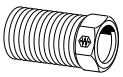
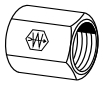
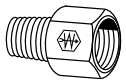
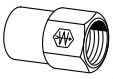
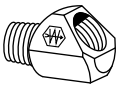
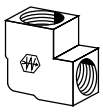
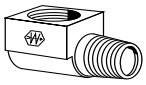
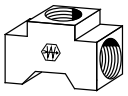
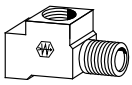
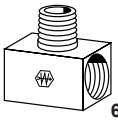
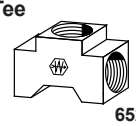
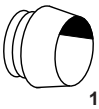
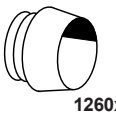
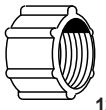
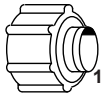
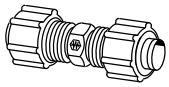
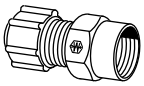
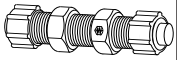
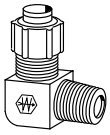
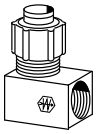
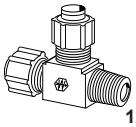
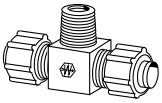
Brass Fittings

Visual Index

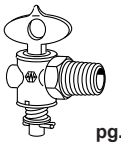
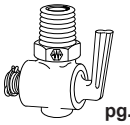
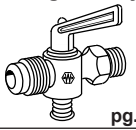
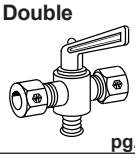
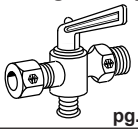
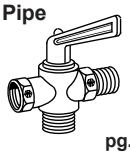
INVERTED FLARE

Tube Nut (Steel)  105x pg. 38	Tube Nut (Brass)  100x pg. 38	Plug (Steel)  131x pg. 38	Tube Nut Long (Steel)  7896x pg. 38	Union  252x pg. 38	Adapter SAE 45° Flare to Inv. Flare  pg. 39	Male Connector  202x pg. 39
Female Connector  252x pg. 39	Fuel Line Adapter  pg. 40	45° Male Elbow  352x pg. 40	Union Elbow  502x pg. 40	Male Elbow  402x pg. 40	Female Elbow  452x pg. 40	Union Tee  702x pg. 41
Male Run Tee  752x pg. 41	Male Branch Tee  602x pg. 41	Female Branch Tee  652x pg. 41				

POLYLINE® FLARELESS

Plastic Sleeve  1260x pg. 61	Brass Sleeve  1260x-B pg. 61	Brass Nut  1261x pg. 61	Brass Nut Assy (w/Plastic Sleeve)  1261x-A pg. 62	Brass Nut Assy (w/Brass Sleeve)  1261x-B pg. 62	Brass Bulkhead Nut  1202x pg. 62	Union  1262x pg. 62
Male Connector  1268x pg 62	Female Connector  1266x pg. 63	Bulkhead Union  1274x pg. 63	Male Elbow  1269x pg. 63	Female Elbow  1270x pg. 63	Union Tee  1264x pg. 64	Male Run Tee  1271x pg. 64
Male Branch Tee  1272x pg. 64						

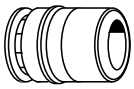
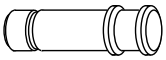
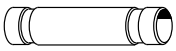
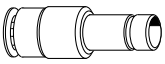
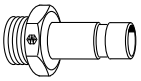
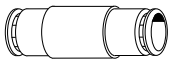
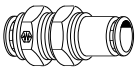
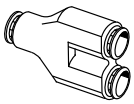
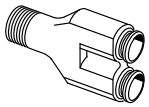
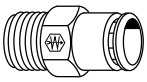
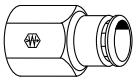
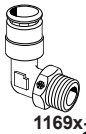
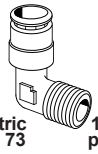
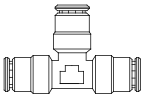
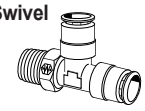
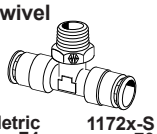
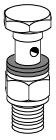
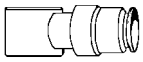
GROUND PLUG & MULTIPLE SHUT-OFFS

Draincock  pg. 118	Ground Plug Drain  pg. 118	Compression Flareless 3-Way Shut-Off  pg. 118	SAE 45° Flare Double  pg. 118	SAE 45° Flare Straight-Away  pg. 119	Compression Double  pg. 119	Compression Straight-Away  pg. 119
Male to Female Pipe  pg. 119	Truck Shut-Off to Female Pipe pg. 119	Marine Shut-Off Male to Female Pipe pg. 120	Female Pipe pg. 120	3-Way Shut-Off pg. 120	3-Way Multiple Shut-Off pg. 120	4-Way Multiple Shut-Off pg. 120

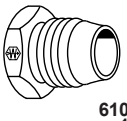
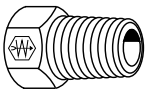
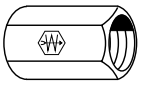
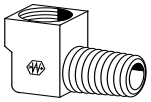
Visual Index

Brass Fittings

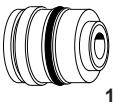
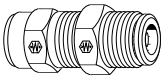
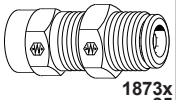
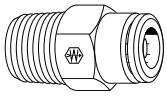
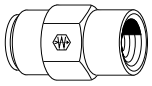
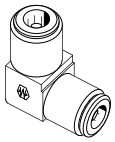
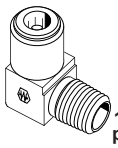
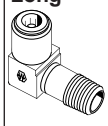
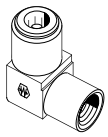
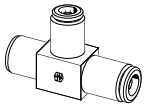
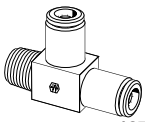
PUSH > CONNECT

Cartridge  Metric pg. 71 — 1611x pg. 66	**Plug (Plastic)**  Metric pg. 71 — 1129x pg. 66	**Double Union**  Metric pg. 71 — 1105x pg. 66	**Reducer**  Metric pg. 71 — 1109x pg. 66	**Stem Adapter**  Metric pg. 71 — 1180x pg. 67	**Union**  Metric pg. 71 — 1162x pg. 67	**Bulkhead Union**  Metric pg. 71 — 1174x pg. 67
Union "Y"  Metric pg. 72 — 1107x pg. 67	**Male "Y"**  Metric pg. 72 — 1108x pg. 68	**Male Connector**  Metric pg. 72 — 1168x pg. 68	**Female Connector**  Metric pg. 72 — 1166x pg. 68	**Union Elbow**  Metric pg. 73 — 1165x pg. 68	**Swivel Male Elbow**  Metric pg. 73 — 1169x-S pg. 69	**Male Elbow**  Metric pg. 73 — 1169x pg. 69
Union Tee  Metric pg. 73 — 1164x pg. 69	**Male Run Tee Swivel**  Metric pg. 74 — 1171x-S pg. 69	**Male Branch Tee Swivel**  Metric pg. 74 — 1172x-S pg. 70	**Stud Manifolds**  pg. 70	**Banjos**  pg. 70	**Flow Controls**  pg. 76	PUSH > CONNECT PLUS see pages 77 & 78.

THREADED SLEEVE

Nut  6100x pg. 103	**Male Connector**  6200x pg. 103	**Union**  6300x pg. 103	**Male Elbow**  6400x pg. 103			

QUICK > CONNECT AIR BRAKE

Encapsulated Cartridge  1861x pg. 85	**Union**  1862x pg. 85	**Bulkhead Union**  1874x pg. 85	**Female Bulkhead Union**  1873x pg. 85	**Male Connector**  1868x pg. 86	**Female Connector**  1866x pg. 86	**Male Elbow 45°**  1880x pg. 86
Swivel Male 45° Elbow  1880x-S pg. 87	**Union Elbow**  1865x pg. 87	**Male Elbow 90°**  1869x pg. 87	**Male Elbow 90° Long**  1869x-L pg. 87	**Swivel Male 90° Elbow**  1869x-S pg. 88	**Female Elbow**  1870x pg. 88	**Union Tee**  1864x pg. 88
Male Run Tee  1871x pg. 89	**Swivel Male Run Tee**  1871x-S pg. 89	**Male Branch Tee** 1872x pg. 89	**Swivel Male Branch Tee** 1872x-S pg. 90	**Female Branch Tee** 1877x pg. 90	**Adapter Tee** 1883x pg. 90	**Pressure Plug** 1829x pg. 90

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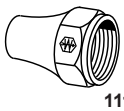
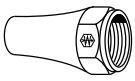
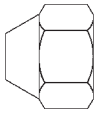
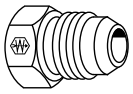
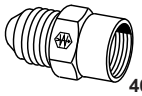
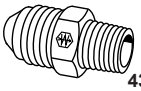
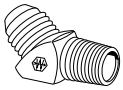
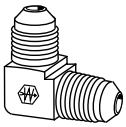
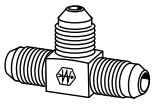
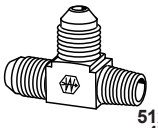
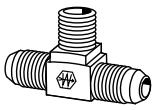
APPLICATION

SAE 45° FLARE

Nut  1110x pg. 43	Long Nut  41x pg. 43	Cap  40x pg. 43	Plug  39x pg. 43	Union  42x pg. 43	Male Connector  48x pg. 44	Female Connector  46x pg. 44
Male Ball Check Connector  43x pg. 44	45° Male Elbow  54x pg. 44	Fem 45° Flare Swivel to Male SAE 45° Elbow (Steel)  9154x pg. 45	AC Type Adapter  pg. 45	Adapter SAE 45° Flare to Inv. Flare  pg. 45	Union Elbow  55x pg. 45	Male Elbow  49x pg. 46
Female Elbow  50x pg. 46	90° Elbow 45° Female Swivel to SAE 45° (Steel)  9151x pg. 46	Union Tee  44x pg. 47	Male Run Tee  51x pg . 47	Male Branch Tee  45x pg. 47	Adapter Tee  56x pg. 47	

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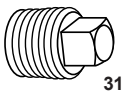
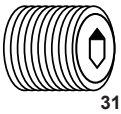
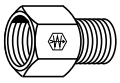
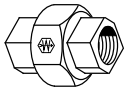
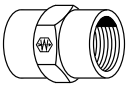
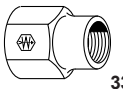
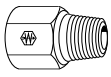
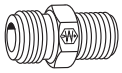
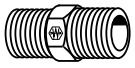
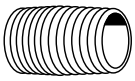
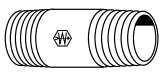
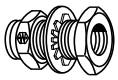
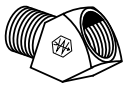
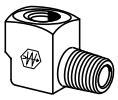
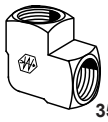
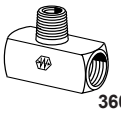
Cap  3129x pg. 105	Slotted Plug  3150x pg. 105	Square Head Plug  3151x pg. 105	Hex Head Plug  3152x pg.	Hex Socket Plug  3153x pg. 105	Adapter  3200x pg. 105	Bushing  3220x pg. 106
Union  3250x pg. 106	Coupling  3300x pg. 106	Reducer Coupling  3300x pg. 106	Restriction Pipe Adapter  pg. 106	Fuel Line Adapter  pg. 107	Hex Nipple  3325x pg. 107	Close Nipple  3326x pg. 107
Long Nipple  3331x pg. 107	Bulkhead Coupling (brass)  pg. 108	45° Street Elbow  3350x pg. 108	Street Elbow  3400x pg. 108	Elbow  3500x pg. 109	Male Branch Tee  3600x pg. 109	Tee 3700x pg. 109
Male Run Tee 3750x pg. 109	Cross 3950x pg. 109					

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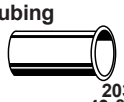
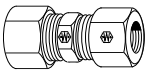
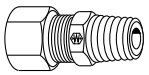
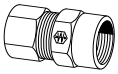
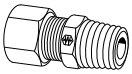
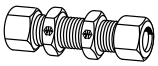
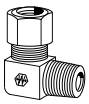
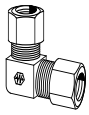
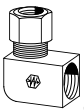
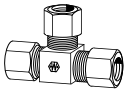
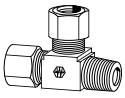
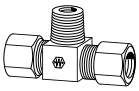
COMPRESSION & SELFALIGN FITTINGS

Tube Support For Plastic Tubing  2030x pg. 49 & 56	Sleeve  60x pg. 49 601x pg. 56	Nut  61x pg. 49 611x pg. 56	Long Nut  1611x pg. 50 & 56	Bulkhead Nut  0102x pg. 50 & 56	Union  62x pg. 50 621x pg. 57	Male Connector  68x pg. 50 681x pg. 57
Female Connector  66x pg. 51 661x pg. 57	Male Ball Check Connector  63x pg. 51 631x pg. 57	Bulkhead Union  74x pg. 51 741x pg. 58	Male Elbow  69x pg. 52 691x pg. 58	Union Elbow  65x pg. 52 651x pg. 58	Female Elbow  70x pg. 52 701x pg. 58	Union Tee  64x pg. 53 641x pg. 59
Male Run Tee  71x pg. 53 711x pg. 59	Male Branch Tee  72x pg. 53 721x pg. 59	Adapter Tee  76x pg. 53				

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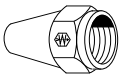
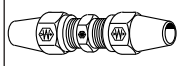
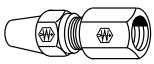
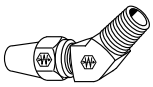
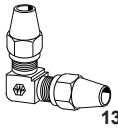
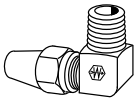
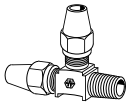
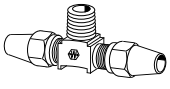
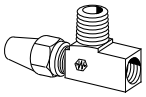
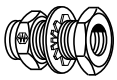
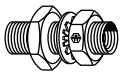
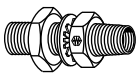
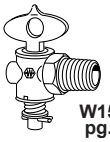
Sleeve  1360x pg. 98	Nut  1361x pg. 98	Union  1362x pg. 98	Male Connector  1368x pg. 98	Female Connector  1366x pg. 99	45° Male Elbow  1380x pg. 99	Union Elbow  1365x pg. 99
90° Male Elbow  1369x pg. 99	90° Male Elbow Long  1369x-L pg. 99	90° Female Elbow  1370x pg. 100	Union Tee  1364x pg. 100	Male Run Tee  1371x pg. 100	Male Branch Tee  1372x pg. 100	Adapter Tee  1382x pg. 100
Bulkhead Coupling (Brass)  pg. 101	Bulkhead Coupling (Brass)  pg. 101	Bulkhead Coupling (Brass)  pg. 101	Drain Cock  W15310 pg. 101	Shut-Off Valve  W2033L pg. 101	External Seat Draincock  145 pg. 101	

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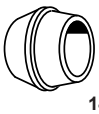
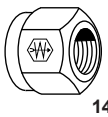
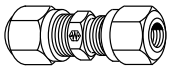
Sleeve  1460x pg. 92	Nut  1461x pg. 92	Union  1462x pg. 92	Male Connector 1468x pg. 93	Female Connector 1466x pg. 93	Bulkhead Union 1474x pg. 93	45° Male Elbow 1480x pg. 93
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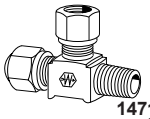
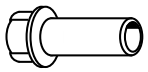
Male Run Tee  1471x pg. 95	Adapter Tee  1482x pg. 96	Insert  1484x pg. 96	Gauge Ring  1485x pg. 96			

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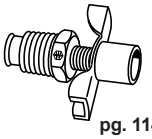
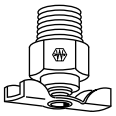
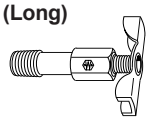
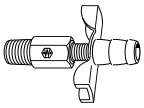
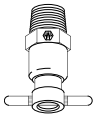
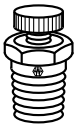
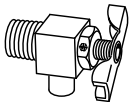
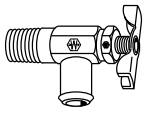
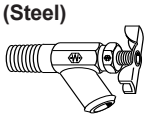
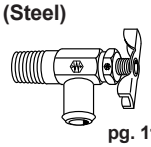
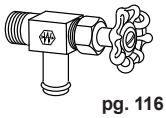
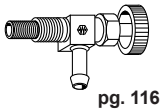
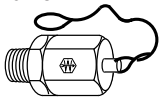
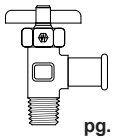
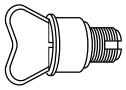
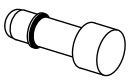
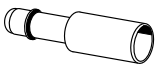
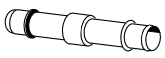
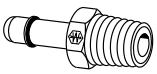
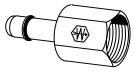
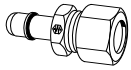
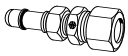
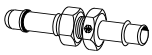
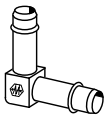
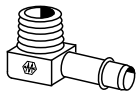
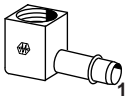
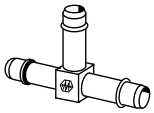
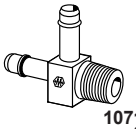
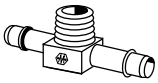
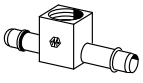
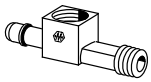
External Seat  pg. 114	External Seat  pg. 114	Internal Seat  pg. 114	Internal Seat (Long)  pg. 114	Internal Seat  pg. 115	Internal Seat Drain Valve  pg. 115	Air Vent  pg. 115
Angle Bib Drain  pg. 115	Angle Bib Drain  pg. 115	Hose to Pipe (Steel)  pg. 116	Hose to Pipe (Steel)  pg. 116	Pipe to Hose Shut-Off  pg. 116	Gasoline Shut-Off  pg. 116	Air Tank Drain Valve  pg. 116
Truck Valves  pg. 117	Plastic Drain Cocks  pg. 117					

MINI-BARB®

Plug  1073x pg. 80	Solder Connector  1079x pg. 80	Union  1062x pg. 80	Male Connector  1068x pg. 80	Female Connector  1066x pg. 80	Compression Connector  1078x pg. 80	Bulkhead Compression Connector  1067x pg. 81
Bulkhead Union  1074x pg. 81	Union Elbow  1065x pg. 81	90° Male Elbow  1069x pg. 81	90° Female Elbow  1070x pg. 81	Union Tee  1064x pg. 82	Male Run Tee  1071x pg. 82	Male Branch Tee  1072x pg. 82
Female Branch Tee  1077x pg. 82	Adapter Tee  1075x pg. 82					

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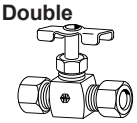
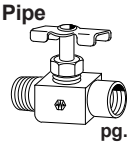
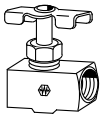
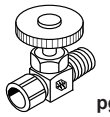
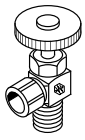
Compression Double  pg. 111	Compression Straight-Away  pg. 111	Compression Angle  pg. 111	Inverted Straight-Away  pg. 111	Male Pipe  pg. 112	Female to Male Pipe  pg. 112	Female Pipe  pg. 112
SAE 45° Flare Double  pg. 112	SAE 45° Flare Straight-Away  pg. 113	SAE 45° Flare Angle  pg. 113	Polyline Straight-Away  pg. 113	Polyline Angle  pg. 113		

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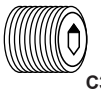
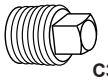
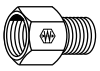
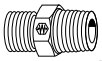
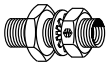
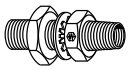
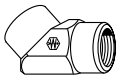
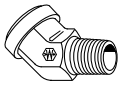
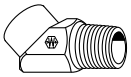
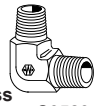
Seal-Nut for Male Pipe Threads  C3059x pg. 140	Hex Socket Plug  C3169x pg. 140	Square Head Plug  C3179x pg. 140	Hex Head Plug  Stainless Steel No. 3171x C3159x pg. 140	Bushing  Stainless Steel No. 3121x C3109x pg. 141	Straight Thread O-Ring to Female Pipe Adapter  C3269x pg. 141	Adapter  Stainless Steel No. 3221x C3209x pg. 141
Female Straight Thread O-Ring to Male Pipe Adapter  C3239x pg. 142	Coupling  Stainless Steel No. 3321x C3309x pg. 142	Hex Nipple  Stainless Steel No. 3081x C3069x pg. 142	Male Connector  4205x pg. 142	Male Straight Thread O-Ring to Male Pipe Adapter  C3249x pg. 142	Bulkhead Coupling  W05465 pg. 143	Bulkhead Coupling  W05498 pg. 143
Bulkhead Coupling  W05730 pg. 143	45° Elbow  C3559x pg. 143	45° Elbow  TF3559x pg. 143	45° Street Elbow  Stainless Steel No. 3371x C3359x pg. 143	45° Street Elbow  TF3359x pg. 143	90° Elbow  Stainless Steel No. 3521x C3509x pg. 144	90° Elbow  TF3509x pg. 144
90° Street Elbow  Stainless Steel No. 3421x C3409x pg. 144	90° Street Elbow  TF3409x pg. 144	90° Straight Thread O-Ring Male Elbow  C3459x pg. 145	90° Straight Thread O-Ring Male Elbow  TF3459x pg. 145	90° Straight Thread O-Ring Male Elbow Long  C3469x pg. 145	90° Straight Thread O-Ring Male Elbow to Male Pipe  TF3569x pg. 145	90° Male Elbow  Stainless Steel No. 3541x C3529x pg. 146
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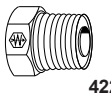
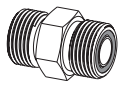
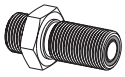
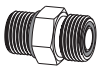
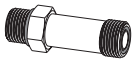
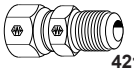
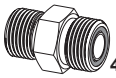
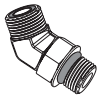
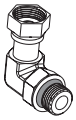
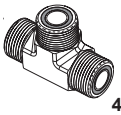
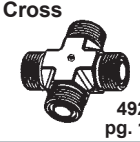
Tailpiece Silver Braze  4165x pg. 157	For-Seal® Cadmium Free Braze Ring  4640x pg. 157	Bulkhead Nut  4924x pg. 157	Nut  4105x pg. 157	Cap  4129x pg. 157	Plug  4229x pg. 158	Union  4305x pg. 158
Bulkhead Union  4325x pg. 158	Straight Thread O-Ring Connector  4315x pg. 158	Straight Thread O-Ring Extended Connector  4316x pg. 159	Male 37° Flare to Female For-Seal  4213x pg. 159	For-Seal Male to Ermeto Connector  4307x pg. 159	45° Male Elbow  4325x pg. 160	Straight Thread O-Ring Connector 45° Elbow  4365x pg. 160
45° Bulkhead Elbow  4375x pg. 160	Union 90° Elbow  4505x pg. 160	Bulkhead Union 90° Elbow  4525x pg. 161	90° Male Elbow  4405x pg. 161	Straight Thread O-Ring 90° Elbow  4515x pg. 161	90° Straight Thread Swivel  4535x pg. 162	Union Tee  4705x pg. 162
Straight Thread Branch Tee  4715x pg. 162	Straight Thread Run Tee  4716x pg. 163	Bulkhead Run Tee  4726x pg. 163	Male For-Seal Cross  4929x pg. 163	O-Ring For-Seal  4629x pg. 163		

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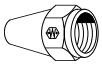
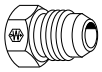
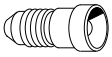
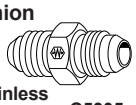
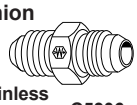
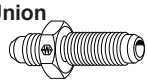
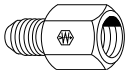
Sleeve 3 Piece  Stainless Steel No. 5177x C5165x pg. 166	Sleeve 3 Piece Metric  C5165x pg. 166	Nut 3 Piece  Stainless Steel No. 5117x C5105x pg. 166	Nut 2 Piece (Short)  C5125x pg. 166	Nut 2 Piece  C5115x pg. 166	Bulkhead Nut  Stainless Steel No. 7936x C5924x pg. 167	Cap  Stainless Steel No. 5141x C5129x pg. 167
Plug  Stainless Steel No. 5241x C5229x pg. 167	Reducer  Stainless Steel No. 5027x C5015x pg. 167	Small Hex Union  Stainless Steel No. 5317x C5305x pg. 168	Large Hex Union  Stainless Steel No. 5318x C5306x pg. 168	Bulkhead Union  Stainless Steel No. 5337x C5325x pg. 168	Male Connector  Stainless Steel No. 5217x C5205X pg. 169	Female Connector  C5255x pg. 169
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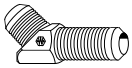
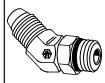
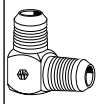
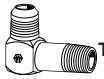
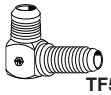
45° Bulkhead Union Elbow  TF5375x pg. 173	**Straight Thread O-Ring 45° Elbow**  C5365x pg. 174	**Straight Thread O-Ring 45° Elbow**  TF5365x pg. 174	**90° Union Elbow**  Stainless Steel No. 5517x C5505x pg. 174	**90° Union Elbow**  TF5505x pg. 174	**90° Male Elbow**  Stainless Steel No. 5417x C5405x pg. 175	**90° Male Elbow**  TF5405x pg. 175
90° Male Elbow Long  C5425x pg. 176	**90° Male Elbow Long**  TF5425x pg. 176	**90° Male Elbow Extra Long**  TF5435x pg. 176	**Bulkhead Union 90° Elbow**  Stainless Steel No. 5537x C5525x pg. 176	**Bulkhead Union 90° Elbow**  TF5525x pg. 176	**90° Female Elbow**  Stainless Steel No. 5467x C5455x pg. 177	**90° Female Elbow**  TF5455x pg. 177
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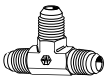
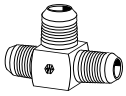
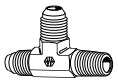
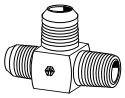
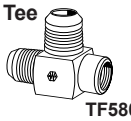
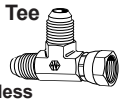
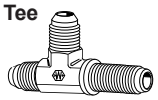
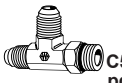
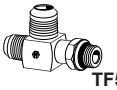
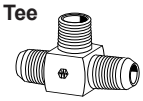
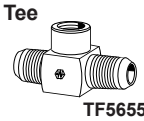
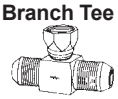
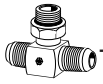
Union Tee  Stainless Steel No. 5717x C5705x pg. 179	**Union Tee**  TF5705x pg. 179	**Male Run Tee**  Stainless Steel No. 5767x C5755x pg. 180	**Male Run Tee**  TF5755x pg. 180	**Female Run Tee**  TF5805x pg. 180	**Swivel Nut Run Tee**  Stainless Steel No. 5718x C5706x pg. 180	**Swivel Nut Run Tee**  TF5706x pg. 180
Bulkhead Run Tee  TF5726x pg. 161 C5726x pg. 181	**Straight Thread O-Ring Run Tee**  C5716x pg. 181	**Straight Thread O-Ring Run Tee**  TF5716x pg. 181	**Male Branch Tee**  Stainless Steel No. 5617x C5605x pg. 181	**Male Branch Tee**  TF5605x pg. 181	**Female Branch Tee**  Stainless Steel No. 5667x C5655x pg. 182	**Female Branch Tee**  TF5655x pg. 182
Swivel Nut Branch Tee  Stainless Steel No. 5719x C5707x pg. 182	**Swivel Nut Branch Tee**  TF5707xx pg. 182	**Bulkhead Union Tee**  Stainless Steel No. 5737x TF5725x pg. 182	**Straight Thread O-Ring Branch Tee**  C5715x pg. 183	**Straight Thread O-Ring Branch Tee**  TF5715x pg. 183	**Cross** Stainless Steel No. 5967x TF5955x pg. 183	**Straight Thread O-Ring** 7629x pg. 183

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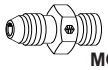
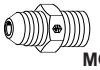
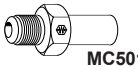
Metric Flareless Sleeve  7165x pg. 211	Metric Flareless Nut - Light Series  ML7105x pg. 211	Metric Flareless Nut - Heavy Series  MH7105x pg. 211	Male SAE 37° to 24° Metric Tube Seat (Light)  MC5206x pg. 212	Male SAE 37° to 24° Metric Tube Seat (Heavy)  MC5208x pg. 212	Male SAE (JIC) 37° to 60° Metric Tube Seat  MC5207x pg. 212	Male SAE 37° to Male Metric Stand Pipe  MC5019x pg. 212
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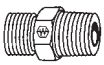
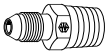
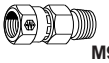
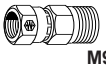
Coupling  MC3309x pg. 215	Hex Nipple  MC3069x pg. 216	Male BSPT to Male SAE 37°  MC5205x pg. 216	BSPP Female To NPTF Male Adapter  1150x pg. 216	BSPP Male To NPTF Female Adapter  1100x pg. 217	Male BSPP to Male SAE 37°  MB5315x pg. 217	Female SAE 37° Swivel to Male BSPP  M9800x pg. 217
Female SAE 37° Swivel to Male BSPP  M9600x pg. 217	Male BSPT to Male SAE 37° Elbow  MC5405x pg. 218	Male BSPP to Male SAE 37° Elbow  MB5515x pg. 218	British Retaining Ring  MB7630x pg. 218	British O-Ring  MB7629x pg. 218		

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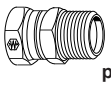
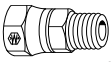
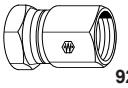
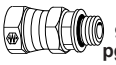
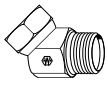
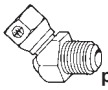
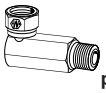
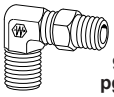
Female Pipe Swivel to Male Pipe  9205x pg. 148	Fem. SAE 37° Swivel to Male Pipe  9100x pg. 148	Fem. Pipe Sw. to Fem. Pipe  9255x pg. 149	Male Straight Thread O-Ring to Fem. Pipe Swivel  9315x pg. 149	Female Pipe Swivel to Male Pipe 45° Elbow  9355x pg. 150	Female Pipe Swivel to Female Pipe 45° Elbow  9385x pg. 150	Female 45° Flare Swivel to Male SAE 45° Elbow  9154x pg. 150
Male Straight Thread O-Ring to Fem. Pipe Sw. 45° Elbow  9365x pg. 151	Female Pipe Swivel to Male Pipe 90° Elbow  9405x pg. 151	Fem. Pipe Sw. to Male Pipe 90° Elbow - Long  9405x pg. 151	Fem. Pipe Sw. to Fem. Pipe 90° Elbow  9455x pg. 152	90° Elbow 45° Female Swivel to SAE 45°  9151x pg. 152	Male Straight Thread O-Ring to Fem. Pipe Sw. 90° Elbow  9515x pg. 152	Male Pipe Swivel to Male Pipe Rigid 90° Elbow  9435x pg. 153
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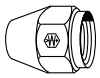
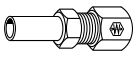
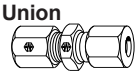
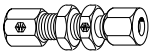
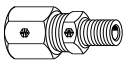
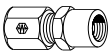
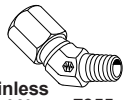
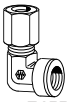
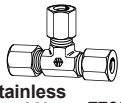
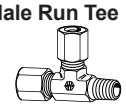
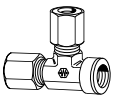
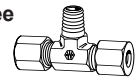
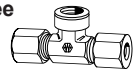
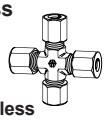
Sleeve  Stainless Steel No. 7165x 7176x pg. 201	**Sleeve - For Diesel Nut**  8165x pg. 201	**Nut**  Stainless Steel No. 7105x 7117x pg. 201	**Diesel Nut**  8112x pg. 201	**Bulkhead Nut**  Stainless Steel No. 7924x 7936x pg. 201	**Cap**  Stainless Steel No. 7129x 7141x pg. 202	**Plug**  Stainless Steel No. 7229x 7241x pg. 202
Reducer  Stainless Steel No. 7015x 7027x pg. 202	**Small Hex Union**  Stainless Steel No. 7305x 7317x pg. 202	**Large Hex Union**  Stainless Steel No. 7306x 7318x pg. 202	**Bulkhead Union**  Stainless Steel No. 7325x 7337x pg. 203	**Male Connector**  Stainless Steel No. 7205x 7217x pg. 203	**Female Connector**  Stainless Steel No. 7255x 7267x pg. 203	**Straight Thread O-Ring Connector**  Stainless Steel No. 7315x 7327x pg. 203
45° Male Elbow  Stainless Steel No. 7355x 7367x pg. 204	**90° Union Elbow**  Stainless Steel No. 7505x 7517x pg. 204	**90° Male Elbow**  Stainless Steel No. 7405x 7417x pg. 204	**90° Female Elbow**  Stainless Steel No. 7455x 7467x pg. 204	**Straight Thread O-Ring 90° Elbow**  Stainless Steel No. 7515x 7527x pg. 205	**Union Tee**  Stainless Steel No. 7705x 7717x pg. 205	**Male Run Tee**  Stainless Steel No. 7755x 7767x pg. 205
Female Run Tee  7805x pg. 205	**Straight Thread O-Ring Run Tee**  Stainless Steel No. 7716x 7728x pg. 206	**Male Branch Tee**  Stainless Steel No. 7605x 7617x pg. 206	**Female Branch Tee**  Stainless Steel No. 7655x 7667x pg. 206	**Straight Thread O-Ring Branch Tee**  Stainless Steel No. 7715x 7727x pg. 207	**Cross**  Stainless Steel No. 7955x 7967x pg. 207	**Straight Thread O-Ring**  7629x pg. 207

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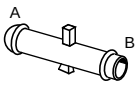
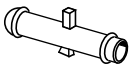
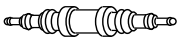
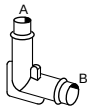
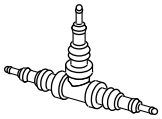
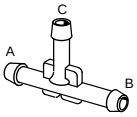
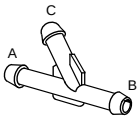
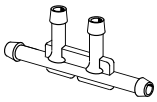
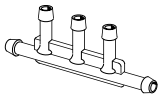
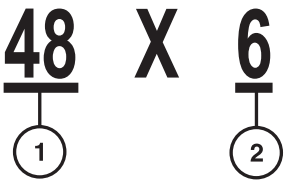
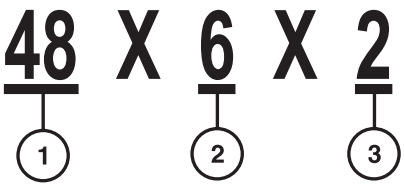
KYNAR Check Valve  1531x pg. 136						

Additional Plastic Fittings

Straight Connector  pg. 137	Restrictor Connector  pg. 137	Universal Connector  pg. 137	Elbow Connector  pg. 137	Universal Tee  pg. 137	3 Way Tee  pg. 137	Y Connector  pg. 137
4 Way Tee  pg. 137	5 Way Tee  pg. 137					

Numbering Systems





Numbering Systems

Fittings are identified by a series of numbers separated by the letter “X.”

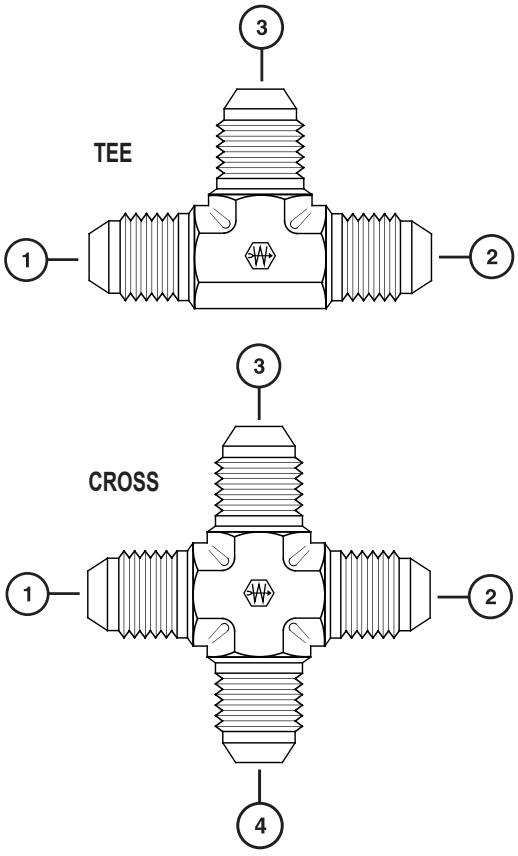
1. The number preceding the “X” is the Catalog “Base Number” and indicates the type of fitting. See Table 1 below for additional base number data (sometimes refered to as dash size).

2. The second number is the tube and/or pipe size in sixteenths of an inch. When a pipe thread for a given tube size follows the SAE standard as shown in Table 2, no other number is required. Example: 48X6 = SAE 45° Flare Male Connector–3/8" tube, 1/4" Male Pipe.

3. If the pipe size is not to the SAE standard, another “X” is added followed by the pipe size indicated in sixteenths of an inch. Example: 1/8" is equal to 2/16" or X2 suffix.

TABLE 1

Type	Example Male Connector	Example Female Connector
45° Flare	48	46
Compression	68	66
Polyline®	1268	1266
Selfalign®	681	661
Air Brake (Nylon)	1468	1466
Air Brake (Copper)	1368	1366
(JIC) Flare-Twin®	C5205	C5255
7000 Series Ermeto®	7205	7255



In designating tube and pipe sizes for tees and crosses that are not SAE standard, indicate the sizes in the sequence shown.

TABLE 2

	Tube Size	Pipe Threads	
		Brass Fitting	Steel Fitting
X2	1/8"	1/8"	1/8"
X3	3/16"	1/8"	1/8"
X4	1/4"	1/8"	1/8"
X5	5/16"	1/8"	1/8"
X6	3/8"	1/4"	1/4"
X7	7/16"	1/4"	1/4"
X8	1/2"	3/8"	3/8"
X10	5/8"	1/2"	1/2"
X12	3/4"	1/2"	3/4"
X14	7/8"	3/4"	3/4"
X16	1"	1"	1"
X20	1-1/4"	No Standard	1-1/4"
X24	1-1/2"	No Standard	1-1/2"
X32	2"	No Standard	2"

Plating

Standard Boston Weatherhead Steel Pipe and Flare fittings are supplied with Zinc plate and a yellow Dichromate finish.

Steel Flareless fittings are supplied standard with the exclusive Weathercote® finish. Forged (JIC 37°) Flare-Twin fittings are designated by a prefix "C". To special order alternative plating, add prefix letter to the catalog base number. For example, a “C” prefix indicates Zinc plate (C7205X4), and a “W” prefix indicates Weathercote® (W5205X4).

Tube Fitting Selector Chart

Refer to safety information regarding tube fitting selection on page 1.

Weatherhead Fitting Types	Mini-Barb®	Polyline®	Threaded Sleeve	Pipe	Inverted Flare	SAE 45° Flare	Compression	Selfalign®	1400 Series Air Brake	1300 Series Air Brake	Push© Connect	Pipe	SAE 37° Flare-Twin®	7000 Series Ermeto®	For-Seal®	Q-CAB®	Molded Compression	
Fitting Material	Brass	Brass	Brass	Brass	Brass	Brass	Brass	Brass	Brass	Brass	Brass	Steel S.S.	Steel S.S.	Steel S.S.	Steel	Brass	Nylon Poly	
Tube Size (O.D. range in inches)	1/8 1/2	1/8 1/2	1/8 3/8	1/8 3/4	1/8 1	1/8 3/4	1/8 1	1/8 1	1/4 3/4	1/4 3/4	1/8 1/2	1/8 2	1/8 2	1/8 2	1/4 1-1/2	5/32 3/4	1/8 3/4	
Maximum Working Pressure (psi) Depends on tubing material, O.D., wall thickness and fitting size.	135	500	500	1200	2000	2000	2000	2000	150	150	250	6000	6,000	10,000	6,000	150	50/220	
Vibration (Comparative)																		
Fair																		
Good																		
Excellent																		
Tubing Types																		
Copper		E												A				
Steel																		
Aluminum		E																
Stainless Steel-Annealed															G			
Stainless Steel - 1/8-Hard															G			
Polyethylene							w/insert	w/insert										
Nylon									w/insert							E		
Polyvinyl Chloride (PVC)							w/insert	w/insert										
Bundy							B	B										
Conforms																		
SAE																		
JIC																		
UL				F	F	F	F											
ASA																		
ASME																		
Military									H									
DOT																		
Typical Use																		
Instrumentation																		
Oil-Air-Water																		
Refrigeration																		
Hydraulic Systems																		
Cooling Systems																		
Lubrication Systems																		
Air Brake																		

Recommendation and

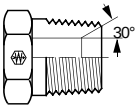
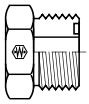
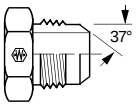
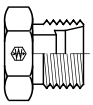
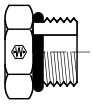
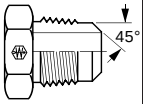
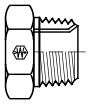
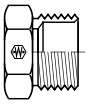
A — Copper tubing (half or full hard) may be used

E — Use brass sleeve only

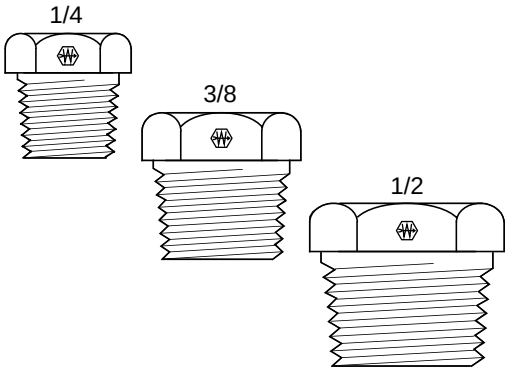
G — Cadmium Free Braze Ring

Application Fitting Identification

Fitting Thread Size Comparison Chart – The male connections have (Male unified thread class 2 fit) UN-2A specification threads and the female connections have (Female unified thread class 2 fit) UN-2B specification threads. The exceptions are male and female pipe threads.

								
Size	**Pipe Size**	**FOR-SEAL®**	**37° Flare Flare-Twin®**	**Ermeto® 7000 Series**	**Straight Thread O-Ring SAE**	**45° Flare**	**Inverted Flare**	**Compression**
1/16	1/16–27	–	–	–	–	–	–	–
1/8	1/8–27	–	5/16–24	5/16–24	5/16–24	5/16–24	5/16–28	5/16–24
3/16	–	–	3/8–24	3/8–24	3/8–24	3/8–24	3/8–24	3/8–24
1/4	1/4–18	9/16–18	7/16–20	7/16–20	7/16–20	7/16–20	7/16–24	7/16–24
5/16	–	–	1/2–20	1/2–20	1/2–20	1/2–20	1/2–20	1/2–24
3/8	3/8–18	11/16–16	9/16–18	9/16–18	9/16–18	5/8–18	5/8–18	9/16–24
7/16	–	–	–	–	–	11/16–16	11/16–18	5/8–24
1/2	1/2–14	13/16–16	3/4–16	3/4–16	3/4–16	3/4–16	3/4–18	11/16–20
5/8	–	1–14	7/8–14	7/8–14	7/8–14	7/8–14	7/8–18	13/16–18
3/4	3/4–14	1-3/16–12	1-1/16–12	1-1/16–12	1-1/16–12	1-1/16–14	1-1/16–16	1–18
7/8	–	1-3/16–12	1-3/16–12	1-3/16–12	1-3/16–12	–	1-3/16–16	–
1	1–11-1/2	1-7/16–12	1-5/16–12	1-5/16–12	1-5/16–12	–	1-5/16–16	1-1/4–18
1-1/4	1-1/4–11-1/2	1-11/16–12	1-5/8–12	1-5/8–12	1-5/8–12	–	–	–
1-1/2	1-1/2–11-1/2	2–12	1-7/8–12	1-7/8–12	1-7/8–12	–	–	–
2	2–11-1/2	2-1/2–12	2-1/2–12	2-1/2–12	2-1/2–12	–	–	–

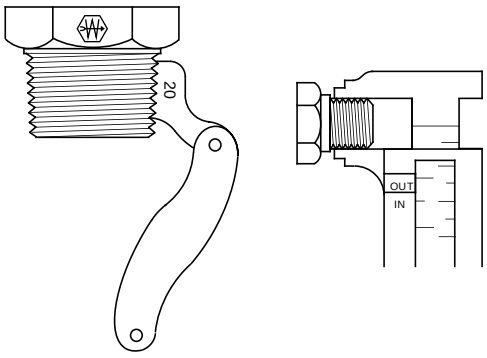
ACTUAL PIPE THREAD SIZES



PIPE FITTINGS

The Society of Automotive Engineers in cooperation with industry set up a standard for improvement in pipe threads. This improvement is known as the Dryseal Pipe Thread. All Weatherhead pipe threads are Dryseal American Standard Tapered Pipe Threads (NPTF). The metal to metal seal is formed by contact at the thread crest and root.

Nominal pipe sizes do not agree with either the I.D., O.D., or thread sizes. To determine pipe size (up to 1-1/4") measure the diameter of the threads and subtract 1/4". For example, subtract 1/4" from a 1" thread O.D. to obtain the nominal pipe size of 3/4".



TUBE FITTINGS

There are four basic types of tube fittings; Flare, Flareless, Straight Thread O-Ring, and Flat Face O-Ring Seal (FOR-SEAL®). Tube fittings seal in two ways. Flare and Flareless fittings use metal to metal contact joints. Straight Thread O-Ring and Flat Face O-Ring fittings use a rubber O-Ring. Where extreme vibration is present, use Flareless, Straight Thread or Flat Face O-Ring Seal fittings.

SIZING: For accuracy, it is recommended the male thread be measured. Measure the outside diameter. For our example use 7/16". Next measure the threads per inch, use 20. Our fitting size measures 7/16-20. Refer to the thread chart above for appropriate tube size and illustration.

Fitting Identification

Identifying metric, or non-USA, threaded connections is similar to identifying the connections that have been commonly used in the United States. The following text covers how to identify the different styles of metric connections offered by Weatherhead.

THREADS - The thread forms and their corresponding specifications listed below are used on all of the metric styles of connections which will be discussed later. These cover the basic forms of the threads but not the style of connection.

Thread Type	Specifications
British Parallel Pipe Threads	BS 2779, ISO/R 228
British Taper Pipe Threads	BS 21, ISO/R 7
Metric Parallel Threads	DIN 3852, ISO/R 6149
Metric Taper Threads	DIN 3852

NOTE: BS–British Standards Institution
ISO–International Standards Organization
DIN–Deutsche Industrie Norme

To identify metric connections, you will need instruments that can accurately measure thread inside and outside diameters, thread pitch and fitting seat angles. The TA-1002 Thread Measuring Guide and Tool Kit is a basic kit that will help you in identifying most of the connections you will be encountering on imported equipment.

PARALLEL and TAPERED THREADS

Parallel Threads ('G')

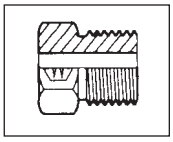


Figure 1.

Tapered Threads ('R')

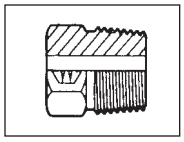


Figure 2.

The first step in identifying thread forms is to determine if the thread is parallel or tapered. Parallel threads are not used for sealing fluids. Sealing is achieved by an elastomeric o-ring, metal seal, machined ring into the hex itself or a seat machined into the end of the fitting. This style is similar to straight thread o-ring port connections where the threads are used for retention of the sealing method against a machine port. Parallel threads can be determined by laying a straight edge along the threads. If the threads are parallel to the center line of the fitting, then the fitting has parallel threads. See Figure 1.

Tapered threads seat by the interference caused by the male and female threads. These threads create a pressure-tight joint by metal deformation when they are tightened. Sealants on the threads are commonly used in this style of connection. Laying a straight edge on the threads, compare this line with the center line of the fitting. If this line tapers slightly away from the center line, then the threads are tapered. See Figure 2.

BRITISH PIPE THREADS

There are two forms of British Standard Pipe Threads that are used in the world today. They are BSPP (British Standard Pipe Parallel) and BSPT (British Standard Pipe Tapered). The BSPT male thread mates with the female BSPT thread similar to an NPTF connection. The 30° BSPP male adapters connect to a female BSPP thread with a 30° cone. This style is comparable to an NPSM swivel style. These threads are almost identical to the NPTF Pipe Thread except for the flank angle. This angle is 55° versus 60° on the NPTF. See Figure 3. Because of this difference, the two forms are **NOT** interchangeable.

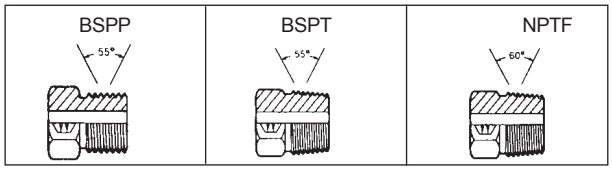


Figure 3.

Identifying BSP threads starts with determining if it is a parallel or tapered thread. Next, referencing Figure 4, measure the lead thread diameter. Compare this measurement to the listed dimensions to determine size. If instruments are not available to measure this, you can compare it end-to-end with a known NPTF thread to approximately arrive at the nominal BSP size. Finally, measure the pitch and compare it to the chart on Figure 4a to complete the identification. These dimensions will be the same for both BSPP and BSPT.

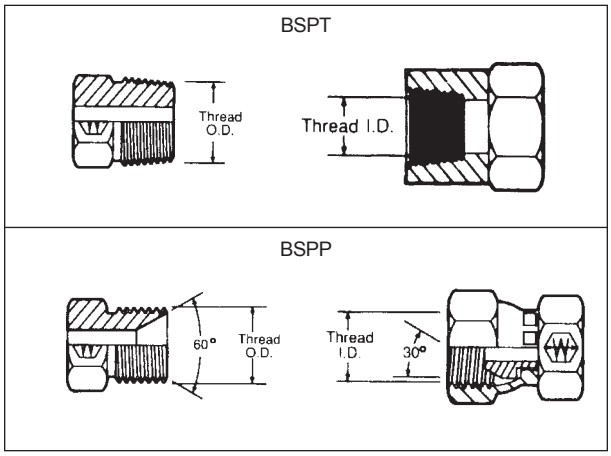


Figure 4.

BSP Thread Size	1/8-28	1/4-19	3/8-19	1/2-14	5/8-14	3/4-14	1-11	1-1/4–11	1-1/2–11	2-11
Male Thread Diameter	9.72 (.375)	13.16 (.518)	16.66 (.656)	20.96 (.825)	22.91 (.902)	26.44 (1.041)	33.25 (1.309)	41.91 (1.650)	47.80 (1.882)	59.51 2.347
Female Thread Diameter	8.73 (.343)	11.66 (.459)	15.37 (.605)	18.90 (.744)	20.85 (.821)	24.38 (.960)	30.61 (1.205)	39.24 (1.545)	45.24 (1.781)	55.94 2.242
Pitch	.91 (.036)	1.34 (.053)	1.34 (.053)	1.81 (.071)	1.81 (.071)	1.81 (.071)	2.31 (.091)	2.31 (.091)	2.31 (.091)	2.31 (.091)

BSPP & BSPT Thread Chart

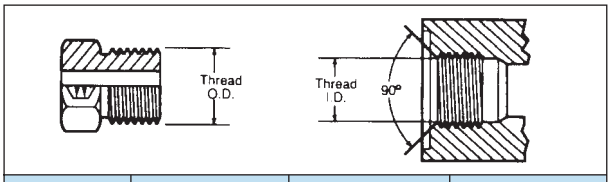
Figure 4a. Dimension Note: MM(IN)

See page 224 for Thread Measuring Kits.

Fitting Identification

METRIC THREADS

Metric threads are similar to inch-sized threads except for the sizing which is based on standard metric units. Identifying metric threads starts with determining if it is a parallel or tapered thread. Next, measure the thread diameter. Compare this measurement to the dimensions listed in Figure 5 to determine size. Finally, measure the pitch and compare to chart. These dimensions will be common for both parallel and tapered threads.

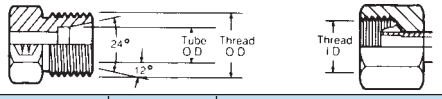


Metric Thread Size	Male Thread Diameter		Female Thread Diameter		Pitch	
	MM	IN	MM	IN	MM	IN
M10 x 1.0	10.0	.394	8.5	.335	1.0	.039
M12 x 1.5	12.0	.472	10.5	.413	1.5	.059
M14 x 1.5	14.0	.551	12.5	.492	1.5	.059
M16 x 1.5	16.0	.630	15.5	.610	1.5	.059
M18 x 1.5	18.0	.709	16.5	.650	1.5	.059
M20 x 1.5	20.0	.787	18.5	.728	1.5	.059
M22 x 1.5	22.0	.866	20.5	.807	1.5	.059
M24 x 1.5	24.0	.945	22.5	.886	1.5	.059
M26 x 1.5	26.0	1.024	24.5	.964	1.5	.059
M27 x 2.0	27.0	1.063	25.5	1.004	2.0	.079
M30 x 2.0	30.0	1.181	28.5	1.122	2.0	.079
M33 x 2.0	33.0	1.299	31.5	1.240	2.0	.079
M36 x 2.0	36.0	1.417	34.5	1.358	2.0	.079
M42 x 2.0	42.0	1.653	40.5	1.594	2.0	.079

Figure 5.

METRIC FLARELESS CONNECTIONS–Din 3901/3902L, 3901/3902S

The most popular metric flareless, or bite-type, fitting style is the 24° Metric Tube Seat. This style incorporates a tapered seat in the fitting body with a bite-type sleeve, or ferrule, for the connection. When the nut is tightened, the tapered seat forces the sleeve into the tube creating a positive seal. This style of connection is available in both a Light and Heavy series and is designed for medium and high pressure applications respectively. The two series have different parallel thread sizes in relationship to the nominal tube outside diameter, but share a common sleeve. This style can be identified by the combination of the 24° internal seat and a male metric parallel thread. The series can be determined by measuring the seat counterbore, which is the approximate tube outside diameter, and comparing it to the thread size. Compare these dimensions to those shown in Figure 6 to determine the series. The nominal sleeve size is taken directly from the tube outside diameter dimension.



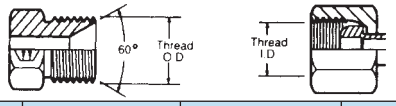
Tube O.D.		Nom. O.D.	Series–Thread	
MM	IN	(MM)	LIGHT - l.Rh.	HEAVY - s.Rh.
8	.315	8	M14 x 1.5	M16 x 1.5
10	.394	10	M16 x 1.5	M18 x 1.5
12	.472	12	M18 x 1.5	M20 x 1.5
14	.551	14	—	M22 x 1.5
15	.591	15	M22 x 1.5	—
16	.630	16	—	M24 x 1.5
18	.709	18	M26 x 1.5	—
20	.787	20	—	M30 x 2.0
22	.866	22	M30 x 2.0	—
25	.984	25	—	M36 x 2.0
28	1.102	28	M36 x 2.0	—
30	1.181	30	—	M42 x 2.0

Figure 6.

See page 224 for Thread Measuring Kits.

METRIC 60° TUBE SEAT–DIN 7631

This series combines an internal 60° seat with parallel metric Light series threads. Mating with female metric swivel fittings with a globe seal made to DIN 3863L, this connection provides a metal to metal seal when tightened. This style can be identified by the internal 60° seat on the male metric threaded portion. Reference Figure 7 for thread information.

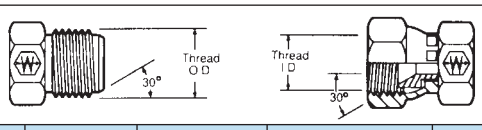


Metric Thread Size	Male Thread Diameter		Female Thread Diameter		Pitch	
	MM	IN	MM	IN	MM	IN
M12 x 1.5	12.0	.472	10.5	.413	1.5	.059
M14 x 1.5	14.0	.551	12.5	.492	1.5	.059
M16 x 1.5	16.0	.630	15.5	.610	1.5	.059
M18 x 1.5	18.0	.709	16.5	.650	1.5	.059
M22 x 1.5	22.0	.866	20.5	.807	1.5	.059
M26 x 1.5	26.0	1.024	24.5	.964	1.5	.059

Figure 7.

JAPANESE METRIC 30° FLARE

The Japanese 30° flare style is similar to the 37° JIC flare connection except for two things. The seat angle is 30° and threads are metric straight threads. This fitting is often referred to as a 'Komatsu' style connection. To identify this style, first verify the seat angle is 30°. Next establish the metric thread size by measuring the thread outside diameter. Compare this dimension to those shown in Figure 8. The threads in this series will conform to Japanese Industrial Standard (JIS) B 0207.

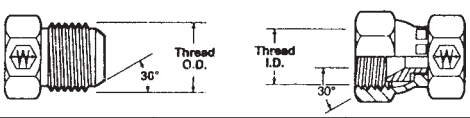


Metric Tube Size	Metric Thread Size	Male Thread Diameter		Female Thread Diameter		Pitch	
MM	MM	MM	IN	MM	IN	MM	IN
6	M14x1.5	14	.551	12.5	.492	1.5	.059
9	M18x1.5	18	.709	16.5	.650	1.5	.059
12	M22x1.5	22	.866	20.5	.807	1.5	.059
16	M24x1.5	24	.945	22.5	.886	1.5	.059
19	M30x2.0	30	1.181	28.5	1.122	2.0	.079
25	M33x2.0	33	1.299	31.5	1.240	2.0	.079
32	M42x2.0	42	1.653	40.5	1.594	2.0	.079

Figure 8.

JAPANESE 30° FLARE (JIS)

Similar to BSPP and a 30° seat. The seal is made when contact is made between the male and female flares, with the threads retaining the connection. The JIS 30° flare is similar to the 37° flare connection. To determine the difference between the JIS 30° flare and the JIC 37° flare, carefully measure the seat angle. The threads in this series conform to Japanese Industrial Standard (JIS) B 0202.



Inch Size	Thread Size	Male Thread O.D.		Female Thread I.D.	
		IN	MM	IN	MM
1/4	1/4-19	17/32	13.7	1/2	12.4
3/8	3/8-19	11/16	17.2	5/8	16.0
1/2	1/2-14	27/32	21.5	25/32	19.8
3/4	3/4-14	1-1/16	26.9	1	25.4
1	1-11	1-11/32	34.0	1-1/4	31.8
1-1/4	1-1/2-11	1-29/32	48.5	1-27/32	46.2
2	2-11	2-3/8	60.4	2-5/16	58.2

Figure 9.

Tubing Selection

⚠ Refer to safety information regarding tubing selection on page 1.

To select tubing for a particular installation, two factors must be determined…
1.) **tubing type** - material and construction and
2.) **size** - inside diameter (I.D.) and wall thickness. Information listed below will aid in your tubing selection.

TUBING TYPES

Commercial tubing is available in a wide variety of materials, types of construction and quality. Each is best suited for certain specific applications.

STEEL TUBING - Seamless SAE 1010 fully annealed and SAE welded types suitable for bending and flaring. This is the only tubing material approved without restrictions by SAE standards.

STAINLESS STEEL TUBING - Both seamless *18-8 fully annealed and welded types suitable for bending and flaring. Stainless steel tubing is recommended for use with very high pressures and where large diameter tubing is required. It is also suited for many applications where corrosion is a problem.

* (302, 303 and/or 304)

ALUMINUM TUBING - Seamless annealed is approved by SAE for low pressure applications.

COPPER TUBING - Seamless fully annealed coils and fully annealed or quarter-hard straight lengths can be used for systems that do not use petroleum based fluids (copper acts as an oil-oxidation catalyst, causing sludge). Copper also tends to work harden when flared or bent and has poor resistance to vibration. Therefore, the use of copper tubing is limited to low-pressure stationary applications and air circuits.

SPECIAL ALLOY TUBING - May be required for specific corrosion problems. Information on these applications can be obtained from your tubing supplier or from tubing manufacturers.

TUBING SIZE

The two variables in tubing size are the inside diameter (ID) and the wall thickness. Each of these is dependent upon a number of factors.

INSIDE DIAMETER - The tubing I.D. will determine the flow and velocity of the fluid in the system.

Flow is the volume of fluid that is to be moved through the line to perform a given job within a specified time. Flow rate is expressed in gallons per minute (gpm).

Velocity is the rate of speed at which the fluid passes through the line. It is expressed in feet per second (fps). With a given flow rate, the velocity will increase as the inside diameter of the tubing decreases.

To determine the appropriate tubing I.D. for specific flow rate and velocity, refer to the Velocity vs. Flow chart on page 21.

WALL THICKNESS - The required wall thickness of the tubing depends upon operating pressure, safety factor, temperatures, and tubing material.

Operating Pressure is the pressure of the fluid in the system. It is expressed in pounds per square inch (psi).

Safety Factor is a multiplier applied to the wall thickness that compensates for additional mechanical strains and hydraulic shocks to which the tubing may be subjected during operation.

To determine the appropriate wall thickness, refer to the data on pages 22 and 23.

PRESSURE DROP

Total pressure supplied to a line must equal usable pressure (or output) plus the pressure that is lost through fluid transmission, which is referred to as pressure drop. These pressure drops cause loss of energy and should be kept to a minimum. Elements which cause pressure drop in the transmission of fluids include sudden enlargements or contractions, bends, fittings and valves.

Mathematical analysis of pressure drop, although possible, is not precise because of the interrelationship of factors such as fluid velocity, density, flow area and friction coefficients. Therefore, to obtain optimum efficiency, the system (or the questionable portions of the system) should be mocked-up to obtain empirical pressure drop data.

Application — Tubing Selection

⚠ Refer to safety information regarding tubing selection on page 1.

Following is a typical problem that illustrates, step by step, the procedure for determining tube size.

Select 1010 steel tubing with the appropriate I.D. and wall thickness for the following conditions:

Flow	— 5 gpm
Velocity	— not to exceed 10 fps
Pressure	— 2000 psi
Safety Factor	— 4:1

SOLUTION:

1. Using the Flow/Velocity chart on Page 21, follow the horizontal flow line (5 gpm) until it intersects the vertical velocity line (10fps). From this point, follow the diagonal line upward to get the required tube I.D. (.444). If the horizontal flow line and the vertical velocity line intersect between two diagonal lines, normally the larger inside diameter would be selected since it would mean less velocity.

2. Refer to the chart of Standard Size Hydraulic Tubing, at right. Note that .444 I.D. tubing is not listed. If you want to use standard tubing, select one with a larger I.D. Do not select a smaller size since this would increase the velocity to over the 10 fps limit. Therefore, by going to the next largest size, you would select the 5/8" O.D. tubing having an I.D. of .459 and a wall thickness of .083.

3. To determine whether this tubing will meet the pressure and safety factor requirements, refer to the Recommended Wall Thickness data on pages 24 and 25. For 5/8" O.D. tubing at 2000 psi, the chart for 1010 steel indicates that the minimum wall thickness with a safety factor of 4:1 is .04545. Since you have selected a tubing with a .083 wall, this would easily fulfill the requirements. However, for savings on weight and cost, you can select another tubing with a thinner wall that will still meet the performance requirements. Therefore, refer again to the chart on standard size tubing and select a tubing with a wall thickness closer to the minimum requirements. This would be the 5/8" O.D. tubing with a .527 I.D. and a .049 wall. This tubing will handle the pressure requirements of 2000 psi with a safety factor of 4:1, and also provides the required flow while keeping the velocity within the 10 fps limitation.

STANDARD SIZE HYDRAULIC TUBING

Tube O.D.	Tube I.D.	Wall	Tube O.D.	Tube I.D.	Wall
1/8"	.055	.035	3/4"	.584	.083
	.061	.032		.606	.072
	.065	.030		.620	.065
	.069	.028		.634	.058
3/16"	.117	.035		.652	.049
	.123	.032		.680	.035
	.127	.030	7/8"	.657	.109
1/4"	.120	.065		.685	.095
	.134	.058		.709	.083
	.152	.049		.731	.072
	.166	.042		.745	.065
	.180	.035		.759	.058
	.190	.030		.777	.049
5/16"	.182	.065	1"	.760	.120
	.196	.058		.782	.109
	.214	.049		.810	.095
	.228	.042		.834	.083
	.242	.035		.856	.072
	.248	.032		.870	.065
3/8"	.245	.065		.884	.058
	.259	.058		.902	.049
	.277	.049	1-1/4"	.982	.134
	.291	.042		1.010	.120
	.305	.035		1.032	.109
	.311	.032		1.060	.095
1/2"	.310	.095		1.084	.083
	.334	.083		1.106	.072
	.358	.072		1.120	.065
	.370	.065		1.134	.058
	.384	.058		1.152	.049
	.402	.049	1-1/2"	1.232	.134
	.416	.042		1.260	.120
	.430	.035		1.282	.109
	.436	.032		1.310	.095
5/8"	.435	.095		1.334	.083
	.459	.083		1.356	.072
	.481	.072		1.370	.065
	.495	.065	2"	1.732	.134
	.509	.058		1.760	.120
	.527	.049		1.782	.109
	.541	.042		1.810	.095
	.555	.035		1.834	.083
3/4"	.532	.109		1.856	.072
	.560	.095		1.870	.065

Tubing Selection

TO FIND REQUIRED TUBE I.D.

Flow–20 gpm • Velocity–9 fps

Follow horizontal flow line (20 gpm) until it intersects vertical velocity line (9 fps). From this point follow diagonal line to get required Tube I.D. –(.944).

TO FIND PERMISSIBLE FLOW

Velocity–15 fps • Tube I.D.–.495

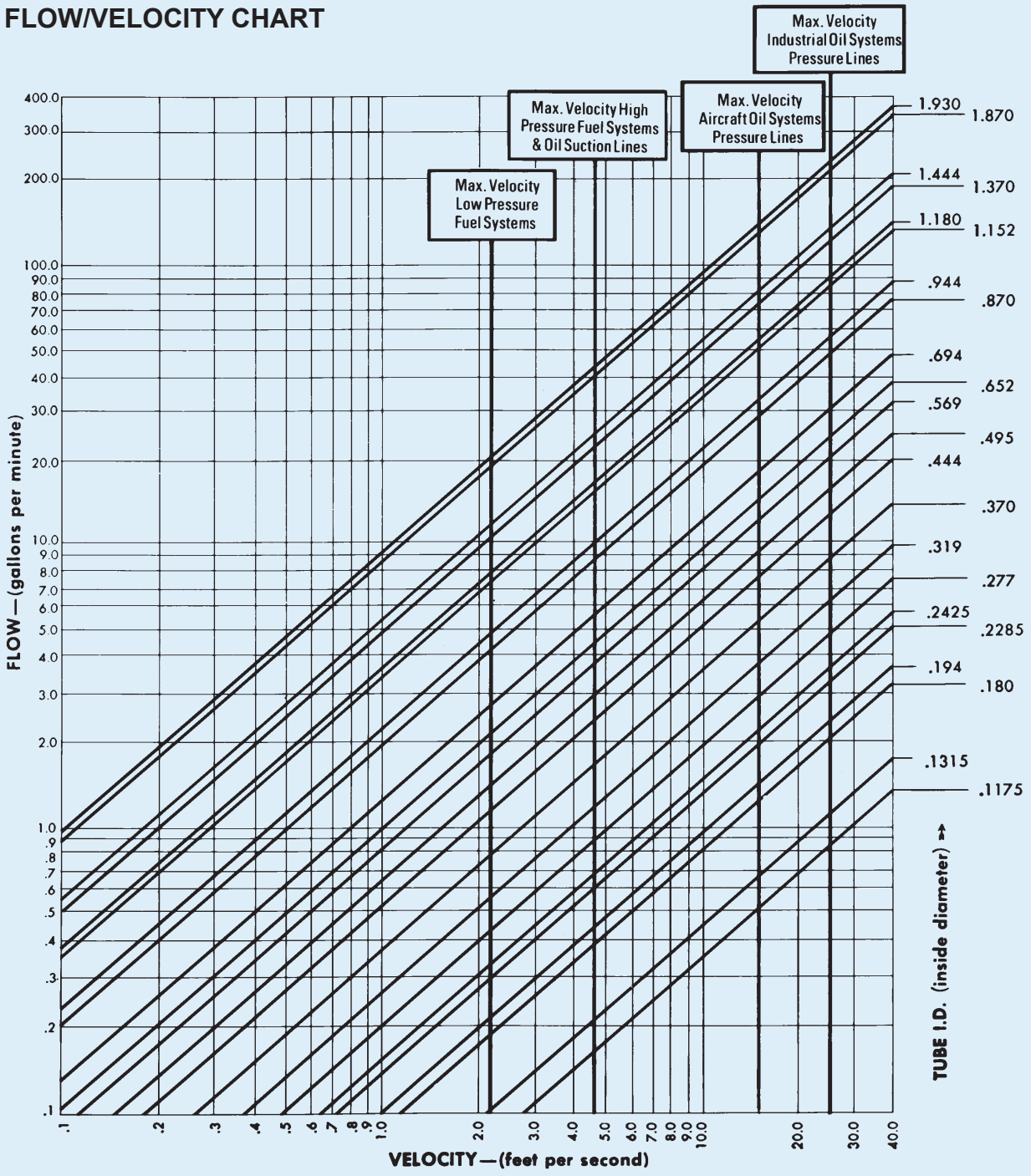
Follow vertical velocity line (15 fps) until it intersects diagonal line representing .495 tube I.D. Then project this point horizontally to get the permissible flow–(9 gpm).

TO FIND VELOCITY OF FLUID IN SYSTEM

Flow–6 gpm • Tube I.D.–.694

Follow horizontal flow line (6 gpm) until it intersects diagonal line representing .694 tube I.D. Then project this point vertically downward to get the velocity of fluid –(5 fps).

FLOW/VELOCITY CHART



Tubing Selection

⚠ Refer to safety information regarding tubing selection on page 1.

With the following Recommended Wall Thickness tables the tubing wall can be selected that is best suited for a particular application. The data given in these tables are raw figures based on the equation –

$$t = \frac{Dp(FS)}{2S}$$

t–wall thickness (inches)
D–O.D. of tube (inches)
p–pressure (psi)
FS–Safety Factor
S–tensile strength of tubing material

Therefore, many of the wall thicknesses given in these tables are not found on standard tubing, but serve to establish the minimum wall required.

SAFETY FACTOR – The standard safety factors indicate three grades of severity of service:
4:1 –mechanical and hydraulic shocks not excessive
6:1 –considerable mechanical strain and hydraulic shock
8:1 –hazardous applications with severe service conditions

The wall thickness shown in these tables are based on ultimate strength of material and a safety factor of 4:1.

To obtain the recommended wall for a specific pressure based on a safety factor of 6:1, multiply the wall thickness indicated in the table by 1.5. For a safety factor of 8:1, multiply by 2:

TEMPERATURE – The wall thickness found by using these tables can be corrected for temperature by multiplying the wall thickness by the appropriate correction factor given in the chart below. The table is based on strength reduction due to increased temperature.

RECOMMENDED WALL THICKNESS TABLES

Temperature	1010 Steel	Stainless Steel	Copper	Aluminum
+100F.	1.00	1.00	1.00	1.00
+200F.	1.00	1.00	1.08	1.00
+300F.	1.00	1.00	1.22	1.08
+400F.	1.00	1.00	2.30	1.41
+500F.	1.00	1.00	–	2.10
+600F.	1.00	1.00	–	–
+700F.	1.00	1.00	–	–
+800F.	1.08	1.07	–	–
+900F.	1.32	1.13	–	–
+1000F.	1.66	1.22	–	–

RECOMMENDED WALL THICKNESS TABLES

1010 STEEL Based on 55,000#/in.² Strength (F S=4)

TUBE O.D.	working pressure (psi) 1,000	2,000	3,000	4,000	5,000
1/8	.00455	.00909	.01364	.01818	.02273
3/16	.00682	.01364	.02045	.02727	.03409
1/4	.00909	.01818	.02727	.03636	.04545
5/16	.01136	.02273	.03409	.04545	.05682
3/8	.01364	.02727	.04091	.05455	.06818
1/2	.01818	.03636	.05455	.07273	.09091
5/8	.02273	.04545	.06818	.09091	.11364
3/4	.02727	.05455	.08182	.10909	.13636
7/8	.03182	.06364	.09545	.12727	.15909
1	.03636	.07273	.10909	.14545	.18182
1-1/4	.04545	.09091	.13636	.18182	.22727
1-1/2	.05455	.10909	.16364	.21818	.27273
2	.07273	.14545	.21818	.29091	.36364

1020 STEEL Based on 65,000#/in.² Strength (F S=4)

TUBE O.D.	working pressure (psi) 1,000	2,000	3,000	4,000	5,000
1/8	.00385	.00790	.01154	.01538	.01923
3/16	.00577	.01154	.01731	.02308	.02885
1/4	.00769	.01538	.02308	.03077	.03846
5/16	.00962	.01923	.02885	.03846	.04808
3/8	.01154	.02308	.03462	.04615	.05769
1/2	.01538	.03077	.04615	.06154	.07692
5/8	.01923	.03846	.05769	.07692	.09615
3/4	.02308	.04615	.06923	.09231	.11538
7/8	.02692	.05385	.08077	.10769	.13462
1	.03077	.06154	.09231	.12308	.15385
1-1/4	.03846	.07692	.11538	.15385	.19231
1-1/2	.04615	.09231	.13846	.18462	.23077
2	.06154	.12308	.18462	.24615	.30769

4130 STEEL Based on 90,000#/in.² Strength (F S=4)

TUBE O.D.	working pressure (psi) 1,000	2,000	3,000	4,000	5,000
1/8	.00278	.00556	.00833	.01111	.01389
3/16	.00417	.00833	.01250	.01667	.02083
1/4	.00556	.0111	.01667	.02222	.02778
5/16	.00694	.01389	.02083	.02778	.03472
3/8	.00833	.01667	.02499	.03333	.04167
1/2	.01111	.02222	.03333	.04444	.05556
5/8	.01389	.27778	.04167	.05556	.06944
3/4	.01667	.03333	.04999	.06667	.08333
7/8	.01944	.03889	.05833	.07778	.09722
1	.02222	.04444	.06667	.08889	.11111
1-1/4	.02778	.05556	.08333	.11111	.13889
1-1/2	.03333	.06667	.09999	.13333	.16667
2	.04444	.08889	.13333	.17778	.22222

BUNDYWELD Based on 42,000#/in.² Strength (F S=4)

TUBE O.D.	working pressure (psi) 1,000	2,000	3,000	4,000	5,000
1/8	.00595	.01190	.01786	.02381	.02976
3/16	.00893	.01786	.02679	.03571	.04464
1/4	.01190	.02381	.03571	.04762	.05952
5/16	.01488	.02976	.04464	.05952	.07440
3/8	.01786	.03571	.05357	.07143	.08929
1/2	.02381	.04762	.07143	.09524	.11905
5/8	.02976	.05952	.08929	.11905	.14881
3/4					
1					
1-1/4					
1-1/2					
2					

Tubing Selection

⚠ Refer to safety information regarding tubing selection on page 1.

TUBE O.D.	STAINLESS STEEL (304) ANNEALED BASED ON 75,000#/IN.² STRENGTH (F.S. –4) working pressure (psi)					STAINLESS STEEL (304) ANNEALED BASED ON 105,000#/IN.² STRENGTH (F.S. –4) working pressure (psi)				
	1,000	2,000	3,000	4,000	5,000	1,000	2,000	3,000	4,000	5,000
1/8	.00333	.00666	.00999	.01333	.01666	.00238	.00476	.00714	.00952	.01190
3/16	.00499	.00999	.01498	.01999	.02499	.00357	.00714	.01071	.01429	.01786
1/4	.00666	.01332	.01998	.02667	.03333	.00476	.00952	.01429	.01905	.02381
5/16	.00833	.01665	.02497	.03333	.04165	.00595	.01190	.01786	.02381	.02976
3/8	.0099	.01998	.02997	.03999	.04998	.00714	.01429	.02143	.02857	.03571
1/2	.01332	.02664	.03996	.05333	.06664	.00957	.01904	.02857	.03810	.04762
5/8	.01665	.03333	.04995	.06666	.08330	.01190	.02381	.03571	.04762	.05952
3/4	.01998	.03996	.05994	.07999	.09996	.01429	.02857	.04286	.05714	.07143
7/8	.02331	.04662	.06996	.09333	.11662	.01667	.03333	.05000	.06666	.08333
1	.02664	.05328	.07992	.10666	.13328	.01904	.03810	.05714	.07619	.09524
1-1/4	.03333	.06666	.09999	.13333	.16666	.02381	.04762	.07143	.09524	.11905
1-1/2	.03996	.07992	.11988	.15999	.19992	.02857	.05714	.08371	.11429	.14286
2	.05328	.10656	.15984	.21333	.26666	.03810	.07619	.11428	.15238	.19048

TUBE O.D.	ANNEALED COPPER BASED ON 30,000#/IN.² STRENGTH (F.S. –4) working pressure (psi)					COPPER (UNS C12200 LIGHT DRAWN) BASED ON 40,000#/IN.² STRENGTH (F.S. –4) working pressure (psi)				
	1,000	2,000	3,000	4,000	5,000	1,000	2,000	3,000	4,000	5,000
1/8	.00833	.01667	.02500	.03333	.04167	.00625	.01250	.01875	.02500	.03125
3/16	.01250	.02499	.03750	.04999	.06250	.00938	.01875	.02812	.03750	.04688
1/4	.01667	.03333	.05000	.06666	.08333	.01250	.02500	.03750	.05000	.06250
5/16	.02083	.04167	.06250	.08333	.10417	.01562	.03125	.04688	.06250	.07812
3/8	.02499	.04999	.07500	.09999	.12499	.01875	.03750	.05625	.07500	.09375
1/2	.03333	.06667	.10000	.13333	.16667	.02500	.05000	.07500	.10000	.12500
5/8	.04167	.08333	.12500	.16666	.20883	.03125	.06250	.09375	.12500	.15625
3/4	.04999	.09999	.15000	.19999	.24999	.03750	.07500	.11250	.15000	.18750
7/8	.05833	.11667	.17500	.23333	.29166	.04375	.08750	.13125	.17500	.21875
1	.06667	.13333	.20000	.26666	.33333	.05000	.10000	.15000	.20000	.25000
1-1/4	.08333	.16667	.25000	.33333	.41667	.06250	.12500	.18750	.25000	.31250
1-1/2	.09999	.19999	.30000	.39999	.49999	.07500	.15000	.22500	.30000	.37500
2	.13333	.26667	.40000	.53333	.66667	.10000	.20000	.30000	.40000	.50000

TUBE O.D.	ALUMINUM 3003 (H-14) BASED ON 20,000#/IN.² STRENGTH (F.S. –4) working pressure (psi)					ALUMINUM 5052 (H-32) BASED ON 31,000#/IN.² STRENGTH (F.S. –4) working pressure (psi)				
	1,000	2,000	3,000	4,000	5,000	1,000	2,000	3,000	4,000	5,000
1/8	.01250	.02500	.3750	.05000		.00806	.01613	.02419	.03226	.04032
3/16	.01875	.03750	.05650	.07500		.01210	.02419	.03629	.04839	.06048
1/4	.02500	.05000	.07500	.10000		.01613	.03226	.04839	.06452	.08065
5/16	.03125	.06250	.09375	.12500		.02016	.04032	.06048	.08065	.10081
3/8	.03750	.07500	.11250	.15000		.02419	.04839	.07258	.09677	.12097
1/2	.05000	.10000	.15000	.20000		.03227	.06452	.09677	.12903	.16129
5/8	.06250	.12500	.18750	.25000		.04032	.08065	.12097	.16129	.20161
3/4	.07500	.15000	.22500	.30000		.04839	.09677	.14516	.19355	.24194
7/8	.08750	.17500	.26250	.35000		.05645	.11290	.16935	.22581	.28226
1	.10000	.20000	.30000	.40000		.06452	.12903	.19355	.25806	.32258
1-1/4	.12500	.25000	.37500	.50000		.08065	.16129	.24194	.32258	.40323
1-1/2	.15000	.30000	.45000	.60000		.09677	.19355	.29032	.38710	.48387
2	.20000	.40000	.60000	.80000		.12903	.25806	.38710	.51613	.64516

TUBE O.D.	CUPRO-NICKEL 30% BASED ON 52,000#/IN.² STRENGTH (F.S. –4) working pressure (psi)				
	1,000	2,000	3,000	4,000	5,000
1/8	.00481	.00962	.01442	.01923	.02404
3/16	.00721	.01442	.02163	.02885	.03606
1/4	.00962	.01923	.02885	.03846	.04808
5/16	.01202	.02404	.03606	.04808	.06010
3/8	.01442	.02885	.04327	.05769	.07212
1/2	.01923	.03846	.05769	.07692	.09615
5/8	.02404	.04808	.07212	.09615	.12019
3/4	.02885	.05769	.08654	.11538	.14423
7/8	.03365	.06731	.10096	.13462	.16827
1	.03846	.07692	.11538	.15385	.19231
1-1/4	.04808	.09615	.14423	.19231	.24038
1-1/2	.05769	.11538	.17308	.23077	.28846
2	.07692	.15385	.23077	.30769	.38462

SHADED AREAS

Tubing wall thickness listed in the shaded areas are generally either too light or too heavy for practical applications, and are listed only to provide data for accurate computation.

Tubing Selection

⚠ Refer to safety information regarding tubing selection on page 1.

These tables provide data on required wall thickness for various sizes and pressures, and when to use flared or flareless fittings. Although heavier wall tubing can be ordered for higher operating pressures, only standard size hydraulic tubing is listed in these tables.

High temperature effects are not considered in these tables.

1010 STEEL TUBING WALL THICKNESS

	4:1 SAFETY FACTOR					6:1 SAFETY FACTOR					8:1 SAFETY FACTOR				
TUBE O.D.	working pressure (psi) 1,000	2,000	3,000	4,000	5,000	working pressure (psi) 1,000	2,000	3,000	4,000	5,000	working pressure (psi) 1,000	2,000	3,000	4,000	5,000
1/8	.028	.028	.028	.028	.028	.028	.028	.028	.028	.035	.028	.028	.028	.035	–
3/16	.030	.030	.030	.030	.035	.030	.030	.030	–	–	.030	.030	–	–	–
1/4	.030	.030	.030	.042	.049	.030	.030	.042	.058	–	.030	.035	.058	–	–
5/16	.032	.032	.035	.049	.058	.032	.032	.058	.065	–	.032	.049	.065	–	–
3/8	.032	.032	.042	.058	–	.032	.042	.058	–	–	.032	.058	–	–	–
1/2	.032	.042	.058	.072	–	.032	.058	.083	–	–	.042	.072	–	–	–
5/8	.035	.049	.072	.095	–	.035	.072	–	–	–	.049	.095	–	–	–
3/4	.035	.058	.083	.109	–	.049	.083	–	–	–	.058	.109	–	–	–
7/8	.049	.065	.095	–	–	.049	.095	–	–	–	.065	–	–	–	–
1	.049	.072	.109	–	–	.058	.109	–	–	–	.072	–	–	–	–
1-1/4	.049	.095	–	–	–	.072	–	–	–	–	.095	–	–	–	–
1-1/2	.065	.109	–	–	–	.083	–	–	–	–	.109	–	–	–	–
2	.072	–	–	–	–	.109	–	–	–	–	–	–	–	–	–

1020 STEEL TUBING WALL THICKNESS

	4:1 SAFETY FACTOR					6:1 SAFETY FACTOR					8:1 SAFETY FACTOR				
TUBE O.D.	working pressure (psi) 1,000	2,000	3,000	4,000	5,000	working pressure (psi) 1,000	2,000	3,000	4,000	5,000	working pressure (psi) 1,000	2,000	3,000	4,000	5,000
1/8	.028	.028	.028	.028	.028	.028	.028	.028	.028	.030	.028	.028	.028	.030	–
3/16	.030	.030	.030	.030	.030	.030	.030	.030	.035	–	.030	.030	.035	–	–
1/4	.030	.030	.030	.030	.042	.030	.030	.035	.049	.058	.030	.030	.049	–	–
5/16	.032	.032	.032	.042	.049	.032	.032	.042	.058	–	.032	.042	.058	–	–
3/8	.032	.032	.035	.049	.058	.032	.035	.058	.065	–	.032	.049	–	–	–
1/2	.032	.032	.049	.065	.083	.032	.049	.072	–	–	.032	.065	–	–	–
5/8	.035	.042	.058	.083	–	.035	.058	.095	–	–	.042	.083	–	–	–
3/4	.035	.049	.072	.095	–	.035	.072	.109	–	–	.049	.095	–	–	–
7/8	.049	.058	.083	–	–	.049	.083	–	–	–	.058	.109	–	–	–
1	.049	.065	.095	–	–	.049	.095	–	–	–	.065	–	–	–	–
1-1/4	.049	.083	.120	–	–	.058	.120	–	–	–	.083	–	–	–	–
1-1/2	.065	.095	–	–	–	.072	–	–	–	–	.095	–	–	–	–
2	.065	–	–	–	–	.095	–	–	–	–	.134	–	–	–	–

Both SAE 37° SINGLE FLARE FLARE-TWIN or ERMETO® flareless recommended.

ERMETO® flareless only.

NOTE: Only Weatherhead Ermeto flareless fittings can be used with high pressure, heavy wall tubing which is impractical to flare.

Tubing Selection

⚠ Refer to safety information regarding tubing selection on page 1.

These tables provide data on required wall thickness for various sizes and pressures, and when to use flared or flareless fittings. Although heavier wall tubing can be ordered for higher operating pressures, only standard size hydraulic tubing is listed in these tables.

High temperature effects are not considered in these tables.

STAINLESS STEEL (304) ANNEALED TUBING WALL THICKNESS

	4:1 SAFETY FACTOR					6:1 SAFETY FACTOR					8:1 SAFETY FACTOR				
TUBE O.D.	working pressure (psi) 1,000	2,000	3,000	4,000	5,000	working pressure (psi) 1,000	2,000	3,000	4,000	5,000	working pressure (psi) 1,000	2,000	3,000	4,000	5,000
1/8	.028	.028	.028	.028	.028	.028	.028	.028	.028	.035	.028	.028	.028	.028	.035
3/16	.030	.030	.030	.030	.030	.030	.030	.030	.030	.035	.030	.030	.030	.035	–
1/4	.030	.030	.030	.030	.035	.030	.030	.030	.042	.058	.030	.030	.035	.058	.065
5/16	.032	.032	.032	.035	.042	.032	.032	.035	.058	.065	.032	.032	.049	.065	–
3/8	.032	.032	.032	.042	.058	.032	.042	.065	.083	–	.032	.042	.058	–	–
1/2	.032	.032	.042	.058	.072	.032	.042	.065	.083	–	.032	.058	.083	–	–
5/8	.035	.035	.058	.072	.083	.035	.058	.083	.095	–	.035	.065	–	–	–
3/4	.035	.049	.065	.083	.109	.035	.065	.095	–	–	.049	.083	–	–	–
7/8	.049	.049	.072	.095	–	.049	.072	.109	–	–	.049	.095	–	–	–
1	.049	.058	.083	.109	–	.049	.083	.120	–	–	.058	.109	–	–	–
1-1/4	.049	.072	.109	–	–	.058	.109	–	–	–	.065	.134	–	–	–
1-1/2	.065	.083	.120	–	–	.065	.120	–	–	–	.083	–	–	–	–
2	.065	.109	–	–	–	.083	–	–	–	–	.109	–	–	–	–

STAINLESS STEEL (304) 1/8 HARD TUBING WALL THICKNESS

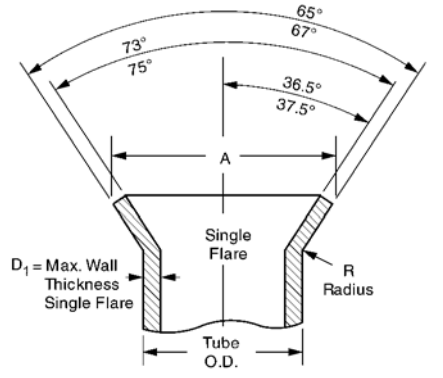
	4:1 SAFETY FACTOR					6:1 SAFETY FACTOR					8:1 SAFETY FACTOR				
TUBE O.D.	working pressure (psi) 1,000	2,000	3,000	4,000	5,000	working pressure (psi) 1,000	2,000	3,000	4,000	5,000	working pressure (psi) 1,000	2,000	3,000	4,000	5,000
1/8	.028	.028	.028	.028	.028	.028	.028	.028	.028	.028	.028	.028	.028	.028	.028
3/16	.030	.030	.030	.030	.030	.030	.030	.030	.030	.030	.030	.030	.030	.030	.035
1/4	.030	.030	.030	.030	.030	.030	.030	.030	.030	.035	.030	.030	.030	.042	.049
5/16	.032	.032	.032	.032	.032	.032	.032	.032	.035	.049	.032	.032	.035	.049	.058
3/8	.032	.032	.032	.032	.042	.032	.032	.032	.042	.058	.032	.032	.042	.058	–
1/2	.032	.032	.032	.042	.049	.032	.032	.042	.058	.072	.032	.042	.058	.083	–
5/8	.035	.035	.042	.049	.065	.035	.035	.058	.072	.095	.035	.049	.072	.095	–
3/4	.035	.035	.049	.058	.072	.035	.049	.065	.095	.109	.035	.058	.095	–	–
7/8	.049	.049	.058	.072	.083	.049	.058	.083	.109	–	.049	.065	.109	–	–
1	.049	.049	.058	.083	.095	.049	.058	.095	–	–	.049	.072	–	–	–
1-1/4	.049	.049	.072	.095	.120	.049	.072	.109	–	–	.049	.095	–	–	–
1-1/2	.065	.065	.095	–	–	.065	.095	–	–	–	.065	–	–	–	–
2	.065	.083	.120	–	–	.065	–	–	–	–	.083	–	–	–	–

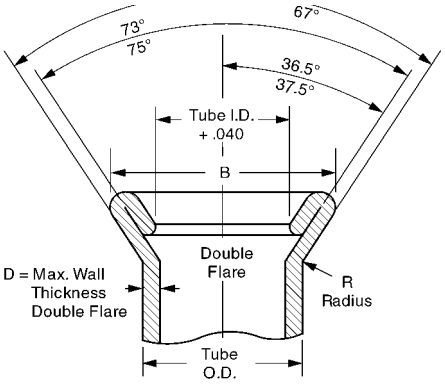
Both SAE 37° SINGLE FLARE FLARE-TWIN or ERMETO® flareless recommended.

ERMETO® flareless only.

NOTE: Only Weatherhead Ermeto flareless fittings can be used with high pressure, heavy wall tubing which is impractical to flare.

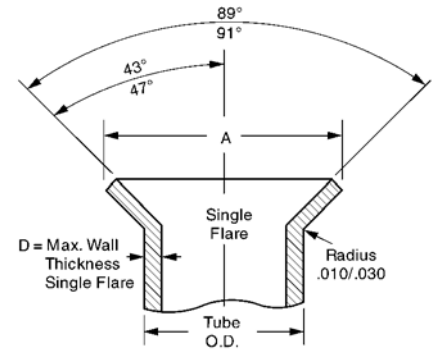
Flare Dimensions

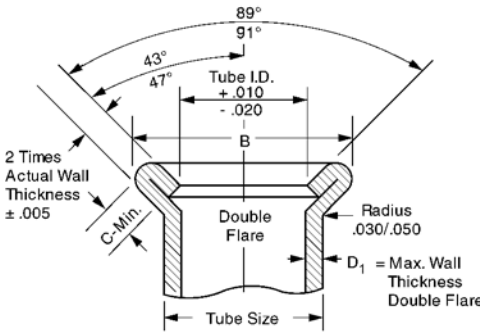




JIC 37° FLARE TUBES (SAE J533)

Tube Size O.D.	Single Flare A Diameter		Double Flare B Diameter		R Radius ±.020	Maximum Wall Thickness	
	Max.	Min.	Max.	Min.		Single Flare D	Double Flare D_1
1/8	.200	.180	.200	.180	.030	.035	.025
3/16	.280	.260	.280	.260	.030	.035	.028
1/4	.360	.340	.360	.340	.030	.065	.035
5/16	.430	.400	.430	.400	.030	.065	.035
3/8	.490	.460	.490	.460	.040	.065	.049
1/2	.660	.630	.660	.630	.060	.083	.049
5/8	.790	.760	.790	.760	.060	.083	.049
3/4	.950	.920	.960	.920	.080	.109	.049
7/8	1.070	1.040	1.070	1.040	.080	.109	.065
1	1.200	1.170	1.200	1.170	.090	.120	.065
1 1/4	1.510	1.480	1.510	1.480	.090	.120	.065
1 1/2	1.730	1.700	1.730	1.700	.110	.120	.065
2	2.360	2.330	2.360	2.330	.110	.134	.065



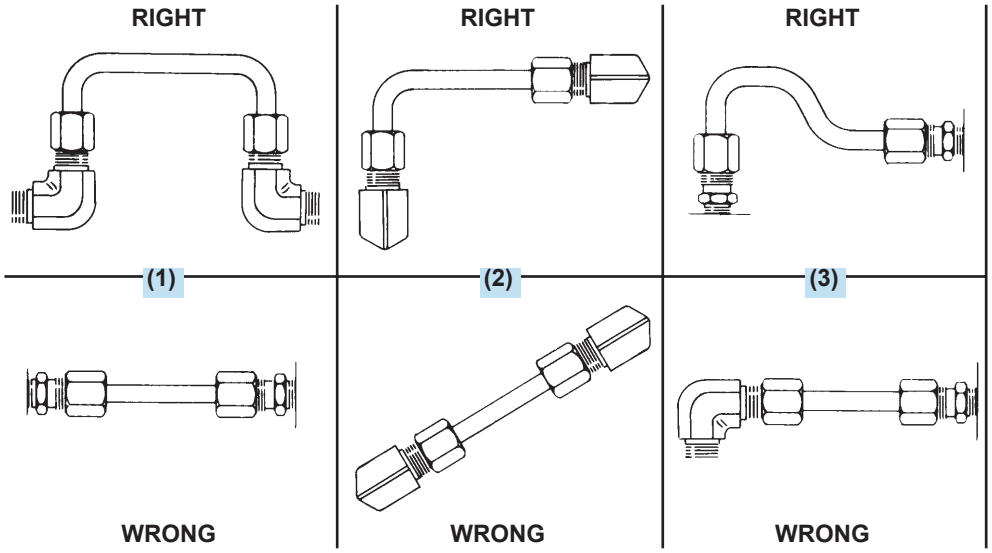


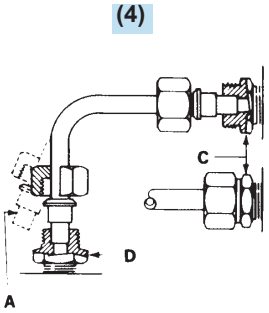
SAE 45° FLARE TUBE (SAE J533)

Tube Size	Single Flare A Diameter		Double Flare B Diameter		Double Flare Coined Seat Length C	Maximum Wall Thickness	
	Max.	Min.	Max.	Min.		Single Flare D	Double Flare D_1
1/8	.171	.181	.198/	.213	.040	.035	.025
3/16	.239/	.249	.265/	.280	.040	.035	.028
1/4	.315/	.325	.345/	.360	.040	.049	.035
5/16	.388/	.404	.410/	.425	.062	.049	.035
3/8	.471/	.487	.485/	.500	.062	.065	.049
7/16	.545/	.561	.555/	.570	.062	.065	.049
1/2	.607/	.623	.625/	.640	.062	.083	.049
9/16	.660/	.676	.697/	.712	.062	.083	.049
5/8	.732/	.748	.757/	.772	.062	.095	.049
3/4	.900/	.916	.897/	.912	.062	.109	.049
7/8	1.025/	1.041	—		–	.109	–
1	1.141/	1.157	—		–	.120	–

Tubing Installation

⚠ Refer to safety information regarding tubing installation on page 2.





Springing the tubing to force alignment places strain on fitting joints.

Nearly all industrial equipment now in service makes some use of fluid lines. From an economic point of view, the best fluid lines system is that which is easiest to maintain at the lowest original cost. The use of tubing and tube fittings on lines up to 2" diameter is usually more economical than the use of pipe and pipe fittings in modern installations. A few of the more important reasons follow:

1. Size for size, tubing is lighter weight, easier to handle and can be bent more easily than iron pipe.
2. Ductile hydraulic tubing reduces the number of connections required, thus reducing material and labor costs. Bent tubing also reduces pressure drop and turbulence in the system.
3. Fewer joints means lower costs and fewer points of potential leakage.
4. The use of tube fittings makes every joint a union, permitting easier, faster maintenance and repair work.
5. Modern flared and flareless tube fittings eliminate the need for threading, soldering, or welding.

TUBE BENDING

Tubing should be bent wherever possible to reduce the number of fittings.

Copper tubing can be bent easily with a hand bender. Steel tubing can be bent in sizes 1/8" to 5/8" O.D. by using a hand bender designed for steel tubing. For production quantities, or for sizes larger than 5/8" O.D., a power bender is generally used.

Tubing should be bent accurately. Tubing manufacturers will advise the correct radii for various types and wall thicknesses of tubing. Kinks, flattened bends, wrinkles and tube breakage or loss should be avoided by the use of proper tube bending equipment.

PRECAUTIONS

Avoid straight line connections wherever possible, especially in short runs.

Design piping systems symmetrically. They are easier to install and present a neat appearance.

Care should be taken to eliminate stress from tubing lines. Long tubing runs should be supported by brackets or clips. All parts installed on tubing lines such as heavy fittings, valves, etc., should be bolted down to eliminate tubing fatigue.

Before installing tubing, inspect the tube to see that it conforms to the required specifications, is of the correct diameter and wall thickness and is not out of round.

Cut tube ends reasonably square and lightly deburr inside and outside edge. Chamfer on outside edge will destroy bearing of tube end on the fittings seat.

To avoid difficulty in assembly and disconnecting, a sufficient straight length of tube must be allowed from the end of the tube to the start of the bend. Allow twice the length of the nut as a minimum.

Tubes should be formed to assemble with true alignment to the center line of the fittings, without distortion or tension. Tubing which has to be sprung from position, "A", (see Fig. 4), to be inserted into the fitting has not been properly fabricated, and when so installed and connected, places the tubing under stress.

When assembling the tubing, insert the longer leg to the fitting as at "C" (Fig. 4). With the nut free, the short leg of the tubing can be easily moved and brought to proper position with and inserted into the seat in fitting "D". The nuts can then be tightened as required.

Application Chemical Compatibility Chart

Refer to safety information regarding proper selection of tubing and tube fittings on page 1.

These tables alphabetically list commonly used materials of various chemical composition. After each agent listing you will find the basic tubing and fitting materials rated according to their chemical resistance to each individual agent. The chart is intended to be used as a guide only. Many factors (concentration, temperature, intermittent or continuous exposure, etc.) have a bearing upon the suitability of any tubing or connector for any specific application, and these factors must be considered by you as you review the chemical compatibility chart.

Where unusual conditions exist or where questions arise, consult Boston Weatherhead for expert assistance on your tubing application requirements.

Fluid	Nylon 11 TP160, NT100	Nylon 6/6 PT230	PVC PT200	Polyethylene PT240 (LDPE)	Brass	Steel	316 Stainless
Acetaldehyde	G	F	X	X	X	X	G
Acetic Acid (Concentrated)	X	X	X	X	X	X	G
Acetic Acid (Dilute)	F	X	F	G	X	X	G
Acetic Anhydride	X	X	X	X	X	F	F
Acetone	G	F	X	G	G	G	G
Acrylonitrile	G	—	G	—	—	G	G
Air	G	G	G	G	G	G	G
Alcohols							
Amyl Alcohol	G	G	X	G	G	F	F
Butyl Alcohol, Butanol	G	G	X	G	G	G	G
Ethyl Alcohol, Ethanol	G	G	F	G	G	F	G
Isopropyl Alcohol, Isopropanol	G	G	G	G	G	G	G
Methyl Alcohol, Methanol	G	G	X	G	G	F	G
Aluminum Chloride	X	X	G	G	X	X	F
Aluminum Fluoride	X	X	G	G	X	X	X
Aluminum Hydroxide	G	G	G	G	X	F	G
Aluminum Nitrate	G	F	G	G	X	X	G
Aluminum Sulfate	G	F	G	G	X	X	G
Alums	F	G	G	G	X	X	F
Ammonia, Anhydrous	Use approved anhydrous ammonia hose				X	F	G
Ammonia Solution (10%)	G	X	G	G	X	G	G
Ammonium Chloride	X	X	G	G	X	G	F
Ammonium Hydroxide	G	X	X	G	X	F	G
Ammonium Nitrate	G	G	G	G	—	—	G
Ammonium Phosphate	G	G	F	G	X	X	G
Ammonium Sulfate	G	G	G	G	X	X	F
Amyl Acetate	G	G	X	X	G	F	G
Amyl Alcohol	G	G	X	G	G	F	F
Aniline	X	X	X	X	X	G	G
Aniline Dyes	X	X	X	X	X	X	F
Animal Oils and Fats	G	—	G	X	G	G	G
Anti-Freeze (Glycol Base)	G	—	G	F	G	G	G
Aqua Regia	X	X	X	X	—	X	X
Aromatic Hydrocarbons	G	G	X	G	G	G	G
Asphalt Emulsion	G	—	X	—	G	G	G
Barium Chloride	G	—	G	G	X	F	G
Barium Hydroxide	G	G	G	G	X	G	G
Barium Sulfate	G	G	G	G	G	G	G
Barium Sulfide	X	—	G	G	X	X	G
Beet Sugar Liquors	G	G	G	G	X	G	G
Benzaldehyde	G	G	X	X	F	F	G
Benzene, Benzol	G	G	X	X	G	G	G
Benzoic Acid	X	X	X	G	F	X	F
Black Sulfate Liquor	X	X	X	G	X	G	G
Bleach Solution	X	X	F	G	X	X	G
Borax Solution	G	—	G	G	G	G	G
Boric Acid	G	G	G	G	X	X	G
Brake Fluid (Glycol Ether Base)	G	—	X	X	G	G	G
Brine	G	—	G	G	—	X	F
Bromine	X	X	X	X	X	X	X

NOTE: All data given herein is believed to be accurate and reliable but presented without guarantee, warranty, or responsibility of any kind, express or implied, on our part. Chemical resistance will vary with the wide diversity of possible mixtures and service conditions. It is not therefore possible to give any guarantee whatsoever in individual cases. CODES: G=Good Resistance F=Fair Resistance X=Incompatible – =No data available

+ Call Technical Support for specific application

Chemical Compatibility Chart

⚠ Refer to safety information regarding proper selection of tubing and tube fittings on page 1.

Fluid	Nylon 11 TP160, NT100	Nylon 6/6 PT230	PVC PT200	Polyethylene PT240 (LDPE)	Brass	Steel	316 Stainless
Butane	Use H336 or H243 Hose Only						
Butyl Acetate	G	—	X	X	G	G	G
Butyl Alcohol, Butanol	G	G	X	G	G	G	G
Calcium Bisulfite	G	X	G	G	X	X	X
Calcium Chloride	G	X	G	G	X	F	F
Calcium Hydroxide	G	G	G	G	F	G	G
Calcium Hypochlorite	X	X	G	G	F	X	F
Cane Sugar Liquors	G	--	G	G	F	G	G
Carbon Dioxide (Dry)	G	G	G	G	G	G	G
Carbon Dioxide (Wet)	G	G	G	G	F	G	G
Carbon Disulfide (Bisulfide)	X	X	X	X	G	G	G
Carbon Monoxide (Hot)	X	X	X	X	X	F	G
Carbon Tetrachloride	G	G	X	X	G	G	G
Carbonic Acid	G	—	G	G	X	X	F
Castor Oil	G	—	G	X	G	G	G
Cellosolve Acetate	G	—	X	—	X	X	G
Chlorinated Solvents	F	G	X	X	G	G	F
Chloroacetic Acid	X	X	X	X	X	X	F
Chlorobenzene	X	X	X	X	F	F	G
Chlorine Gas (Dry)	X	X	X	X	F	F	G
Chlorine Gas (Wet)	X	X	X	X	X	X	X
Chloroform	F	G	X	X	G	G	G
Chlorosulfonic Acid	X	X	X	X	X	F	X
Chromic Acid (under 25%)	X	X	F	F	X	X	G
Chromic Acid (over 25%)	X	X	X	X	X	X	F
Citric Acid	X	F	G	G	X	X	G
Coke Oven Gas	G	—	X	G	F	G	G
Copper Chloride	X	X	G	G	X	X	G
Copper Cyanide	G	G	G	G	X	X	G
Copper Sulfate	G	G	G	G	X	X	G
Corn Syrup (Non-food)	G	—	G	G	—	G	G
Cottonseed Oil	G	—	F	G	G	G	G
Creosote	X	X	X	X	F	—	G
Cresol	X	X	X	X	—	G	G
Cyclohexanol	G	G	X	F	G	F	G
Dextrose (Food Grade)	X	X	X	G	—	—	G
Dichlorobenzene	G	—	X	X	—	—	G
Diesel Fuel	G	—	X	X	G	G	G
Diethanolamine	G	—	X	—	X	G	G
Diethylenetriamine	X	X	X	G	—	—	—
Dowtherm A	X	X	X	X	X	F	G
Enamel (Solvent Base)	G	—	X	G	G	—	G
Ethanolamine	G	—	X	G	X	G	G
Ethers (Ethyl Ether)	G	—	X	X	G	G	G
Ethyl Alcohol	G	G	F	G	F	G	G
Ethyl Acetate	G	G	X	G	G	G	G
Ethyl Acrylate	X	—	X	—	—	G	G
Ethyl Methacrylate	X	—	X	—	—	G	G
Ethylamine	X	X	X	G	G	—	G
Ethyl Cellulose	F	—	X	G	F	G	F
Ethyl Chloride	G	—	X	X	F	F	G
Ethylenediamine	X	X	X	G	G	G	G
Ethylene Dibromide	F	—	X	—	—	—	—
Ethylene Dichloride	F	—	X	X	G	X	X
Ethylene Glycol	G	G	G	G	F	G	G
Ethylene Oxide	G	—	X	X	X	F	F

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Application Chemical Compatibility Chart

Refer to safety information regarding proper selection of tubing and tube fittings on page 1.

Fluid	Nylon 11 TP160, NT100	Nylon 6/6 PT230	PVC PT200	Polyethylene PT240 (LDPE)	Brass	Steel	316 Stainless
Fatty Acids	G	G	G	G	F	F	G
Ferric Chloride 5%	G	G	G	G	X	X	X
Ferric Sulfate	G	G	G	G	X	X	F
Fertilizer Salts Solution	F	—	G	G	—	—	G
Formaldehyde	G	G	X	G	F	X	G
Formic Acid	X	X	X	G	F	X	G
Freon 12	Use approved Freon 12 hose				G	G	G
Freon 134a	Use approved Freon 134a hose				—	G	G
Fuel Oil	G	—	F	X	F	G	G
Furfural	X	X	X	X	F	G	G
Gasoline (Refined)	G	G	X	X	G	G	G
Gasoline (Unleaded)	G	G	X	X	G	G	G
Gasoline (10% Ethanol)	G	G	X	X	G	G	G
Gasoline (10% Methanol)	G	G	X	X	G	G	G
Glucose (non-food)	G	G	G	G	G	G	G
Glycerine, Glycerol (Non-food)	G	G	G	G	G	G	G
Greases	G	G	G	G	G	G	G
Green Sulfate Liquor	X	X	G	G	X	X	G
Heptane	G	G	X	X	G	G	G
Hexane	G	G	X	X	G	G	G
Houghto Safe 273 to 640	G	—	F	G	G	G	G
Houghto Safe 5046, 5047F	G	—	G	G	G	G	G
Houghto Safe 1000 Series	G	—	X	X	G	G	G
Hydraulic Oils							
Straight Petroleum Base	G	G	G	G	G	G	G
Water Petroleum Emulsion	G	—	—	F	G	G	G
Water Glycol	G	G	X	—	G	G	G
Straight Phosphate Ester	G	G	X	X	G	G	G
Phos. Ester/Petroleum Blend	G	G	X	X	G	G	G
Polyol Ester	G	—	—	—	G	G	G
Hydrobromic Acid (under 48%)	X	X	G	G	X	X	X
Hydrochloric Acid	X	X	G	G	X	X	X
Hydrocyanic Acid	X	X	G	G	X	F	G
Hydrofluoric Acid (under 50%)	X	X	F	F	X	X	G
Hydrofluoric Acid (over 50%)	X	X	X	X	X	X	G
Hydrofluosilicic Acid	X	X	G	G	X	X	X
Hydrogen	Use approved hydrogen hose or metal tubing				—	—	G
Hydrogen Peroxide	X	X	—	G	X	X	G
Hydrogen Sulfide	X	X	G	G	F	F	F
Hydrolube	G	—	G	G	G	G	G
Iodine	X	X	X	X	X	X	X
Isocyanates	X	X	X	X	—	—	—
Isopropyl Alcohol, Isopropanol	G	G	G	G	G	G	G
Isopropylamine	X	—	X	—	G	—	G
Iso-Octane	G	G	X	X	G	G	G
Jet Fuel (Transfer Only)	G	G	X	X	G	F	G
Kerosene	G	G	X	X	G	G	G
Lacquer	G	G	X	F	G	X	G
Lacquer Solvents	G	G	X	F	G	X	G
Lactic Acid	G	G	G	G	F	F	G
Lime Sulfur	G	F	G	G	X	—	G
Lindol	G	G	—	—	F	G	G
Linseed Oil	G	G	G	G	F	G	G
Lubricating Oils	G	G	G	G	G	G	G
Lye	G	F	G	G	F	X	G
Magnesium Chloride	G	G	G	G	F	F	G

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Chemical Compatibility Chart

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Fluid	Nylon 11 TP160, NT100	Nylon 6/6 PT230	PVC PT200	Polyethylene PT240 (LDPE)	Brass	Steel	316 Stainless
Magnesium Hydroxide	G	G	G	G	G	G	G
Magnesium Sulfate	G	G	G	G	F	G	G
Mercuric Chloride	X	X	F	G	X	X	X
Mercury	G	G	F	G	X	G	G
Methyl Alcohol, Methanol	G	G	X	G	F	G	G
Methyl Acrylate	X	X	X	—	G	G	G
Methyl Bromide	G	F	X	X	G	G	G
Methyl Chloride	G	G	X	X	G	G	G
Methylene Chloride	F	F	X	X	G	G	G
Methyl t-Butyl Ether (MTBE)	G	G	X	—	—	G	G
Methyl Ethyl Ketone	G	G	X	G	G	G	G
Methyl Isobutyl Ketone	G	G	X	G	G	G	G
Methyl Isopropyl Ketone	G	G	X	G	G	G	G
Methyl Methacrylate	X	—	X	—	—	G	G
Mineral Oil	G	G	F	X	G	G	G
Mineral Spirits	G	G	X	G	G	G	G
Naphtha	G	G	X	G	F	G	G
Napthalene	G	G	X	X	F	G	G
Nickel Acetate	G	G	G	G	G	G	G
Nickel Chloride	G	G	G	G	X	X	F
Nickel Sulfate	G	G	G	G	X	X	G
Nitric Acid (under 35%)	X	X	G	F	X	X	G
Nitric Acid (35% to 60%)	X	X	F	X	X	X	G
Nitric Acid (over 60%)	X	X	X	X	X	X	G
Nitrobenzene	X	—	X	X	F	G	G
Nitrogen Gas	G	G	G	G	G	G	G
Nitrous Oxide	F	F	X	X	G	G	G
Oleic Acid	G	G	F	G	F	F	G
Oleum (Fuming Sulfuric Acid)	X	X	X	X	X	F	G
Oxalic Acid	X	X	G	G	F	X	G
Oxygen (non-breathing,non-welding) +	G	G	G	G	G	G	G
Ozone (300 pphm)	X	X	X	X	—	F	G
Paint (Solvent Base)	G	G	X	F	G	G	G
Palmitic Acid	G	G	F	G	X	F	F
Paper Mill Liquors	X	X	X	X	—	—	—
Pentane	G	—	X	X	G	G	G
Perchloroethylene	F	G	X	X	F	G	G
Petroleum Ether	G	G	X	X	G	G	G
Petroleum Oils	G	G	G	G	G	G	G
Phenol	X	X	X	X	F	X	F
Phosphoric Acid (to 85%)	X	X	G	G	X	X	F
Picric Acid (Molten)	X	X	X	X	X	X	F
Picric Acid (Solution)	X	X	X	X	X	X	F
Potassium Chloride	G	G	G	G	F	X	G
Potassium Cyanide	G	G	G	G	X	G	G
Potassium Dichromate	F	—	G	G	X	G	G
Potassium Hydroxide	G	F	G	G	F	X	G
Potassium Permanganate	X	X	G	G	—	—	—
Potassium Sulfate	G	G	G	G	F	F	G
Propane Liquid	Use H366 Hose Only						
Propylene Glycol	G	—	F	G	F	G	G
Pyridine	X	X	X	G	F	G	G
Sea Water	G	G	G	G	G	F	G
Silver Nitrate	G	G	G	G	X	X	F
Skydrol	G	G	X	X	G	G	G

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Soap Solution	G	G	G	X	G	G	G
Sodium Bicarbonate	G	G	G	G	F	F	G
Sodium Bisulfate	G	G	G	G	F	F	F
Sodium Bisulfite	G	G	G	G	F	X	G
Sodium Borate	G	G	G	G	G	G	G
Sodium Carbonate	G	G	G	G	X	G	G
Sodium Chloride	G	G	G	G	X	F	G
Sodium Cyanide	G	G	G	G	X	F	G
Sodium Hydroxide	G	F	G	G	F	X	G
Sodium Hypochlorite	X	X	G	G	X	X	F
Sodium Nitrate	G	G	G	G	F	G	G
Sodium Perborate	G	F	G	G	F	F	G
Sodium Peroxide	X	X	X	X	X	F	G
Sodium Phosphates	G	G	G	G	F	F	F
Sodium Silicate	G	G	G	G	F	F	G
Sodium Sulfate	G	G	G	G	F	F	G
Sodium Sulfide	G	G	G	G	X	X	G
Sodium Thiosulfate	G	G	G	G	X	X	G
Soybean Oil	G	—	F	G	G	G	G
Stannic Chloride	F	X	G	G	X	X	X
Steam 450° F	X	X	X	X	F	F	G
Stearic Acid	G	G	F	G	X	X	G
Stoddard Solvent	G	G	X	X	G	G	G
Styrene	G	G	X	X	G	G	G
Sulfur 70o F	G	G	F	G	X	X	G
Sulfur 200o F	X	X	X	X	X	X	G
Sulfur Chloride	X	X	X	G	X	X	X
Sulfur Dioxide	X	X	X	X	X	—	G
Sulfuric Acid (under 50%)	X	X	G	G	X	X	X
Sulfuric Acid (51% to 70%)	X	X	G	X	X	X	X
Sulfuric Acid (71% to 95%)	X	X	X	X	X	X	X
Sulfuric Acid (96% to 98%)	X	X	X	X	X	X	X
Tannic Acid	X	X	G	G	F	X	G
Tar	G	G	X	X	F	F	G
Tartaric Acid	G	G	G	G	F	X	F
Tetrachloroethane	F	—	X	F	—	—	G
Tetrahydrofuran (THF)	G	—	X	X	—	—	G
Toluene	G	G	X	G	G	G	G
Transmission Oil (Petrol. Base)	G	G	G	G	G	G	G
Trichloroethane	F	G	X	G	G	G	G
Trichloroethylene	F	G	X	G	G	G	G
Tung Oil	G	—	—	—	F	G	G
Turpentine	G	G	X	G	F	G	G
Urea (Water Solution)	G	G	G	G	—	G	G
Uric Acid	G	G	G	G	—	—	F
Varnish	G	G	X	G	G	G	G
Vegetable Oil (Non-food)	G	G	F	G	G	G	G
Vinegar	G	X	G	G	X	F	G
Vinyl Acetate	G	—	X	—	F	G	G
Water (non-potable)	G	G	G	G	F	F	G
Water-Glycol Mixture	G	G	X	—	G	G	G
Water-Petroleum Mixture	G	G	—	F	G	G	G
Xylene	G	G	X	G	G	G	G
Zinc Chloride	X	X	G	G	X	X	X
Zinc Sulfate	G	G	G	G	X	X	G

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