



# Materials Data

## Physical Properties of Thermoplastic Piping Materials

ASTM Test Methods	Properties	MATERIAL			
		PVC 12454-B	CPVC 23447-B	PVDF	Polypropylene
<b>GENERAL</b>					
D-792	Specific Gravity	1.38	1.55	1.76	.905
D-570	Water Absorption % 24 Hrs. @ 73°F	.05	.05	.04	.02
<b>MECHANICAL</b>					
D-638	Tensile Strength psi @ 73°F	7,940	8,400	6,000	5,000
D-638	Modulus of Elasticity in Tension psi @ 73°F x 10 <sup>6</sup>	4.2	4.2	2.1	1.7
D-790	Flexural Strength psi	14,500	15,600	9,700	7,000
D-256	Izod Impact Strength @ 73°F (Notched)	.65	3.0	3.8	1.3
<b>THERMAL</b>					
D-696	Coefficient of thermal Expansion in/in/°F 10 <sup>-5</sup>	3.0	3.8	7.9	5.0
C-177	Thermal Conductivity BTU/HR/Sq. Ft./ °F/in	1.2	.95	.79	1.2
D-648	Heat Distortion Temp. °F @ 66 psi	NA	238	284	220
D-648	Heat Distortion Temp. °F @ 264 psi	160	221	194	140
	Resistance to Heat °F at continuous Drainage	140	210	280	180
<b>FLAMMABILITY</b>					
D-2863	Limiting Oxygen Index (%)	43	60	44	17
E-84	Flame Spread	15-20	15	0	NA
	Underwriters Lab Rating	94V-O	94V-O	94V-O	94HB

### Disclaimer Of Liability

As the conditions or methods of use are beyond our control, we do not assume any responsibility and expressly disclaim any liability for any use of this material. Information contained herein is believed to be true and accurate but all statements or suggestions are made without warranty, expressed or implied, regarding accuracy of the information, the hazards connected with the use of the material or results to be obtained from the use thereof. Compliance with all applicable federal, state and local laws and regulations remains the responsibility of the user.

### Disclaimer Of Liability

To the best of our knowledge the information contained in the publication is accurate. However, ALSCO Industrial does not assume any liability whatsoever for the accuracy or completeness of such information. Final determination of the suitability of any information or product for the use to be contemplated is the sole responsibility of the user. The manner of that use and whether there is any infringement of patents is also the sole responsibility of the user.

ALSCO Industrial Products, Inc. makes no guarantees for any data or information contained in this catalog. All data and information is given based on present knowledge. Data and technology are constantly being changed, therefore it is the responsibility of the user to use pilot installation for each application. Please contact our Technical Sales Department for any questions or doubts concerning your specific applications.



# Pipe Technical Data

## PVC Pipe Type I and Type II

SCHEDULE 40 NSF								SCHEDULE 80 NSF							
Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Wt./ Ft.		Max. W.P. PSI *		Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Wt./ Ft.		Max. W.P. PSI *	
				Type I	Type II	Type I	Type II					Type I	Type II	Type I	Type II
1/8	.405	.261	.068	.045	.044	810	400	1/8	.405	.203	.095	.058	.056	1230	610
1/4	.540	.354	.088	.081	.080	780	390	1/4	.540	.288	.119	.100	.098	1130	570
3/8	.675	.483	.091	.109	.107	620	310	3/8	.675	.407	.126	.138	.135	920	460
1/2	.840	.608	.109	.161	.158	600	300	1/2	.840	.528	.147	.202	.197	850	420
3/4	1.050	.810	.113	.214	.210	480	240	3/4	1.050	.724	.154	.273	.268	690	340
1	1.315	1.033	.133	.315	.309	450	220	1	1.315	.935	.179	.402	.394	630	320
1 1/4	1.660	1.364	.140	.426	.417	370	180	1 1/4	1.660	1.256	.191	.554	.542	520	260
1 1/2	1.900	1.592	.145	.509	.498	330	170	1 1/2	1.900	1.476	.200	.673	.659	470	240
2	2.375	2.049	.154	.682	.668	280	140	2	2.375	1.913	.218	.932	.912	400	200
2 1/2	2.875	2.445	.203	1.076	1.053	300	150	2 1/2	2.875	2.289	.276	1.419	1.389	420	210
3	3.500	3.042	.216	1.409	1.379	260	130	3	3.500	2.864	.300	1.903	1.863	370	190
3 1/2	4.000	3.520	.226	1.697	1.661	240	120	3 1/2	4.000	3.326	.318	2.322	2.273	350	170
4	4.500	3.998	.237	2.006	1.963	220	110	4	4.500	3.786	.337	2.782	2.723	320	160
5	5.563	5.017	.258	2.726	2.668	190	100	5	5.563	4.767	.375	3.867	3.784	290	140
6	6.625	6.031	.280	3.535	3.460	180	90	6	6.625	5.709	.432	5.313	5.200	280	140
8	8.625	7.943	.322	5.305	5.190	160	80	8	8.625	7.565	.500	8.058	7.883	250	120
10	10.750	9.976	.365	7.532	7.368	140	70	10	10.750	9.492	.593	11.956	11.695	230	120
12	12.750	11.890	.406	9.949	9.733	130	70	12	12.750	11.294	.687	16.437	—	230	—
14	14.000	13.072	.437	11.810	—	130	—	14	14.000	12.410	.750	19.790	—	220	—
16	16.000	14.940	.500	15.416	—	130	—	16	16.000	14.214	.843	25.430	—	220	—
								18	18.000	16.014	.937	31.830	—	220	—

\* For water at 73°F with solvent cemented joints. Threading not recommended for Schedule 40. Use 50% of indicated pressure rating (W.P.) for threaded pipe. For fluids other than water, see Chemical Resistance Guide.

## CPVC Pipe

SCHEDULE 40 NSF **						SCHEDULE 80 NSF						
Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Wt./ Ft.	Max. W.P. PSI *	Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Wt./ Ft.	Max. W.P. PSI *	
											Plain End	Threaded
1/4	.540	.354	.088	.091	780	1/4	.540	.288	.119	.112	1130	565
3/8	.675	.483	.091	.122	620	3/8	.675	.407	.126	.154	920	460
1/2	.840	.608	.109	.180	590	1/2	.840	.528	.147	.225	850	425
3/4	1.050	.810	.113	.239	480	3/4	1.050	.724	.154	.305	690	345
1	1.315	1.033	.133	.352	450	1	1.315	.935	.179	.449	630	315
1 1/4	1.660	1.364	.140	.475	365	1 1/4	1.660	1.256	.191	.618	520	260
1 1/2	1.900	1.592	.145	.568	330	1 1/2	1.900	1.476	.200	.751	470	235
2	2.375	2.049	.154	.761	275	2	2.375	1.913	.218	1.040	400	200
2 1/2	2.875	2.445	.203	1.201	300	2 1/2	2.875	2.289	.276	1.584	420	210
3	3.500	3.042	.216	1.572	260	3	3.500	2.864	.300	2.124	370	185
3 1/2	4.000	3.520	.226	1.905	240	3 1/2	4.000	3.326	.318	2.607	350	175
4	4.500	3.998	.237	2.239	220	4	4.500	3.786	.337	3.105	320	160
6	6.625	6.031	.280	3.945	180	6	6.625	5.709	.432	5.929	280	140
8	8.625	7.943	.322	5.958	160	8	8.625	7.565	.500	9.051	250	125
10	10.750	9.976	.365	8.458	140	10	10.750	9.492	.593	13.429	230	115
12	12.750	11.890	.406	11.172	130	12	12.750	11.294	.687	18.458	230	115

\* Water 73.4°F. For fluids other than water, see Chemical Resistance Guide.

\*\* Pipe should not be threaded. Use flanged joints, unions, or victaulic rolled groove couplings where disassembly is necessary. Operating above 140°F PVC and 200°F for CPVC are not recommended.

10

PVC PIPE		Temperature De-Rating Factors	CPVC PIPE	
Working Temperature (°F)	De-Rating Factor		Working Temperature (°F)	De-Rating Factor
73	1.00	<p><b>PVC Pipe</b> to be applied to 73.4°F working pressures with water for SDR, Sch. 40, 80, &amp; 120 PVC pipe, either Type 1120 or 2110.</p> <p>** Pipe should not be threaded. Use flanged joints, unions, or victaulic rolled groove couplings where disassembly is necessary. Operating above 140°F PVC and 200°F for CPVC are not recommended.</p>	73	1.00
80	0.88		110	0.72
90	0.75		120	0.65
100	0.62		130	0.57
110	0.51		140 **	0.50
120	0.40		150 **	0.42
130 **	0.31		160 **	0.40
140 **	0.22		170 **	0.29
			180 **	0.25
			200 **	0.20

## ASTM Standards (American Society for Testing and Materials)

### ASTM Standard D-1784

This standard covers PVC and CPVC compounds used in the manufacture of plastic pipe, valves, and fittings. It provides a means for selecting and identifying compounds on the basis of a number of physical and chemical criteria. Conformance to a particular material classification in this standard requires meeting a number of minimum physical and chemical properties.

### ASTM Standards D-2464 and F-437

These standards cover PVC (D-2464) and CPVC (F-437) Schedule 80 threaded pressure fittings. Thread dimensional specifications, wall thickness, burst, material quality, and identification requirements are specified.

### ASTM Standards D-2467 and F-439

These standards cover Schedule 80 PVC (D-2467) and CPVC (F-493) Socket Type Pressure Fittings. Dimensions, burst strength, resin compound stipulation and scheme of product identification requirements are specified.

### ASTM Standards D-4101 (Formerly D-2146)

This standard covers the polymeric content and physical characteristics of PP (polypropylene) Plastic Materials for injection molding and extrusion.

### ASTM Standard D-2657

This standard covers the procedure for heat-fusion bonding of polyolefin materials.

### ASTM Standard D-3222

This standard covers the polymerization method and physical properties of PVDF (polyvinylidene fluoride) fluoroplastic Materials for molding and extrusion.

### ANSI B1.20.1 (was B2.1)

#### (American National Standards Institute)

This specification details the dimensions and tolerance for tapered pipe threads. This standard is referenced in the ASTM standard for threaded fittings mentioned above.

### ANSI B16.5

This specification sets forth standards for bolt holes, bolt circle, and overall dimensions for steel 150# flanges.

## Temperature Correction Factors

Operating Temperature °F	FACTORS			
	PVC	CPVC	PP	PVDF
70	1.00	1.00	1.00	1.00
80	0.90	0.96	0.97	0.95
90	0.75	0.92	0.91	0.87
100	0.62	0.85	0.85	0.80
110	0.50	0.77	0.80	0.75
115	0.45	0.74	0.77	0.71
120	0.40	0.70	0.75	0.68
125	0.35	0.66	0.71	0.66
130	0.30	0.62	0.68	0.62
140	0.22	0.55	0.65	0.58
150	N.R.	0.47	0.57	0.52
160	N.R.	0.40	0.50	0.49
170	N.R.	0.32	0.26	0.45
180	N.R.	0.25	*	0.42
200	N.R.	0.18	N.R.	0.36
210	N.R.	0.15	N.R.	0.33
240	N.R.	N.R.	N.R.	0.25
280	N.R.	N.R.	N.R.	0.18

\* Recommended for intermittent drainage pressure not exceeding 20 psi.  
N.R. — Not Recommended

## Valves, Flanges and Unions

The maximum pressure rating for Chemtrol valves, flanges, and unions, regardless of size, is 150 psi at 73°F. As with all other thermoplastic piping components, the maximum non-shock operating pressure is related to temperature. Above 100°F refer to the chart below.

### Max. Operating Pressure (psi) vs. Temperature

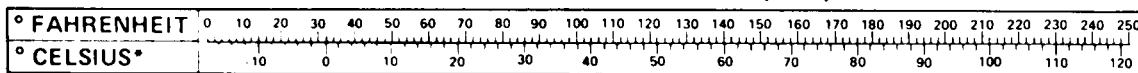
Operating Temperature °F	Operating Pressure (psi)			
	PVC	CPVC	PP	PVDF
100	150	150	150	150
110	135	140	140	150
120	110	130	130	150
130	75	120	118	150
140	50	110	105	150
150	N.R.	100	93	140
160	N.R.	90	80	133
170	N.R.	80	70	125
180	N.R.	70	50	115
190	N.R.	60	N.R.	106
200	N.R.	50	N.R.	97
250	N.R.	N.R.	N.R.	50
280	N.R.	N.R.	N.R.	25

N.R. — Not Recommended

## Temperature Conversions

$$F = C \times 1.8 + 32$$

$$C = (F - 32) \div 1.8$$

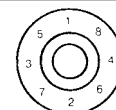


\* Formerly known as Centigrade

Flange Size	Recommended Torque *
1/2 - 1 1/2"	10 - 15 ft. lbs.
2 - 4"	20 - 30 ft. lbs.
6 - 8"	33 - 50 ft. lbs.
10"	53 - 75 ft. lbs.
12"	80 - 110 ft. lbs.

\* For a well lubricated bolt with flat washers under bolt head and nut.

The following tightening pattern is suggested for the flange bolts.





# Pipe Technical Data

## Support Spacing (ft.) for PVC Pipe\*

Horizontal pipe systems support spacings are greatly influenced by operating temperature. The charts show the recommended support spacing according to size, schedule, and operating temperatures. Do not clamp supports tightly — this restricts axial movement of the pipe. If short spacing is necessary, continuous supports may be more economical. Charts are based on liquids up to 1.00 specific gravity, but do not include concentrated loads, nor do they include allowance for aggressive reagents.

Pipe Size (in.)	SCHEDULE 40 Temperature °F					SCHEDULE 80 Temperature °F					SCHEDULE 120 Temperature °F					
	60°	80°	100°	120°	140°	60°	80°	100°	120°	140°	60°	80°	100°	120°	140°	
1/4	4	3 1/2	3 1/2	2	2	4	4	3 1/2	2 1/2	2						
3/8	4	4	3 1/2	2 1/2	2	4 1/2	4 1/2	4	2 1/2	2 1/2						
1/2	4 1/2	4 1/2	4	2 1/2	2 1/2	5	4 1/2	4 1/2	3	2 1/2	5	5	4 1/2	3	2 1/2	
3/4	5	4 1/2	4	2 1/2	2 1/2	5 1/2	5	4 1/2	3	2 1/2	5 1/2	5	4 1/2	3	3	
1	5 1/2	5	4 1/2	3	2 1/2	6	5 1/2	5	3 1/2	3	6	5 1/2	5	3 1/2	3	
1 1/4	5 1/2	5 1/2	5	3	3	6	6	5 1/2	3 1/2	3	6 1/2	6	5 1/2	3 1/2	3 1/2	
1 1/2	6	5 1/2	5	3 1/2	3	6 1/2	6	5 1/2	3 1/2	3 1/2	6 1/2	6 1/2	6	4	3 1/2	
2	6	5 1/2	5	3 1/2	3	7	6 1/2	6	4	3 1/2	7 1/2	7	6 1/2	4	3 1/2	
2 1/2	7	6 1/2	6	4	3 1/2	7 1/2	7 1/2	6 1/2	4 1/2	4	8	7 1/2	7	4 1/2	4	
3	7	7	6	4	3 1/2	8	7 1/2	7	4 1/2	4	8 1/2	8	7 1/2	5	4 1/2	
3 1/2	7 1/2	7	6 1/2	4	4	8 1/2	8	7 1/2	5	4 1/2	9	8 1/2	7 1/2	5	4 1/2	
4	7 1/2	7	6 1/2	4 1/2	4	9	8 1/2	7 1/2	5	4 1/2	9 1/2	9	8 1/2	5 1/2	5	
5	8	7 1/2	7	4 1/2	4	9 1/2	9	8	5 1/2	5	10 1/2	10	9	6	5 1/2	
6	8 1/2	8	7 1/2	5	4 1/2	10	9 1/2	9	6	5	11 1/2	10 1/2	9 1/2	6 1/2	6	
8	9	8 1/2	8	5	4 1/2	11	10 1/2	9 1/2	6 1/2	5 1/2						
10	10	9	8 1/2	5 1/2	5	12	11	10	7	6						
12	11 1/2	10 1/2	9 1/2	6 1/2	5 1/2	13	12	10 1/2	7 1/2	6 1/2						
14	12	11	10	7	6	13 1/2	13	11	8	7						
16	12 1/2	11 1/2	10 1/2	7 1/2	6 1/2	14	13 1/2	11 1/2	8 1/2	7 1/2						
	SDR 41					SDR 26										
18	13	12	11	8	7	14 1/2	14	12	9	8						
20	13 1/2	12 1/2	11 1/2	8 1/2	7 1/2	15	14 1/2	12 1/2	9 1/2	8 1/2						
24	14	13	12	9	8	15 1/2	15	13	10	9						

Note: Although support spacing is shown at 140°F, consideration should be given to the use of CPVC or continuous support above 120°F. The possibility of temperature overrides beyond regular working temperatures and cost may make either of the alternatives more desirable. This chart based on continuous spans and for uninsulated line carrying fluids of specific gravity up to 1.00.

## Support Spacing (ft.) for CPVC Pipe\*

Pipe Size (in.)	SCHEDULE 40 Temperature °F						SCHEDULE 80 Temperature °F					
	73°	100°	120°	140°	160°	180°	73°	100°	120°	140°	160°	180°
1/2	5	4 1/2	4 1/2	4	2 1/2	2 1/2	5 1/2	5	4 1/2	4 1/2	3	2 1/2
3/4	5	5	4 1/2	4	2 1/2	2 1/2	5 1/2	5 1/2	5	4 1/2	3	2 1/2
1	5 1/2	5 1/2	5	4 1/2	3	2 1/2	6	6	5 1/2	5	3 1/2	3
1 1/4	5 1/2	5 1/2	5 1/2	5	3	3	6 1/2	6	6	5 1/2	3 1/2	3
1 1/2	6	6	5 1/2	5	3 1/2	3	7	6 1/2	6	5 1/2	3 1/2	3 1/2
2	6	6	5 1/2	5	3 1/2	3	7	7	6 1/2	6	4	3 1/2
2 1/2	7	7	6 1/2	6	4	3 1/2	8	7 1/2	7 1/2	6 1/2	4 1/2	4
3	7	7	7	6	4	3 1/2	8	8	7 1/2	7	4 1/2	4
3 1/2	7 1/2	7 1/2	7	6 1/2	4	4	8 1/2	8 1/2	8	7 1/2	5	4 1/2
4	7 1/2	7 1/2	7	6 1/2	4 1/2	4	8 1/2	9	8 1/2	7 1/2	5	4 1/2
6	8 1/2	8	7 1/2	7	5	4 1/2	10	9 1/2	9	8	5 1/2	5
8	9 1/2	9	8 1/2	7 1/2	5 1/2	5	11	10 1/2	10	9	6	5 1/2
10	10 1/2	10	9 1/2	8	6	5 1/2	11 1/2	11	10 1/2	9 1/2	6 1/2	6
12	11 1/2	10 1/2	10	8 1/2	6 1/2	6	12 1/2	12	11 1/2	10 1/2	7 1/2	6 1/2

Note: This chart based on continuous spans for uninsulated line carrying fluids of specific gravity up to 1.00.

\* NOTE: The data furnished herein is based on information furnished by manufacturers of the raw material. This information may be considered as a basis for recommendation, but not as a guarantee. Materials should be tested under actual service to determine suitability for a particular purpose.



# Friction Loss & Flow Velocity

## Schedule 40 Pipe

Friction Loss Ft. Water / 100 Ft.

Velocity Ft. / Second

Gals. Per Min.	1/2"		3/4"		1"		1 1/4"		1 1/2"		2"		2 1/2"		3"	
	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss
1	1.13	2.08	0.63	0.51												
2	2.26	4.16	1.26	1.02	0.77	0.55	0.44	0.14	0.33	0.07						
5	5.64	23.44	3.16	5.73	1.93	1.72	1.11	0.44	0.81	0.22	0.49	0.066	0.30	0.038	0.22	0.015
7	7.90	43.06	4.43	10.52	2.72	3.17	1.55	0.81	1.13	0.38	0.69	0.11	0.49	0.051	0.31	0.021
10	11.28	82.02	6.32	20.04	3.86	6.02	2.21	1.55	1.62	0.72	0.98	0.21	0.68	0.09	0.44	0.03
15	4 in.		9.48	42.46	5.79	12.77	3.31	3.28	2.42	1.53	1.46	0.45	1.03	0.19	0.66	0.07
20	0.51	0.03	12.65	72.34	7.72	21.75	4.42	5.59	3.23	2.61	1.95	0.76	1.37	0.32	0.88	0.11
25	0.64	0.04	5 in.		9.65	32.88	5.52	8.45	4.04	3.95	2.44	1.15	1.71	0.49	1.10	0.17
30	0.77	0.06	0.49	0.02	11.58	46.08	6.63	11.85	4.85	5.53	2.93	1.62	2.05	0.68	1.33	0.23
35	0.89	0.08	0.57	0.03			7.73	15.76	5.66	7.36	3.41	2.15	2.39	0.91	1.55	0.31
40	1.02	0.11	0.65	0.03			8.84	20.18	6.47	9.43	3.90	2.75	2.73	1.16	1.77	0.40
45	1.15	0.13	0.73	0.04	6 in.		9.94	25.10	7.27	11.73	4.39	3.43	3.08	1.44	1.99	0.50
50	1.28	0.16	0.81	0.05	0.56	0.02	11.05	30.51	8.08	14.25	4.88	4.16	3.42	1.75	2.21	0.60
60	1.53	0.22	0.97	0.07	0.67	0.03			9.70	19.98	5.85	5.84	4.10	2.46	2.65	0.85
70	1.79	0.30	1.14	0.10	0.79	0.04					6.83	7.76	4.79	3.27	3.09	1.13
75	1.92	0.34	1.22	0.11	0.84	0.05					7.32	8.82	5.13	3.71	3.31	1.28
80	2.05	0.38	1.30	0.13	0.90	0.05					7.80	9.94	5.47	4.19	3.53	1.44
90	2.30	0.47	1.46	0.16	1.01	0.06	8 in.				8.78	12.37	6.15	5.21	3.98	1.80
100	2.56	0.58	1.62	0.19	1.12	0.08	0.65	0.03			9.75	15.03	6.84	6.33	4.42	2.18
125	3.20	0.88	2.03	0.29	1.41	0.12	0.81	0.035					8.55	9.58	5.52	3.31
150	3.84	1.22	2.44	0.40	1.69	0.16	0.97	0.04					10.26	13.41	6.63	4.63
175	4.48	1.63	2.84	0.54	1.97	0.22	1.14	0.055	10 in.						7.73	6.16
200	5.11	2.08	3.25	0.69	2.25	0.28	1.30	0.07	0.82	0.027					8.83	7.88
250	6.40	3.15	4.06	1.05	2.81	0.43	1.63	0.11	1.03	0.035					11.04	11.93
300	7.67	4.41	4.87	1.46	3.37	0.60	1.94	0.16	1.23	0.05	12 in.					
350	8.95	5.87	5.69	1.95	3.94	0.79	2.27	0.21	1.44	0.065	1.01	0.027				
400	10.23	7.52	6.50	2.49	4.49	1.01	2.59	0.27	1.64	0.09	1.16	0.04				
450			7.31	3.09	5.06	1.26	2.92	0.33	1.85	0.11	1.30	0.05				
500			8.12	3.76	5.62	1.53	3.24	0.40	2.05	0.13	1.45	0.06				
750							4.86	0.85	3.08	0.28	2.17	0.12				
1000							6.48	1.45	4.11	0.48	2.89	0.20				
1250									5.14	0.73	3.62	0.31				
1500									6.16	1.01	4.34	0.43				
2000											5.78	0.73				
2500											7.23	1.11				

NOTE: In larger diameters, particularly 6" and greater, it is recommended that velocities be maintained at or below 5 feet per second.

10

### FRICITION LOSS THROUGH FITTINGS

Friction loss through fittings is expressed in equivalent feet of the same pipe size and schedule for the system flow rate.

Schedule 40 head loss per 100' valves are usually used for other wall thicknesses and standard iron pipe size O.D.'s.

#### Average Friction Loss for PVC and CPVC Fittings in Equivalent Feet of Straight Run Pipe

Item	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16	18	20	24
Tee Run	1.0	1.4	1.7	2.3	2.7	4.0	4.9	6.1	7.9	12.3	14.0	17.5	20.0	25.0	27.0	32.0	35.0	42.0
Tee Branch	3.8	4.9	6.0	7.3	8.4	12.0	14.7	16.4	22.0	32.7	49.0	57.0	67.0	78.0	88.0	107.0	118.0	137.0
90° Ell	1.5	2.0	2.5	3.8	4.0	5.7	6.9	7.9	11.4	16.7	21.0	26.0	32.0	37.0	43.0	53.0	58.0	67.0
45° Ell	.8	1.1	1.4	1.8	2.1	2.6	3.1	4.0	5.1	8.0	10.6	13.5	15.5	18.0	20.0	23.0	25.0	30.0



# Friction Loss & Flow Velocity

## Schedule 80 Pipe

Friction Loss Ft. Water / 100 Ft.

Velocity Ft. / Second

Gals. Per Min.	1/2"		3/4"		1"		1 1/4"		1 1/2"		2"		2 1/2"		3"	
	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss	Vel	Loss
1	1.48	4.02	0.74	0.86												
2	2.95	8.03	1.57	1.72	0.94	0.88	0.52	0.21	0.38	0.10						
5	7.39	45.23	3.92	9.67	2.34	2.75	1.30	0.66	0.94	0.30	0.56	0.10	0.39	0.05	0.25	0.02
7	10.34	83.07	5.49	17.76	3.28	5.04	1.82	1.21	1.32	0.55	0.78	0.15	0.54	0.07	0.35	0.028
10			7.84	33.84	4.68	9.61	2.60	2.30	1.88	1.04	1.12	0.29	0.78	0.12	0.50	0.04
15	4 in.		11.76	71.70	7.01	20.36	3.90	4.87	2.81	2.20	1.68	0.62	1.17	0.26	0.75	0.09
20	0.57	0.04			9.35	34.68	5.20	8.30	3.75	3.75	2.23	1.06	1.56	0.44	1.00	0.15
25	0.72	0.06	5 in.		11.69	52.43	6.50	12.55	4.69	5.67	2.79	1.60	1.95	0.67	1.25	0.22
30	0.86	0.08	0.54	0.03	14.03	73.48	7.80	17.59	5.63	7.95	3.35	2.25	2.34	0.94	1.49	0.31
35	1.00	0.11	0.63	0.04			9.10	23.40	6.57	10.58	3.91	2.99	2.73	1.25	1.74	0.42
40	1.15	0.14	0.72	0.04			10.40	29.97	7.50	13.55	4.47	3.83	3.12	1.60	1.99	0.54
45	1.29	0.17	0.81	0.06	6 in.		11.70	37.27	8.44	16.85	5.03	4.76	3.51	1.99	2.24	0.67
50	1.43	0.21	0.90	0.07	0.63	0.03	13.00	45.30	9.38	20.48	5.58	5.79	3.90	2.42	2.49	0.81
60	1.72	0.30	1.08	0.10	0.75	0.04			11.26	28.70	6.70	8.12	4.68	3.39	2.99	1.14
70	2.01	0.39	1.26	0.13	0.88	0.05					7.82	10.80	5.46	4.51	3.49	1.51
75	2.15	0.45	1.35	0.14	0.94	0.06					8.38	12.27	5.85	5.12	3.74	1.72
80	2.29	0.50	1.44	0.16	1.00	0.07					8.93	13.83	6.24	5.77	3.99	1.94
90	2.58	0.63	1.62	0.20	1.13	0.08					10.05	17.20	7.02	7.18	4.48	2.41
100	2.87	0.76	1.80	0.24	1.25	0.10	8 in.				11.17	20.90	7.80	8.72	4.98	2.93
125	3.59	1.16	2.25	0.37	1.57	0.16	0.90	0.045					9.75	13.21	6.23	4.43
150	4.30	1.61	2.70	0.52	1.88	0.22	1.07	0.05					11.70	18.48	7.47	6.20
175	5.02	2.15	3.15	0.69	2.20	0.29	1.25	0.075	10 in.						8.72	8.26
200	5.73	2.75	3.60	0.88	2.51	0.37	1.43	0.09	0.90	0.036					9.97	10.57
250	7.16	4.16	4.50	1.34	3.14	0.56	1.79	0.14	1.14	0.045					12.46	16.00
300	8.60	5.83	5.40	1.87	3.76	0.78	2.14	0.20	1.36	0.07	12 in.					
350	10.03	7.76	6.30	2.49	4.39	1.04	2.50	0.27	1.59	0.085	1.12	0.037				
400	11.47	9.93	7.19	3.19	5.02	1.33	2.86	0.34	1.81	0.11	1.28	0.05				
450			8.09	3.97	5.64	1.65	3.21	0.42	2.04	0.14	1.44	0.06				
500			8.99	4.82	6.27	2.00	3.57	0.51	2.27	0.17	1.60	0.07				
750							5.36	1.08	3.40	0.36	2.40	0.15				
1000							7.14	1.84	4.54	0.61	3.20	0.26				
1250									5.67	0.92	4.01	0.40				
1500									6.80	1.29	4.81	0.55				
2000											6.41	0.94				
2500																

NOTE: In larger diameters, particularly 6" and greater, it is recommended that velocities be maintained at or below 5 feet per second.

### FRICITION LOSS THROUGH FITTINGS

Friction loss through fittings is expressed in equivalent feet of the same pipe size and schedule for the system flow rate.

Schedule 40 head loss per 100' valves are usually used for other wall thicknesses and standard iron pipe size O.D.'s.

#### Average Friction Loss for PVC and CPVC Fittings in Equivalent Feet of Straight Run Pipe

Item	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16	18	20	24
Tee Run	1.0	1.4	1.7	2.3	2.7	4.0	4.9	6.1	7.9	12.3	14.0	17.5	20.0	25.0	27.0	32.0	35.0	42.0
Tee Branch	3.8	4.9	6.0	7.3	8.4	12.0	14.7	16.4	22.0	32.7	49.0	57.0	67.0	78.0	88.0	107.0	118.0	137.0
90° Ell	1.5	2.0	2.5	3.8	4.0	5.7	6.9	7.9	11.4	16.7	21.0	26.0	32.0	37.0	43.0	53.0	58.0	67.0
45° Ell	.8	1.1	1.4	1.8	2.1	2.6	3.1	4.0	5.1	8.0	10.6	13.5	15.5	18.0	20.0	23.0	25.0	30.0



## Liquid Measure and Weight

To Obtain Multiply by	U.S. Gallon	Imperial Gallon	U.S. Pound Water	U.S. Cubic Foot	U.S. Cubic Inch	Liter	Cubic Meter
U.S. Gallon	1	0.8327	8.337	0.13368	231.0	3.785	0.003785
Imperial Gallon	1.2009	1	10.0	0.16054	277.78	4.546	0.004546
U.S. Pound Water	0.11995	0.1	1	0.016035	27.708	0.45404	0.000454
U.S. Cubic Feet	7.4805	6.2288	62.365	1	1728.0	28.316	0.028314
U.S. Cubic Inch	0.004329	0.00360	0.03609	0.000578	1	0.016387	0.0000164
Liter	0.26418	0.21997	2.202	0.035315	61.025	1	0.0010
Cubic Meter	264.2	219.99	2202.6	35.3183	61030.0	999.97	1

## Pressure and Head

To Obtain Multiply By	pound sq. inch	pound sq. foot	Atmo- sphere	kilogram sq. cm	inch water	foot water	inch mercury	mm mercury	bar
pound/sq. inch	1	144.0	0.068046	0.070307	27.7276	2.3106	2.0360	51.7150	0.06895
pound/sq. foot	0.006945	1	0.000473	0.000488	0.1926	0.01605	0.014139	0.35913	0.000479
Atmosphere	14.696	2116.22	1	1.0332	407.484	33.9570	29.921	760.0	1.01325
kilogram/sq. cm.	14.2233	2048.16	0.96784	1	394.27	32.864	28.959	735.558	0.9807
inch water	0.03607	5.194	0.002454	0.00254	1	0.08333	0.0734	1.865	0.00249
foot water	0.43278	62.3205	0.029449	0.03043	12.0	1	0.8811	22.381	0.02984
inch mercury	0.49115	70.726	0.033421	0.03453	13.617	1.1349	1	25.40	0.03386
mm mercury	0.019337	2.7845	0.0013158	0.0013595	0.5361	0.04468	0.03937	1	0.001333
bar	14.5038	2088.55	0.98692	1.0197	402.1	33.51	29.53	750.0	1

To convert from one unit to another, locate the starting unit in the left hand column. Multiply by the factor shown horizontally to the right under the desired unit.

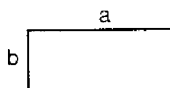
## Area and Volume Formulas

A = Area    S = Surface area of solid    V = Volume    C = Circumference    R = Radius of circumscribed circle

Rectangle

$$A = a * b$$

$$C = 2 * a + 2 * b$$



Circle

$$A = 3.142 * r * r$$

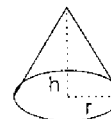
$$C = 6.283 * r$$



Cone

$$V = 1.047 * r * r * h$$

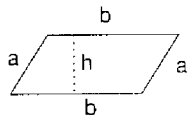
$$S = 3.142 * r * r * \sqrt{r * r + h * h}$$



Parallelogram

$$A = b * h$$

$$C = 2 * a + 2 * b$$



Sector of Circle

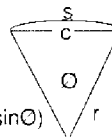
Central angle  $\theta$  measured in radians

$$s = r * \theta$$

$$c = 2 * r * \sin(\theta/2)$$

$$A (\text{sector}) = .5 * r * r * \theta$$

$$A (\text{segment}) = .5 * r * r * \theta * (1 - \sin \theta)$$



Sphere

$$V = 4.189 * r * r * r$$

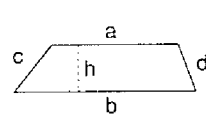
$$S = 12.57 * r * r$$



Trapezoid

$$A = .5 * (a+b) * h$$

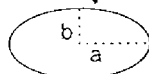
$$C = a+b+c+d$$



Ellipse

$$A = 3.142 * a * b$$

$$C = 6.284 * \sqrt{(a * a + b * b) / 2}$$

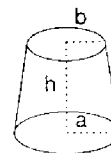


Frustum of Right

Circular Cone

$$V = 1.047 * h * [a * a + b * b + a * b]$$

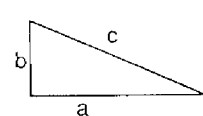
$$S = 3.142 * [a+b] * \sqrt{(a-b) * (a-b) + h * h}$$



Right Triangle

$$A = .5 * a * b$$

$$R = .5 * c$$

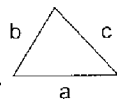


General Triangle

$$S = .5 * (a+b+c) * r$$

$$A = \sqrt{s * (s-a) * (s-b) * (s-c)}$$

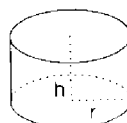
$$R = a * b * c / (2.5 * A)$$



Cylinder

$$V = 3.142 * r * r * h$$

$$S = 6.284 * r * r + 2 * r * h$$

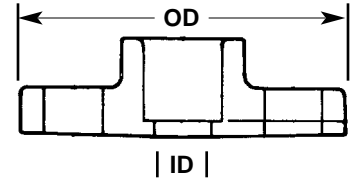




# Technical Data



## Flanges Schedule 80 Class 150 ANSI



Nominal Pipe Size	OD	ID	Number of Holes	Dia. of Bolt Circle	Nominal Pipe Size	OD	ID	Number of Holes	Dia. of Bolt Circle
1/2	3 1/2	.528	4	2 3/8	3	7 1/2	2.864	4	6
3/4	3 7/8	.724	4	2 3/4	4	9	3.786	8	7 1/2
1	4 1/4	.935	4	3 1/8	6	11	5.709	8	9 1/2
1 1/4	4 5/8	1.256	4	3 1/2	8	13 1/2	7.565	8	11 3/4
1 1/2	5	1.476	4	3 7/8	10	16	9.492	12	14 1/4
2	6	1.913	4	4 3/4	12	19	11.294	12	17
2 1/2	7	2.289	4	5 1/2					

### Drill Sizes for Pipe Taps

Tap Size	Threads Per in.	Diam. of Drill	Tap Size	Threads Per in.	Diam. of Drill
1/8	27	11/32	2	11 1/2	2 3/16
1/4	18	7/16	2 1/2	8	2 9/16
3/8	18	37/64	3	8	3 3/16
1/2	14	23/32	3 1/2	8	3 11/16
3/4	14	59/64	4	8	4 3/16
1	11 1/2	1 5/32	4 1/2	8	4 3/4
1 1/4	11 1/2	1 1/2	5	8	5 5/16
1 1/2	11 1/2	1 49/64	6	8	6 5/16

### Pipe and Water Weight Per Line Foot

Nominal Pipe Size	WEIGHT OF:		WEIGHT OF:	
	Std. Pipe	Water	XS Pipe	Water
1/2	.851	.132	1.088	.101
3/4	1.131	.231	1.474	.187
1	1.679	.374	2.172	.311
1 1/4	2.273	.648	2.997	.555
1 1/2	2.718	.882	3.632	.765
2	3.653	1.453	5.022	1.278
2 1/2	5.794	2.073	7.622	1.835
3	7.580	3.200	10.250	2.860
3 1/2	9.110	4.280	12.510	3.850
4	10.790	5.510	14.990	4.980
5	14.620	8.660	20.780	7.880
6	18.980	12.510	28.580	11.290
8	28.560	21.680	43.400	19.800
10	40.500	34.100	54.700	32.300
12	49.600	49.000	65.400	47.000
14	54.600	59.700	72.100	57.500
16	62.600	79.100	82.800	76.500
18	70.600	101.200	93.500	98.300
20	78.600	126.000	104.100	122.800
24	94.600	183.800	125.500	179.900
30	118.700	291.000	157.600	286.000

### Feet Head Of Water To PSI

Feet Head	Pounds Square Inch	Feet Head	Pounds Square Inch
1	.43	100	43.31
2	.87	110	47.64
3	1.30	120	51.97
4	1.73	130	56.30
5	2.17	140	60.63
6	2.60	150	64.96
7	3.03	160	69.29
8	3.46	170	73.63
9	3.90	180	77.96
10	4.33	200	86.62
15	6.50	250	108.27
20	8.66	300	129.93
25	10.83	350	151.58
30	12.99	400	173.24
40	17.32	500	216.55
50	21.65	600	259.85
60	25.99	700	303.16
70	30.32	800	346.47
80	34.65	900	389.78
90	38.98	1000	433.00

### Water Pressure To Feet Head

Pounds Per Square Inch	Feet Head	Pounds Per Square Inch	Feet Head
1	2.31	100	230.90
2	4.62	110	253.93
3	6.93	120	277.07
4	9.24	130	300.16
5	11.54	140	323.25
6	13.85	150	346.34
7	16.16	160	369.43
8	18.47	170	392.52
9	20.78	180	415.61
10	23.09	200	461.78
15	34.63	250	577.24
20	46.18	300	692.69
25	57.72	350	808.13
30	69.27	400	922.58
40	92.36	500	1154.48
50	115.45	600	1385.39
60	138.54	700	1616.30
70	161.63	800	1847.20
80	184.72	900	2078.10
90	207.81	1000	2309.00

Note: One foot of water at 62° F. equals .433 pound pressure per square inch. To find the pressure per square inch for any feet head not given in the table above, multiply the feet head by .433.

To find feet head of water multiply pressure pounds per square inch by 2.309.

## Flanged joints between plastic pipes and metal pipes (with flat gaskets).

Where the transition is made from plastic to metal, the flanged joints usually incorporate a flat gasket. It is not permissible to use plasticised PVC seals in conjunction with PVC flange adaptors, as this can lead to stress corrosion cracking due to migration of the plasticizer.

Flanges with flat gaskets must have sufficient stability to withstand higher torques required when tightening the bolts in this jointing method.

In case of flanged joints with flat gaskets, the bolts should also be tightened with the aid of a torque wrench in order to prevent damage to the flanges or flange adaptors. Approximate values for the torque required, depending upon the pipe diameter, are given in the table below.

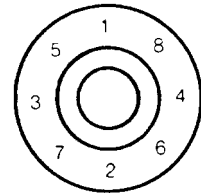
### George Fischer +GF+ Recommended Torque Values

Pipe OD	mm	16	20	25	32	40	50	63	75	90	110	125	140	160	200	225
Diameter	inch	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	4 1/2	5	6	7	8
Torque	Nm	6	7	9	10	20	25	30	35	40	45	45	50	60	75	75
Torque	Ft. Lbs.	4.4	5.2	6.6	7.4	14.8	18.4	22.1	25.8	29.5	33.2	33.2	36.9	44.3	55.3	55.3

### Chemtrol Recommended Torque Values

Flange Size	Recommended Torque *
1/2 - 1 1/2"	10 - 15 Ft. Lbs.
2 - 4"	20 - 30 Ft. Lbs.
6 - 8"	33 - 50 Ft. Lbs.
10"	53 - 75 Ft. Lbs.
12"	80 - 110 Ft. Lbs.

The following tightening pattern is suggested for the flange bolts.



\* For a well lubricated bolt with flat washers under bolt head and nut.

## Bulkhead Fitting Sizing Chart for Tanks

### Threaded Bulkhead Fitting

Threaded bulkhead fittings are available for below liquid level installation depending on the tank diameter and placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult sales office for placement questions.

Note: Tank wall thickness must be considered for bulkhead fitting placement. The maximum wall thickness and tank diameter sizes are shown below.

### Bolted 150 lb. Flange Fitting

Bolted flange fittings are required for below liquid level installation for sizes above 2 in. depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult sales office for placement questions. Bolted flange fittings provide the best strength and sealing characteristics of any tank fitting available. Allowable fittings sizes based on tank diameter for curved surfaces are shown below. Note: The bolted flange fittings shall allow tank wall thickness up to 2 1/2 in.

Sizing Chart For Bulkhead Fittings

Bulkhead Size (in.)	Max. Wall Thickness		Tank Diameter	
	Threaded	Bolted	Threaded	Bolted
1/4	-	-	48-142"	-
3/8	-	-	48-142"	-
1/2	.750	-	48-142"	-
3/4	.875	-	48-142"	-
1	.875	-	48-142"	-
1 1/4	.875	-	48-142"	-
1 1/2	.875	-	48-142"	-
2	1.00 *	-	48-142"	-
3	1.125 *	2.5	-	48 - 88"
4	1.125 *	2.5	-	90 - 102"
6	1.125 *	2.5	-	120 - 142"

\* Flat surface only

Hole Sizing Chart For Bulkhead Fittings

Bulkhead Size	Hole Saw Size	Bulkhead Size	Hole Saw Size
1/4"	-	1 1/2"	2 3/8"
3/8"	-	2"	3 1/4"
1/2"	1 3/8"	3"	4 1/2"
3/4"	1 5/8"	4"	5 3/4"
1"	1 7/8"	6"	-
1 1/4"	2 3/8"	Note: Use jig saw for 6"	



# Conversion Factors / Abbreviations

## Basic Unit of Measurement - Length (Meter)

U.S. TO METRIC	METRIC TO U.S.
1 inch = 25.40 millimeters	1 millimeter = 0.03937 inch
1 inch = 2.540 centimeters	1 centimeter = 0.3937 inch
1 foot = 30.480 centimeters	1 meter = 39.37 inches
1 foot = 0.3048 meter	1 meter = 3.2808 feet
1 yard = 91.440 centimeter	1 meter = 1.0936 yards
1 yard = 0.9144 meter	1 kilometer = 0.62137 mile
1 mile = 1.609 kilometers	

## AREA

U.S. TO METRIC	METRIC TO U.S.
1 sq. inch = 645.16 sq. millimeters	1 sq. millimeter = 0.00155 sq. inch
1 sq. inch = 6.4516 sq. centimeters	1 sq. centimeter = 0.1550 sq. inch
1 sq. foot = 929.03 sq. centimeters	1 sq. meter = 10.7640 sq. feet
1 sq. foot = 0.0929 sq. meter	1 sq. meter = 1.196 sq. yards
1 sq. yard = 0.836 sq. meter	1 sq. hectometer = 2.471 acres
1 acre = 0.4047 sq. hectometer	1 hectare = 2.471 acres
1 acre = 0.4047 hectare	1 sq. kilometer = 0.386 sq. mile
1 sq. mile = 2.59 sq. kilometers	

## Abbreviations

<b>AGA</b> American Gas Association	<b>IAPMO</b> International Association of Plumbing & Mechanical Officials	<b>PVC</b> Polyvinyl Chloride
<b>ANSI</b> American National Standards Institute	<b>ISO</b> International Standards Organization	<b>PVDF</b> Polyvinylidene Fluoride
<b>API</b> American Petroleum Institute	<b>IAPD</b> International Association of Plastics Distributors	<b>RMA</b> Rubber Manufacturers Association
<b>AQL</b> Acceptable Quality Level	<b>NEMA</b> National Electrical Manufacturers Association	<b>SI</b> International System (of units)
<b>ASME</b> American Society for Testing & Materials	<b>NPT</b> American National Standard Taper Pipe Thread	<b>SPC</b> Statistical Process Control
<b>AWWA</b> American Water Works Association	<b>NSF</b> National Sanitation Foundation	<b>SPE</b> Society of Plastics Engineers
<b>BOCA</b> Building Officials & Code Administrators	<b>OSHA</b> Occupational Safety & Health Administration	<b>SPI</b> Society of the Plastics Industry, Inc.
<b>BS</b> British Standards Institution	<b>PPI</b> Plastic Pipe Institute	<b>UL</b> Underwriters Laboratories, Inc.
<b>CPVC</b> Chlorinated Polyvinyl Chloride	<b>PPL</b> Polypropylene	<b>w•o•g</b> Water, Oil, Gas
<b>CSA</b> Canadian Standards Association	<b>psi</b> Pounds per Square Inch	
<b>DIN</b> German Industrial Norms	<b>psig</b> Pounds per Square Inch Gauge Pressure	
<b>EPDM</b> Ethylene Propylene diene monomer	<b>PTFE</b> Polytetrafluoroethylene	
<b>gpm</b> Gallons per Minute		



# Technical Data

## Conversion Chart: Fraction to Decimals with Drill Size and Tap Size

Fraction	Drill Size	Decimal Equiv.	Tap Size	
1/64	80	.0135		
	79	.0145		
		.0156		
	78	.0160		
	77	.0180		
	76	.0200		
	75	.0210		
	74	.0225		
	73	.0240		
	72	.0250		
1/32	71	.0260		
	70	.0280		
	69	.0292		
	68	.0310		
		.0312		
	67	.0320		
	66	.0330		
	65	.0350		
	64	.0360		
	63	.0370		
3/64	62	.0380		
	61	.0390		
	60	.0400		
	59	.0410		
	58	.0420		
	57	.0430		
	56	.0465		
		.0469	0-80	
	55	.0520		
	54	.0550		
1/16	53	.0595	1-64, 72	
		.0625		
	52	.0635		
	51	.0670		
	50	.0700	2-56, 64	
	49	.0730		
	48	.0760		
	5/64		.0781	
		47	.0785	3-48
		46	.0810	
45		.0820	3-56	
44		.0860		
43		.0890	4-40	
42		.0935	4-48	
		.0938		
3/32		41	.0960	
		40	.0980	
	39	.0995		
	38	.1015	5-40	
	37	.1040	5-44	
	36	.1065	6-32	
		.1094		
	7/64	35	.1100	
		34	.1110	
		33	.1130	6-40
32		.1160		
31		.1200		
		.1250		
1/8		30	.1285	
		29	.1360	8-32, 36
		28	.1405	

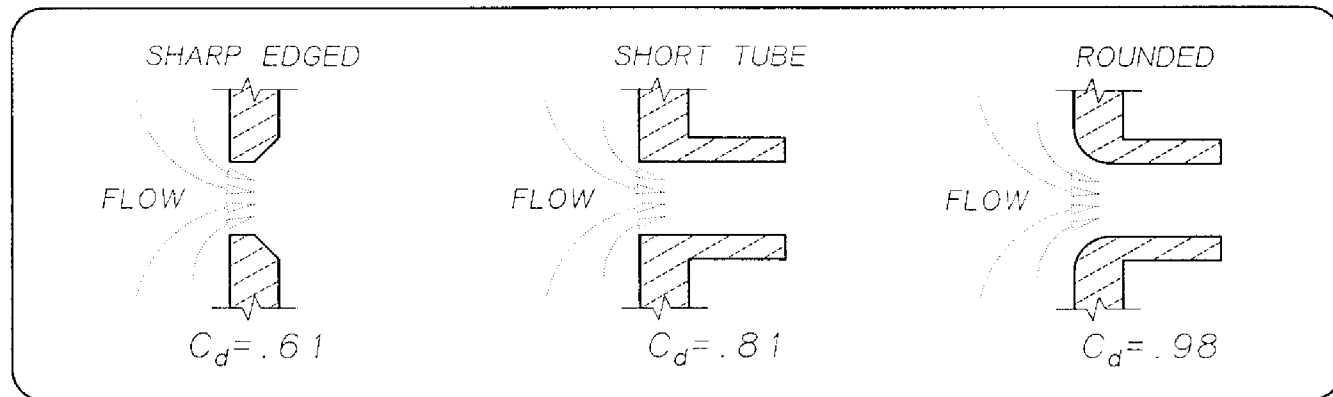
Fraction	Drill Size	Decimal Equiv.	Tap Size
9/64		.1406	
	27	.1440	
	26	.1470	
	25	.1495	10-24
	24	.1520	
5/32	23	.1540	
		.1562	
	22	.1570	
	21	.1590	10-32
	20	.1610	
11/64	19	.1660	
	18	.1695	
		.1719	
	17	.1730	
	16	.1770	12-24
3/16	15	.1800	
	14	.1820	12-28
	13	.1850	
		.1875	
	12	.1890	
13/64	11	.1910	
	10	.1935	
	9	.1960	
	8	.1990	
	7	.2010	1/4 - 20
7/32		.2031	
	6	.2040	
	5	.2055	
	4	.2090	
	3	.2130	1/4-28
15/64		.2188	
	2	.2210	
	1	.2280	
	A	.2340	
		.2344	
1/4	Letter Size Drills	B	.2380
		C	.2420
		D	.2460
		E	.2500
		F	.2570
17/64		.2610	
		.2656	
		.2660	
		.2720	5/16-24
		.2770	
9/32		.2810	
		.2812	
		.2900	
		.2950	
		.2969	
19/64		.3020	
		.3125	3/8-16
		.3160	
		.3230	
		.3281	
21/64		.3320	3/8-24
		.3390	
		.3438	
		.3480	
		.3580	
11/32		.3594	
		.3680	7/16 - 14
		.3680	
		.3780	
		.3850	
23/64		.3950	
		.4000	
		.4050	
		.4100	
		.4150	

Fraction	Drill Size	Decimal Equiv.	Tap Size
3/8		.3750	
	Letter Size Drills	V	.3770
		W	.3860
25/64		.3960	7/16-20
	X	.3970	
	Y	.4040	
13/32		.4062	
	Z	.4130	
		.4219	1/2-13
27/64		.4375	
29/64		.4531	1/2-20
15/32		.4688	
31/64		.4844	9/16-12
1/2		.5000	
33/64		.5156	9/16-18
17/32		.5312	5/8-11
35/64		.5469	
9/16		.5625	
37/64		.5781	5/8-18
19/32		.5938	
39/64		.6094	
5/8		.6250	
41/64		.6406	
21/32		.6562	3/4-10
43/64		.6719	
11/16		.6875	3/4-16
45/64		.7031	
23/32		.7188	
47/64		.7344	
3/4		.7500	
49/64		.7656	7/8-9
25/32		.7812	
51/64		.7969	
13/16		.8125	7/8 - 14
53/64		.8281	
27/32		.8438	
55/64		.8594	
7/8		.8750	1 - 8
57/64		.8906	
29/32		.9062	
59/64		.9219	1 - 12
15/16		.9375	
61/64		.9531	
31/32		.9688	
63/64		.9844	1 1/8 - 7
1		1.0000	
1 3/64		1.0469	1 1/8 - 12
1 7/64		1.1094	1 1/4 - 7
1 1/8		1.1250	
1 11/64		1.1719	1 1/4 - 12
1 7/32		1.2188	1 3/8 - 6
1 1/4		1.2500	
1 15/64		1.2969	1 3/8 - 12
1 11/32		1.3438	1 1/2 - 6
1 3/8		1.3750	
1 27/64		1.4219	1 1/2 - 12
1 1/2		1.5000	

PIPE THREAD SIZE			
Thread	Drill	Thread	Drill
1/8 - 27	R	1 1/2 - 11 1/2	1 47/64
1/4 - 18	7/16	2 - 11 1/2	2 7/32
3/8 - 18	37/64	2 1/2 - 8	2 5/8
1/2 - 14	23/32	3 - 8	3 1/4
3/4 - 14	59/64	3 1/2 - 8	3 3/4
1 - 11 1/2	1 5/32	4 - 8	4 1/4
1 1/4 - 11 1/2	1 1/2		

## Formulas for Calculating the Time Required to Empty a Vessel

The following formulas are based on turbulent flow of a Newtonian fluid through an outlet (orifice) in a tank. The discharge coefficient  $C_d$  depends on the configuration of the outlet. Some typical values for discharge coefficient are shown below.

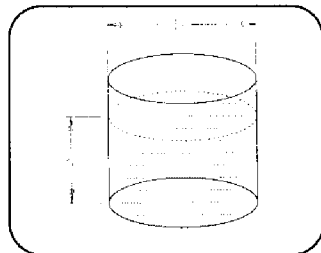


Variables:

- h elevation of fluid (ft.)
- D diameter of tank (ft.)
- A orifice area (ft.<sup>2</sup>)
- G gravitational acceleration = 32.2 ft./sec.<sup>2</sup>
- $\Delta t$  time required to empty tank (sec.)

### Vertical Cylindrical Tank

$$\Delta t = \frac{\pi * D^2}{C_d * A} * \sqrt{\frac{h}{8 * G}}$$



Example 1:

A vertical cylindrical tank 12 ft. in diameter is fitted with a 2" Hayward bulkhead fitting (comparable to a short tube outlet). The area of the outlet is:

$$A = \frac{\pi * d_{orf}^2}{4 * 144} = \frac{\pi * 2^2}{4 * 144} = .0218 \text{ ft}^2$$

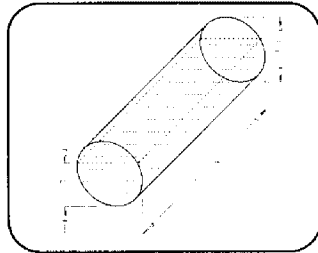
If the tank is filled with water to a height of 20 ft., and if we assume turbulent flow the approximate time to empty the tank is given by:

$$\Delta t = \frac{\pi * 12^2}{.81 * .0218} * \sqrt{\frac{20}{8 * 32.2}} = 7,139 \text{ sec}$$

The tank should be empty in about 2 hours.

### Horizontal Cylindrical Tank

$$\Delta t = \frac{L * [D^{3/2} - (D-h)^{3/2}]}{3 * C_d * A} * \sqrt{\frac{8}{G}}$$



Example 2:

A 7 ft. diameter by 9 ft. long horizontal cylindrical tank has a 4" diameter sharp edged orifice outlet. The area of the outlet is:

$$A = \frac{\pi * d_{orf}^2}{4 * 144} = \frac{\pi * 4^2}{4 * 144} = .0873 \text{ ft}^2$$

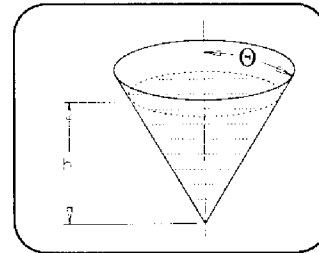
If the tank is filled with water to a height of 5 ft., and if we assume turbulent flow the approximate time to empty the tank is given by:

$$\Delta t = \frac{9 * [7^{3/2} - (7-5)^{3/2}]}{3 * .61 * .0873} * \sqrt{\frac{8}{32.2}} = 440 \text{ sec}$$

The tank should empty in about 7 minutes.

### Conical Tank

$$\Delta t = \frac{\pi * h^{5/2} * \tan^2 \Theta}{5 * C_d * A} * \sqrt{\frac{2}{G}}$$



Example 3:

A conical tank with a taper angle of 25° is fitted with a 2" diameter short tube type outlet. The area of the outlet is:

$$A = \frac{\pi * d_{orf}^2}{4 * 144} = \frac{\pi * 2^2}{4 * 144} = .0218 \text{ ft}^2$$

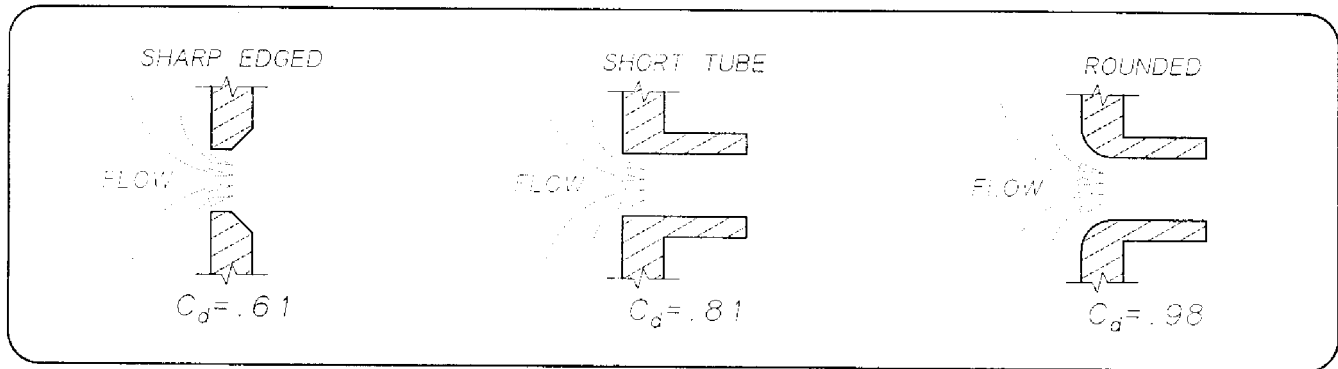
If the tank is filled with water to a height of 28 ft., and if we assume turbulent flow the approximate time to empty the tank is given by:

$$\Delta t = \frac{\pi * 28^{5/2} * \tan^2 25^\circ}{5 * .81 * .0218} * \sqrt{\frac{2}{32.2}} = 8,000 \text{ sec}$$

The tank should empty in about 2 1/4 hours.

## Formulas for Calculating Flow Rate from a Vessel

The following formulas are for calculating the rate at which a fluid will flow from a tank when the fluid level is maintained constant (h is constant). The discharge coefficient  $C_d$  depends on the configuration of the outlet. Some typical values for discharge coefficient are shown below.

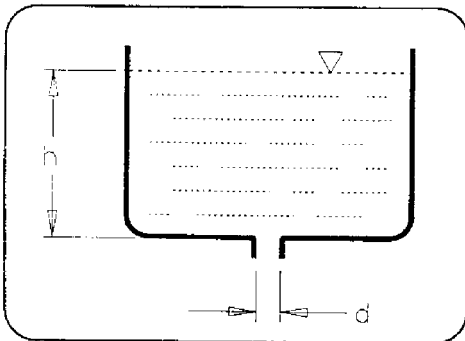


Variables:

- h fluid elevation above outlet (in.)
- d diameter of orifice (in.)
- a orifice area (in.<sup>2</sup>)
- g gravitational acceleration = 386 in./sec.<sup>2</sup>
- q volume flow rate of fluid through opening (in.<sup>3</sup>/sec.)
- $C_d$  discharge coefficient

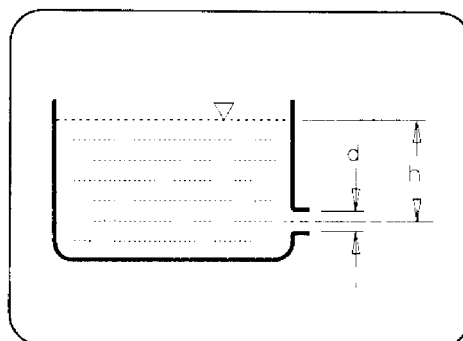
Bottom Opening

$$q = C_d * a * \sqrt{2 * g * h}$$



Side Opening

$$q = C_d * a * \sqrt{2 * g * h}$$



Example 1:

An open tank is continuously fed with water such that the height from the water surface to the outlet is maintained at 60". The outlet has a 1" diameter bulkhead fitting (comparable to a short tube outlet). The outlet area is calculated by:

$$a = \frac{\pi * d^2}{4} = \frac{\pi * 1^2}{4} = .7854 \text{ in}^2$$

The flow of water through the outlet is given by:

$$q = .81 * .7854 * \sqrt{2 * 386 * 60} = 137 \text{ in}^3/\text{sec}$$

This flow rate is equivalent to about 36 gpm.

## Chemtrol® Thermo-Sealing (Socket Fusion) Instructions for Black & Natural Polypropylene and Red & Natural PVDF (Kynar) Pressure Piping Systems

### Scope

The socket fusion joining method which is detailed herein applied to all Chemtrol polypropylene and PVDF pressure piping systems including molded socket fittings, and socket type valve connections. This procedure involves the application of regulated heat uniformly and simultaneously to pipe and fitting mating surfaces so that controlled melting occurs at these surfaces.

All recommendations and instructions presented herein for socket fusion are based upon the use of a Thermo-Seal fusion tool for applying uniform heat to pipe and fittings.

### Joining Equipment and Materials

- Cutting tools
- Deburring tool
- Cotton rags
- Vise
- Thermo-Seal tool
- Electric Model DD-1 with 1/2" - 2" tool pieces  
115V 6.7 amps 800 watts
- Electric Model DD-2 with 1/2" - 6" tool pieces  
115V 1.38 amps 1650 watts

**CAUTION:** Socket Fusion and Fillet Welding involve temperatures in excess of 540°F. Severe burns can result from contacting equipment or molten plastic material at or near these temperatures.

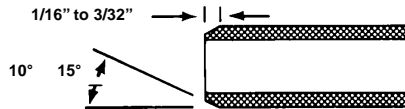
### Preparation and Joining

#### 1. Cutting

The smaller sizes of plastic pipe (1/2" - 4") can easily be cut with a pipe or tubing cutter (Reed Part # 04140), which has a cutting wheel that is specifically designed for plastic.

#### 2. Deburring and Beveling

All burrs, chips, fillings, etc., should be removed from both the pipe I.D. and O.D. before joining. Use a deburring tool or a knife. Best done with a Reed Beveling tool (Part # 04395).



#### 3. Cleaning

Using a clean, dry cotton rag, wipe away all loose dirt and moisture from the I.D. and O.D. of the pipe end and the I.D. of the fitting. **DO NOT ATTEMPT TO SOCKET FUSE WET SURFACES.**

#### 4. Joint Sizing

In order to provide excess material for fusion bonding, polypropylene and PVDF components are manufactured to socket dimensions in which the socket I.D. is smaller than the pipe O.D. Therefore, it should not be possible to easily slip the pipe into the fitting socket past the initial socket entrance depth, and in no case should it ever be possible to bottom the pipe in the socket prior to fusion.

Before making socket fusion joints, fittings should be checked for proper socket dimensional tolerances, based on the above discussion, by attempting to insert the pipe into the fitting socket. If a fitting socket appears to be oversized, it should not be used.

#### 5. Planning Construction

Socket fusion joints are more easily made when there is sufficient space to properly secure the Thermo-Seal tool and to maneuver pipe and fittings into the Thermo-Seal tool. Therefore, it is recommended that the piping system be pre-fabricated, as much as possible, in an area where there is sufficient room to work, and that as few joints as possible should be made in areas where there is limited working space. Mechanical joints such as flanges or unions may be considered in extremely tight areas.

#### 6. Thermo-Seal Tool Set Up

**WARNING: DISCONNECT ELECTRICAL POWER BEFORE ADJUSTING HEATER TEMPERATURE. IF NOT, THE THERMOSWITCH COULD BE SHORTED OUT, RESULTING IN SEVERE ELECTRICAL SHOCK.**

- a. Install the male and female tool pieces on either side of the Thermo-Seal tool and secure with set screws.
- b. Insert the electrical plug into a ground 100 VAC electrical source, and allow the tool to come to the proper operating temperature. The tool temperature is read directly from the mounted temperature gauge, and tool temperature can be adjusted by turning the thermostat adjustment screw with a screwdriver. (Counterclockwise to raise the temperature, and clockwise to lower the temperature.)

**NOTE:** One turn of the adjustment screw will give approximately a 25°F temperature change.

**IMPORTANT:** Good socket fusion joints can be made only when the Thermo-Seal tool is operating at the proper temperature, and only when the length of time that the pipe and fittings remain on the heated tool pieces does not exceed those times recommended for the particular size of pipe and fitting to be joined as listed in the next column. (Note: Heating times should begin after pipe and fitting have been completely placed in position on the heat tool.)

### Recommended Heating Time

Pipe Size In.	Polypropylene	PVDF
	Heating Time at 540°F	Heating Time at 565°F
1/2	10 - 15 Sec.	20 - 25 Sec.
3/4	13 - 18 Sec.	20 - 25 Sec.
1	14 - 20 Sec.	25 - 30 Sec.
1 1/2	15 - 20 Sec.	30 - 45 Sec.
2	20 - 25 Sec.	30 - 45 Sec.
3	25 - 30 Sec.	30 - 45 Sec.
4	25 - 35 Sec.	45 - 60 Sec.
6	35 - 50 Sec.	60 - 75 Sec.

Low temperatures and insufficient heating times will result in a lack of or incomplete melting making it impossible to make a good socket fusion joint

### Making Socket Fusion Joints

- Place the proper size depth gauge over the end of the pipe.
- Attach the end of the depth gauge clamp to the pipe by butting the clamp up to the end of the depth gauge and locking it into place. Then remove the depth gauge.
- Simultaneously place pipe and fitting squarely and fully on heat tool pieces so that the I.D. of the fitting and the O.D. of the pipe are in contact with the heating surfaces. Care should be taken to insure that the pipe fitting are not cocked when they are inserted on the tool pieces.
- Hold the pipe and fitting on the tool pieces for the prescribed amount of time. During this time a bead of melted material will appear around the complete circumference of the pipe at the entrance of the tool piece.
- Simultaneously remove the pipe and fitting from the tool pieces and immediately insert the pipe, squarely and fully and without purposeful rotation, into the socket of the fitting. Hold the complete joint in place and avoid relative movement between components for at least 15 seconds.  
Once a joint has been completed the clamp can be removed and preparation for the next joint can be started.
- The surfaces of the female and male tool pieces are Teflon coated to prevent sticking of the hot plastic.  
It is important that the tool pieces be kept as clean as possible. Any residue left on the tool pieces should be removed immediately by wiping with a cotton cloth.  
**CAUTION: HOT PLASTIC MATERIAL CAN CAUSE SEVERE BURNS: AVOID CONTACT WITH IT.**

### Procedures for making good socket fusion joints can be summarized into five basic principles as follows:

- The tool must be operated at the proper temperature.
- The pipe end must be beveled.
- The fitting must be slipped squarely onto the male tool while the pipe is simultaneously inserted into the female tool.
- The fitting and pipe must not remain on the heat tool for an excessive period of time. Recommended heating times must be followed.
- The pipe must be inserted squarely into the fitting socket immediately after removal from the heated tools.
- The Thermo-Seal tool must be kept clean at all times.

### Pressure Testing

The strength of a socket fusion joint develops as the material in the bonded area cools. One hour after the final joint is made, a socket fusion piping system can be pressure tested up to 100% of its hydrostatic pressure rating.

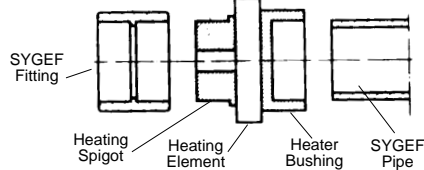
**NOTE: ONLY TRAINED PERSONNEL MAY CARRY OUT FUSION JOINING!**

## GEORGE FISCHER +GF+ Instructions for Socket Fusion Joining of SYGEF (PVDF) Pipes and Fittings, using heated tools

### Fusion Joining Method

Fusion Joining is carried out using heated tools, with the fitting overlapping the pipe. No additional materials are used. The pipe end and fitting socket are heated to fusion joining temperature using a heater bushing and a heating spigot respectively, and are then pushed together. Resulting in a homogeneous joint.

#### Fusion Procedure Components



### Combination Socket / Butt Fusion Machine



For 16 mm through 110 mm socket fusion or 160 mm butt fusion. Unit can be ordered complete with peeling tools, heater bushings, and motor driven facing tool. Ideal for large projects that require large diameter piping.

### Manually-operated Fusion Joining Tools



The element is heated electrically. The heater bushing and spigot are interchangeable. A separate pair of tools is required for each pipe size.



### Preparing the Fusion Joint (Standard Joints)

Preset the temperature of the heating tool to 500°F (260°C) and check that it is correct using a fast-acting thermo-probe or "tempil" sticks. The temperature is to be measured on the outer side of the heater bushing used to heat the pipe. The fusion joining temperature must lie between 482 and 518°F (250°C and 270°C). In order to test the thermostats, the fusion joining temperature should be checked from time to time.

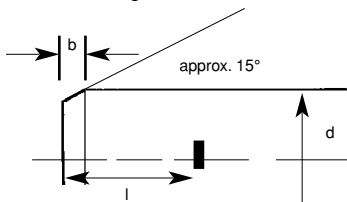
**Clean** the heater bushing and heating spigot with a clean cloth or dry paper. The tools must be cleaned after each fusion joint.



**Squarely Cut** off the pipe using a pipe cutter suitable for plastic pipes. Deburr internally with a knife. (See our tools section.)



**Chamfer** the pipe end externally with a chamfering tool, as shown in the sketch.



<b>d</b>	inch	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
	mm	16	20	25	32	40	50	63	75	90	110
<b>b</b>	inch	1/16									
	mm	2									
<b>l</b>	inch	1/2	1/2	5/8	11/16	3/4	7/8	1	1 1/4	1 3/8	1 5/8
	mm	13	14	16	18	20	22	26	31	35	41

**Thoroughly Clean** the joining surfaces of the fitting socket and pipe end using absorbent paper and solvent (e.g. alcohol). Use a fresh piece of paper each time. When using the manually-operated tool, mark the fusion length *l* on the pipe with a soft pencil.



If necessary, **mark** the required position on the pipe and fitting before joining.



### Fusion Joining Procedure

#### Heating

Push the fitting on to the heating spigot to the full extent possible, and — in the case of manual operation — push pipe into the heater bushing up to the pencil marking, without turning, and hold firmly. The heating time, as given below, begins at this moment.

<b>Pipe ø</b>											
mm	16	20	25	32	40	50	63	75	90	110	
inch	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	
<b>Heating time sec.</b>	4	6	8	10	12	18	20	22	25	30	

#### Joining

When the heating time has elapsed, quickly pull the fitting and pipe from the heating tools with a "snap off" action and immediately push them together axially, without turning. The fitting and pipe must be aligned and held together for the same duration as the heating time.



### Clean Joining Procedure

For pure water systems slightly modified preparation and joining procedures should be followed:

1. Peel the pipe end with George Fischer peeling tool so that the wall thickness is slightly reduced.
2. Heater bushings are to be dedicated to fusing SYGEF only, for contamination reasons.
3. The SYGEF pipe end and fitting are to be washed in acetone with a clean, used once, lint-free paper towel with special care given to the OD of the pipe and the ID of the fitting.
4. The depth of penetration of the fitting onto the male heater bushing needs to be decreased by approx. 1/16 to 1/8 inch.
5. Care should be exercised not to overheat the pipe. As soon as a sufficient external pipe bead is visible, a joint should be made. Recommended temperature (thermostat) setting is 473°F (245°C) to enhance reduced inside bead size.
6. Integrity of the Teflon coating on the heater bushings must not be impaired, scratched, or marred. Iron or aluminum contamination of the joint could occur.

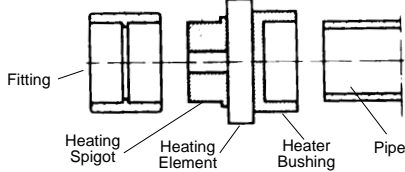
**NOTE: ONLY TRAINED PERSONNEL MAY CARRY OUT FUSION JOINING!**

## Instructions for Socket Fusion Joining of +GF+ Pipes & Fittings Polypropylene

### Socket Fusion Joining Method

Fusion Joining is carried out using heated tools, with the fitting overlapping the pipe. No additional materials are used. The pipe end and fitting socket are heated to fusion joining temperature using a heater bushing and a heating spigot respectively, and are then pushed together. Resulting in a homogeneous joint.

#### Fusion Procedure Components



### Combination Socket / Butt Fusion Machine



For 16 mm through 110 mm socket fusion or 160 mm butt fusion. Unit can be ordered complete with peeling tools, heater bushings, and motor driven facing tool. Ideal for large projects that require large diameter piping.

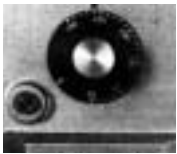
### Manually-operated Fusion Joining Tools



The element is heated electrically. The heater bushing and spigot are interchangeable. A separate pair of tools is required for each pipe size.

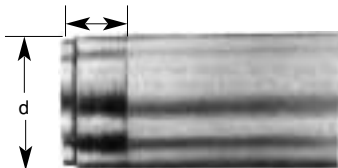
**Important:** When processing PP pipes and fittings it is essential that the heater bushing and heating spigots are coated with PTFE (e.g. Teflon).

### Preparing the Fusion Joint (Standard Joints)



Pre-set the temperature of the heating tool to 500°F (260°C) and check that it is correct using a fast-acting thermo-probe or "tempil" sticks. The temperature is to be measured on the outer side of the heater bushing used to heat the pipe. The fusion joining temperature must lie between 482 and 518°F (250°C and 270°C). In order to test the thermostats, the fusion joining temperature should be checked from time to time.

**Using the Peeling Tool**, in the case of pipe diam. 20 mm to 110 mm, peel the pipe end with peeling tool until the blades are flush with the pipe end.



If the ovality of the pipe prevents the peeling tool from being pushed on, the pipe must first of all be re-round-ed (e.g. in a vise or with a screw clamp).

Any areas which remain partially unpeeled due to ovality must be thoroughly cleaned with cleaning fluid. If the peeling tool can be pushed onto the pipe without removing any material, the dimensional accuracy of the pipe outside diameter and of the peeling tool should be checked.

After resharpening, the blades must be adjusted to the following diameters using an appropriate mandrel gauge.

Pipe Outside diameter d	Peeled diameter		Inch Size
	mm	inch	
20 mm	19.9 - 20.0	.783 - .787	1/2
25 mm	24.9 - 25.0	.980 - .984	3/4
32 mm	31.9 - 32.0	1.256 - 1.260	1
40 mm	39.8 - 40.0	1.567 - 1.575	1 1/4
50 mm	49.8 - 50.0	1.961 - 1.969	1 1/2
63 mm	62.7 - 63.0	2.469 - 2.480	2
75 mm	74.7 - 75.0	2.941 - 2.953	2 1/2
90 mm	89.7 - 90.0	3.531 - 3.543	3
110 mm	109.6 - 110.0	4.315 - 4.331	4

The peeling tool length l corresponds to the blade length of the peeling tool.

**Clean** the heater bushing and heating spigot with a clean cloth or dry paper. The tools must be cleaned after each fusion joint.



**Thoroughly Clean** the joining surfaces of the fitting socket and pipe end using absorbent paper and solvent (e.g. alcohol). Use a fresh piece of paper each time. When using the manually-operated tool, mark the fusion length l on the pipe with a soft pencil.



In the case of 16 mm (3/8") diameter pipes, chamfer the pipe end to an angle of 15°, approximately 3 mm (1/8") in length. Then prepare the pipe end for a length of ~ 15 mm (5/8") with a scraper or rough emery cloth. Clean the prepared surface with Isopropyl alcohol. Mark the joining length, i.e. 14 mm (9/16"), on the pipe.

### Fusion Joining Procedure

#### Heating

Push the fitting on to the heating spigot to the full extent possible, and — in the case of manual operation — push pipe into the heater bushing up to the pencil marking, without turning, and hold firmly. 16 mm diam. pipes are to be pushed into the heater bushing up to the position marked. 20 -110 mm diam. pipes are to be pushed into the heater bushing until the end of the peeled surface is flush with the edge of the heater bushing. The heating time, as given below, begins at this moment.

Pipe ø											
	mm	16	20	5	32	40	50	63	75	90	110
inch	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	
Heating time sec.	5	5	7	8	12	18	24	30	40	50	

**Squarely Cut** off the pipe using a pipe cutter suitable for plastic pipes. Deburr internally with a knife. (See our tools section.)



If necessary, **mark** the required position on the pipe and fitting before joining.



#### Joining

When the heating time has elapsed, quickly pull the fitting and pipe from the heating tools with a "snap off" action and immediately push them together axially, without turning. The fitting and pipe must be aligned and held together for the same duration as the heating time.



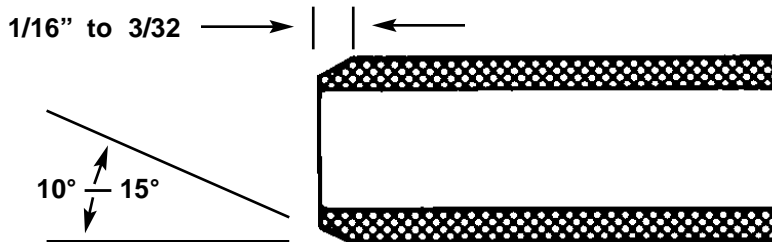
**NOTE: ONLY TRAINED PERSONNEL MAY CARRY OUT FUSION JOINING!**

## SOLVENT CEMENT JOINING OF PLASTIC PIPE WHAT EVERY USER SHOULD KNOW

- 1) **WHAT IS SOLVENT CEMENT?** It is a complex mixture of solvents and dispersed resins with various additives (depending upon the particular solvent cement application).
- 2) **HOW DOES A SOLVENT CEMENT WORK?** The solvents penetrate the plastic surface and cause the plastic to swell. The swelling continues until the gaps between the pipe and fitting walls are closed and pressing against each other.
- 3) **WHAT PLASTICS CAN BE SOLVENT CEMENTED?** PVC (Polyvinyl chloride), CPVC (chlorinated polyvinyl), ABS (Acetylonitrile-Butadiene-Styrene), polycarbonate[PC or Lexan] styrene, Gelyol and other plastic materials.
- 4) **WHAT PLASTICS CANNOT BE SOLVENT CEMENTED?** Polyethylene, polypropylene, polybutylene, nylon and other engineering plastics (usually polyolefins).
- 5) **WHAT ABOUT USING SOLVENT CEMENT WHEN A JOINT IS WET?** All solvent cements have the ability to absorb some water and still perform well enough to effect an adequate joint. However, our research shows that the presence of 10% water in solvent cement can slow the penetration and swelling rate by up 65%. This joint with water inside will always be an inferior joint and subject to problems.
- 6) **WHAT IS THE DIFFERENCE BETWEEN PIPE CLEANER AND PIPE PRIMER?** A pipe cleaner is a mixture of solvents used to clean any dirt or foreign materials on the surface of the pipe which could prevent the penetration of the cement into the pipe surface. The cleaner must be wiped off with a clean rag immediately. A primer is a mixture of solvents used to penetrate the pipe and fitting and start the swelling process ahead of the application of the solvent cement. It is not wiped off. The solvent cement is applied on top of the primer immediately while wet.
- 7) **WHAT IS THE DIFFERENCE BETWEEN SET AND CURE TIMES?** Set time is that initial period of swelling required to give the joint enough mechanical strength to be gently handled. Cure time is the total time period of required swelling for the joint to acquire enough strength that it can perform its job transporting materials through it (at whatever pressure and temperature required) without coming apart or leaking.
- 8) **WHAT MAKES A GOOD SOLVENT CEMENT JOINT?**
  - A) User selects proper cement & follows proper procedure
  - B) Cut pipe square
  - C) Deburr pipe inside and outside
  - D) Check the dry fit
  - E) Use pipe cleaner when necessary
  - F) Use pipe primer on every joint
  - G) Apply cement properly
  - H) Insert pipe into the fitting properly
  - I) Wait the proper set and cure times

### 5 - Step Solvent Cementing Instructions GENERAL INSTRUCTIONS

1. Condition pipe and fittings to the same temperature conditions. Cut ends of pipe square, using fine-toothed hand saw and miter box or power saw. Tube cutters with wheels designed for use with PVC are acceptable, provided they do not leave a raised bead on the outside diameter of the pipe.
2. Using a chamfering tool or file, put a 10° to 15° chamfer (bevel) on the end of the pipe.



3. Check dry fit of the pipe and fittings. Pipe should enter the fitting about 1/3 to 3/4 depth. Position pipe and fitting to assure alignment. Using a clean rag, wipe the pipe surface and fitting socket to remove all dirt, moisture, and grease. If wiping fails to clean the surfaces, a chemical cleaner must be used.
4. Using a clean, natural bristle brush about 1/2 the size of the pipe diameter, freely apply the primer to the fitting socket with a scrubbing motion until the surface is penetrated. Repeated applications may be necessary. Now apply the primer to the pipe surface equal to the depth of the fitting socket in the same manner, making sure the surface is well penetrated. Again apply primer to the fitting socket, to make sure it is still damp.
5. Using a clean natural bristle brush 1/2 the size of the pipe diameter (not a dauber brush), flow on a heavy coat of solvent cement to the male end of the pipe. Load the brush and do not trim. The amount should be more than sufficient to fill any gap. Next apply a liberal coat of solvent cement to the inside of the socket, using straight outward strokes to keep excess cement out of the socket. While BOTH SURFACES are STILL WET with solvent cement, insert the pipe into the socket with a 1/4 turn twisting motion. The pipe MUST go to the BOTTOM of the socket. The application of solvent cement to pipe and fitting, and the insertion of the pipe into the fitting, should be completed in LESS THAN 1 MINUTE. If necessary, use two men to simultaneously apply the solvent cement to pipe and fitting. Hold the joint together for approximately 30 seconds until both surfaces are firmly gripped. Allow proper set time before disturbing joints. After assembly, a properly-made joint will usually show a bead of cement around its entire perimeter. This should be brushed off. Allow the joint to cure for an adequate time before pressure testing.



# Solvent Cementing Technical Data

## Storage of Solvent Cements and Primers

Solvent cements have a definite shelf life and each can and carton is clearly marked with a date of manufacture. Stock should be rotated to ensure that the oldest material is used first. Primer does not have a shelf life but it is good practice to rotate this stock also. Solvent cements and primers should be stored in a relatively cool shelter away from direct sun exposure.

**CAUTION:** Solvent cements and primers are composed of various solvents and as such require special conditions for storage. Because of their flammability they must not be stored in an area where they might be exposed to ignition, heat, sparks or open flames.

## Handling of Solvent Cements and Primers

Keep containers for solvent cements tightly closed except when in use. Avoid prolonged breathing of solvent vapors, and when pipe and fittings are being joined in partially enclosed areas use a ventilating device to attenuate vapor levels. Keep solvent cements, primers and cleaners away from all sources of ignition, heat, sparks and open flames. Avoid repeated contact with the skin by wearing proper gloves impervious to the solvents. Application of the solvents or cements with rags and bare hands is not recommended; natural fiber brushes and other suitable applicators can produce satisfactory results.

**DANGER: Extremely flammable. Vapor harmful. May be harmful if swallowed. May cause skin or eye irritation.**

### Initial Set Times for Heavy Weight PVC & CPVC Solvent Cements

Temperature Range	Pipe Sizes 1/2" to 1 1/4"	Pipe Sizes 1 1/2" to 3"	Pipe Sizes 4" to 8"	Pipe Sizes 10" to 20"	Pipe Sizes 18" to 24"
60° - 100°F	15 Min.	30 Min.	1 Hr.	2 Hr.	3 Hr.
40° - 60°F	1 Hr.	2 Hr.	4 Hr.	8 Hr.	12 Hr.
0° - 40°F	3 Hr.	6 Hr.	12 Hr.	24 Hr.	36 Hr.

### Joint Cure Schedule for Heavy Weight PVC & CPVC Solvent Cements

Relative Humidity 60 % or Less	Cure Time Pipe Sizes 1/2" to 1 1/4"		Cure Time Pipe Sizes 1 1/2" to 3"		Cure Time Pipe Sizes 4" to 8"		Cure Time Pipe Sizes 10" to 16"		Cure Time Pipe Sizes 18" to 24"	
	Up to 180 psi	Above 180 to 370 psi	Up to 180 psi	Above 180 to 315 psi	Up to 180 psi	Above 180 to 315 psi	Up to 100 psi	Up to 100 psi	Up to 100 psi	Up to 100 psi
60° - 100°F	1 Hr.	6 Hr.	2 Hr.	6 Hr.	6 Hr.	24 Hr.	24 Hr.	24 Hr.	24 Hr.	36 Hr.
40° - 60°F	2 Hr.	12 Hr.	4 Hr.	24 Hr.	12 Hr.	48 Hr.	40 Hr.	40 Hr.	40 Hr.	72 Hr.
0° - 40°F	8 Hr.	48 Hr.	16 Hr.	96 Hr.	48 Hr.	8 Days	8 Days	8 Days	8 Days	10 to 12 Days

### TEMPERATURE CORRECTION FACTORS

Operating Temperature (F°)	73.4	80	90	100	110	115	120	125	130	140	150	160	170	180	200
PVC 1120	1.00	.88	.75	.62	.50	.45	.40	.35	.30	.22	Not Recommended				
CPVC 4120	1.00	1.00	.91	.82	.77	.74	.65	.66	.62	.50	.47	.40	.32	.25	N/R

#### Estimated Quantities of PVC / CPVC Cement

Size In.	# of PINTS			# of QUARTS		
	Joints	Coup. & 90's	Tees	Joints	Coup. & 90's	Tees
1/2	190	95	64	380	190	127
3/4	120	60	40	240	120	80
1	100	50	33	200	100	66
1 1/4	70	35	24	140	70	48
1 1/2	50	25	17	100	50	33
2	30	15	10	60	30	20
2 1/2	25	12	8	50	24	16
3	20	10	6	40	20	12
4	12	6	4	24	12	8
5	9	4.5	3	18	9	6
6	5	2.5	1.7	10	5	3.3
8	-	-	-	5	2.12	1.6
10	-	-	-	.75	-	-
12	-	-	-	1.0	-	-
14	-	-	-	1.25	-	-
16	-	-	-	1.50	-	-
18	-	-	-	2.00	-	-

#### Hot Weather Cementing

Since cement contains a solvent, certain precautions or steps should be taken when the atmospheric temp. is above 90°F to avoid excessive evaporation of the solvent from the cement just prior to joining. Such evaporation will cause the cement to prematurely set before joining, thus adversely affecting the joint integrity. Use one or a combination of the below to reduce the chances of this condition occurring.

- Shade or shelter the joint surfaces from direct exposure to the sun's rays for at least one hour prior to joining and during the joining process.
- Make cement joints during early morning hours.
- Apply cement quickly. On 6" and larger pipe, it is recommended that two men apply cement to pipe surface while the third applies it to the fitting socket.
- Join pipe to fittings as quickly as possible after applying cement.

#### Cold Weather Cementing

Because the solvents in the cement will not evaporate as readily when the temperature is below 40°F, the pipe joints will not set up as rapidly in cold weather. If solvent cementing must be done when the temp. is below 40°F, the following suggestions are offered:

- Store pipe, fittings, cement & primer in heated area.
- Pre-fab as much of the system as possible in a heated work area.
- Joints that must be made outside should be protected with a portable shelter and heated with indirect heat to surface temperatures above 40°F prior to joining. The shelter and heat should remain in place for at least two hours after joint assembly.
- Pipe and fittings must be dry prior to joining and the joints should be kept dry until the cement has had sufficient time to set.

**CAUTION:** DO NOT ATTEMPT TO SPEED THE SETTING OR DRYING OF THE CEMENT BY APPLYING DIRECT HEAT TO THE SOLVENT WELDED JOINT. Forced rapid drying by heating will cause the cement solvents to boil off, forming porosity, bubbles and blisters in the cement film.

#### Handling of Primer and Cement

**NOTE:** Observe the "use prior to" date. Cement has a limited shelf life. Do not permit solvent cement can to stand open. Do not use cement that has dried to the point where it becomes lumpy and stringy. Throw it away. Do not attempt to thin out sluggish cement with thinner or primer.