-T5	Artificially aged only (castings only).
-T6	Solution heat-treated and artificially aged.
-T62	Solution heat-treated and aged by user re-gardless of prior temper (applicable only to 2014 and 2024 alloys).
-T351, -T451, -T3510, -T3511, -T4510, -T4511	Solution heat-treated and stress relieved by stretching to produce a permanent set of 1 to 3 percent, depending on the product.
-T651, 4851, -T6510, -T8510, -T6511, -T8511	Solution heat-treated, stress relieved by stretching to produce a permanent set of 1 to 3 percent, and artificially aged.

Fig 4-9b

BASIC TEMPER DESIGNATIONS AND SUBDIVISIONS FOR ALLUMINUM ALLOYS

Temper designation	Heat-treatable Alloys Definition
-T652	Solution beat-treated, compressed to produce a permanent set and then artificially aged.
-T81	Solution heat-treated, cold-worked by the flattening of straightening operation, and then artificially aged.
-T86	Solution heat-treated, cold-worked by reduc-tion of 6 percent, and then artificially aged.
-F	For wrought alloys; as fabricated. No me-chanical properties limits. For cast alloys; as cast.

Fig. 4-10

CONDITIONS FOR HEAT-TREATMENT OF ALUMINUM ALLOYS

	Solution heat-treatment			Precipitation heat-treatment		
Alloy	Temp., °F	Quench	Temp. Desig.	Temp., °F	Time of Aging	Temp. Desig.
2017	930-950	Cold Water	T4			T
2117	930-950	Cold Water	T4			T
2024	910-930	Cold Water	T4			T
6061	960-980	Water	T4	315-325	18 hr	T6
				or		
				345-355	8 hr	T6
7075	870	Water		250	24 hr	T6

Fig. 4-11

AGING TEMPERATURE FOR ALUMINUM ALLOYS

Wrought Alloy Excluding Forgings	Aging Time (Hr)	Aging Temperature (°F)		Aging Temperature (°C)	
		From	To	From	To
2017, 2117, 2024	96	ROOM TEMPERATURE			
Alclad 024	8	345	355	174	179
2014	5	355	365	179	185
6053,6061	12 to 20	315	325	157	163
7075[a]	6 to 10	345	355	174	179
Alclad 7075	24	245	255	118	124
2014, 2017, 2117					

a. Unless the aging temperature is begun within 2 hours after quenching, the material should be allowed to age harden at room temperature for not less than 2 days before it is subjected to the aging treatment.

Fig. 4-12

SUGGESTED HEAT-TREATING (SOAKING) TEMPERATURE FOR ALUMINUM ALLOYS

Wrought Alloys (Excluding Forgings)	Temperature (°F) From	Temperature (°F) To	Temperature (°C) From	Temperature (°C) To
2014,2017,2117	930	950	499	510
2024, Alclad 2024	910	930	488	499
6053, 6061	960	980	516	527
7075, Alclad 7075 (sheet)	860	930	460	499
7075 (Extruded shapes)	860	880	460	471

Fig. 4-13

TYPICAL MECHANICAL PROPERTIES OF WROUGHT ALUMINUM ALLOYS

Alloy and Temper	Ultimate Strength, PSI ball	Brinell 500-kg. load 10-mm.	Shearing Strength, PSI
1100-0	13,000	23	9,500
1100-H14	17,000	32	11,000
1100-H18	24,000	44	13,000
3003-0	16,000	28	11,000
3003-H14	21,000	40	14,000
3003-H18	29,000	55	16,000
2017-T4	62,000	100	36,000
2117-T4	43,000	70	26,000
2024-0	26,000	42	18,000
2024-T4	68,000	105	41,000
2024-T36	70,000	116	42,000
Alclad			
2024-T3	62,000		40,000
Alclad			
2024-T36	66,000		41,000
5052-0	29,000	45	18,000
5052-H14	37,000	67	21,000
5052-H18	41,000	85	24,000
6061-0	18,000	30	12,500
6061-T6	45,000	95	30,000
7075-0	33,000	60	22,000
7075-T6	82,000	150	49,000
Alclad			
7075-0	32,000		22,000
7075-T6	76,000		46,000

Sheet Metal Layout and Bend Allowance

Bend Allowance

Aluminum alloys, of which most aircraft are made, can be formed into complex shapes without cracking, as long as simple procedures are adhered to. One of the most fundamental restrictions when sheet metal is formed involves the radius of the bend. Fig. 4-14 is a chart of minimum bend radii for a 90° bend.

Fig. 4-14

RECOMMENDED RADII FOR 90° BENDS IN ALUMINUM ALLOYS

Alloy. and temper	Approximate sheet thickness (T) (inch)					
	0.016	0.032	0.064	0.128	0.182	0.258
2024-0[1]	0	0-1T	0-1T	0-1T	0-1T	0-1T
2024-T3[1,2]	1.5T-3T	2T-4T	3T-5T	4T-6T	4T-6T	5T-7T
2024-T6[1]	2T-4T	3T-5T	3T-5T	4T-6T	5T-7T	6T-10T
5052-0	0	0	0-1T	0-1T	0-1T	0-1T
5052-H32	0	0	.5T-1T	.5T-1.5T	.5T-1.5T	.5T-1.5T
5052-H34	0	0	.5T-1.5T	1.5T-2.5T	1.5T-2.5T	2T-3T
5052-H36	0-1T	.5-1.5T	1T-2T	1.50T-3T	2T-4T	2T-4T
5052-H38	.5T-1.5T	1T-2T	1.5T-3T	2T-4T	3T-5T	4T-6T
6061-0	0	0-1T	0-1T	0-1T	0-1T	0-1T
6061-T4	0-1T	0-1T	.5T-1.5T	1T-2T	1.5T-3T	2.5T-4T
6061-T6	0-1T	.5T-1.5T	1T-2T	1.5T-3T	2T-4T	3T-4T
7075-0	0	0-1T	0-1T	.5T-1.5T	1T-2T	1.5T-3T
7075-T6[1]	2T-4T	3T-5T	4T-6T	5T-7T	5T-7T	6T-10T

[1] Alclad sheet may be bent over slightly smaller radii than the . corresponding tempers of un-coated alloy.

[2] Immediately after quenching, this alloy may be formed over appreciably smaller radii.

When a bend is made in sheet metal using a radius, the metal cuts across the corner. The metal on the outside stretches and the metal on the inside of the bend shrinks. To find the actual amount of material used in the bend, the measurement is made from a line somewhere near the middle of the thickness. In Fig. 4-15, consider a circle whose radius is equal to the bend-radius plus one half the metal thickness. The circumference of this circle divided by 360 is the amount of material required for each degree of bend. A 90° bend will of course, use one fourth of the circumference. The formula in Fig. 4-15 may be used to calculate bend allowance, or the bend allowance may be obtained by using the chart in Fig. 4-16.

Fig. 4-15

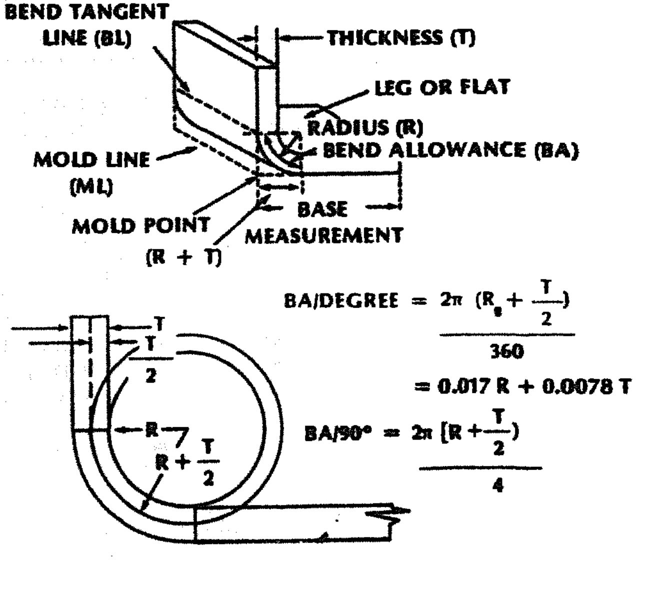


Fig. 4-16

SHEET-METAL BEND ALLOWANCE CHART FOR 1-DEG ANGLE

R \ T	.020 .022	.023 .025	.028 .029	.031 .032	.038 .040	.050 .051	.063 .064	.081	.091 .094	.125 .129
1/32	00072	00073	00076	00079	00086	00094	00104	00117	00125	00154
1/16	00126	00128	00131	00135	00140	00149	00159	00172	00180	00209
3/32	00180	00183	00185	08188	00195	00203	00213	00226	00234	00263
1/8	00235	00237	00240	00243	00249	00258	00268	00281	00289	00317
5/32	00290	00292	00294	00297	00304	00312	00322	00335	00343	00372
3/16	00344	00346	00349	00352	00358	00367	00377	00390	00398	00426
7/32	00398	00401	00403	00406	00412	00421	00431	00444	00452	00481
1/4	00454	00455	00458	00461	00467	00476	00486	00500	00507	00535
9/32	00507	00510	00512	00515	00521	00530	00540	00553	00561	00590
5/16	00562	00564	00567	00570	00576	00584	00595	00608	00616	00644
11/32	00616	00619	00620	00624	00630	00639	00649	00662	00670	00699
3/8	00671	00673	00675	00679	00685	00693	00704	00717	00725	00753
13/32	00725	00728	00730	00733	00739	00748	00758	00771	00779	00808
7/16	00780	00782	00784	00767	00794	00802	00812	00826	00834	00862
15/32	00834	00836	00839	00842	00848	00857	00867	00853	00888	00917
1/2	00889	00891	00893	00896	00903	00911	00921	00935	00943	00971
17/32	00943	00945	00948	00951	00957	00966	00976	00989	00997	01025
9/16	00998	01000	01002	01005	01012	01020	01030	01044	01051	01080
19/32	01051	01054	01055	01058	01065	01073	01083	01098	01105	01133
5/8	01107	01109	01111	01114	01121	01129	01139	01152	01160	01189
21/32	01161	01163	01166	01170	01175	01183	01193	01207	01214	01245
11/16	01216	01218	01220	01223	01230	01238	01248	01261	01269	01298
23/32	01269	01272	01273	01276	01283	01291	01301	01316	01322	01351
3/4	01324	01327	01329	01332	01338	01347	01357	01370	01378	01407
25/32	01378	01381	01383	01386	01392	01401	01411	01425	01432	01461
13/16	01433	01436	01438	01441	01447	01456	01466	01479	01487	01516
27/32	01487	01490	01491	01494	01501	01509	01519	01534	01540	01569
7/8	01542	01545	01548	01550	01556	01565	01575	01588	01596	01625
29/32	01596	01600	01601	01604	01610	01619	01629	01643	01650	01679
15/16	01651	01654	01655	01657	01665	01674	01684	01697	01705	01734
31/32	01705	01708	01709	01712	01718	01727	01737	01752	01758	01787
1	01760	01763	01765	01768	01774	01783	01793	01806	01814	01834

Minimum allowance below line ———————— for hard dural.

Minimum allowance below line – – – – – – – for soft dural and steel.

Setback

In order to make a straight bend in a piece of metal, Some sort of bending machine is used. For most aircraft shops, the cornice or leaf brake is most generally available.

Setback is the distance from the bend-tangent line (the point at which the bend starts) to the mold point (the intersection of the lines extended from the outer surface of the part). As seen in Fig. 4-17, the setback for a 90° bend is equal to the bend radius plus the thickness of the metal. For any other angle of bend a K-chart, such as is shown in Fig. 4-17, is used.

Fig. 4-17

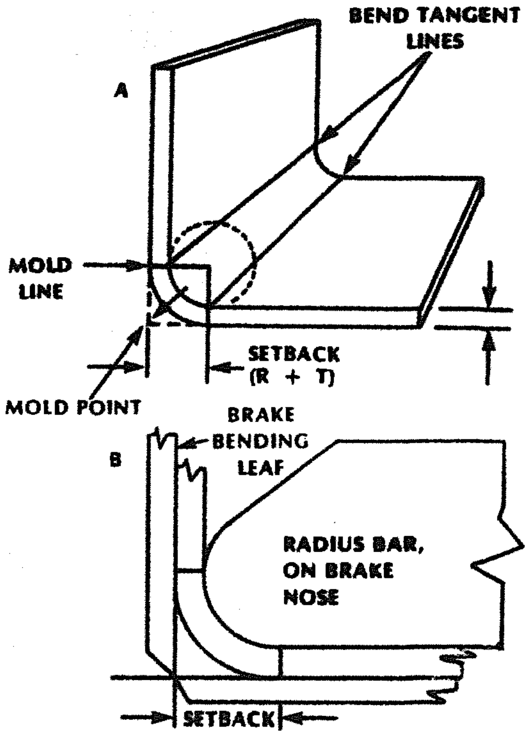


Fig. 4-17 (cont.)

MEASUREMENT OF SETBACK

For bend other than 90°
Setback = K(R / T)

Angle (deg)	K-value	Angle	K-value (deg)
1	0.00873	37	0.33459
2	0.01745	38	0.34433
3	0.02618	39	0.35412
4	0.03492	40	0.36397
5	0.04366	41	0.37388
6	0.05241	42	0.38386
7	0.06116	43	0.39391
8	0.06993	44	0.40403
9	0.07870	45	0.41421
10	0.08749	46	0.42447
11	0.09629	47	0.43481
12	0.10510	48	0.44523
13	0.11393	49	0.45573
14	0.12278	50	0.46631
15	0.13165	51	0.47697
16	0.14054	52	0.48773
17	0.14945	53	0.49858
18	0.15838	54	0.50952
19	0.16734	55	0.52057
20	0.17633	56	0.53171
21	0.18534	57	0.54295
22	0.19438	58	0.55431
23	0.20345	59	0.56577
24	0.21256	60	0.57735
25	0.22169	61	0.58904
26	0.23087	62	0.60086
27	0.24008	63	0.61280
28	0.24933	64	0.62487
29	0.25862	65	0.63707
30	0.26795	66	0.64941
31	0.27732	67	0.66188
32	0.28674	68	0.67451
33	0.29621	69	0.68728
34	0.30573	70	0.70021
35	0.31530	71	0.71329
36	0.32492	72	0.72654

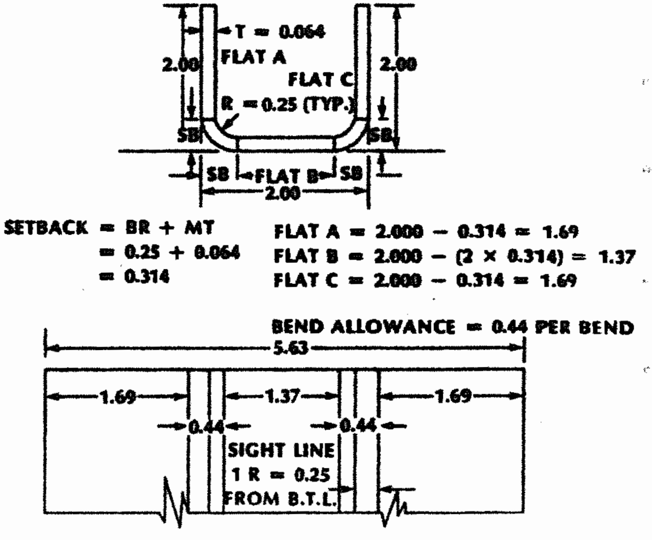
MEASUREMENT OF SETBACK (cont.)

Angle (deg)	K-value	Angle (deg)	K-value	Angle (deg)	K-value
73	0.73996	109	1.4019	145	3.1716
74	0.75355	110	1.4281	146	3.2708
75	0.76733	111	1.4550	147	3.3759
76	0.78128	112	1.4826	148	3.4874
77	0.79543	113	1.5108	149	3.6059
78	0.80978	114	1.5399	150	3.7320
79	0.82434	115	1.5697	151	3.8667
80	0.83910	116	1.6003	152	4.0108
81	0.85408	117	1.6318	153	4.1653
82	0.86929	118	1.6643	154	4.3315
83	0.88472	119	1.6977	155	4.5107
84	0.90040	120	1.7320	156	4.7046
85	0.91633	121	1.7675	157	4.9151
86	0.93251	122	1.8040	158	5.1455
87	0.94890	123	1.8418	159	5.3995
88	0.96569	124	1.8807	160	5.6713
89	0.98270	125	1.9210	161	5.9758
90	1.0000	126	1.9626	162	6.3737
91	1.0176	127	2.0057	163	6.6911
92	1.0355	128	2.0503	164	7.1154
93	1.0538	129	2.0965	165	7.5957
94	1.0724	130	2.1445	166	8.1443
95	1.0913	131	2.1943	167	8.7769
96	1.1106	132	2.2460	168	9.5144
97	1.1303	133	2.2998	169	10.385
98	1.1504	134	2.3558	170	11.430
99	1.1708	135	2.4142	171	12.706
100	1.1917	136	2.4751	172	14.301
101	1.2131	137	2.5386	173	16.350
102	1.2349	138	2.6051	174	19.081
103	1.2572	139	2.6746	175	22.904
104	1.2799	140	2.7475	176	26.636
105	1.3032	141	2.8239	177	38.138
106	1.3270	142	2.9042	178	57.290
107	1.3514	143	2.9887	179	114.390
108	1.3764	144	3.0777	180	Infinite

Flat Pattern Layout

In order to cut a piece of material so that it can be formed to the dimensions called for, a flat pattern layout must be made, with a bend-tangent line and sight lines marked on the metal. Fig. 4-18 is a flat pattern layout for a channel made of 0.064-inch aluminum alloy, using a quarter-inch bend radius and having outside dimensions of two inches across the bottom and up each side.

Fig. 4-18

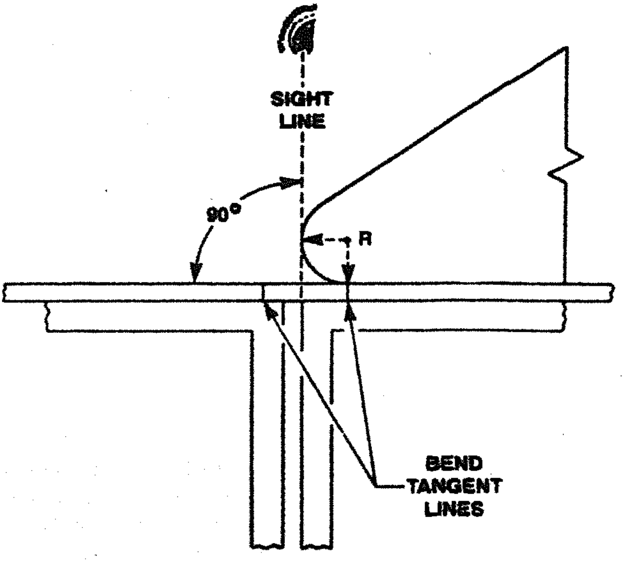


The first step is to find the setback, which is the bend radius plus the metal thickness, or 0.25 plus 0.064 or 0.314-inch. Subtract this setback from the two inch mold line length to find the length of Flat A, 1.69 inches. Flat C is exactly the same length as Flat A. Flat B has the setback taken off both ends, so that it is 2.00 – (2 X 0.314) or 1.37 inches. The distance between the flats will be the amount of material allowed for the bends, or the bend allowance found in the Fig. 4-16 chart. For a quarter inch radius and a metal thickness of 0.064-inch, this will be 0.437 or, for practical purposes 0.44-inch.

Making The Bends

When the material for the channel just discussed has been cut t‹ size, and all of the bend-tangent lines have been marked; the brake i: adjusted with the proper setback and a sight line is drawn. The sight line seen in Fig. 4-19, is drawn one bend radius from the bend tangent line The material is positioned correctly in the brake by sighting directl› down along the edge of the radius bar or the upper nose of the brake When the sight line is aligned with the radius bar, the bend-tangent lin‹ will be under the radius bar at this point. The bending leaf should b‹ lifted very carefully. The bending leaf should be lifted up a few degree: beyond the desired angle to allow for springback.

Fig. 4-19



Aircraft Drawings

An important skill of the aviation technician is the ability to interpret technical drawings. Many shop operations and aircraft maintenance instructions are presented in graphic form, such as blueprints. The technician must be able to accurately interpret the information on drawings and apply them to the operations necessary to make repairs or alterations.

Lines

Drawings are made up of various types of lines, each with its own meaning. Presented here are some of the most common types of lines with an example of their use.

Fig 5-1

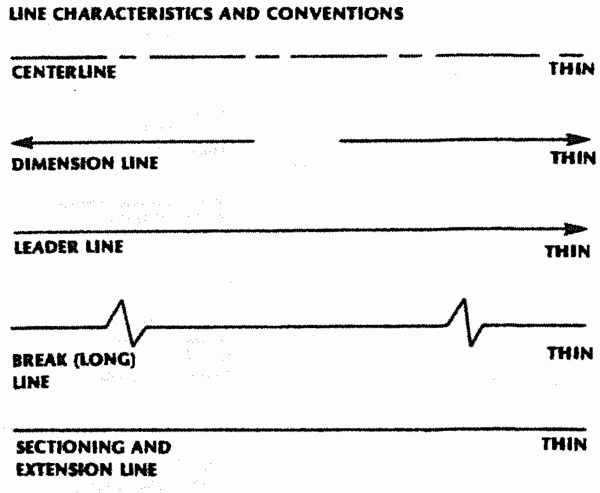
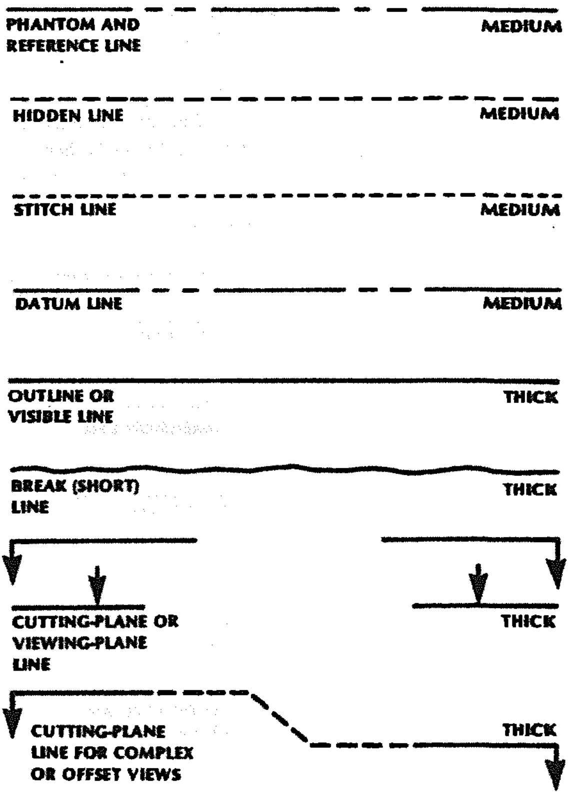


Fig 5-1 (cont.)


PHANTOM AND REFERENCE LINE
MEDIUM
HIDDEN LINE
MEDIUM
STITCH LINE
MEDIUM
DATUM LINE
MEDIUM
OUTLINE OR VISIBLE LINE
THICK
BREAK (SHORT) LINE
THICK
CUTTING-PLANE OR VIEWING-PLANE LINE
THICK
CUTTING-PLANE LINE FOR COMPLEX OR OFFSET VIEWS
THICK

Electrical schematics are used by the aircraft technician for the maintenance and troubleshooting of aircraft electrical systems. It is important that the technician recognize standard electrical symbols used on these drawings. Fig. 5-2 presents some of the most common electrical symbols.

Fig. 5-2

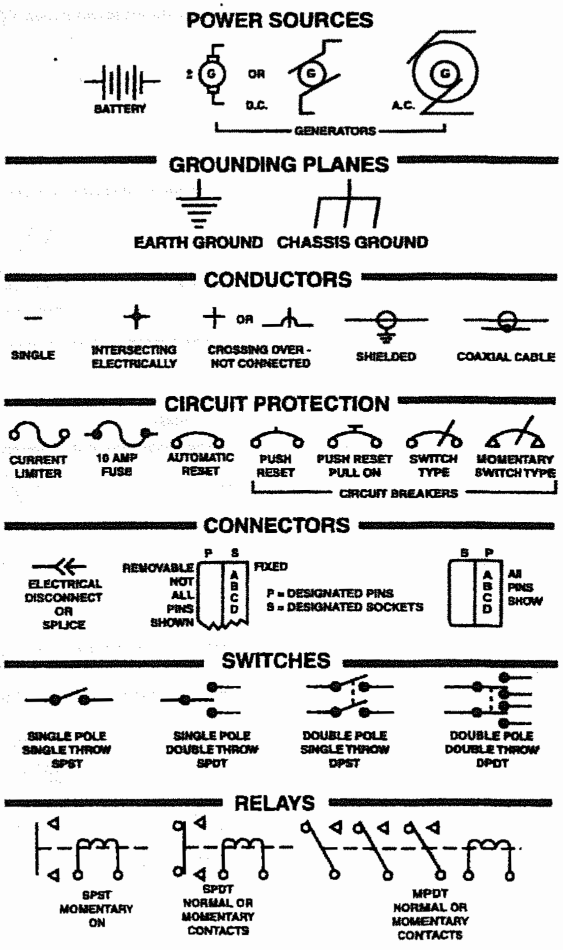
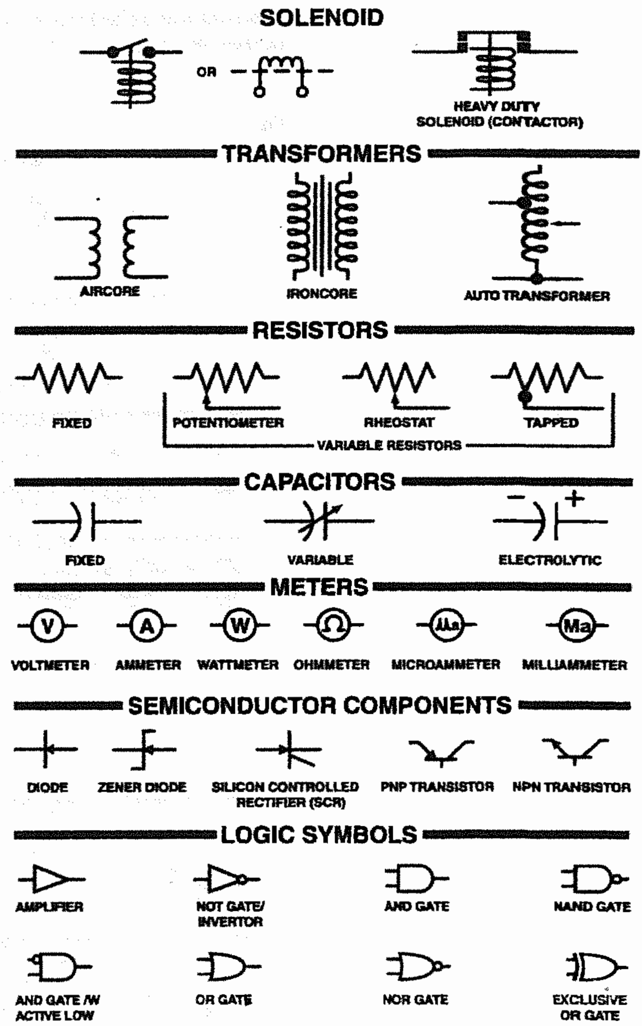


Fig 5-2 (cont.)


SOLENOID
OR
HEAVY DUTY SOLENOID (CONTACTOR)
TRANSFORMERS
AIRCORE
IRONCORE
AUTO TRANSFORMER
RESISTORS
FIXED
POTENTIOMETER
RHEOSTAT
TAPPED
VARIABLE RESISTORS
CAPACITORS
FIXED
VARIABLE
ELECTROLYTIC
METERS
VOLTMETER
AMMETER
WATTMETER
OHMMETER
MICROAMMETER
MILLIAMMETER
SEMICONDUCTOR COMPONENTS
DIODE
ZENER DIODE
SILICON CONTROLLED RECTIFIER (SCR)
PNP TRANSISTOR
NPN TRANSISTOR
LOGIC SYMBOLS
AMPLIFIER
NOT GATE/ INVERTOR
AND GATE
NAND GATE
AND GATE /W ACTIVE LOW
OR GATE
NOR GATE
EXCLUSIVE OR GATE

Interpreting Station Notation

The ability to relate the parts illustrated on a drawing to their location on the aircraft is an important skill. To help make this task easier, a system of standard reference lines has been adopted. These lines are known as stations, water lines, and buttock lines.

Stations are points of reference within an aircraft identified by distance in inches from the datum. The ***datum*** is the zero station line, the reference point from which fuselage stations are measured. On some aircraft the datum might be the nose of the aircraft, the firewall, or the leading edge of the wing. Stations in front of the datum would have negative station numbers and those aft would have positive station numbers. The datum is sometimes placed at a point at, or in front of the aircraft so that all station numbers are positive. See Fig. 5-3. Wing and control surface stations are usually measured from the centerline of the fuselage as illustrated in Fig. 5-4, or possibly from the root of the wing. Horizontal stations are also known as buttock lines, butt lines, or abbreviated BL.

Fig. 5-3

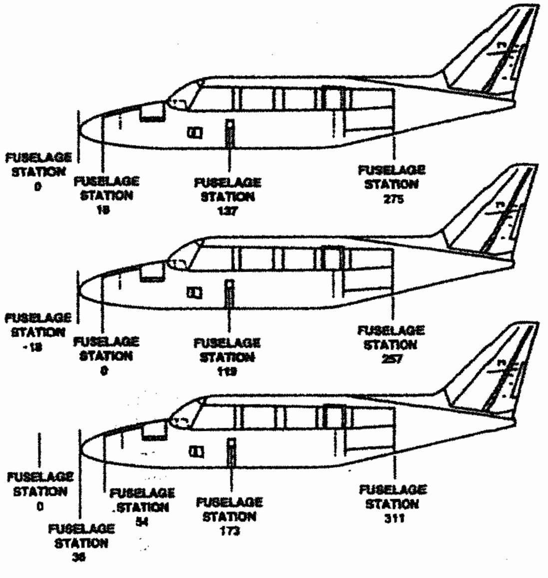
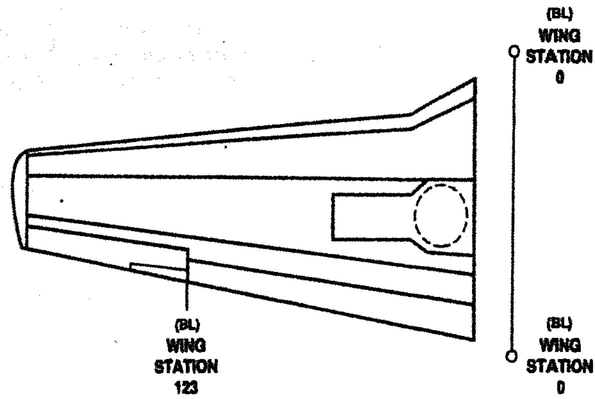
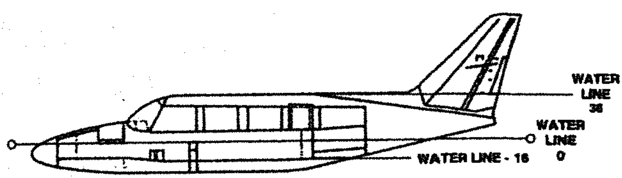


Fig 5-4



The ***zero water line*** is a horizontal line through the center of the aircraft in its flying position. Other water lines are drawn parallel to the zero line. These water lines are usually labeled in inches from the zero line. The ones above the zero line are positive and the ones below it are negative. An example of water lines may be seen in. Fig. 5-5. Sometimes water lines are measured from some other point on the aircraft such as the bottom of the fuselage, or from the ground. Water lines are abbreviated WL.

Fig. 5-5



It is very important to hold the drill motor in such a way that the force of the two hands balance, so there will be control of the drill as it cuts through the metal. The proper way to hold the drill motor is seen in Fig. 2-10. Failure to use the proper technique could result in expensive damage to the aircraft's structure, or inadvertently drilling into an electrical wire or fluid supply line.

Fig. 2-10

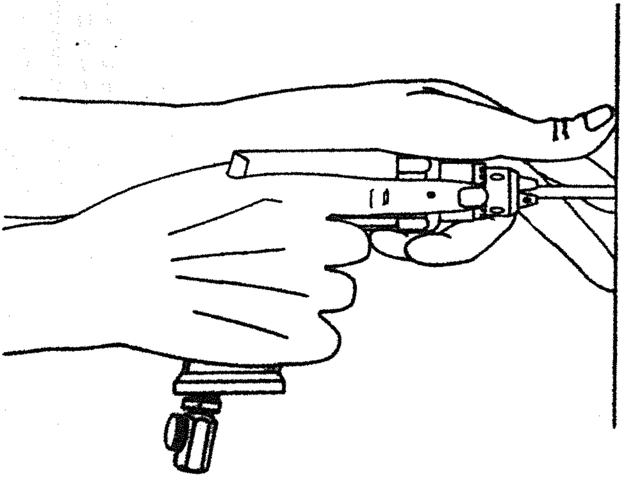


Fig. 2-9 (cont.)

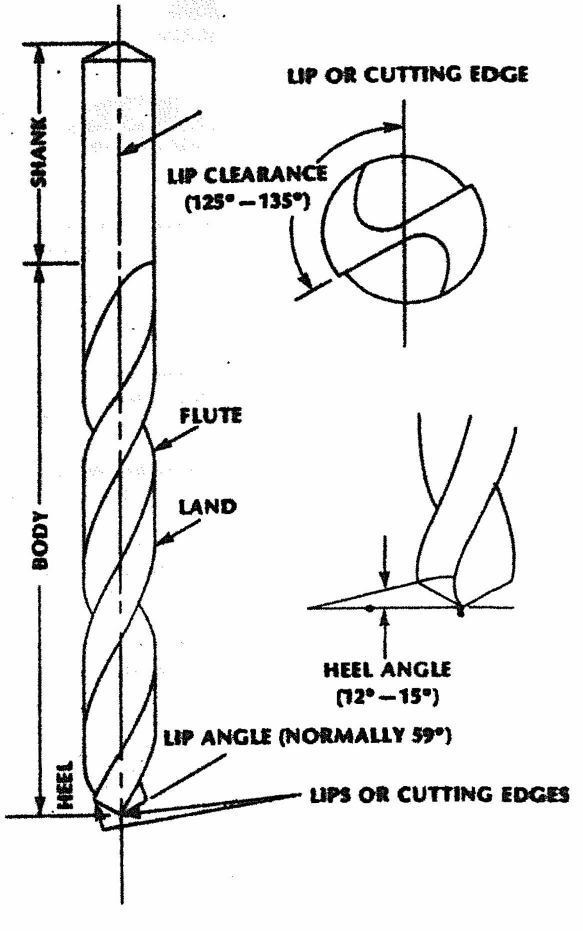
TWIST DRILL SIZES

Size	Decimal Equivalent	Size	Decimal Equivalent	Size	Decimal Equivalent
1/2	0.5000	3	0.2130	3/32	0.0937
31/64	0.4844	4	0.2090	42	0.0935
15/32	0.4687	5	0.2055	43	0.0890
29/64	0.4531	6	0.2040	44	0.0860
7/16	0.4375	13/64	0.2031	45	0.0820
27/64	0.4219	7	0.2010	46	0.0810
Z	0.4130	8	0.1990	47	0.0785
13/32	0.4062	9	0.1960	5/64	0.0781
Y	0.4040	10	0.1935	48	0.0760
X	0.3970	11	0.1910	49	0.0730
25/64	0.3906	12	0.1890	50	0.0700
W	0.3860	3/16	0.1875	51	0.0670
V	0.3770	13	0.1850	52	0.0635
3/8	0.3750	14	0.1820	1/16	0.0625
U	0.3680	15	0.1800	53	0.0550
23/64	0.3594	16	0.1770	54	0.0550
T	0.3580	17	0.1730	55	0.0520
S	0.3480	11/64	0.1719	3/64	0.0469
11/32	0.3437	18	0.1695	56	0.0465
R	0.3390	19	0.1660	57	0.0430
Q	0.3320	20	0.1610	58	0.0420
21/64	0.3281	21	0.1590	59	0.0410
P	0.3230	22	0.1570	60	0.0400
0	0.3160	5/32	0.1562	61	0.0390
5/16	0.3125	23	0.1540	62	0.0380
N	0.3020	24	0.1520	63	0.0370
19/64	0.2969	25	0.1495	64	0.0360
M	0.2950	26	0.1470	65	0.0350
L	0.2900	27	0.1440	66	0.0330
9/32	0.2812	9/64	0.1406	1/32	0.0320
K	0.2810	28	0.1405	67	0.0312
J	0.2770	29	0.1360	68	0.0310
I	0.2720	30	0.1285	69	0.0292
H	0.2660	1/8	0.1250	70	0.0280
17/64	0.2656	31	0.1200	71	0.0260
G	0.2610	32	0.1160	72	0.0250
F	0.2570	33	0.1130	73	0.0240
E-1/4	0.2500	34	0.1110	74	0.0225
D	0.2460	35	0.1100	75	0.0210
C	0.2420	7/64	0.1094	76	0.0200
B	0.2380	36	0.1065	77	0.0190
15/64	0.2344	37	0.1040	1/64	0.0160
A	0.2340	38	0.1015	78	0.0156
1	0.2280	39	0.0995	79	0.0145
2	0.2210	40	0.0980	80	0.0135
7/32	0.2187	41	0.0960		

Drills

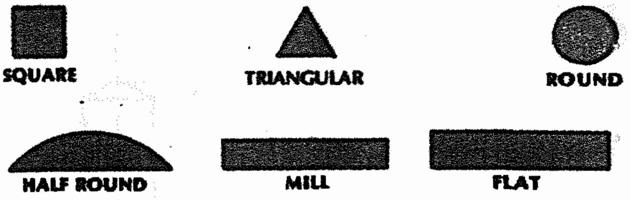
The twist drill is used for originating or enlarging holes in a variety of materials. Parts of the twist drill are shown in Fig. 2-9.

Fig 2-9



In selecting the file for a job, the shape of the finished work must be considered, as files are available in a variety of shapes. File shapes are shown in Fig. 2-8.

Fig. 2-8



Square files are longitudinally tapered on all four sides and are used to enlarge square or rectangular holes.

Triangular files are longitudinally tapered on all three sides and are used to file acute internal angles, and to clear out square corners.

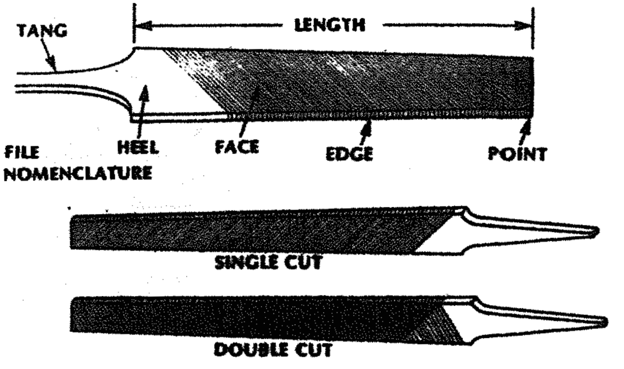
Round files are also known as "rat-tail" files because of their similarity in appearance to the rodent's appendage. Their primary use is enlarging round or oval holes.

Half-round files provide a handy combination. The flat side may be used on flat surface and the rounded side for curved surfaces.

Mill files are tapered in thickness and width. One edge of a mill file has no teeth and is known as the safe edge. Mill files are always single-cut and are used for draw filing and other fine work.

Flat files are a general purpose files and may be single- or double-cut. The double-cut is used for rough work and the single-cut for fine work.

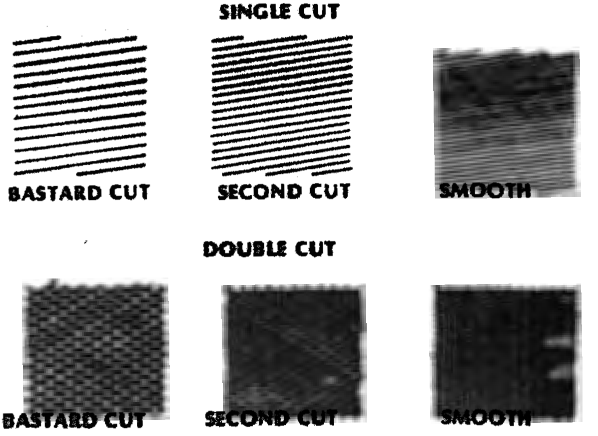
Fig 2-6



SINGLE AND DOUBLE-CUT FILES

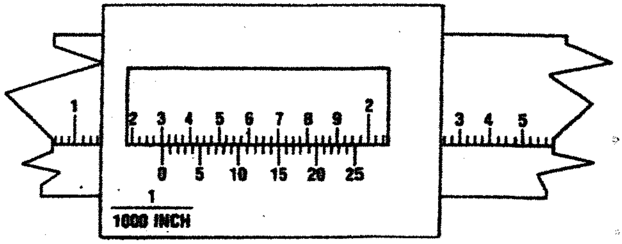
Files are also graded according to the spacing and size of their teeth. Fig. 2-7 shows three common grades and the way they appear on both single- and double-cut files. In addition to these, there are dead-smooth files which have very fine teeth and some rough files with very course teeth.

Fig. 2-7



DESIGN AND SPACING OF FILE TEETH

Fig. 2-5



The vernier scale has moved one inch, plus three-tenths of an inch "plus fourteen-thousandths inch.
1.000 + 0.300 inch + 0.014 = 1.314 inches.

Files

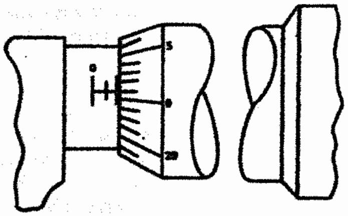
Files are available in a variety of grades and shapes and no tool kit is complete without an assortment of them. Files are graded according to the degree of fineness and whether they have single- or double-cut teeth.

A single-cut file will have rows of teeth parallel to each other and at an angle of about 65 degrees from the centerline. This is the best file to use for finish or draw filing and for sheet metal work.

The double-cut file has crisscrossed rows of teeth. This double cut forms diamond shaped teeth that are good for rough work and quick removal of metal. Single- and double-cut files are illustrated in Fig. 2-6.

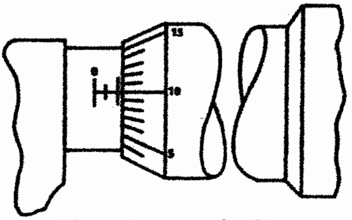
Fig. 2-4 (cont.)

C



The thimble has moved out two complete turns plus one twenty-fifth of the way around again. The total reading is 0.051 inch.

D



The thimble has moved out two complete turns plus ten twenty-fifths of another turn. The reading is 0.060 inch.

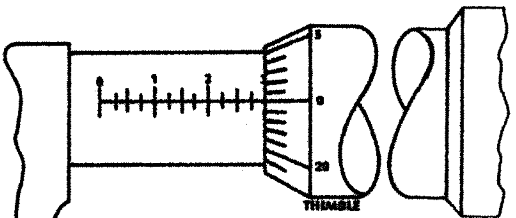
Vernier calipers are used to make accurate inside or outside measurements faster than can be made with a micrometer. To read the caliper shown in Fig. 2-5, read the inches first (one inch) then the tenths (three-tenths), then look at the zero on the vernier scale and see that it is beyond the 1.300 inch mark. Exactly how much beyond is determined by the line on the vernier scale that lines up with one of the marks on the bar. In this case, the line marked fourteen lines up with one of the marks on the bar, so fourteen thousandths is added to the basic reading. The tool reading is 1.314 inches.

The spindle of the micrometer is threaded with accurately ground threads. This screw has a pitch of 40 threads per inch; in other words, if the screw is turned 40 times, it will move the spindle exactly one inch. A single turn of the screw will move the spindle 1/40th (.025)of an inch. or

The barrel is divided into 40 parts, each representing one full turn of the thimble or .025 inch. Each fourth division is given a number 1 through 10 which represents 100 thousandths, 200 thousandths, etc. The numbers 1 through 25 around the thimble each represent .001 inch, and are read using the one aligning with the horizontal line on the barrel. An example of how a micrometer is read is shown in Fig. 2-4

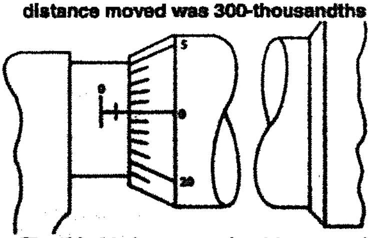
Fig. 2-4

A



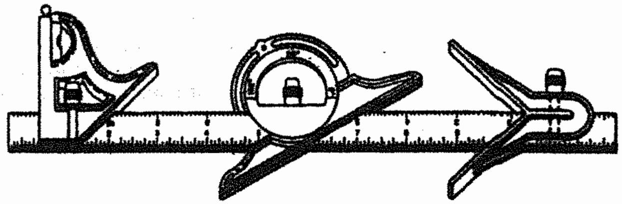
The thimble of this micrometer has moved out exactly twelve revolutions, each revolution moving the spindle 25-thousandths of an inch. The total distance moved was 300-thousandths of an inch.

B



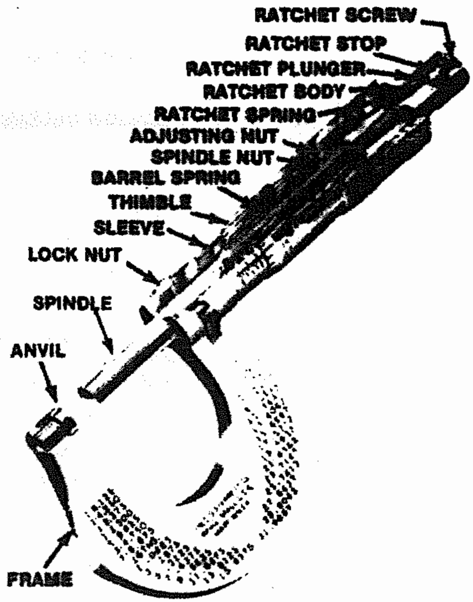
The thimble has moved out two complete turns which gives a reading of 0.050 inch.

Fig. 2-2



The ***micrometer caliper*** is graduated down to .001 or .0001 inch and provides precision measurement. Micrometer calipers are available for many special applications. The maintenance technician should be familiar with the operation of the hand-held micrometer, since this is the tool that is used for many dimensional inspections. The parts of the micrometer caliper are seen in Fig. 2-3.

Fig. 2-3



Basic Hand Tools

The aviation technician must rely on hand tools to accomplish most of his work. A basic understanding of each tool's use is necessary to obtain the best service from the tool.

Measuring Tools

The detailed inspections required to assure safe operation of an aircraft include many dimensional inspections. The accuracy of these inspections depends largely on the skill of the technician and an understanding of how to interpret the readings on the measuring device.

Rules are graduated measuring instruments, usually made of metal. They are available with a variety of graduations; however, the aircraft technician will probably find thirty-seconds and sixty-fourths or tenths and thousandths of an inch most practical. A typical rule is seen in Fig. 2-1.

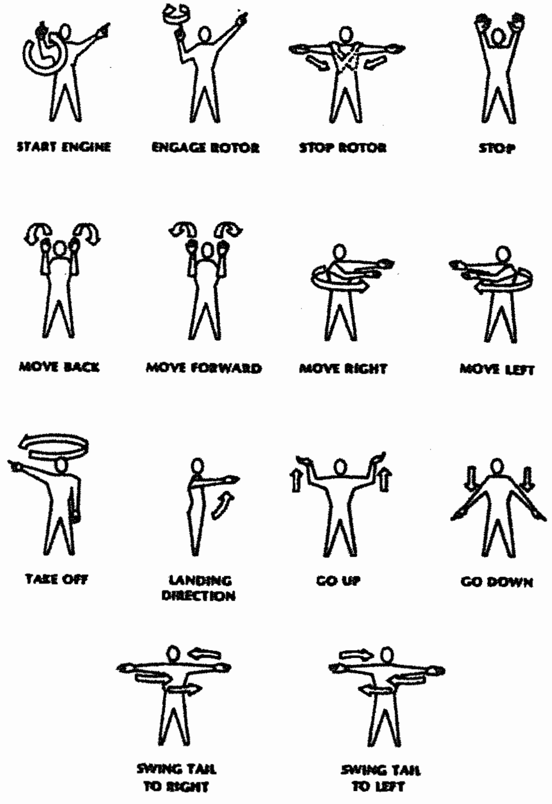
Fig. 2-1

Scales must not be confused with rules, despite their similar appearance. A scale is graduated to indicate proportional, rather than actual measurements. This is handy if you want to lay out work to one half size, for example.

The ***combination set*** is one of the handiest and most used measuring tools. This may be purchased with almost any combination of rules. The combination set has three heads that may be mounted to any point on the blade or removed entirely. The square has a small bubble level perpendicular to the blade, and a small scriber in the head. The protractor can measure any angle between the head and the blade from 0° to 180°, and the centering head makes locating the center of any circular surface an easy matter. Fig. 2-2 shows a typical combination set.

Fig 1-23 (cont.)

HAND SIGNALS FOR DIRECTING AIRCRAFT



Helicopter operating signals.

Fig. 1-23

HAND SIGNALS FOR DIRECTING AIRCRAFT

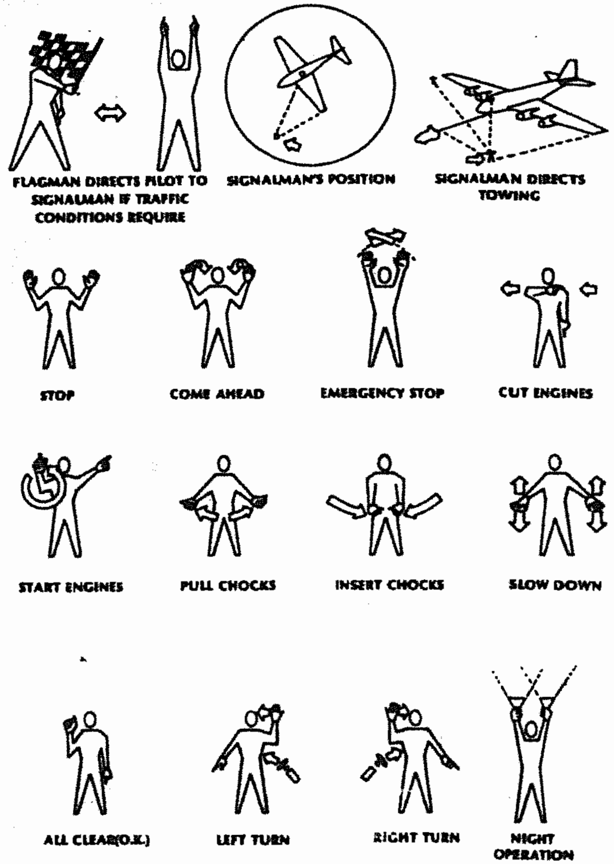
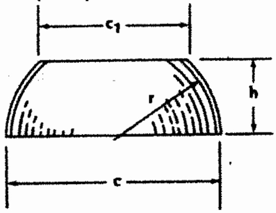


Fig 1-22 (cont.)

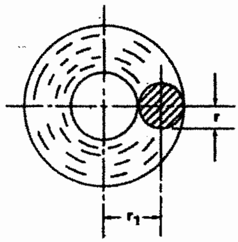


Area of Spherical Surface
$A = 6.2832rh$

Total Surface Area
$A = .7854\,(8rh + c^2 + c_1^2)$

Volume
$V = .1318h\,(3c^2 + 3c_1^2 + 4h^2)$

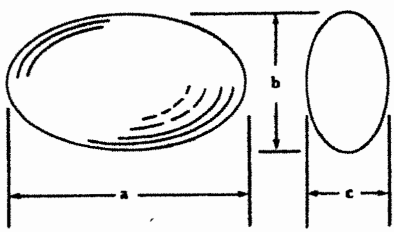
TORUS



Surface Area
$A = 39.478rr_1$

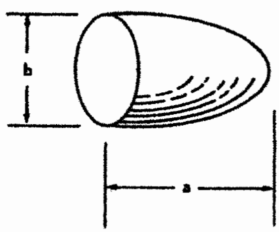
Volume
$V = 19.739r^2r_1$

ELLIPSOII



Volume
$V = .5236abc$

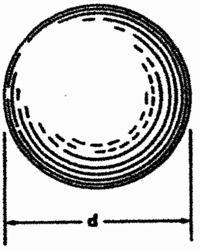
PARABOLOID



Volume
$V = .3927ab^2$

Fig 1-22 (cont.)

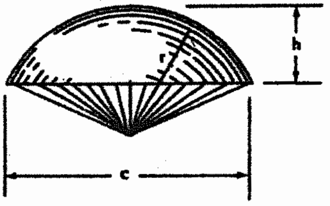
SPHERE



Surface Area
$A = 3.1416d^2$

Volume
$V = .5236d^3$

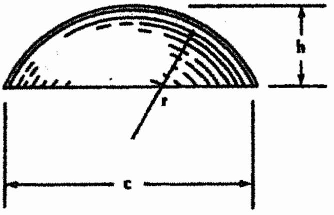
SECTOR OF SPHERE



Surface Area
$A = 1.5708\ r\ (4h + c)$

Volume
$V = 2.0944r^2h$

SEGMENT OF SPHERE



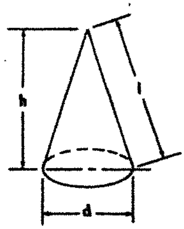
Surface Area of Top Section
$A = 6.2832rh$ or
$A = .7854\ (4h^2 + c^2)$

Total Surface Area
$A = 1.5708\ (2h^2 + c^2)$

Volume
$V = 1.0472h^2\ (3r - h)$ or
$V = .1318h\ (3c^2 + 4h^2)$

Fig 1-22 (cont.)

RIGHT REGULAR CONE



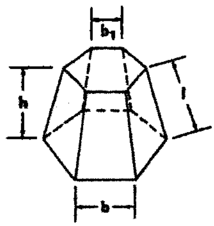
Surface Area

$A = 1.5708d\,(.5d + l)$

Volume

$V = .2618d^2h$

FRUSTUM OF RIGHT REGULAR PYRAMID



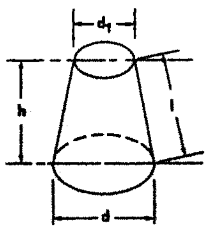
Surface Area

$A = 1/2\ nl(b + b_1) + A_B + A_T$

Volume

$V = 1/3h\,(A_B + A_T + \sqrt{A_B A_T}\,)$

FRUSTUM OF RIGHT REGULAR CONE



Surface Area

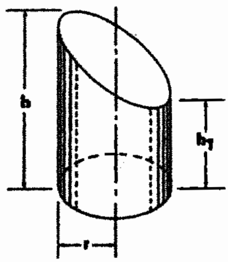
$A = .3927\,[d^2 + d_1^2 + 4l(d + d_1)]$

Volume

$V = .2618h\,(d^2 + dd_1 + d_1^2)$

Fig 1-22 (cont.)

FRUSTUM OF RIGHT CIRUCLAR CYLINDER



Lateral Area
$A = 3.146\ r\ (h + h_1)$

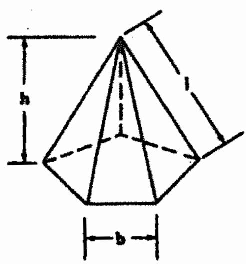
Area of Top Section

$$A = 31416\ r \sqrt{r^2 + \left(\frac{h_1 - h}{2}\right)^2}$$

Area of Base
$A = 3.1416\ r^2$

Volume
$V = 1.5708\ r^2\ (h + h_1)$

RIGHT REGULAR PYRAMID



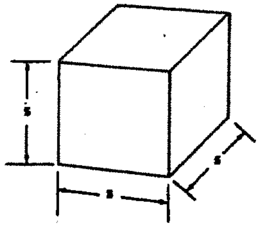
Surface Area
A = 1/2nbl + Ab (area of base)

Volume
V = 1/3ABh

Fig 1-22 (cont.)

THREE DIMENSIONAL FIGURES (SOLID GEOMETRY)

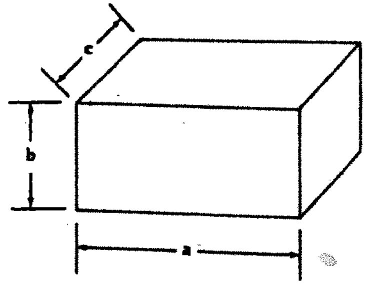
CUBE



Surface Area
$A = 6s^2$

Volume
$V = s^3$

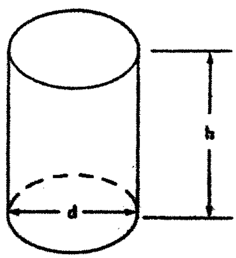
RECTANGULAR SOLID



Surface Area
$A = 2(ab + bc + ac)$

Volume
$V = abc$

CYLINDER



Surface Area
$A = 1.5708\, d\, (2h + d)$

Volume
$V = \pi \times \left(\frac{d}{2}\right)^2 \times h$

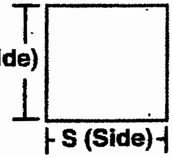
Note: $\pi = 3.1416$

Note: Engine displacement is derived by figuring the total volume of all the engine cylinders. The stroke of the engine is used as "h" in the formula. The cylinder bore equals "d". Total displacement is found by multiplying the displacement (volume) of an individual cylinder and then multiplying by the total number of cylinders.

Fig 1-22

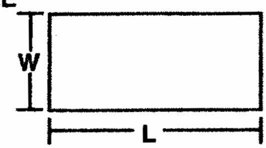
TWO DIMENSIONAL FIGURES (PLANE GEOMETRY)

SQUARE



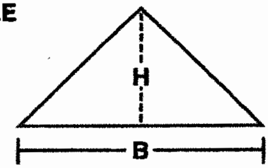
Area = S^2

RECTANGLE



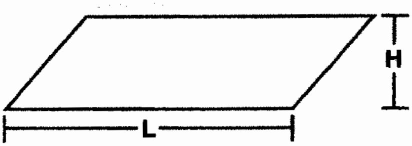
Area = W x L

TRIANGLE



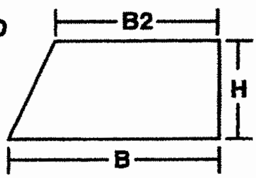
Area = $\frac{B \times H}{2}$

PARALLELOGRAM



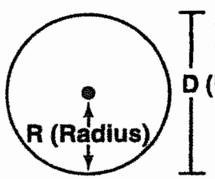
Area = L x H

TRAPEZOID



Area = $\frac{(B1 + B2)\ H}{2}$

CIRCLE



Area = πR^2

Circumference = πD

Fig 1-21 (cont.)

TRIGONOMETRIC FUNCTIONS

Degrees	Sin	Cos	Tan	Cot
72	.9511	.3090	3.078	.3249
73	.9563	.2924	3.271	.3057
74	.9613	.2756	3.487	.2868
75	.9659	.2588	3.732	.2680
76	.9703	.2419	4.011	.2493
77	.9744	.2250	4.331	.2309
78	.9782	.2079	4.705	.2126
79	.9816	.1908	5.145	.1944
80	.9648	.1737	5.671	.1763
81	.9877	.1564	6.314	.1564
82	.9903	.1392	7.115	.1405
83	.9926	.1219	8.144	.1228
84	.9945	.1045	9.514	.1051
85	.9962	.0972	11.43	.0875
86	.9976	.0698	14.30	.0699
87	.9986	.0523	19.08	.0524
88	.9994	.0349	28.64	.0349
89	.9999	.0175	57.29	.0175
90	1.000	0	+∞	0

Fig 1-21 (cont.)

TRIGONOMETRIC FUNCTIONS

Degrees	Sin	Cos	Tan	Cot
36	.5878	.8090	.7265	1.376
37	.6018	.7986	.7536	1.327
38	.6157	.7880	.7813	1.280
39	.6293	.7772	.8098	1.235
40	.6428	.7660	.8391	1.192
41	.6561	.7547	.8693	1.150
42	.6691	.7431	.9004	1.111
43	.6820	.7314	.9325	1.072
44	.6947	.7193	.9657	1.036
45	.7071	.7071	1.000	1.000
46	.7193	.6947	1.036	.9657
47	.7314	.6820	1.072	.9325
48	.7431	.6691	1.111	.9004
49	.7547	.6561	1.150	.8693
50	.7660	.6428	1.192	.8391
51	.7772	.6293	1.235	.8098
52	.7880	.6157	1.280	.7813
53	.7986	.6018	1.327	.7536
54	.8090	.5878	1.376	.7265
55	.8192	.5736	1.428	.7002
56	.8290	.5592	1.483	.6745
57	.8387	.5446	1.540	.6494
58	.8481	.5299	1.600	.6249
59	.8572	.5150	1.664	.6009
60	.8660	.5000	1.732	.5774
61	.8746	.4848	1.804	.5543
62	.8830	.4695	1.861	.5317
63	.8910	.4540	1.963	.5095
64	.8988	.4384	2.050	.4877
65	.9063	.4226	2.145	.4663
66	.9136	.4067	2.246	.4452
67	.9205	.3907	2.356	.4245
68	.9272	.3746	2.475	.4040
69	.9336	.3584	2.605	.3839
70	.9397	.3420	2.747	.3640
71	.9455	.3256	2.904	.3443

Table Continued on Next Page

Fig 1-21 (cont.)

TRIGONOMETRIC FUNCTIONS

Degrees	Sin	Cos	Tan	Cot
0	.0	1.000	.0	+∞
1	.0175	.9999	.0175	57.29
2	.0349	.9994	.0349	28.64
3	.0523	.9986	.0524	19.08
4	.0698	.9976	.0699	14.30
5	.0972	.9962	.0875	11.43
6	.1045	.9945	.1051	9.514
7	.1219	.9926	.1228	8.144
8	.1392	.9903	.1405	7.115
9	.1564	.9877	.1564	6.314
10	.1737	.9648	.1763	5.671
11	.1908	.9816	.1944	5.145
12	.2079	.9782	.2126	4.705
13	.2250	.9744	.2309	4.331
14	.2419	.9703	.2493	4.011
15	.2588	.9659	.2680	3.732
16	.2756	.9613	.2868	3.487
17	.2924	.9563	.3057	3.271
18	.3090	.9511	.3249	3.078
19	.3256	.9455	.3443	2.904
20	.3420	.9397	.3640	2.747
21	.3584	.9336	.3839	2.605
22	.3746	.9272	.4040	2.475
23	.3907	.9205	.4245	2.356
24	.4067	.9136	.4452	2.246
25	.4226	.9063	.4663	2.145
26	.4384	.8988	.4877	2.050
27	.4540	.8910	.5095	1.963
28	.4695	.8830	.5317	1.861
29	.4848	.8746	.5543	1.804
30	.5000	.8660	.5774	1.732
31	.5150	.8572	.6009	1.664
32	.5299	.8481	.6249	1.600
33	.5446	.8387	.6494	1.540
34	.5592	.8290	.6745	1.483
35	.5736	.8192	.7002	1.428

Table Continued on Next Page

Fig. 1-21

TRIGONOMETRIC FUNCTIONS

$$\text{Tangent (Tan)} = \frac{\text{Opposite side}}{\text{Adjacent Side}}$$

$$\text{Sine (Sin)} = \frac{\text{Opposite side}}{\text{Hypotenuse}}$$

$$\text{Cosine (Cos)} = \frac{\text{Adjacent side}}{\text{Hypotenuse}}$$

$$\text{Cosecant (Csc)} = \frac{1}{\text{Sine}} = \frac{\text{Hypotenuse}}{\text{Opposite side}}$$

$$\text{Secant (Sec)} = \frac{1}{\text{Cosine}} = \frac{\text{Hypotenuse}}{\text{Adjacent side}}$$

$$\text{Cotangent (Cot)} = \frac{1}{\text{Tangent}} = \frac{\text{Adjacent side}}{\text{Opposite side}}$$

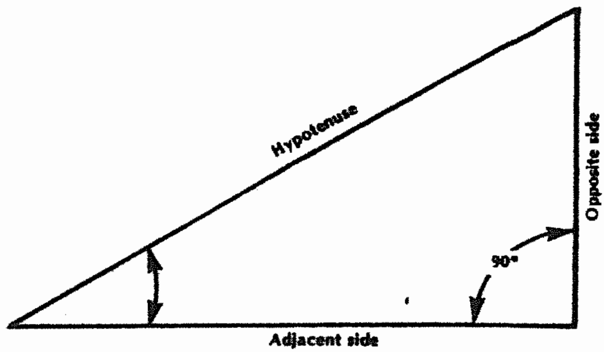


Fig 1-20 (cont.)

ESTIMATING CONTENTS OF 55 GALLON DRUM

Inches	Gallons	Inches	Gallons
20	55	10	25
19	52-1/2	9	22
18	50	8	18-1/2
17	47-1/2	7	15-1/2
16	44-1/2	6	12-1/2
15	41-1/2	5	9-1/2
14	38-1/2	4	7
13	35	3	4-1/2
12	32	2	2-1/2
11	28-1/2	1	0.8

HORIZONTAL

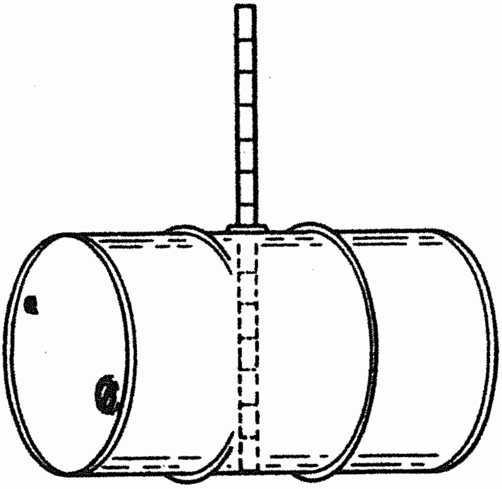


Fig 1-20

ESTIMATING CONTENTS OF 55 GALLON DRUM

Inches	Gallons
31	54
30	52
29	50
28	48-1/2
27	47
26	45
25	43-1/2
24	41-1/2
23	40
22	38
21	36-1/2
20	34-1/2
19	33
18	31-1/2
17	29-1/2
16	27-1/2
15	26
14	24-1/2
13	22-1/2
12	21
11	19
10	17-1/2
9	15-1/2
8	14
7	12
6	10-1/2
5	8-1/2
4	7
3	5
2	3-1/2
1	2

VERTICAL

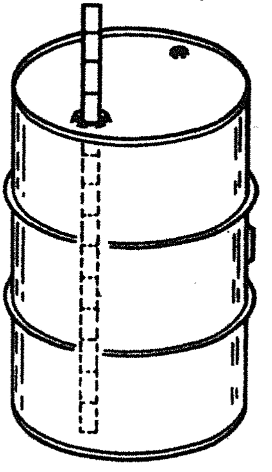


Fig 1-19 (cont.)

TEMPERATURE CONVERSION TABLE

°F = 9/5 (°C) +32 °R =°F + 460
°C = 5/9 (°F -32) °K= °C + 273

For interpolation 1°C = 1.8°F (9/5°F) and 1°F = .5556°C (5/9°C)

°C from	°F/°C	to °F	°C from	°F/°C	to °F
96.1	205	401.0	237.8	460	860.0
98.9	210	410.0	243.3	470	878.0
101.7	215	419.0	248.9	480	896.0
104.4	220	428.0	254.4	490	914.0
107.2	225	437.0	260.0	500	932.0
110.0	230	446.0	265.6	510	950.0
112.8	235	455.0	271.1	520	968.0
115.6	240	464.0	276.7	530	986.0
118.3	245	473.0	282.2	540	1004.0
121.1	250	482.0	287.8	550	1022.0
126.7	260	500.0	293.3	560	1040.0
132.2	270	518.0	298.9	570	1058.0
137.8	280	536.0	304.4	580	1076.0
143.3	290	554.0	310.0	590	1094.0
148.9	300	572.0	315.6	600	1112.0
154.4	310	590.0	326.7	620	1148.0
160.0	320	608.0	337.8	640	1184.0
165.6	330	626.0	348.9	660	1220.0
171.1	340	644.0	360.0	680	1256.0
176.7	350	662.0	371.1	700	1292.0
182.2	360	680.0	382.2	720	1328.0
187.8	370	698.0	393.3	740	1364.0
193.3	380	716.0	404.4	760	1400.0
198.9	390	734.0	415.6	780	1436.0
204.4	400	752.0	426.7	800	1472.0
210.0	410	770.0	437.8	820	1508.0
215.6	420	788.0	454.4	850	1562.0
221.1	430	806.0	482.2	900	1652.0
226.7	440	824.0	510.0	950	1742.0
232.2	450	842.0	537.8	1000	1832.0

Fig 1-19

TEMPERATURE CONVERSION TABLE

°F = 9/5 (°C) +32 **°R =°F + 460**
°C = 5/9 (°F -32) **°K= °C + 273**

For interpolation 1°C = 1.8°F (9/5°F) and 1°F = .5556°C (5/9°C)

°C	from °F/°C to	°F	°C	from °F/°C to	°F
-62.2	-80	-112.0	23.9	75	167.0
-56.7	-70	-94.0	26.7	80	176.0
-51.1	-60	-76.0	29.4	85	185.0
-45.6	-50	-58.0	32.2	90	194.0
-40.0	-40	-40.0	35.0	95	203.0
-34.4	-30	-22.0	37.8	100	212.0
-31.7	-25	-13.0	40.6	105	221.0
-28.9	-20	-4.0	43.3	110	230.0
-26.1	-15	+5.0	46.1	115	239.0
-23.3	-10	14.0	48.9	120	248.0
-20.6	-5	23.0	51.7	125	257.0
-17.8	0	32.0	54.4	130	266.0
-15.0	+5	41.0	57.2	135	275.0
-12.2	10	50.0	60.0	140	284.0
-9.4	15	59.0	62.8	145	293.0
-6.7	20	68.0	65.6	150	302.0
-3.9	25	77.0	68.3	155	311.0
-1.1	30	86.0	71.1	160	320.0
+1.7	35	95.0	73.9	165	329.0
4.4	40	104.0	76.7	170	338.0
7.2	45	113.0	79.4	175	347.0
10.0	50	122.0	42.2	180	356.0
12.8	55	131.0	85.0	185	365.0
15.6	60	140.0	87.8	190	374.0
18.3	65	149.0	90.6	195	383.0
21.1	70	158.0	93.3	200	392.0

Table Continued on Next Page

Fig 1-18 (cont.)

CONVERSION FACTORS FOR WEIGHTS AND MEASURES

TO CONVERT FROM

TERM	TO	MULTIPLY BY
Square millimeters	Square inches	.00155
Square yards	Acres	.0002066
	Square feet	9
	Square inches	1,296
	Square meters	.83613
Stones	Pounds	14
Tons, long	Pounds	2.240
	Kilograms	1,016.0461
	Short tons	1.12
	Metric tons	1.0160
Tons, long per sq in	Pounds per square inch	2,240
Tons, metric	Pounds	2,204.6
	Long tons	.9842
Tons, short	Pounds	2,000
	Kilograms	907.2
	Long tons	.8929
Tons, ship	Cubic feet	40
Weeks	Hours	168
Yards	Meters	.9144

Fig 1-18 (cont.)

CONVERSION FACTORS FOR WEIGHTS AND MEASURES

TO CONVERT FROM

TERM	TO	MULTIPLY BY
Miles per hour	Inches per second	117.604
	Kilometers per hour	1.609
	Feet per second	1.466
	Knots	.8684
Millimeters	Inches	.03937
Mils	Inches	.001
Ounces (apothecary)	Grams	31.10348
Ounces (avoirdupois)	Pounds	.0625
	Grams	28.34953
Ounces (fluid)	Cubic inches	1.805
	Cubic centimeters	29.5737
Pounds (avoirdupois)	Kilogram	.45359
	Gram	453.59
	Long tons	.0004464
	Ounces	16
Pounds per cubic foot	kilogram per cubic meter	16.018
Pounds per cubic inch	Grams per cubic centimeter	27.6799
Pounds-feet	Kilogram-meters	.1383
Pounds per square inch	Inches of water	27.70
	Feet of water	2.307
	Inches of mercury	2.036
	Atmospheres	.06805
	Kilograms per square centimeter	.07031
	Pounds per square foot	144
Pounds per square foot	Kilograms per square meter	4.8824
Pounds of water	Gallons (US)	.01603
	Liters	.1198
Quarts	Liters	.94633
Radians	Degrees	57.30
Reams	Sheets	500
Rods	Feet	16.5
Square centimeters	Square inches	.1550
Square feet	Square inches	144
	Square meters	.0929
Square inches	Square centimeters	6.45163
	Square feet	.006944
Square meters	Square feet	10.7639
	Square yards	1.1960
Square miles	Square kilometers	2.58999
	Acres	640

Table Continued on Next Page

Fig 1-18 (cont.)

CONVERSION FACTORS FOR WEIGHTS AND MEASURES

TO CONVERT FROM

TERM	TO	MULTIPLY BY
Hundredweight	Pound(England)	112
	Pound(USA)	100
	Kilograms	50.8023
Inches	Centimeters	2.54
	Feet	.08333
	mils	1,000
Inches of mercury	Pounds per square inch	.4912
	Inches of water	13.61
	Feet of water	1.134
	Atmosphere	.03342
	Kilograms per square centimeter	.03453
Inches of water	Pounds per square inch	.03614
	Inches of mercury	.07355
	Atmosphere	.002456
	Kilograms per square centimeter	.002538
Kilograms	Pounds (avoirdupois)	2.20462
	Hundredweight	.01968
	Long tons	.0009842
Kilograms-meter	Pound-feet	7.235
Kilograms per square meter	Pounds per square foot	.204817
Kilograms per square millimeter	Pounds per square inch	1,422.33
Kilometers	Miles	.62137
	Miles (nautical)	.5396
Kilowatts	Horsepower	1.3410
Knots	Miles per hour	1.152
	Miles per hour (nautical)	1
Links (surveyor's)	Inches	7.92
Liters	Quarts	1.05668
	Cubic inches	61.02
	Gallons (British)	.2200
	Gallons (US)	.2642
Meters	Feet	3.2808
	Inches	39.37
	Yard	1.0936
Miles	Feet	5,280
	Kilometers	1.60935
	Inches	63,360
	Miles (nautical)	.8684
	Yard	1,760
Miles (nautical)	Feet	6,080
	Miles	1.1516

Table Continued on Next Page

Fig 1-18 (cont.)

CONVERSION FACTORS FOR WEIGHTS AND MEASURES

TO CONVERT FROM

TERM	TO	MULTIPLY BY
Degrees	Minutes (circular)	60
	Radians	.0174533
Drams	Grams	1.772
	Ounces	.0625
Fathoms	Feet	6
Feet	Meters	.3048
	Fathoms	.1667
	Inches	12
	Yards	.333
Feet of water	Pounds per square inch	.4331
	Inches of mercury	.8826
	Atmosphere	.02947
	Kilograms per square centimeter	.03045
	Pounds per square foot	62.43
Feet per minute	Miles per hour	.01136
Feet per second	Knots	.5921
	Miles per hour	.6618
Foot pounds	Kilogram-meters	.13826
Gallons (British)	Cubic feet	.1605
	Gallons (US)	1.201
Gallons (US)	Pounds of distilled water	8.32675
	Cubic feet	.13368
	Cubic inches	231
	Liter	3.78543
	Gallon (British)	.8327
Gallons per minute	Cubic feet per second	.002228
Grains	Milligrams	64.7111892
Grams	Ounces (avoirdupois)	.03527
	grains	15.43
	Kilogram	.001
	Pounds	.002205
Grams per cubic centimeter	Pounds per cubic meter	.03613
Hours	Days	.04167
	Weeks	.005952
Horsepower	Foot-pounds per minute	33,000
	Feet per second	550
	Kilowatts	.7457
	BTUs per minute	42.40
Horsepower (boiler)	BTUs per hour	33,475
Horsepower hours	BTUs	2,545

Table Continued on Next Page

Fig. 1-18

CONVERSION FACTORS FOR WEIGHTS AND MEASURES

TO CONVERT FROM

TERM	TO	MULTIPLY BY
Acres	Square feet	43,560
	Square meters	4,047
Atmospheres	Pounds per square inch	14.696
	Inches of water	408
	Feet of water	34
	Inches of mercury	29.9
Board feet	Cubic inches	144
Boiler horsepower	BTUs/hr	33,475
British thermal unit (BTU)	Calories	252
	Ft-lb	778
Bushels (British)	Bushels (US)	1.032
Bushels (US)	Bushels (British)	.969
	Cubic feet	1.244
	Quart (dry)	32
Calories	Btu	.00397
Carat	Grains	3.08647
	Grams	0.2
Centimeters	Inches	.3937
	Feet	.03281
Cubic centimeters	Fluid ounces	.0344
	Cubic inches	.06102
	Liters	.001
Cubic feet	Cubic inches	1,728
	Gallons (US)	7.481
	Liters	28.32
	Cubic yards	.03704
	Bushels	.80354
	Cubic meters	.02832
	Tons (ship)	.25
Cubic feet of water	Pounds	62.288
Cubic feet/minute	Gallons per second	.1247
Cubic feet/second	Gallons per day	646,315
Cubic inches	Cubic centimeters	16.38716
	Cubic feet	.0005787
	Gallon (US)	.004329
	Liters	.01639
Cubic meter	Cubic feet	35.3147
	Cubic yards	1.3080
Cubic yard	Cubic feet	27
	Cubic meters	.76456
Days	Minutes	1,440

Table Continued on Next Page

Fig 1-17 (cont.)

DECIMAL AND METRIC EQUIVALENT OF INCHES

Inches			Decimal Equivalent	Millimeter Equivalent
43/64			.6719	17.067
		11/16	**.6875**	17.463
45/64			.7031	17.860
	23/32		.7188	18.238
47/64			.7344	18.635
		3/4	**.7500**	19.049
49/64			.7656	19.446
	25/32		.7813	19.842
51/64			.7969	20.239
		13/16	**.8125**	20.636
53/64			.8281	21.033
	27/32		.8438	21.430
55/64			.8594	21.827
		7/8	**.8750**	22.224
57/64			.8906	22.621
	29/32		.9063	23.018
59/64			.9219	23.415
		15/16	**.9375**	23.812
61/64			.9531	24.209
	31/32		.9688	24.606
63/64			.9844	25.004
		1.0	1.0000	25.400

NOTE: Bold indicates not rounded

Fig. 1-17

DECIMAL AND METRIC EQUIVALENT OF INCHES

Inches			Decimal Equivalent	Millimeter Equivalent
1/64			.0156	0.397
	1/32		.0313	0.794
3/64			.0469	1.191
		1/16	**.0625**	1.588
5/64			.0781	1.985
	3/32		.0938	2.381
7/64			.1094	2.778
		1/8	**.1250**	3.175
9/64			.1406	3.572
	5/32		.1563	3.969
11/64			.1719	4.366
		3/16	**.1875**	4.762
13/64			.2031	5.159
	7/32		.2188	5.556
15/64			.2344	5.953
		1/4	**.2500**	6.350
17/64			.2656	6.747
	9/32		.2813	7.144
19/64			.2969	7.541
		5/16	**.3125**	7.937
21/64			.3281	8.334
	11/32		.3438	8.731
23/64			.3594	9.128
		3/8	**.3750**	9.525
25/64			.3906	9.922
	13/32		.4063	10.319
27/64			.4219	10.716
		7/16	**.4375**	11.112
29/64			.4531	11.509
	15/32		.4688	11.905
31/64			.4844	12.303
		1/2	**.5000**	12.700
33/64			.5156	13.097
	17/32		.5313	13.494
35/64			.5469	13.891
		9/16	**.5625**	14.287
37/64			.5781	14.664
	19/32		.5938	15.081
39/64			.6094	15.478
		5/8	**.6250**	15.875
41/64			.6406	16.272
	21/32		.6563	16.669

Table Continued on Next Page

Fig. 1-16 (cont.)

U.S. STANDARD ATMOSPHERE (cont.)

Alt Ft.	Temp. ºF	Temp. ºC	Press. In. Hg.	Speed of Sound Kts.
35000	- 65.6	- 54.2	7.060	576.3
36000	- 69.2	- 56.2	6.732	573.7
37000	- 69.7	- 56.5	6.417	573.3
38000	- 69.7	- 56.5	6.117	573.3
39000	- 69.7	- 56.5	5.831	573.3
40000	- 69.7	- 56.5	5.558	573.3
41000	- 69.7	- 56.5	5.299	573.3
42000	- 69.7	- 56.5	5.051	573.3
43000	- 69.7	- 56.5	4.815	573.3
44000	- 69.7	- 56.5	4.590	573.3
45000	- 69.7	- 56.5	4.375	573.3
46000	- 69.7	- 56.5	4.171	573.3
47000	- 69.7	- 56.5	3.976	573.3
48000	- 69.7	- 56.5	3.790	573.3
49000	- 69.7	- 56.5	3.613	571.3
50000	- 69.7	- 56.5	3.444	573.3
51000	- 69.7	- 56.5	3.284	573.3
52000	- 69.7	- 56.5	3.130	573.3
53000	- 69.7	- 56.5	2.984	573.3
54000	- 69.7	- 56.5	2.845	573.3
55000	- 69.7	- 56.5	2.712	573.3
56000	- 69.7	- 56.5	2.585	573.3
57000	- 69.7	- 56.5	2.465	573.3
58000	- 69.	- 56.5	2.350	573.3
59000	- 69.7	- 56.5	2.240	573.3
60000	- 69.7	- 56.5	2.135	573.3
61000	- 69.7	- 56.5	2.036	573.3
62000	- 69.7	- 56.5	1.941	573.3
63000	- 69.7	- 56.5	1.850	573.3
64000	- 69.7	- 56.5	1.764	573.3
65000	- 69.7	- 56.5	1.682	573.3
66000	- 69.6	- 56.5	1.603	573.4
67000	- 69.1	- 56.1	1.528	573.8
68000	- 68.5	- 55.8	1.457	574.2
69000	- 68.0	- 55.5	1.390	574.6
70000	- 67.4	- 55.2	1.325	575.0

Fig. 1-16

U.S. STANDARD ATMOSPHERE

Alt Ft.	Temp. °F	Temp. °C	Press. In. Hg.	Speed of Sound Kts.
-2000	66.11	9.0	32.15	666.0
-1000	62.6	17.0	31.02	663.6
0	59.0	15.0	29.92	661.2
1000	55.4	13.0	28.86	658.9
2000	51.9	11.0	27.82	656.6
3000	48.3	9.1	26.82	654.3
4000	44.7	7.1	25.84	652.0
5000	41.2	5.1	24.90	649.7
6000	37.6	3.1	23.98	647.4
7000	34.0	1.1	23.09	645.1
8000	30.5	- 0.8	22.23	642.7
9000	26.9	- 2.8	21.39	640.4
10000	23.3	- 4.8	20.58	638.0
11000	19.8	- 6.8	19.80	635.7
12000	16.2	- 8.8	19.03	633.3
13000	12.7	- 10.7	18.30	631.0
14000	9.1	- 12.7	17.58	628.6
15000	5.5	- 14.7	16.99	626.2.
16000	2.0	-16.7	16.22	623.8
17000	- 1.6	- 18.7	15.58	621.4
18000	- 5.1-	20.6	14.95	618.9
19000	- 8.7	- 22.6	14.35	616.5
20000	- 12.2	- 24.6	13.76	614.1
21000	- 15.8	- 26.6	13.20	611.6
22000	- 19.4	- 28.5	12.65	609.2
23000	- 22.9	- 30.5	12.12	606.7
24000	- 26.5	- 32.5	11.61	604.2
25000	- 30.1	- 34.5	11.12	601.7
26000	- 33.6	- 36.5	10.64	599.2
27000	- 37.2	- 38.4	10.18	596.7
28000	- 40.7	- 40.4	9.741	594.2
29000	- 44.	- 42.4	9.314	591.7
30000	- 47.8	- 44.4	8.903	589.2
31000	- 51.4-	46.3	8.506	586.6
32000	- 54.9	- 48.3	8.124	584.1
33000	- 58.5	- 50.3	7.756	581.5
34000	- 62.1	- 52.3	7.40	578.9

Table Continued on Next Page

Fig. 1-15

ATMOSPHERIC STANDARDS

	English	Metric
Gravity	32.17405 ft/sec^2	9.80665 m/sec^2
Absolute zero	- 459.688°F	- 273.16°C
Standard Values at Sea Level		
Pressure	29.9213 in. Hg	760 mm Hg
Pressure	2116.2281 lb/ft^2	10332 kg/m^2
Temperature	59°F	15°C
Abs temp	518.67°R	288.15°K
Specific wt	0.076474 lb/ft^3	1.2250 kg/m^3
Density	0.0023769 lb-sec^2/ft^4	0.12492 kg-sec^2/m^4

WEIGHTS OF LIQUIDS

Liquid	Specific Gravity	Weight Lbs/U.S. gallon	Weight Lbs/Cu Ft
Alcohol (methyl)	0.810	6.75	50.50
Carbon Tetrachloride	1.595	13.32	99.65
Ethylene Glycol	1.12	9.3	69.57
Gasoline	0.72	6.00	44.89
JP4	0.785	6.55	49.00
JP5	0.817	6.82	51.02
Kerosene	0.82	6.84	51.17
Mercury	13.546	113.0	845.35
Oil	0.89	7.4	55.36
Synthetic Oil	0.928	7.74	57.90
Water (Pure H_2O, no minerals, carbonation, etc.)	1.000	8.35	62.43
Prist®	1.013	8.45	63.22
Hydraulic Fluid (MIL-H-5606)	.86	7.18	53.69
Hydraulic Fluid(Skydrol® LD-4)	1.009	8.42	62.99

WEIGHTS OF GASES

Gas	Specific Wt*lb/cu ft
Air	.07651
Carbon dioxide	.12341
Helium	.01114
Hydrogen	.005611
Nitrogen	.07907
Oxygen	.099212

*At atmospheric pressure and 0°C

Fig. 1-14 (cont)

LIQUID ROCKET ENGINE SYMBOLS

I_{vac}	Specific Impulse at pa = 0	lb_f-sec/lb_m
k or γ	Ratio of Specific Heats	
L*	Characteristic Chamber Length	in.
M	Mach Number	
M	Molecular Weight of Exhaust Products	$\frac{lb_m}{\text{lb mole}}$
N	Rotational Speed	rpm
Ns	Pump Specific Speed Parameter	$\frac{(rpm)(gpm)^{1/2}}{ft^{3/4}}$
PC	Chamber Pressure (throat total)	psia
Pa	Ambient Pressure	psia
Pse	Nozzle Exit Pressure (static)	psia
ϕ	Pump Flow Coefficient	
ψ	Pump Head Coefficient	
Q	Volume Flow Rate	gal/min.
R	Universal Gas Constant	$\frac{1546\ lb_f\text{-ft}}{\text{lb mole-°R}}$
r	Mixture Ratio (oxidizer to fuel) by weight	
ρp	Propellant Bulk Density	lb_m/ft^3
ρf	Fuel Density	lb_m/ft^3
ρo	Oxidizer Density	lb_m/ft^3
S	Pump Suction Specific Speed Parameter	$\frac{(rpm)(gpm)^{1/2}}{ft^{3/4}}$
T_c	Combustion Chamber Temperature	°R
U_e	Actual Exhaust Velocity	ft/sec
U_t	Tip Velocity	ft/sec
V_c	Combustion Chamber Volume (measured from injector face to chamber throat)	
W_f	Fuel Flow Rate	lb_m/sec
W_o	Oxidizer Flow Rate	lb_m/sec
W_p	Propellant Flow Rate	lb_m/sec
	Indicates Theoretical Value	

Fig. 1-14

LIQUID ROCKET ENGINE SYMBOLS

A_D	Design Aero Ratio	
A_e	Nozzle Exit Area	$in.^2$
A_t	Throat Area	$in.^2$
c	Effective Exhaust Velocity	ft/sec
C_F	Thrust Coefficient	
C_{FID}	Ideal Thrust Coefficient (for an optimum expansion ratio nozzle)	
C_s	Steam Thrust Coefficient (ratio of actual to theoretical vacuum thrust coefficient)	
C_v	Velocity Coefficient (ratio of actual to ideal thrust coefficient at constant chamber to ambient pressure ratio, area ratio not necessarily constant)	
c*	Characteristic Exhaust Velocity	ft/sec
η_{c*}	Characteristic Exhaust Velocity Efficiency	
D_e	Nozzle Exit Diameter	in.
d_t	Nozzle Throat Diameter	
δ_f	Fuel Specific Gravity	
δ_o	Oxidizer Specific Gravity	
δ_p	Propellant Bulk Specific	
ε_e	Nozzle Exit to Throat Area Ratio — Ae/At	
F	Thrust	lb_f
g_o	Gravitational Constant 32.174	$lbmft/lb_f\text{-}sec^2$
Δh	Turbopump Head Rise ft.	
h_{av}	Pump Suction Head Above Vapor Pressure	ft.
$I_{\underline{s}}$	Specific Impulse (instantaneous) $lbf\text{-}sec/lb_m$	
I_s	Time-Averaged Specific Impulse (when operating in changing ambient pressure)	$lb_f\text{-}sec/lb_m$
I_{sl}	Sea Level Specific Impulse	$lb_f\text{-}sec/lb_m$

Table Continued on Next Page

Fig. 1-13

GAS TURBINE ENGINE SUBSCRIPTS

am	1, 2, 3, etc. engine station position
am	ambient (t_{am})
a	air (V_a), added (q_a)
av	average
ax	axial
b	burner, combustion chamber (ηb)
bl	bleed
c	compressor (η_c), compressible (q_c)
cr	critical (P_{cr})
d	diffuser, duct
e	exhaust, exit
f	fuel (w_f), fluid (h_f)
g	gas (w_g), gross (F_g), gear (D_H), gaseous (Q_g)
H	hub (D_H), higher (Q_H)
h	heat exchanger, intercooler
i	inlet (ηi), indicated (observed, V_i)
j	jet (F_j)
L	lower (Q_L)
n	nozzle (ηn) net (F_n)
o	standard sea level values, To = 518.7°R, po = 29.92 in. Hg.
p	propeller (ηp), propulsion, tail pipe, airplane, constant pressure (C_p) (Q_p)
r	ram (ηr) radial (V_r), rejected (q_r)
s	static (p_s), shaft, isentropic (Δhss)
T	tip (D_T)
t	total (p_t); turbine (ηt)
th	thermal (η_{th})
v	volume
w	wall (T_w), work (q_w), wake (V_w)

Fig. 1-12 (cont.)

GAS TURBINE ENGINE SYMBOLS

Δ	finite difference	
η	efficiency	percent
θ	relative absolute temperature, static or total T/T_0; where and T have subscripts referring to static or total and to any particular station, To = 518.7°R	None
μ	absolute viscosity	lb sec/ft^2
υ	kinematic viscosity	lb sec/ft^2
π	3.141592653589793	None
ρ	density (mass per unit volume)	slug/ft^3
	(ρ_0 = 0.0023769)	lb sec^2/ft^4
σ	relative density, ρ / ρ_0	None
ω	angular velocity	radians/sec

Fig. 1-12 (cont.)

GAS TURBINE ENGINE SYMBOLS

sfc	specific fuel consumption (esfc, bsfc, equiv. brake)	lb/hr/hp
tsfc	thrust specific fuel consumption	lb/hr/lb
T	absolute temperature	ºR, ºK
t	temperature	ºF, ºC ºF, ºC
t	time	second
u	internal energy (specific)	Btu/lb.
u	rotor linear velocity	ft/sec
V	velocity	ft/sec
V	volume	ft^3
v	specific volume	ft^3/lb.
W	weight (force)	lb
w	rate of flow	lb/sec, lb/hr
w	gas velocity relative to rotating coordinates	ft/sec
Y	$\left(\frac{p_2}{p_1}\right)^{\frac{\gamma - 1}{\gamma}}$ -1, where $p_2/p_1 > 1.00$	None
a	angle of attack	deg.
a	angular acceleration	radians/sec^2
γ, k	ratio of specific heats (c_p/c_v)	None
δ	relative absolute pressure, static or total, p/po ; where δ and p have subscripts referring to static or total and to any particular station, p_o = 29.92 in. Hg.	None

Table Continued on Next Page

Fig. 1-12 (cont.)

GAS TURBINE ENGINE SYMBOLS

M	moment, torque	lb-ft
M	Mach number – V/c	None
N	rotational speed	rpm
n	polytropic exponent in pvn = constant	None
p	absolute pressure	lb/ft^2
p	pressure	lb/in^2, in. Hg.
Pr	Prandtl number	None
Q	volume rate of flow	ft^3/sec
Q	heating value of fuel	Btu/lb
qa	quantity of heat (specific) added Btu/sec	
qr	quantity of heat rejected Btu/lb	
qw	quantity of heat to work Btu/lb	
q	dynamic pressure, incompressible flow $=1/2\rho V^2$	lb/ft^2
qc	dynamic pressure corrected for compressibility $(p_t - p_s)$ lb/ft^2	
R	universal gas constant for any gas - 1545	(ft-lb/°R/lb) (mol)
R	gas constant for air = 53.35	ft-lb/°R/lb
R	gas constant for air = 1715	$ft^2/sec^2/°F$
Re	Reynolds number	None
r	radius	ft, in.
s	entropy	Btu/lb-°R

Table Continued on Next Page

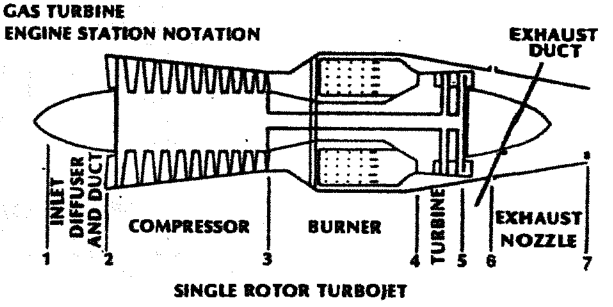
Fig. 1-12

GAS TURBINE ENGINE SYMBOLS

A	cross-sectional area	ft^2, $in.^2$
a	linear acceleration	ft/sec^2
c	speed of sound in air based on static temp	ft/sec
c	gas velocity relative to non-rotating coordinates ft/sec	
C_p, C_v	specific heats at constant pressure, and constant volume	Btu/lb-°R
C	coefficient, factor of proportionality None	
D	diameter	ft, in.
e	2.718281828459045	
F	thrust	lb
F_r	ram drag of engine airflow taken on the basis of total induction air flow	lb
f	frequency	1/sec
9	acceleration due to gravity, standard value = 32.174	ft/sec^2
g	mass conversion factor, 32.174	lb/slug
hp	horsepower (shp, fhp, thp, eshp, shaft, friction, thrust, equivalent shaft) hp	
h_2, h_t	enthalpy, static and total Btu/lb	
J	energy conversion factor, 778.26 ft-lb/Btu	
k, y	ratio of specific heats, c_p/c_v	None
I	length	ft, in.
m	mass	slug, lb sec^2/ft

Table Continued on Next Page

Fig. 1-11



For engines with afterburners, station 5 is the entrance to the exhaust duct, station 6 is the entrance to the afterburner combustion chamber, station 7 is the entrance to the jet nozzle.

Fig. 1-9

ENGINE COLOR CODE IDENTIFIERS

Located between push rods on fins, or around cylinder base

Gray or unpainted	Standard steel cylinder barrels
Orange	Chrome plated cylinder barrels
Blue	Nitride hardened cylinder barrels
Green	Steel cylinder 0.010 oversize
Yellow	Steel cylinder 0.020 oversize

SPARK PLUG COLOR IDENTIFIER

Location - Fins between spark plug hole and rocker box.

Gray or unpainted	Short reach plug
Yellow	Long reach plug

Fig. 1-10

SHOCK ABSORBER CORD COLOR CODING

YEAR MARKING

Year	Threads	Color
1986	2	green
1987	2	red
1988	2	blue
1989	2	yellow
1990	2	black

QUARTER MARKING

Quarter	Threads	Color
Jan., Feb., Mar	1	red
Apr., May, June	1	blue
July, Aug., Sept	1	green
Oct., Nov., Dec	1	yellow

Fig. 1-7

PREFIXES AND SYMBOLS FOR MULTIPLES OF BASIC QUANTITIES

Number	Prefix	Symbol	Scientific Notation
1,000,000,000,000	Tera	T	1×10^{12}
1,000,000,000	Giga	G	1×10^{9}
1,000,000	Mega	M	1×10^{6}
1,000	Kilo	K	1×10^{3}
100	Hecto	H	1×10^{2}
10	Deka	D	1×10^{1}
0.1	deci	d	1×10^{-1}
0.01	centi	c	1×10^{-2}
0.001	milli	m	1×10^{-3}
0.000,001	micro	u	1×10^{-6}
0.000,000,001	nano	n	1×10^{-9}
0.000,000,000,001	pico	p	1×10^{-12}

Fig. 1-8

MATHEMATICAL SYMBOLS

+	Plus, or Positive
-	Minus, or Negative
±	Plus or minus (as in tolerance)
x or ·	Multiplied by
/ or ÷	Divided by
=	Equal to
≠	Not equal to
<	Less than
>	More than
≤	Less than or equal to
≥	More than or equal to
∞	Infinity
Δ	Increment of change
⊥	Perpendicular to
∥	Parallel to
∠	Angle
Σ	Sum of
$\sqrt{a}$	Square root of "a"
$\sqrt[3]{a}$	Cube root of "a"
:	Ratio (a:b or 3:2=6:4)

MATHEMATICAL CONSTANTS

π	= 3.1416
$\sqrt{2}$	= 1.4142
$\sqrt{3}$	= 1.7321

Fig. 1-6

GREEK ALPHABET			INTERNATIONAL PHONETIC ALPHABET	
alpha	— α	— A	A	ALFA
beta	— β	— B	B	BRAVO
gamma	— γ	— Γ	C	CHARLIE
delta	— δ	— Δ	D	DELTA
epsilon	— ε	— E	E	ECHO
zeta	— ζ	— Z	F	FOXTROT
eta	— η	— H	G	GOLF
theta	— θ	— Θ	H	HOTEL
iota	— ι	— I	I	INDIA
kappa	— κ	— K	J	JULIETT
lamda	— λ	— Λ	K	KILO
mu	— μ	— M	L	LIMA
nu	— ν	— N	M	MIKE
xi	— ξ	— Ξ	N	NOVEMBER
omicron	— ο	— O	O	OSCAR
pi	— π	— Π	P	PAPA
rho	— ρ	— P	Q	QUEBEC
sigma	— σ	— Σ	R	ROMEO
tau	— τ	— T	S	SIERRA
upsilon	— υ	— Y	T	TANGO
phi	— ϕ	— Φ	U	UNIFORM
chi	— χ	— X	V	VICTOR
psi	— ψ	— Ψ	W	WHISKEY
omega	— ω	— Ω	X	X-RAY
			Y	YANKEE
			Z	ZULU

Fig 1-5

CHEMICAL ELEMENTS

actinium	Ac	helium	He	rubidium	Rb
aluminum	Al	holmium	Ho	ruthenium	Ru
americum	Am	hydrogen	H	rutherfordium	Rf
antimony	Sb	illnium	Il	samarium	Sm
argon	Ar	indium	In	scandium	Sc
arsenic	As	iodine	I	seaborgium	Sg
astatine	At	iridium	Ir	selenium	Se
barium	Ba	iron	Fe	silicon	Si
berkelium	Bk	joliotium	Jl	silver	U
beryllium	Be	krypton	Kr	sodium	Na
bismuth	Bi	lanthanum	La	strontium	Sr
bohrium	Bh	lawrencium	Lr	sulfur	S
boron	B	lead	Pb	tantalum	Ta
bromine	Br	lithium	Li	technetium	Tc
cadmium	Cd	lutetium	Lu	tellurium	Te
calcium	Ca	magnesium	Mg	terbium	Tb
californium	Cf	manganese	Mn	thallium	Tl
carbon	C	meitnerium	Mt	thorium	Th
cerium	Ce	mendelevium	Md	thulium	Tm
cesium	Cs	mercury	Hg	tin	Sn
chlorine	Cl	molybdenum	Mo	titanium	Ti
chromium	Cr	neodymium	Nd	tungsten	W
cobalt	Co	neon	Ne	uranium	U
columbium	Cb	neptunium	Np	vanadium	V
copper	Cu	nickel	Ni	wolfram	W
curium	Cm	niobium	Nb	xenon	Xe
dubnium	Db	nitrogen	N	ytterbium	Yb
dysprosium	Dy	nobelium	No	yttrium	Y
einsteinium	Es	osmium	Os	zinc	Zn
emanation	Em	oxygen	O	zirconium	Zr
erbium	Er	palladium	Pd		
europium	Eu	phosphorus	P		
fermium	Fm	platinum	Pt		
fluorine	F	plutonium	Pu		
francium	Fr	polonium	Po		
gadolinium	Gd	potassium	K		
gallium	Ga	praseodymium	Pr		
germanium	Ge	promethium	Pm		
glucinium	Gl	protactinium	Pa		
gold	Au	radium	Ra		
hafnium	Hf	radon	Rn		
hahnium	Ha	rhenium	Re		
hassium	Hs	rhodium	Rh		

Fig. 1-4 (cont.)

ATA/JASC CODES

(AIR TRANSPORT ASSOCIATION [ATA] SPECIFICATION 100 or JOINT AIRCRAFT SYSTEM COMPONENT [JASC] CODES)

79	ENGINE OIL
7900	ENGINE OIL SYSTEM (AIRFRAME)
7910	ENGINE OIL STORAGE (AIRFRAME)
7920	ENGINE OIL DISTRIBUTION (AIRFRAME)
7921	ENGINE OIL COOLER
7922	ENGINE OIL TEMP. REGULATOR
7923	OIL SHUTOFF VALVE
7930	ENGINE OIL INDICATING SYSTEM
7931	ENGINE OIL PRESSURE
7932	ENGINE OIL QUANTITY
7933	ENGINE OIL TEMPERATURE
80	STARTING
8000	ENGINE STARTING SYSTEM
8010	ENGINE CRANKING
8011	ENGINE STARTER
8012	ENGINE START VALVES/CONTROLS
81	TURBOCHARGING
8100	EXHAUST TURBINE SYSTEM (RECIP)
8110	POWER RECOVERY TURBINE (RECIP)
8120	EXHAUST TURBOCHARGER
82	WATER INJECTION
8200	WATER INJECTION SYSTEM
83	ACCESSORY GEARBOXES
8300	ACCESSORY GEARBOXES
85	RECIPROCATING ENGINE
8500	ENGINE (RECIPROCATING)
8510	RECIPROCATING ENGINE FRONT SECTION
8520	RECIPROCATING ENGINE POWER SECTION
8530	RECIPROCATING ENGINE CYLINDER SECTION
8540	RECIPROCATING ENGINE REAR SECTION
8550	RECIPROCATING ENGINE OIL SYSTEM

Fig. 1-4 (cont.)

ATA/JASC CODES

(AIR TRANSPORT ASSOCIATION [ATA] SPECIFICATION 100 or JOINT AIRCRAFT SYSTEM COMPONENT [JASC] CODES)

75	AIR
7500	ENGINE BLEED AIR SYSTEM
7510	ENGINE ANTI-ICING SYSTEM
7520	ENGINE COOLING SYSTEM
7530	COMPRESSOR BLEED CONTROL
7531	COMPRESSOR BLEED GOVERNOR
7532	COMPRESSOR BLEED VALVE
7540	BLEED AIR INDICATING SYSTEM
76	ENGINE CONTROLS
7600	ENGINE CONTROLS
7601	ENGINE SYNCHRONIZING
7602	MIXTURE CONTROL
7603	POWER LEVER
7620	ENGINE EMERGENCY SHUTDOWN SYSTEM
77	ENGINE INDICATING
7700	ENGINE INDICATING SYSTEM
7710	POWER INDICATING SYSTEM
7711	ENGINE PRESSURE RATIO (EPR)
7712	ENGINE BMEP/TORQUE INDICATING
7713	MANIFOLD PRESSURE (MP) INDICATING
7714	ENGINE RPM INDICATING SYSTEM
7720	ENGINE TEMP. INDICATING SYSTEM
7721	CYLINDER HEAD TEMP (CHT) INDICATING
7722	ENG. EGT/TIT INDICATING SYSTEM
7730	ENGINE IGNITION ANALYZER SYSTEM
7731	ENGINE IGNITION ANALYZER
7732	ENGINE VIBRATION ANALYZER
7740	ENGINE INTEGRATED INSTRUMENT SYSTEM
78	ENGINE EXHAUST
7800	ENGINE EXHAUST SYSTEM
7810	ENGINE COLLECTOR/TAILPIPE/NOZZLE
7820	ENGINE NOISE SUPPRESSOR
7830	THRUST REVERSER

Table Continued on Next Page

Fig. 1-4 (cont.)

ATA/JASC CODES

(AIR TRANSPORT ASSOCIATION [ATA] SPECIFICATION 100 or JOINT AIRCRAFT SYSTEM COMPONENT [JASC] CODES)

72	TURBINE/TURBOPROP ENGINE
7200	ENGINE (TURBINE/TURBOPROP)
7210	TURBINE ENGINE REDUCTION GEAR
7220	TURBINE ENGINE AIR INLET SECTION
7230	TURBINE ENGINE COMPRESSOR SECTION
7240	TURBINE ENGINE COMBUSTION SECTION
7250	TURBINE SECTION
7260	TURBINE ENGINE ACCESSORY DRIVE
7261	TURBINE ENGINE OIL SYSTEM
7270	TURBINE ENGINE BYPASS SECTION
73	ENGINE FUEL & CONTROL
7300	ENGINE FUEL & CONTROL
7310	ENGINE FUEL DISTRIBUTION
7311	ENGINE FUEL-OIL COOLER
7312	FUEL HEATER
7313	FUEL INJECTOR NOZZLE
7314	ENGINE FUEL PUMP
7320	FUEL CONTROLLING SYSTEM
7321	FUEL CONTROL/ELECTRONIC
7322	FUEL CONTROL/CARBURETOR
7323	TURBINE GOVERNOR
7324	FUEL DIVIDER
7330	ENGINE FUEL INDICATING SYSTEM
7331	FUEL FLOW INDICATING
7332	FUEL PRESSURE INDICATING
7333	FUEL FLOW SENSOR
7334	FUEL PRESSURE SENSOR
74	IGNITION
7400	IGNITION SYSTEM
7410	IGNITION POWER SUPPLY
7411	LOW TENSION COIL
7412	EXCITER
7413	INDUCTION VIBRATOR
7414	MAGNETO/DISTRIBUTOR
7420	IGNITION HARNESS (DISTRIBUTION)
7421	SPARK PLUG/IGNITER
7430	IGNITION SWITCHING

Table Continued on Next Page

Fig. 1-4 (cont.)

ATA/JASC CODES

(AIR TRANSPORT ASSOCIATION [ATA] SPECIFICATION 100 or JOINT AIRCRAFT SYSTEM COMPONENT [JASC] CODES)

63	MAIN ROTOR DRIVE
6300	MAIN ROTOR DRIVE SYSTEM
6310	ENGINE/TRANSMISSION COUPLING
6320	MAIN ROTOR GEARBOX
6321	MAIN ROTOR BRAKE
6322	ROTORCRAFT COOLING FAN SYSTEM
6330	MAIN ROTOR TRANSMISSION MOUNT
6340	ROTOR DRIVE INDICATING SYSTEM
64	TAIL ROTOR
6400	TAIL ROTOR SYSTEM
6410	TAIL ROTOR BLADE
6420	TAIL ROTOR HEAD
6440	TAIL ROTOR INDICATING SYSTEM
65	TAIL ROTOR DRIVE
6500	TAIL ROTOR DRIVE SYSTEM
6510	TAIL ROTOR DRIVE SHAFT
6520	TAIL ROTOR GEARBOX
6540	TAIL ROTOR DRIVE INDICATING SYSTEM
67	ROTORS FLIGHT CONTROL
6700	ROTORCRAFT FLIGHT CONTROL
6710	MAIN ROTOR CONTROL
6711	TILT ROTOR FLIGHT CONTROL
6720	TAIL ROTOR CONTROL SYSTEM
6730	ROTORCRAFT SERVO SYSTEM
71	POWERPLANT
7100	POWERPLANT SYSTEM
7110	ENGINE COWLING SYSTEM
7111	COWL FLAP SYSTEM
7112	ENGINE AIR BAFFLE SECTION
7120	ENGINE MOUNT SECTION
7130	ENGINE FIRESEALS
7160	ENGINE AIR INTAKE SYSTEM
7170	ENGINE DRAINS

Table Continued on Next Page

Fig. 1-4 (cont.)

ATA/JASC CODES

(AIR TRANSPORT ASSOCIATION [ATA] SPECIFICATION 100 or JOINT AIRCRAFT SYSTEM COMPONENT [JASC] CODES)	
57	WINGS
5700	WING STRUCTURE
5710	WING MAIN FRAME STRUCTURE
5711	WING SPAR STRUCTURE
5712	WING RIB STRUCTURE
5713	WING LONGERON/STRINGER
5714	WING CENTER BOX
5720	WING MISCELLANEOUS STRUCTURE
5730	WING PLATES/SKINS
5740	WING ATTACH FITTINGS
5741	WING, FUSELAGE ATTACH FITTINGS
5742	WING, NAC/PYLON ATTACH FITTINGS
5743	WING, LANDING GEAR ATTACH FITTINGS
5744	CONTROL SURFACE ATTACH FITTINGS
5750	WING CONTROL SURFACE STRUCTURE
5751	AILERON STRUCTURE
5752	AILERON TAB STRUCTURE
5753	TE FLAP STRUCTURE
5754	LEADING EDGE DEVICE STRUCTURE
5755	SPOILER STRUCTURE
61	PROPELLERS/PROPULSORS
6100	PROPELLER SYSTEM
6110	PROPELLER ASSEMBLY
6111	PROPELLER BLADE SECTION
6112	PROPELLER DE-ICE BOOT SECTION
6113	PROPELLER SPINNER SECTION
6114	PROPELLER HUB SECTION
6120	PROPELLER CONTROL SYSTEM
6121	PROPELLER SYNCHRONIZER SECTION
6122	PROPELLER GOVERNOR
6123	PROPELLER FEATHERING/REVERSING
6130	PROPELLER BRAKING
6140	PROPELLER INDICATING SYSTEM
62	MAIN ROTOR
6200	MAIN ROTOR SYSTEM
6210	MAIN ROTOR BLADES
6220	MAIN ROTOR HEAD
6230	MAIN ROTOR MAST/SWASHPLATE
6240	MAIN ROTOR INDICATING SYSTEM

Table Continued on Next Page

Fig. 1-4 (cont.)

ATA/JASC CODES

(AIR TRANSPORT ASSOCIATION [ATA] SPECIFICATION 100 or JOINT AIRCRAFT SYSTEM COMPONENT [JASC] CODES)

54	NACELLES/PYLONS
5400	NACELLE/PYLON STRUCTURE
5410	MAIN FRAME (ON NACELLE/PYLON)
5411	FRAME/SPAR/RIB(NACELLE/PYLON)
5412	BULKHEAD/FIREWALL (NAC/PYLON)
5413	LONGERON/STRINGER (NAC/PYLON)
5414	PLATE SKIN (NAC/PYLONS)
5415	ATTACH FITTINGS (NAC/PYLON)
55	STABILIZERS
5500	EMPENNAGE STRUCTURE
5510	HORIZONTAL STABILIZER STRUCTURE
5511	HORIZONTAL STABILIZER SPAR/RIB
5512	HORIZONTAL STABILIZER PLATE/SKIN
5513	HORIZONTAL STABILIZER TAB STRUCTURE
5520	ELEVATOR STRUCTURE
5521	ELEVATOR SPAR/RIB STRUCTURE
5522	ELEVATOR PLATES/SKIN STRUCTURE
5523	ELEVATOR TAB STRUCTURE
5530	VERTICAL STABILIZER STRUCTURE
5531	VERTICAL STABILIZER SPAR/RIB STRUCTURE
5532	VERTICAL STABILIZER PLATES/SKIN
5533	VENTRAL STRUCTURE (ON VERT. STAB)
5540	RUDDER STRUCTURE
5541	RUDDER SPAR/RIB STRUCTURE
5542	RUDDER PLATE/SKIN STRUCTURE
5543	RUDDER TAB STRUCTURE
5550	EMPENNAGE FLT. CONT. ATTACH FITTING
5551	HORIZONTAL STABILIZER ATTACH FITTING
5552	ELEVATOR/TAB ATTACH FITTINGS
5553	VERT. STAB. ATTACH FITTINGS
5554	RUDDER/TAB ATTACH FITTINGS
56	WINDOWS
5600	WINDOW/WINDSHIELD SYSTEM
5610	FLIGHT COMPARTMENT WINDOWS
5620	PASSENGER COMPARTMENT WINDOWS
5630	DOOR WINDOWS
5640	INSPECTION WINDOWS

Table Continued on Next Page

Fig. 1-4 (cont.)

ATA/JASC CODES

(AIR TRANSPORT ASSOCIATION [ATA] SPECIFICATION 100 or JOINT AIRCRAFT SYSTEM COMPONENT [JASC] CODES)

5243	HYDRAULIC COMPARTMENT DOORS
5244	ACCESSORY COMPARTMENT DOORS
5245	AIR CONDITIONING COMPART. DOORS
5246	FLUID SERVICE DOORS
5247	APU DOORS
5248	TAIL CONE DOORS
5250	FIXED INNER DOORS
5260	ENTRANCE STAIRS
5270	DOOR WARNING SYSTEM
5280	LANDING GEAR DOORS
53	FUSELAGE
5300	FUSELAGE STRUCTURE (GENERAL)
5301	AERIAL TOW EQUIPMENT
5302	ROTORCRAFT TAIL BOOM
5310	FUSELAGE MAIN STRUCTURE
5311	FUSELAGE MAIN FRAME
5312	FUSELAGE MAIN BULKHEAD
5313	FUSELAGE MAIN LONGERON/STRINGER
5314	FUSELAGE MAIN KEEL
5315	FUSELAGE MAIN FLOOR BEAM
5320	FUSELAGE MISCELLANEOUS STRUCTURE
5321	FUSELAGE FLOOR PANEL
5322	FUSELAGE INTERNAL MOUNT STRUCTURE
5323	FUSELAGE INTERNAL STAIRS
5324	FUSELAGE FIXED PARTITIONS
5330	FUSELAGE MAIN PLATE/SKIN
5340	FUSELAGE MAIN ATTACH FITTINGS
5341	WING ATTACH FITTINGS (ON FUSELAGE)
5342	STABILIZER ATTACH FITTINGS
5343	LANDING GEAR ATTACH FITTINGS
5344	FUSELAGE DOOR HINGES
5345	FUSELAGE EQUIPMENT ATTACH FITTINGS
5346	POWERPLANT ATTACH FITTINGS
5347	SEAT/CARGO ATTACH FITTINGS
5350	FUSELAGE AERODYNAMIC FAIRINGS

Table Continued on Next Page

Fig. 1-4 (cont.)

ATA/JASC CODES

(AIR TRANSPORT ASSOCIATION [ATA] SPECIFICATION 100 or JOINT AIRCRAFT SYSTEM COMPONENT [JASC] CODES)

37	VACUUM
3700	VACUUM SYSTEM
3710	VACUUM DISTRIBUTION SYSTEM
3720	VACUUM INDICATING SYSTEM
38	WATER/WASTE
3800	WATER & WASTE SYSTEM
3810	POTABLE WATER SYSTEM
3820	WASH WATER SYSTEM
3830	WASTE DISPOSAL SYSTEM
3840	AIR SUPPLY (WATER PRESS. SYSTEM)
45	CENTRAL MAINT. SYSTEM
4500	CENTRAL MAINT. COMPUTER
49	AIRBORNE AUXILIARY POWER
4900	AIRBORNE APU SYSTEM
4910	APU COWLING/CONTAINMENT
4920	APU CORE ENGINE
4930	APU ENGINE FUEL & CONTROL
4940	APU START/IGNITION SYSTEM
4950	APU BLEED AIR SYSTEM
4960	APU CONTROLS
4970	APU INDICATING SYSTEM
4980	APU EXHAUST SYSTEM
4990	APU OIL SYSTEM
51	STANDARD PRACTICES/STRUCTURES
5100	STANDARD PRACTICES/STRUCTURES
5101	AIRCRAFT STRUCTURES
5102	BALLOON REPORTS
52	DOORS
5200	DOORS
5210	PASSENGER/CREW DOORS
5220	EMERGENCY EXIT
5230	CARGO/BAGGAGE DOORS
5240	SERVICE DOORS
5241	GALLEY DOORS
5242	E/E COMPARTMENT DOORS

Table Continued on Next Page

Fig. 1-4 (cont.)

ATA/JASC CODES

(AIR TRANSPORT ASSOCIATION [ATA] SPECIFICATION 100 or JOINT AIRCRAFT SYSTEM COMPONENT [JASC] CODES)

3420	ATTITUDE AND DIRECTION DATA SYSTEM
3421	ATTITUDE GYRO & IND. SYSTEM
3422	DIRECTIONAL GYRO & IND. SYSTEM
3423	MAGNETIC COMPASS
3424	TURN & BANK/RATE OF TURN INDICATOR
3425	INTEGRATED FLT. DIRECTOR SYSTEM
3430	LANDING & TAXI AIDS
3431	LOCALIZER/VOR SYSTEM
3432	GLIDE SLOPE SYSTEM
3433	MICROWAVE LANDING SYSTEM
3434	MARKER BEACON SYSTEM
3435	HEADS UP DISPLAY SYSTEM
3436	WIND SHEAR DETECTION SYSTEM
3440	INDEPENDENT POS. DETERMINING SYSTEM
3441	INERTIAL GUIDANCE SYSTEM
3442	WEATHER RADAR SYSTEM
3443	DOPPLER SYSTEM
3444	GROUND PROXIMITY SYSTEM
3445	AIR COLLISION AVOIDANCE SYSTEM (TCAS)
3446	NON RADAR WEATHER SYSTEM
3450	DEPENDENT POSITION DETERMINING SYSTEM
3451	DME/TACAN SYSTEM
3452	ATC TRANSPONDER SYSTEM
3453	LORAN SYSTEM
3454	VOR SYSTEM
3455	ADF SYSTEM
3456	OMEGA NAVIGATION SYSTEM
3457	GLOBAL POSITIONING SYSTEM
3460	FLIGHT MANAGE. COMPUTING SYSTEM
35	OXYGEN
3500	OXYGEN SYSTEM
3510	CREW OXYGEN SYSTEM
3520	PASSENGER OXYGEN SYSTEM
3530	PORTABLE OXYGEN SYSTEM
36	PNEUMATIC
3600	PNEUMATIC SYSTEM
3610	PNEUMATIC DISTRIBUTION SYSTEM
3620	PNEUMATIC INDICATING SYSTEM

Table Continued on Next Page

Fig. 1-4 (cont.)

ATA/JASC CODES

(AIR TRANSPORT ASSOCIATION [ATA] SPECIFICATION 100 or JOINT AIRCRAFT SYSTEM COMPONENT [JASC] CODES)

3220	NOSE/TAIL LANDING GEAR
3221	NOSE/TAIL LANDING GEAR ATTACH SECTION
3222	NOSE/TAIL LANDING GEAR STRUT/AXLE
3230	LANDING GEAR RETRACT/EXT. SYSTEM
3231	LANDING GEAR DOOR RETRACT SECTION
3232	LANDING GEAR DOOR ACTUATOR
3233	LANDING GEAR ACTUATOR
3234	LANDING GEAR SELECTOR
3240	LANDING GEAR BRAKE SYSTEM
3241	BRAKE ANTI-SKID SECTION
3242	BRAKE
3243	MASTER CYL/BRAKE VALVE
3244	TIRE
3245	TIRE TUBE
3246	WHEEL/SKI/FLOAT
3250	LANDING GEAR STEERING SYSTEM
3251	STEERING UNIT
3252	SHIMMY DAMPER
3260	LANDING GEAR POSITION & WARNING
3270	AUXILIARY GEAR (TAIL SKID)
33	LIGHTS
3300	LIGHTING SYSTEM
3310	FLIGHT COMPARTMENT LIGHTING
3320	PASSENGER COMPARTMENT LIGHTING
3330	CARGO COMPARTMENT LIGHTING
3340	EXTERIOR LIGHTING
3350	EMERGENCY LIGHTING
34	NAVIGATION
3400	NAVIGATION SYSTEM
3410	FLIGHT ENVIRONMENT DATA
3411	PITOT/STATIC SYSTEM
3412	OUTSIDE AIR TEMP. IND./SENSOR
3413	RATE OF CLIMB INDICATOR
3414	AIRSPEED/MACH INDICATING
3415	HIGH SPEED WARNING
3416	ALTIMETER, BAROMETRIC/ENCODER
3417	AIR DATA COMPUTER
3418	STALL WARNING SYSTEM

Table Continued on Next Page

Fig. 1-4 (cont.)

ATA/JASC CODES

(AIR TRANSPORT ASSOCIATION [ATA] SPECIFICATION 100 or JOINT AIRCRAFT SYSTEM COMPONENT [JASC] CODES)

2920	HYDRAULIC, AUXILIARY SYSTEM
2921	HYDRAULIC ACCUMULATOR-AUXILIARY
2922	HYDRAULIC FILTER-AUXILIARY
2923	HYDRAULIC PUMP-AUXILIARY
2925	HYDRAULIC PRESSURE RELIEF-AUXILIARY
2926	HYDRAULIC RESERVOIR-AUXILIARY
2927	HYDRAULIC PRESSURE REGULATOR-AUX.
2930	HYDRAULIC SYSTEM INDICATING
2931	HYDRAULIC PRESSURE INDICATOR
2932	HYDRAULIC PRESSURE SENSOR
2933	HYDRAULIC QUANTITY INDICATOR
2934	HYDRAULIC QUANTITY SENSOR
30	ICE AND RAIN PROTECTION
3000	ICE/RAIN PROTECTION SYSTEM
3010	AIRFOIL ANTI/DE-ICE SYSTEM
3020	AIR INTAKE ANTI/DE-ICE SYSTEM
3030	PITOT/STATIC ANTI-ICE SYSTEM
3040	WINDSHIELD/DOOR RAIN/ICE REMOVAL
3050	ANTENNA/RADOME ANTI-ICE/DE-ICE SYSTEM
3060	PROP/ROTOR ANTI-ICE/DE-ICE SYSTEM
3070	WATER LINE ANTI-ICE SYSTEM
3080	ICE DETECTION
31	INSTRUMENTS
3100	INDICATING/RECORDING SYSTEM
3110	INSTRUMENT PANEL
3120	INDEPENDENT INSTRUMENTS (CLOCK, ETC.)
3130	DATA RECORDERS (FLT/MAINT)
3140	CENTRAL COMPUTERS (EICAS)
3150	CENTRAL WARNING
3160	CENTRAL DISPLAY
3170	AUTOMATIC DATA
32	LANDING GEAR
3200	LANDING GEAR SYSTEM
3201	LANDING GEAR/WHEEL FAIRING
3210	MAIN LANDING GEAR
3211	MAIN LANDING GEAR ATTACH SECTION
3212	EMERGENCY FLOTATION SECTION
3213	MAIN LANDING GEAR STRUT/AXLE/TRUCK

Table Continued on Next Page

Fig. 1-4 (cont.)

ATA/JASC CODES

(AIR TRANSPORT ASSOCIATION [ATA] SPECIFICATION 100 or JOINT AIRCRAFT SYSTEM COMPONENT [JASC] CODES)

2722	RUDDER ACTUATOR
2730	ELEVATOR CONTROL SYSTEM
2731	ELEVATOR TAB CONTROL SYSTEM
2740	STABILIZER CONTROL SYSTEM
2741	STABILIZER POSITION INDICATING
2742	STABILIZER ACTUATOR
2750	TE FLAP CONTROL SYSTEM
2751	TE FLAP POSITION IND. SYSTEM
2752	TE FLAP ACTUATOR
2760	DRAG CONTROL SYSTEM
2761	DRAG CONTROL ACTUATOR
2770	GUST LOCK/DAMPER SYSTEM
2780	LE FLAP CONTROL SYSTEM
2781	LE FLAP POSITION IND. SYSTEM
2782	LE FLAP ACTUATOR
28	FUEL
2800	AIRCRAFT FUEL SYSTEM
2810	FUEL STORAGE
2820	ACFT FUEL DISTRIB. SYSTEM
2821	ACFT FUEL FILTER/STRAINER
2822	FUEL BOOST PUMP
2823	FUEL SELECTOR/SHUTOFF VALVE
2824	FUEL TRANSFER VALVE
2830	FUEL DUMP SYSTEM
2840	ACFT FUEL INDICATING
2841	FUEL QUANTITY INDICATOR
2842	FUEL QUANTITY SENSOR
2843	FUEL TEMPERATURE INDICATING
2844	FUEL PRESSURE INDICATOR
29	HYDRAULIC POWER
2900	HYDRAULIC POWER SYSTEM
2910	HYDRAULIC, MAIN SYSTEM
2911	HYDRAULIC POWER-ACCUMULATOR-MAIN
2912	HYDRAULIC FILTER-MAIN SYSTEM
2913	HYDRAULIC PUMP, ELECT-ENG.-MAIN
2914	HYDRAULIC HANDPUMP-MAIN
2915	HYDRAULIC PRESSURE RELIEF VLV-MAIN
2916	HYDRAULIC RESERVOIR-MAIN
2917	HYDRAULIC PRESSURE REGULATOR-MAIN

Table Continued on Next Page

Fig. 1-4 (cont.)

ATA/JASC CODES

(AIR TRANSPORT ASSOCIATION [ATA] SPECIFICATION 100 or JOINT AIRCRAFT SYSTEM COMPONENT [JASC] CODES)

2436	DC REGULATOR
2437	DC INDICATING SYSTEM
2440	EXTERNAL POWER SYSTEM
2450	AC POWER DISTRIBUTION SYSTEM
2460	DC POWER/DISTRIBUTION SYSTEM
25	EQUIPMENT/FURNISHINGS
2500	CABIN EQUIPMENT/FURNISHINGS
2510	FLIGHT COMPARTMENT EQUIPMENT
2520	PASSENGER COMPARTMENT EQUIPMENT
2530	BUFFET/GALLEYS
2540	LAVATORIES
2550	CARGO COMPARTMENTS
2551	AGRICULTURAL SPRAY SYSTEM
2560	EMERGENCY EQUIPMENT
2561	LIFE JACKET
2562	EMERGENCY LOCATOR BEACON
2563	PARACHUTE
2564	LIFE RAFT
2565	ESCAPE SLIDE
2570	ACCESSORY COMPARTMENT
2571	BATTERY BOX STRUCTURE
2572	ELECTRONIC SHELF SECTION
26	FIRE PROTECTION
2600	FIRE PROTECTION SYSTEM
2610	DETECTION SYSTEM
2611	SMOKE DETECTION
2612	FIRE DETECTION
2613	OVERHEAT DETECTION
2620	EXTINGUISHING SYSTEM
2621	FIRE BOTTLE, FIXED
2622	FIRE BOTTLE, PORTABLE
27	FLIGHT CONTROLS
2700	FLIGHT CONTROL SYSTEM
2701	CONTROL COLUMN SECTION
2710	AILERON CONTROL SYSTEM
2711	AILERON TAB CONTROL SYSTEM
2720	RUDDER CONTROL SYSTEM
2721	RUDDER TAB CONTROL SYSTEM

Table Continued on Next Page

Fig. 1-4 (cont.)

ATA/JASC CODES

(AIR TRANSPORT ASSOCIATION [ATA] SPECIFICATION 100 or JOINT AIRCRAFT SYSTEM COMPONENT [JASC] CODES)

22	AUTO FLIGHT
2200	AUTO FLIGHT SYSTEM
2210	AUTOPILOT SYSTEM
2211	AUTOPILOT COMPUTER
2212	ALTITUDE CONTROLLER
2213	FLIGHT CONTROLLER
2214	AUTOPILOT TRIM INDICATOR
2215	AUTOPILOT MAIN SERVO
2216	AUTOPILOT TRIM SERVO
2220	SPEED-ATTITUDE CORRECT. SYSTEM
2230	AUTO THROTTLE SYSTEM
2250	AERODYNAMIC LOAD ALLEVIATING
23	COMMUNICATIONS
2300	COMMUNICATIONS SYSTEM
2310	HF COMMUNICATION SYSTEM
2311	UHF COMMUNICATION SYSTEM
2312	VHF COMMUNICATION SYSTEM
2320	DATA TRANSMISSION AUTO CALL
2330	ENTERTAINMENT SYSTEM
2340	INTERPHONE & PA SYSTEM
2350	AUDIO INTEGRATING SYSTEM
2360	STATIC DISCHARGE SYSTEM
2370	AUDIO/VIDEO MONITORING
24	ELECTRICAL POWER
2400	ELECTRICAL POWER SYSTEM
2410	ALTERNATOR-GENERATOR DRIVE
2420	AC GENERATION SYSTEM
2421	AC GENERATOR-ALTERNATOR
2422	AC INVERTER
2423	PHASE ADAPTER
2424	AC REGULATOR
2425	AC INDICATING SYSTEM
2430	DC GENERATING SYSTEM
2431	BATTERY OVERHEAT WARN. SYSTEM
2432	BATTERY/CHARGER SYSTEM
2433	DC RECTIFIER-CONVERTER
2434	DC GENERATOR-ALTERNATOR
2435	STARTER-GENERATOR

Table Continued on Next Page

Fig. 1-4

ATA/JASC CODES

(AIR TRANSPORT ASSOCIATION [ATA] SPECIFICATION 100 or JOINT AIRCRAFT SYSTEM COMPONENT [JASC] CODES)

Note: General Aviation is gradually beginning to use ATA/JASC Codes, but presently might also be using either GAMA (General Aviation Maintenance Association) Codes which are similar to ATA/JASC Codes, or manufacturer specific codes.

05	MAINTENANCE CHECKS (OPERATOR DERIVED)
10	PARKING AND MOORING (OPERATOR DERIVED)
11	PLACARDS AND MARKINGS
1100	PLACARDS AND MARKINGS
12	SERVICING
1210	FUEL SERVICING
1220	OIL SERVICING
1230	HYDRAULIC FLUID SERVICING
1240	COOLANT SERVICING
18	HELICOPTER VIBRATION
1800	HELICOPTER VIB/NOISE ANALYSIS
1810	HELICOPTER VIBRATION ANALYSIS
1820	HELICOPTER NOISE ANALYSIS
21	AIR CONDITIONING
2100	AIR CONDITIONING SYSTEM
2110	CABIN COMPRESSOR SYSTEM
2120	AIR DISTRIBUTION SYSTEM
2121	AIR DISTRIBUTION FAN
2130	CABIN PRESSURE CONTROL SYSTEM
2131	CABIN PRESSURE CONTROLLER
2132	CABIN PRESSURE INDICATOR
2133	PRESSURE REGUL/OUTFLOW VALVE
2134	CABIN PRESSURE SENSOR
2140	HEATING SYSTEM
2150	CABIN COOLING SYSTEM
2160	CABIN TEMPERATURE CONTROL SYSTEM
2161	CABIN TEMPERATURE CONTROLLER
2162	CABIN TEMPERATURE INDICATOR
2163	CABIN TEMPERATURE SENSOR
2170	HUMIDITY CONTROL SYSTEM

Table Continued on Next Page

Fig. 1-3 (cont.)

AIRCRAFT NATIONALITY MARKS BY COUNTRY, ALPHABETICAL

COUNTRY	NATIONALITY MARKING	COUNTRY	NATIONALITY MARKING
Spain	EC	Ukraine	UR
Sri Lanka	4R	United Arab Emirates	A6
Sudan	ST	United Kingdom	G
Suriname	PZ	United Nations	4U
Swaziland	3D	United Republic of Tanzania	5H
Sweden	SE	United States of America	N
Switzerland and Liechtenstein	HB	Uruguay	CX
Syria	YK	Uzbekistan	UK
Taiwan	B	Vanuatu	YJ
Tajikistan	EY	Vatican City	HV
Thailand	HS	Venezuela	YV
Togo	5V	Vietnam	VN
Tonga	A3	Yemen	7O
Trinidad and Tobago	9Y	Yugoslavia	YU
Tunisia	TS	Zaire	9T
Turkey	TC	Zambia	9J
Turkmenistan	EZ	Zimbabwe	Z
Tuvulu	T2		
Uganda	5X		

Fig. 1-3 (cont.)

AIRCRAFT NATIONALITY MARKS BY COUNTRY, ALPHABETICAL

COUNTRY	NATIONALITY MARKING
Ivory Coast	TU
Jamaica	6Y
Japan	J
Jordan	JY
Kazakstan.	UN
Kenya	5Y
Kiribati	T3
Korea, North	P
Korea, South	HL
Krgyz Republic	EX
Kuwait	9K
Laos	RDPL
Latvia	YL
Lebanon	OD
Lesotho	7P
Liberia	EL
Libya	5a
Lithuania	LY
Luxembourg	LX
Macedonia	Z3
Madagascar	5R
Malawi	7Q
Malaysia	9M
Maldives	8Q
Mali	TZ
Malta	9H
Marshall Islands	V7
Mauritania	5T
Mauritius	3B
Mexico	XA, XB, XC
Micronesia	V6
Moldova	ER
Monaco	3A
Mongolia	BNMAU, MONGOL, MT
Morocco	CN
Mozambique	C9
Myanmar	XY, XZ
Nambia	V5
Nauru	C2
Nepal	9N
Netherlands	PH
Netherlands Antilles	PJ
New Zealand	ZK, SL, SN
Nicaragua	YN
Niger	5U
Nigeria	5N
Norway	LN
Oman	A40
Pakistan	AP
Panama	HP
Papua New Guinea	P2
Paraguay	ZP
Peru	OB
Philippines	RP
Poland	SP
Portugal	CS
Portuguese Overseas Provinces	CR
Qatar	A7
Romania	YR
Russia	RA
Rwanda	9XR
Saint Kitts and Nevis	V4
Saint Lucia	J6
Saint Vincent and The Grenadines	J8
Samoa	5W
San Marino	T7
Sao Tome and Principe	S9
Saudi Arabia	HZ
Senegal	6V, 6W
Seychilles	S7
Sierra Leone	9L
Singapore	9V
Slovak Republic	OM
Slovenia	S5
Solomon Islands	H4
Somalia	6O
South Africa	ZS, ZT, ZU

Table Continued on Next Page

Fig. 1-3

AIRCRAFT NATIONALITY MARKS BY COUNTRY, ALPHABETICAL

COUNTRY	NATIONALITY MARKING	COUNTRY	NATIONALITY MARKING
Afghanistan	YA	Costa Rica	TI
Albania	ZA	Croatia	(a
Algeria	7T	Cuba	CU
Andorra	C3	Cyprus	5B
Angola	D2	Czech Republic	OK
Antigua and Barbuda	V2	Denmark	OY
Argentina	LQ, LV	Djibouti	J2
Armenia	RH, EK	Dominica	J7
Australia	VH	Dominican Republican	HI
Austria	OE	Ecuador	HC
Azerbaijan	4K	Egypt	SU
Bahamas	C6	El Salvador	YS
Bahrain	A9C	Equatorial Guinea	3C
Bangladesh	S2, S3	Eritrea	E3
Barbados	8P	Estonia	ES
Belarus	EW	Ethiopia	ET
Belgium	OO	Fiji	DQ
Belize	V3	Finland	OH
Benin	TY	France	F
Bhutan	A5	Gabon	TR
Bolivia	CB, CP	Gambia	C5
Bosnia-Herzegovina	T9	Georgia	4L
Botswana	A2	Germany	D
Brazil	PP, PR, PT	Ghana	9G
Brunei Darussalam	V8	Greece	SX
Bulgaria	LZ	Grenada	J3
Burkina Faso	XT	Guatemala	TG
Burundi	9U	Guinea	3X
Cambodia	XU	Guinea-Bissau	J5
Cameroon	TJ	Guyana	8R
Canada	CF, CG, CI	Haiti	HH
Cape Verde	D4	Honduras	HR
Central African Republic	TL	Hungary	HA
Chad	TT	Iceland	TF
Chile	CC	India	VT
China	XT	Indonesia	PK
Colombia	HK	Iran	EP
Comoros	D6	Iraq	YI
Congo	TN	Ireland	EI
		Israel	4X
		Italy	I

Table Continued on Next Page

Fig. 1-2 (cont.)

AIRCRAFT NATIONALITY MARKS, ALPHABETICAL

NATIONALITY MARKING	COUNTRY	NATIONALITY MARKING	COUNTRY
TS	Tunisia	ZS	South Africa
TT	Chad	ZT	South Africa
TU	Ivory Coast	ZU	South Africa
TY	Benin		
TZ	Mali		
UK	Uzbekistan		
UN	Kazakstan		
UR	Ukraine		
V2	Antigua and Barbuda		
V3	Belize		
V4	Saint Kitts and Nevis		
V5	Nambia		
V6	Micronesia		
V7	Marshall Islands		
V8	Brunei Darussalam		
VH	Australia		
VN	Vietnam		
VT	India		
XA	Mexico		
XB	Mexico		
XC	Mexico		
XT	Burkina Faso		
XT	China		
XU	Cambodia		
XY	Myanmar		
XZ	Myanmar		
YA	Afghanistan		
YI	Iraq		
YJ	Vanuatu		
YK	Syria		
YL	Latvia		
YN	Nicaragua		
YR	Romania		
YS	El Salvador		
YU	Yugoslavia		
YV	Venezuela		
Z	Zimbabwe		
Z3	Macedonia		
ZA	Albania		
ZK	New Zealand		
ZL	New Zealand		
ZN	New Zealand		
ZP	Paraguay		

Fig.1-2 (cont.)

AIRCRAFT NATIONALITY MARKS, ALPHABETICAL

NATIONALITY MARKING	COUNTRY	NATIONALITY MARKING	COUNTRY
ET	Ethiopia	OE	Austria
EW	Belarus	OH	Finland
EX	Krgyz Republic	OK	Czech Republic
EY	Tajikistan	OM	Slovak Republic
EZ	Turkmenistan	OO	Belgium
F	France	OY	Denmark
G	United Kingdom	P	Korea, North
H4	Solomon Islands	P2	Papua New Guinea
HA	Hungary	PH	Netherlands
HB	Switzerland and Liechtenstein	PJ	Netherlands Antilles
		PK	Indonesia
HC	Ecuador	PP	Brazil
HH	Haiti	PR	Brazil
HI	Dominican Republican	PT	Brazil
HK	Colombia	PZ	Suriname
HL	Korea, South	RA	Russia
HP	Panama	RDPL	Laos
HR	Honduras	RH	Armenia
HS	Thailand	RP	Philippines
HV	Vatican City	S2	Bangladesh
HZ	Saudi Arabia	S3	Bangladesh
I	Italy	S5	Slovenia
J	Japan	S7	Seychilles
J2	Djibouti	S9	Sao Tome and Principe
J3	Grenada	SE	Sweden
J5	Guinea-Bissau	SP	Poland
J6	Saint Lucia	ST	Sudan
J7	Dominica	SU	Egypt
J8	Saint Vincent and The Grenadines	SX	Greece
		T2	Tuvulu
JY	Jordan	T3	Kiribati
LN	Norway	T7	San Marino
LQ	Argentina	T9	Bosnia-Herzegovina
LV	Argentina	TC	Turkey
LX	Luxembourg	TF	Iceland
LY	Lithuania	TG	Guatemala
LZ	Bulgaria	TI	Costa Rica
MONGOL	Mongolia	TJ	Cameroon
MT	Mongolia	TL	Central African Republic
N	United States of America		
OB	Peru	TN	Congo
OD	Lebanon	TR	Gabon

Table Continued on Next Page

Fig. 1-2

AIRCRAFT NATIONALITY MARKS, ALPHABETICAL

NATIONALITY MARKING	COUNTRY	NATIONALITY MARKING	COUNTRY
3A	Monaco	9V	Singapore
3B	Mauritius	9XR	Rwanda
3C	Equatorial Guinea	9Y	Trinidad and Tobago
3D	Swaziland	A2	Botswana
3X	Guinea	A3	Tonga
4K	Azerbaijan	A4O	Oman
4L	Georgia	A5	Bhutan
4R	Sri Lanka	A6	United Arab Emirates
4U	United Nations	A7	Qatar
4X	Israel	A9C	Bahrain
5a	Libya	AP	Pakistan
5B	Cyprus	B	Taiwan
5H	United Republic of Tanzania	BNMAU	Mongolia
		C2	Nauru
5N	Nigeria	C3	Andorra
5R	Madagascar	C5	Gambia
5T	Mauritania	C6	Bahamas
5U	Niger	C9	Mozambique
5V	Togo	CB	Bolivia
5W	Samoa	CC	Chile
5X	Uganda	CF	Canada
5Y	Kenya	CG	Canada
6O	Somalia	CI	Canada
6V	Senegal	CN	Morocco
6W	Senegal	CP	Bolivia
6Y	Jamaica	CR	Portuguese Overseas Provinces
7O	Yemen		
7P	Lesotho	CS	Portugal
7Q	Malawi	CU	Cuba
7T	Algeria	CX	Uruguay
8P	Barbados	D	Germany
8Q	Maldives	D2	Angola
8R	Guyana	D4	Cape Verde
9A	Croatia	D6	Comoros
9G	Ghana	DQ	Fiji
9H	Malta	E3	Eritrea
9J	Zambia	EC	Spain
9K	Kuwait	EI	Ireland
9L	Sierra Leone	EK	Armenia
9M	Malaysia	EL	Liberia
9N	Nepal	EP	Iran
9T	Zaire	ER	Moldova
9U	Burundi	ES	Estonia

Table Continued on Next Page