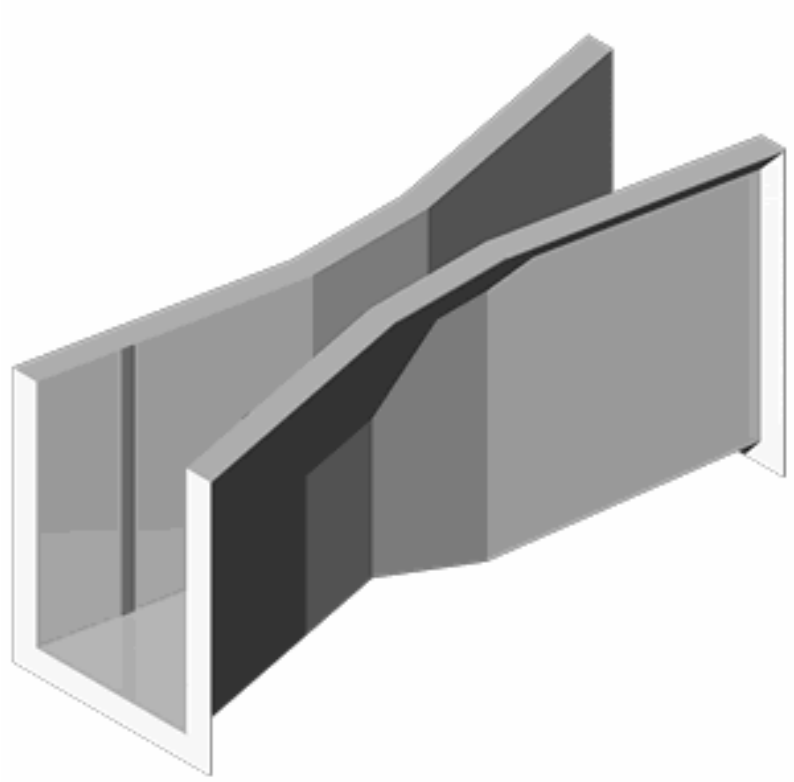
Spagco, Inc.

John Lindsay

PARSHALL FLUMES



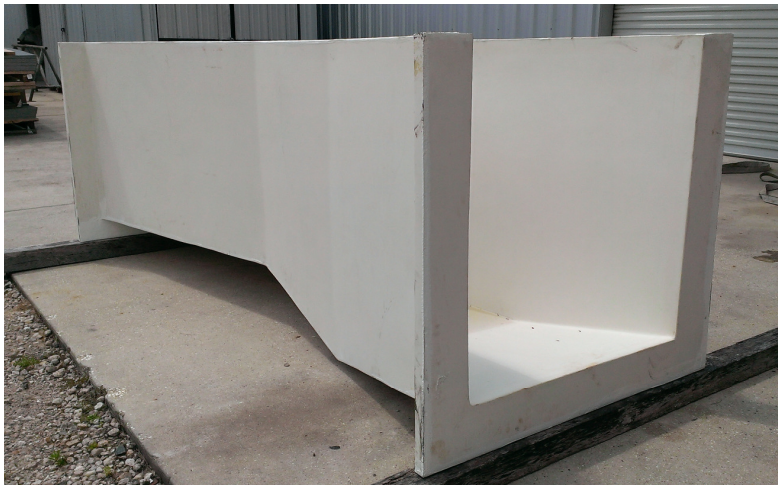
P.O. BOX 7155
THE WOODLANDS, TX 77387-7155
18468 FM 1314
Conroe, TX 77302
(281) 572-2211
(281) 572-2212 FAX
EMAIL: john@glasssteelinc.com

Spagco, Inc.

John Lindsay

INTRODUCTION

Spagco Parshall Flumes are constructed from a fiberglass composite constructed of two fiberglass skins with a polymer concrete core. All Spagco flumes have a total wall thickness of 1 ½". Due to the high moment of inertia of the wall due to the thickness, no stiffeners or other braces are required. The superior strength of the sandwich panel construction allow the flume to act as the concrete form as the concrete trench wall are cast with no need for any internal bracing. All Parshall Flumes are made to same dimensions established by Dr. Ralph L. Parshall in 1922 and are shown in attached table #1 plus drawings #1 & #2. Spagco Parshall Flumes come standard with two built in gauges. The first gauge is set at a distance of 2/3 of the wall length of the approach side of the flume as measured from the start of the flume throat toward the inbound flow. This first gauge is for measuring the flow into the system. The second gauge is set at a point 2" back from the downstream edge of the throat of the flume. This gauge allows a quick visual check for determining whether the flow is in free flow or submerged flow. Table #2 indicates the flow rate in cubic feet per second under free flow conditions as well as the maximum height at gauge to as compared to the gauge #1 reading for free flow to exist. If the water level at gauge #2 is higher than indicated the incoming water in a submerged flow condition and the chart will have to be adjusted to accommodate that flow. Spagco can also supply threaded inserts or mounting brackets for installing ultra sonic sensors or other flow measuring devices as required.

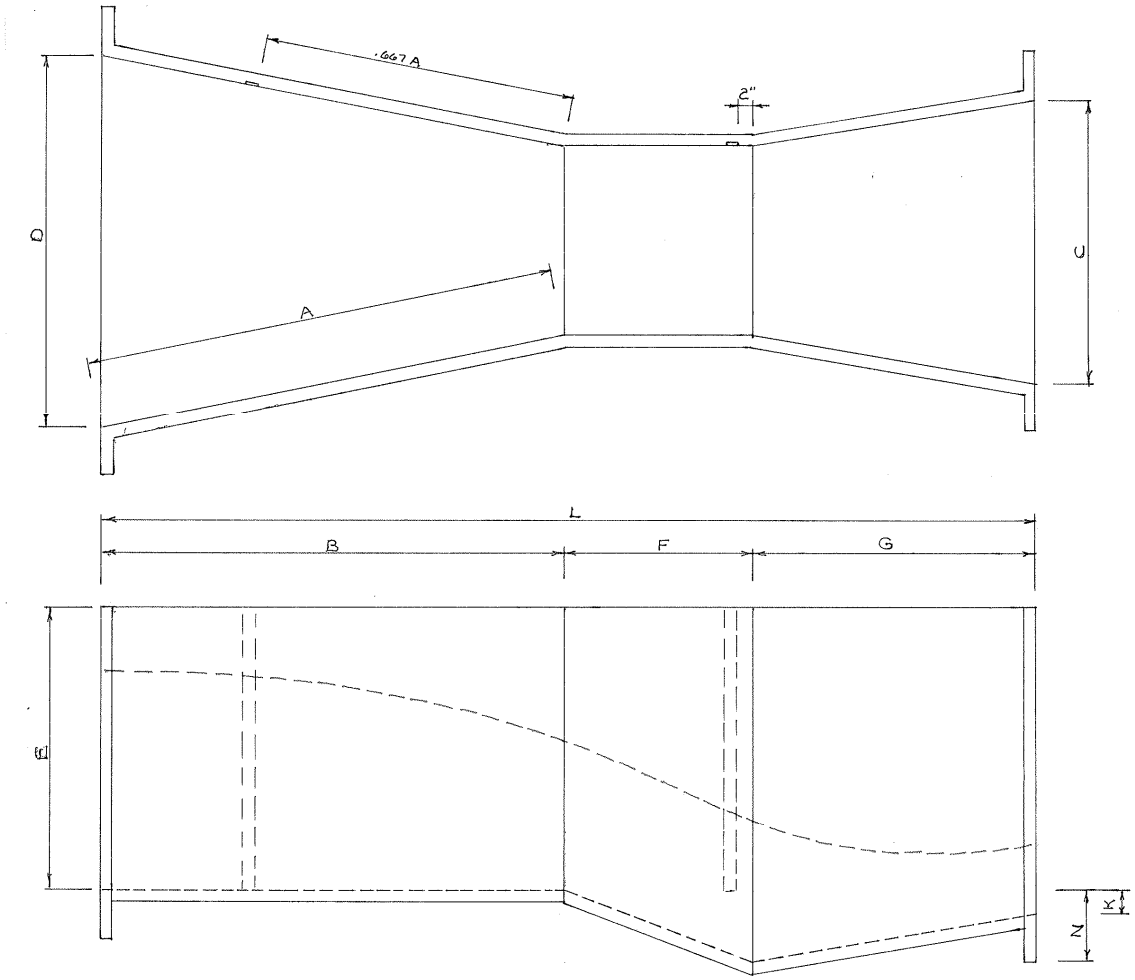


Flume Dimensions

Throat	A	B	C	D	E	F	G	K	L	N	.667A
6"	24.4375	24	15.5	15.625	24	12	24	3	60	4.5	16.3
9"	34.625	34	15	22.625	30	12	18	3	64	4.5	23.095
12"	54	52.875	24	33.25	36	24	36	3	112.875	9	36.018
18"	57	55.875	30	40.375	36	24	36	3	115.875	9	38.019
24"	60	58.875	36	47.5	36	24	36	3	118.875	9	40.02
30"	63	61.8125	42	54.6875	36	24	36	3	121.8125	9	42.021
36"	66	64.75	48	61.875	36	24	36	3	124.75	9	44.022
48"	72	70.625	60	76.25	36	24	36	3	130.625	9	48.024
60"	78	76.5	72	90.625	36	24	36	3	136.5	9	52.026
72"	84	82.125	84	105	36	24	36	3	142.125	9	56.028
84"	90	88.25	96	119.375	36	24	36	3	148.25	9	60.03
96"	96	94.125	108	133.25	36	24	36	3	154.125	9	64.032

Spagco, Inc.

John Lindsay



The dashed line in the above diagram indicates typical water flow profile for free flow

Parshall Flume Flow Rate

Throat Width	Max Discharge	Approx. Head	Weight	D W L
	MGD	Assume 6" Freeboard		Shipping Size
6"	2.526	18"	520#	2'10-1/2" x 2'3-5/8" x 5'0"
9"	5.730	24"	703#	3'4-1/2" x 2'10-5/8" x 9'4-7/8"
12"	10.565	30"	1,204#	3'10-1/2" x 3'9-1/4" x 9'4-7/8"
18"	16.047	30"	1,249#	3'10-1/2" x 4'4-3/8" x 9'7-7/8"
24"	21.396	30"	1,419#	3'10-1/2" x 4'11-1/2" x 9'10-7/8"
30"	26.911	30"	1,534#	3'10-1/2" x 5'1-11/16" x 10'1-13/16"
36"	32.688	30"	1,648#	3'10-1/2" x 6'1-7/8" x 10'4-3/4"
48"	43.986	30"	1,894#	3'10-1/2" x 7'4-1/4" x 10'10-5/8"
60"	55.471	30"	2,161#	3'10-1/2" x 9'6-5/8" x 11'4-1/2"
72"	66.584	30"	2409#	3'10-1/2" x 9'9" x 11'10-1/8"
84"	78.398	30"	2719#	3'10-1/2" x 10'11-3/8" x 12'4-1/4"
96"	90.426	30"	3012#	3'10-1/2" x 12'1-3/8" x 12'10-1/8"

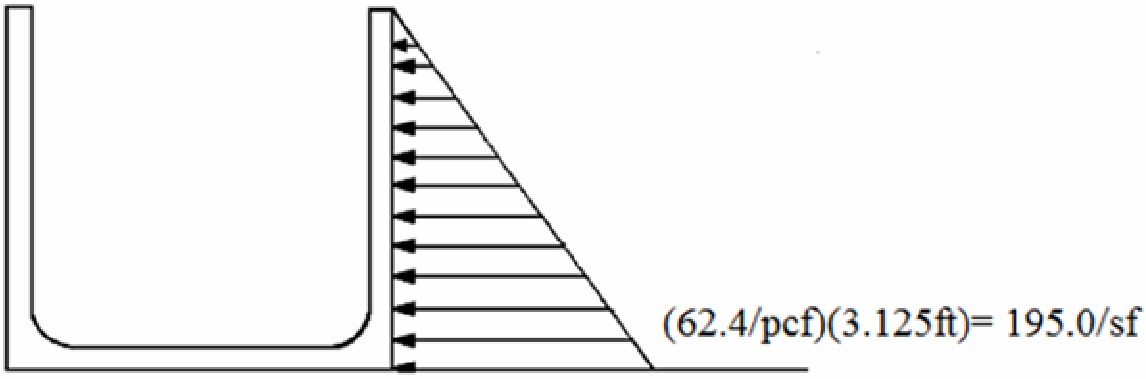
Spagco, Inc.

John Lindsay

Physical Properties

Tensile Strength	8,700psimin ASTM D638
Flexural Strength	18,000psi min ASTM D790
Flexural Modulus	1.0 x 10^6psi min ASTM D790
Compressive Strength	11,000psi min ASTM D695
Average Coefficient of Thermal Expansion	10.5 x 10^{-6} ASTM D696
Water Absorption % 24 hours	.10% ASTM D570

Height of 1-1/2" flume wall is 36" inside depth per the following formula.



Vertically Cantilever Beam-Fixed one end

$$I = \frac{bd^3}{12} = \frac{37.5(1.5)^3}{12} = 10.547$$

$$W = \frac{195.0 \times 3.125}{2} = 304.688$$

$$\triangle \text{MAX} = \frac{WL^3}{} = \frac{304.688(37.5)^3}{} = \frac{1.607 \times 10^7}{} = .0875$$

Four 8'0" throat flumes built in two pieces with tongue and groove connection in the center for easier transport and installation

Flow Chart

Top line is rate of flow

Bottom line is free flow reference

Dedth of flow	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3
Flume throat																										
6"	0.689	0.919	1.173	1.448	1.744	2.06	2.395	2.748	3.118	3.505	3.909	4.329	4.764	5.214	5.679	6.159										
	0.3	0.36	0.42	0.48	0.54	0.6	0.66	0.72	0.78	0.84	0.9	0.96	1.02	1.08	1.14	1.2										
9"	1.063	1.405	1.779	2.182	2.613	3.07	3.552	4.058	4.586	5.137	5.709	6.301	6.914	7.546	8.197	8.866	9.553	10.258	10.979	11.718	12.473					
	0.3	0.36	0.42	0.48	0.54	0.6	0.66	0.72	0.78	0.84	0.9	0.96	1.02	1.08	1.14	1.2	1.26	1.32	1.38	1.44	1.5					
12"	1.349	1.789	2.202	2.795	3.355	3.95	4.579	5.24	5.932	6.054	7.405	8.184	8.991	9.824	10.682	11.566	12.475	13.408	14.364	15.344	16.346	17.37	18.417	19.485	20.574	21.684
	0.35	0.42	0.49	0.56	0.63	0.7	0.77	0.84	0.91	0.98	1.05	1.12	1.19	1.27	1.33	1.4	1.47	1.54	1.61	1.68	1.75	1.82	1.89	1.96	2.03	2.1
18"	2.049	2.718	3.452	4.246	5.096	6	6.955	7.959	9.011	10.108	11.248	12.432	13.657	14.922	16.226	17.569	18.949	20.366	21.819	23.307	24.829	26.385	27.975	29.597	31.251	32.937
	0.35	0.42	0.49	0.56	0.63	0.7	0.77	0.84	0.91	0.98	1.05	1.12	1.19	1.27	1.33	1.4	1.47	1.54	1.61	1.68	1.75	1.82	1.89	1.96	2.03	2.1
24"	2.732	3.624	4.602	5.661	6.985	8	9.274	10.613	12.014	13.476	14.998	16.576	18.209	19.896	21.635	23.425	25.266	27.155	29.092	31.075	33.105	35.18	37.3	39.463	41.668	43.917
	0.35	0.42	0.49	0.56	0.63	0.7	0.77	0.84	0.91	0.98	1.05	1.12	1.19	1.27	1.33	1.4	1.47	1.54	1.61	1.68	1.75	1.82	1.89	1.96	2.03	2.1
30"	3.392	4.507	5.733	7.06	8.484	10	11.603	13.29	15.057	16.907	18.824	20.817	22.882	26.016	27.218	29.485	31.817	34.212	36.669	39.186	41.762	44.397	47.09	49.839	52.643	55.502
	0.35	0.42	0.49	0.56	0.63	0.7	0.77	0.84	0.91	0.98	1.05	1.12	1.19	1.27	1.33	1.4	1.47	1.54	1.61	1.68	1.75	1.82	1.89	1.96	2.03	2.1
36"	4.042	5.381	6.855	8.453	10.17	12	13.937	15.977	18.116	21.352	22.68	25.099	27.605	30.197	32.872	35.629	38.465	41.379	44.37	47.437	50.576	53.788	57.072	60.425	63.848	67.338
	0.35	0.42	0.49	0.56	0.63	0.7	0.77	0.84	0.91	0.98	1.05	1.12	1.19	1.27	1.33	1.4	1.47	1.54	1.61	1.68	1.75	1.82	1.89	1.96	2.03	2.1
48"	5.452	7.139	9.107	11.246	13.546	16	18.6	21.342	24.219	27.227	30.363	33.672	37.002	40.5	44.111	47.835	51.669	55.609	59.655	63.805	68.056	72.407	76.855	81.401	86.042	90.776
	0.35	0.42	0.49	0.56	0.63	0.7	0.77	0.84	0.91	0.98	1.05	1.12	1.19	1.27	1.33	1.4	1.47	1.54	1.61	1.68	1.75	1.82	1.89	1.96	2.03	2.1
60"	6.643	8.877	11.343	14.026	16.915	20	23.273	26.726	30.353	34.149	38.108	42.226	46.499	50.923	55.494	60.21	65.067	70.062	75.193	80.457	85.826	91.377	97.028	102.8	108.7	114.72
	0.35	0.42	0.49	0.56	0.63	0.7	0.77	0.84	0.91	0.98	1.05	1.12	1.19	1.27	1.33	1.4	1.47	1.54	1.61	1.68	1.75	1.82	1.89	1.96	2.03	2.1
72"	7.972	10.653	13.612	16.832	20.298	24	27.927	32.071	36.423	40.978	45.729	50.671	55.799	61.108	66.593	72.252	78.08	84.074	90.232	96.549	103.02	109.65	116.434	123.37	130.44	137.67
	0.35	0.42	0.49	0.56	0.63	0.7	0.77	0.84	0.91	0.98	1.05	1.12	1.19	1.27	1.33	1.4	1.47	1.54	1.61	1.68	1.75	1.82	1.89	1.96	2.03	2.1
84"	9.237	12.365	15.824	19.593	23.656	28	32.613	37.484	42.606	47.969	53.568	59.395	65.445	71.712	78.192	84.88	91.772	98.863	106.151	113.63	121.3	129.16	137.196	145.42	153.81	162.39
	0.35	0.42	0.49	0.56	0.63	0.7	0.77	0.84	0.91	0.98	1.05	1.12	1.19	1.27	1.33	1.4	1.47	1.54	1.61	1.68	1.75	1.82	1.89	1.96	2.03	2.1
96"	10.483	14.06	18.02	22.342	27.007	32	37.307	42.917	48.82	55.007	61.469	68.2	75.192	82.44	89.938	97.681	105.66	113.881	122.33	131.01	139.91	149.02	158.36	167.91	177.67	187.64
	0.35	0.42	0.49	0.56	0.63	0.7	0.77	0.84	0.91	0.98	1.05	1.12	1.19	1.27	1.33	1.4	1.47	1.54	1.61	1.68	1.75	1.82	1.89	1.96	2.03	2.1

All flows are in cu ft/sec

to convert to MGD multiply by .646317

Example 24" Flume with 2.5ft flow is 33.105(.646317) = 21.396 MGD

Spagco, Inc.

John Lindsay