INCH-POUND

MS9194C
16 February 2010
SUPERSEDING
MS9194B (ASG)
27 July 1967

DETAIL SPECIFICATION SHEET

ELBOW, TUBE - SAE-AMS5646, BOSS, 90°

Inactive for new design after 20 September 2000.

This specification is approved for use by all Departments and Agencies of the Department of Defense.

The requirements for acquiring the product described herein shall consist of this specification sheet and SAE-AS4841.

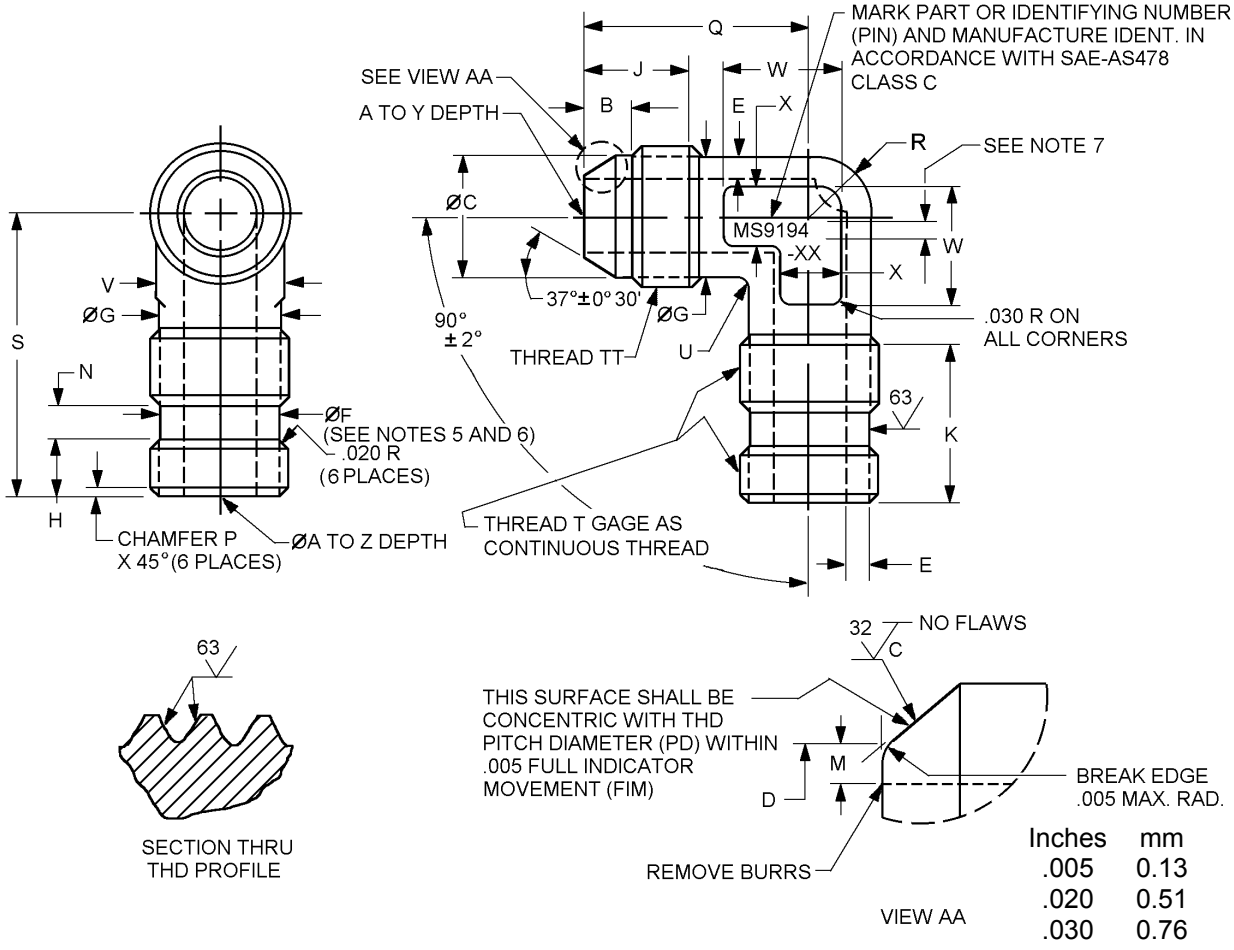


FIGURE 1. Elbow, tube, boss, 90°.

Dash number	Tube OD (reference) inches (mm)	A diameter inches (mm)			B inches (mm) +.015 (0.38) -.000	C diameter inches (mm) +.000 -.010 (0.25)
-02	.125 (3.18)	.058 (1.47)	-	.065 (1.65)	.144 (3.66)	.245 (6.22)
-03	.188 (4.78)	.121 (3.07)	-	.128 (3.25)	.144 (3.66)	.307 (7.80)
-04	.250 (6.35)	.168 (4.27)	-	.175 (4.45)	.160 (4.06)	.359 (9.12)
-05	.313 (7.95)	.230 (5.84)	-	.237 (6.02)	.160 (4.06)	.421 (10.69)
-06	.375 (9.53)	.293 (7.44)	-	.301 (7.65)	.165 (4.19)	.476 (12.09)
-07	.438 (11.13)	.355 (9.02)	-	.363 (9.22)	.165 (4.19)	.539 (13.69)
-08	.500 (12.70)	.387 (9.83)	-	.395 (10.03)	.229 (5.82)	.654 (16.61)
-09	.562 (14.27)	.434 (11.02)	-	.442 (11.23)	.229 (5.82)	.716 (18.19)
-10	.625 (15.88)	.480 (12.19)	-	.488 (12.40)	.255 (6.48)	.767 (19.48)
-11	.688 (17.48)	.542 (13.77)	-	.552 (14.02)	.304 (7.72)	.875 (22.23)
-12	.750 (19.05)	.604 (15.34)	-	.614 (15.60)	.304 (7.72)	.938 (23.83)
-14	.875 (22.23)	.729 (18.52)	-	.739 (18.77)	.304 (7.72)	1.062 (26.97)
-16	1.000 (25.40)	.839 (21.31)	-	.851 (21.62)	.312 (7.92)	1.188 (30.18)
-18	1.125 (28.58)	.948 (24.08)	-	.960 (24.38)	.312 (7.92)	1.375 (34.93)
-20	1.250 (31.75)	1.073 (27.25)	-	1.086 (27.58)	.363 (9.22)	1.500 (38.10)
-24	1.500 (38.10)	1.307 (33.20)	-	1.320 (33.53)	.374 (9.50)	1.750 (44.45)
-28	1.750 (44.45)	1.542 (39.17)	-	1.557 (39.55)	.447 (11.35)	2.125 (53.98)
-32	2.000 (50.80)	1.776 (45.11)	-	1.791 (45.49)	.457 (11.61)	2.375 (60.33)

FIGURE 1. Elbow, tube, boss, 90°- Continued.

Dash number	D diameter inches (mm) ±.003 (0.08)	E (see note 10) inches (mm)	F diameter inches (mm) +.002 (0.05) -.003 (0.08) (see notes 5 and 6)	G diameter inches (mm)	H inches (mm) ±.010 (0.25)
-02	.132 (3.35)	.040 (1.02)	.250 (6.35)	.240 (6.10)	.208 (5.28)
-03	.195 (4.95)	.040 (1.02)	.312 (7.92)	.300 (7.62)	.208 (5.28)
-04	.242 (6.15)	.040 (1.02)	.364 (9.25)	.350 (8.89)	.250 (6.35)
-05	.304 (7.72)	.050 (1.27)	.426 (10.82)	.415 (10.54)	.250 (6.35)
-06	.368 (9.35)	.050 (1.27)	.481 (12.22)	.470 (11.94)	.278 (7.06)
-07	.430 (10.92)	.060 (1.52)	.544 (13.82)	.535 (13.59)	.278 (7.06)
-08	.462 (11.73)	.080 (2.03)	.660 (16.76)	.650 (16.51)	.312 (7.92)
-09	.509 (12.93)	.090 (2.29)	.722 (18.34)	.710 (18.03)	.312 (7.92)
-10	.555 (14.10)	.090 (2.29)	.773 (19.63)	.765 (19.43)	.357 (9.07)
-11	.619 (15.72)	.110 (2.79)	.882 (22.40)	.870 (22.10)	.417 (10.59)
-12	.681 (17.30)	.110 (2.79)	.945 (24.00)	.935 (23.75)	.417 (10.59)
-14	.808 (20.52)	.110 (2.79)	1.070 (27.18)	1.055 (26.80)	.417 (10.59)
-16	.918 (23.32)	.110 (2.79)	1.195 (30.35)	1.185 (30.10)	.417 (10.59)
-18	1.027 (26.09)	.150 (3.81)	1.382 (35.10)	1.365 (34.67)	.417 (10.59)
-20	1.153 (29.29)	.150 (3.81)	1.507 (38.28)	1.495 (37.97)	.417 (10.59)
-24	1.387 (35.23)	.170 (4.32)	1.756 (44.60)	1.745 (44.32)	.417 (10.59)
-28	1.652 (41.96)	.240 (6.10)	2.131 (54.13)	2.120 (53.85)	.417 (10.59)
-32	1.886 (47.90)	.250 (6.35)	2.381 (60.48)	2.370 (60.20)	.417 (10.59)

FIGURE 1. Elbow, tube, boss, 90° - Continued.

Dash number	J inches (mm) ±.010 (0.25)	K inches (mm) ±.010 (0.25)	M min inches (mm)	N inches (mm) +.010 (0.25) -.000
-02	.317 (8.05)	.682 (17.32)	.030 (0.76)	.125 (3.18)
-03	.346 (8.79)	.682 (17.32)	.030 (0.76)	.131 (3.33)
-04	.398 (10.11)	.748 (19.00)	.030 (0.76)	.140 (3.56)
-05	.398 (10.11)	.748 (19.00)	.030 (0.76)	.140 (3.56)
-06	.398 (10.11)	.813 (20.65)	.030 (0.76)	.156 (3.96)
-07	.398 (10.11)	.813 (20.65)	.030 (0.76)	.172 (4.37)
-08	.489 (12.42)	.903 (22.94)	.030 (0.76)	.187 (4.75)
-09	.489 (12.42)	.903 (22.94)	.030 (0.76)	.203 (5.16)
-10	.585 (14.86)	1.018 (25.86)	.030 (0.76)	.219 (5.56)
-11	.663 (16.84)	1.122 (28.50)	.030 (0.76)	.234 (5.94)
-12	.663 (16.84)	1.122 (28.50)	.030 (0.76)	.234 (5.94)
-14	.710 (18.03)	1.122 (28.50)	.030 (0.76)	.234 (5.94)
-16	.720 (18.29)	1.122 (28.50)	.030 (0.76)	.234 (5.94)
-18	.767 (19.48)	1.122 (28.50)	.030 (0.76)	.234 (5.94)
-20	.767 (19.48)	1.122 (28.50)	.030 (0.76)	.234 (5.94)
-24	.889 (22.58)	1.122 (28.50)	.030 (0.76)	.234 (5.94)
-28	1.017 (25.83)	1.205 (30.61)	.044 (1.12)	.234 (5.94)
-32	1.142 (29.01)	1.320 (33.53)	.044 (1.12)	.234 (5.94)

FIGURE 1. Elbow, tube, boss, 90° - Continued.

Dash number	P inches (mm)	Q inches (mm) ±.010 (0.25)	R radius inches (mm)	S inches (mm) +.010 (0.25 mm)
-02	.020 (0.51) - .050 (1.27)	.707 (17.96)	.120 (3.05)	1.000 (25.40)
-03	.020 (0.51) - .050 (1.27)	.764 (19.41)	.150 (3.81)	1.000 (25.40)
-04	.030 (0.76) - .060 (1.52)	.826 (20.98)	.175 (4.45)	1.115 (28.32)
-05	.030 (0.76) - .060 (1.52)	.889 (22.58)	.207 (5.26)	1.140 (28.96)
-06	.040 (1.02) - .070 (1.78)	.998 (25.35)	.235 (5.97)	1.270 (32.26)
-07	.040 (1.02) - .070 (1.78)	.998 (25.35)	.267 (6.78)	1.305 (33.15)
-08	.040 (1.02) - .070 (1.78)	1.195 (30.35)	.325 (8.26)	1.460 (37.08)
-09	.040 (1.02) - .070 (1.78)	1.195 (30.35)	.355 (9.02)	1.490 (37.85)
-10	.050 (1.27) - .080 (2.03)	1.411 (35.84)	.382 (9.70)	1.680 (42.67)
-11	.050 (1.27) - .080 (2.03)	1.614 (41.00)	.435 (11.05)	1.855 (47.12)
-12	.050 (1.27) - .080 (2.03)	1.614 (41.00)	.467 (11.86)	1.885 (47.88)
-14	.050 (1.27) - .080 (2.03)	1.768 (44.91)	.527 (13.39)	1.945 (49.40)
-16	.050 (1.27) - .080 (2.03)	1.778 (45.16)	.592 (15.04)	2.010 (51.05)
-18	.050 (1.27) - .080 (2.03)	2.027 (51.49)	.682 (17.32)	2.100 (53.34)
-20	.050 (1.27) - .080 (2.03)	2.027 (51.49)	.750 (19.05)	2.165 (54.99)
-24	.050 (1.27) - .080 (2.03)	2.293 (58.24)	.872 (22.15)	2.290 (58.17)
-28	.050 (1.27) - .080 (2.03)	2.777 (70.54)	1.062 (26.97)	2.625 (66.68)
-32	.050 (1.27) - .080 (2.03)	3.027 (76.89)	1.188 (30.18)	2.975 (75.57)

FIGURE 1. Elbow, tube, boss, 90° - Continued.

Dash number	Thread T (see note 13)
-02	.3125 - 24UNF-3A
-03	.375 - 24UNF-3A
-04	.4375 - 20UNF-3A
-05	.500 - 20UNF-3A
-06	.5625 - 18UNF-3A
-07	.625 - 18UNF-3A
-08	.7500 - 16UNF-3A
-09	.8125 - 16UN-3A
-10	.8750 - 14UNF-3A
-11	1.000 - 12UNF-3A
-12	1.0625 - 12UN-3A
-14	1.1875 - 12UN-3A
-16	1.3125 - 12UN-3A
-18	1.500 - 12UNF-3A
-20	1.625- 12UN-3A
-24	1.8750 - 12UN-3A
-28	2.2500 - 12UN-3A
-32	2.500 - 12UN-3A

FIGURE 1. Elbow, tube, boss, 90° - Continued.

Dash number	Thread TT (see note 13)								
	Size	Major diameter inches (mm).			Pitch diameter inches (mm)			Minor diameter max inches (mm)
-02	.3125 – 24UNS-3A	.3023 (7.678)	-	.3095 (7.861)	.2797 (7.104)	-	.2824 (7.173)	.2584 (6.563)
-03	.375 – 24UNS-3A	.3648 (9.266)	-	.3720 (9.449)	.3420 (8.687)	-	.3449 (8.760)	.3209 (8.151)
-04	.4375 – 20UNS-3A	.4264 (10.831)	-	.4345 (11.036)	.3989 (10.132)	-	.4020 (10.211)	.3732 (9.479)
-05	.500 – 20UNS-3A	.4889 (12.418)	-	.4970 (12.623)	.4613 (11.717)	-	.4645 (11.80)	.4357 (11.067)
-06	.5625 – 18UNS-3A	.5508 (13.990)	-	.5595 (14.211)	.5200 (13.208)	-	.5234 (13.294)	.4913 (12.479)
-07	.625 – 18UNS-3A	.6133 (15.578)	-	.6220 (15.799)	.5824 (14.793)	-	.5859 (14.881)	.5538 (14.067)
-08	.750 – 16UNS-3A	.7376 (18.735)	-	.7470 (18.974)	.7026 (17.846)	-	.7064 (17.942)	.6703 (17.026)
-09	.8125 – 16UNS-3A	.8001 (20.323)	-	.8095 (20.561)	.7653 (19.44)	-	.7689 (19.530)	.7328 (18.613)
-10	.875 – 14UNS-3A	.8617 (21.887)	-	.8720 (22.149)	.8215 (20.866)	-	.8256 (20.970)	.7844 (19.924)
-11	1.000 – 12UNS-3A	.9856 (25.034)	-	.9970 (25.324)	.9385 (23.838)	-	.9429 (23.950)	.8948 (22.728)
-12	1.0625 – 12UNS-3A	1.0481 (26.622)	-	1.0595 (26.911)	1.0012 (25.430)	-	1.0054 (25.537)	.9573 (24.315)
-14	1.1875 – 12UNS-3A	1.1731 (29.797)	-	1.1845 (30.086)	1.1261 (28.603)	-	1.1304 (28.712)	1.0823 (27.490)
-16	1.3125 – 12UNS-3A	1.2981 (32.972)	-	1.3095 (33.261)	1.2511 (31.778)	-	1.2554 (31.887)	1.2073 (30.665)
-18	1.500 – 12UNS-3A	1.4856 (37.734)	-	1.4970 (38.024)	1.4381 (36.528)	-	1.4429 (36.650)	1.3948 (35.428)
-20	1.625 – 12UNS-3A	1.6106 (40.909)	-	1.6220 (41.199)	1.5635 (39.713)	-	1.5679 (39.825)	1.5198 (38.603)
-24	1.875 – 12UNS-3A	1.8606 (47.259)	-	1.8720 (47.549)	1.8134 (46.060)	-	1.8179 (46.175)	1.7698 (44.953)
-28	2.250 – 12UNS-3A	2.2356 (56.784)	-	2.2470 (57.074)	2.1884 (55.585)	-	2.1929 (55.700)	2.1448 (54.478)
-32	2.500 – 12UNS-3A	2.4856 (63.134)	-	2.4970 (63.424)	2.4429 (62.050)	-	2.4383 (61.933)	2.3948 (60.828)

FIGURE 1. Elbow, tube, boss, 90° - Continued.

Dash number	U radius inches (mm)	V inches (mm)	W inches (mm)	X inches (mm)	Y inches (mm) ±.010 (0.25)
-02	.062 (1.57)	.250 (6.35)	.300 (7.62)	.200 (5.08)	.722 (18.34)
-03	.062 (1.57)	.312 (7.92)	.310 (7.87)	.220 (5.59)	.795 (20.19)
-04	.062 (1.57)	.375 (9.53)	.380 (9.65)	.260 (6.60)	.862 (21.89)
-05	.062 (1.57)	.438 (11.13)	.440 (11.18)	.300 (7.62)	.907 (23.04)
-06	.094 (2.39)	.500 (12.70)	.490 (12.45)	.330 (8.38)	1.013 (25.73)
-07	.094 (2.39)	.562 (14.27)	.490 (12.45)	.330 (8.38)	1.032 (26.21)
-08	.094 (2.39)	.688 (17.48)	.640 (16.26)	.430 (10.92)	1.257 (31.93)
-09	.094 (2.39)	.750 (19.05)	.660 (16.76)	.440 (11.18)	1.257 (31.93)
-10	.094 (2.39)	.812 (20.62)	.750 (19.05)	.500 (12.70)	1.473 (37.41)
-11	.094 (2.39)	.938 (23.83)	.750 (19.05)	.500 (12.70)	1.677 (42.60)
-12	.094 (2.39)	1.000 (25.40)	.750 (19.05)	.500 (12.70)	1.677 (42.60)
-14	.125 (3.18)	1.125 (28.58)	.750 (19.05)	.500 (12.70)	1.893 (48.08)
-16	.125 (3.18)	1.250 (31.75)	.750 (19.05)	.500 (12.70)	1.903 (48.34)
-18	.125 (3.18)	1.438 (36.53)	.900 (22.86)	.600 (15.24)	2.152 (54.66)
-20	.125 (3.18)	1.625 (41.28)	.900 (22.86)	.600 (15.24)	2.152 (54.66)
-24	.125 (3.18)	1.812 (46.02)	.900 (22.86)	.600 (15.24)	2.418 (61.42)
-28	.188 (4.78)	2.188 (55.58)	.900 (22.86)	.660 (16.76)	2.902 (73.71)
-32	.250 (6.35)	2.438 (61.93)	1.125 (28.58)	.750 (19.05)	3.152 (80.06)

FIGURE 1. Elbow, tube, boss, 90° - Continued.

Dash number	Z inches (mm) ±.010 (0.25)	Approx weight lbs/ea (grams/ea)
-02	1.018 (25.86)	.025 (11)
-03	1.033 (26.24)	.036 (16)
-04	1.146 (29.11)	.050 (23)
-05	1.171 (29.74)	.065 (29)
-06	1.301 (33.05)	.083 (38)
-07	1.336 (33.93)	.097 (44)
-08	1.523 (38.68)	.186 (84)
-09	1.553 (39.45)	.215 (98)
-10	1.743 (44.27)	.280 (127)
-11	1.918 (48.72)	.408 (185)
-12	1.948 (49.48)	.445 (202)
-14	2.070 (52.58)	.538 (244)
-16	2.135 (54.23)	.644 (292)
-18	2.225 (56.52)	.954 (433)
-20	2.290 (58.17)	1.087 (493)
-24	2.145 (54.48)	1.436 (651)
-28	2.750 (69.85)	2.612 (1185)
-32	3.100 (78.74)	3.382 (1534)

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for information only.
3. Unless otherwise specified tolerances for linear dimensions are ±.015 inch (0.38 mm) and angular dimensions are ±5°, all dimensions concentric within .010 inch (0.25 mm) FIM.
4. Unless otherwise specified machined surfaces to be 125µ inches (3.18µm) in accordance with ASME B46.1.
5. Diameter F shall be free of thread marks.
6. Diameter F shall be concentric with PD of thread within .0025 inch (1.134 mm) FIM.
7. Lettering height:
   For -02 through -04 size: .020 - .040 inch (0.51 - 1.02 mm).
   For size -05 through -16: .040 - .060 inch (1.02 - 1.52 mm).
   For size -18 and larger: .090 - .150 inch (2.29 - 3.81 mm).
8. All diameters shall be concentric within .010 inch (0.25 mm) FIM unless otherwise specified.
9. Parting line mismatch .015 inch (0.38 mm) max.
10. E minimum wall thickness between forged surface and hole A.
11. Unless otherwise specified break sharp edges .003 - .015 inches (0.08 - 0.38 mm).
12. Dimensions are to sharp corners unless otherwise specified.
13. Threads shall be in accordance with FED-STD-H28/2.

FIGURE 1. Elbow, tube, boss, 90° - Continued.

REQUIREMENTS:

Dimensions and configurations: See figure 1.

Material: Steel, corrosion and heat-resistant in accordance with SAE-AMS5646.

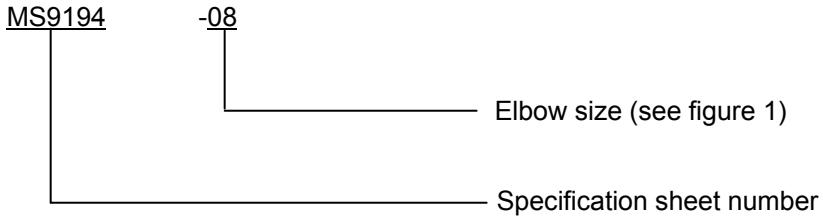
Max operating temperature: Oxidation resistance up to 1500°F (816°C).

Max operating pressure: 1500 psi (10MPa).

Finish: Passivate in accordance with SAE-AMS2700, method 1.

All parts shall be fluorescent penetrant inspected in accordance with ASTM E1417.

PIN:



PIN Example:

MS9194-08 identifies a 90° elbow .500 inch (tube), CRES.

Do not use unassigned PIN's.

Intended usage: Jet engine, miscellaneous parts, oil, fuel, and de-icing kits.

Not to be used on hydraulic, oxygen or applications requiring pressures of 3000 psi (21 MPa).

Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Referenced documents. In addition to SAE-AS4841, this document references the following:

FED-STD-H28/2
ASTM E1417
ASME B46.1
SAE-AS478
SAE-AMS2700
SAE-AMS5646

CONCLUDING MATERIAL

Custodians:
Navy - AS
DLA - CC

Review activity:
Navy - SA

Preparing activity:
DLA - CC

(Project 4730-2009-080)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at http://assist.daps.dla.mil.