

C:\COMPRESS\DATA\QUOTES\PATERSON.VSL May 12, 1999

TOP HEADASME Section VIII Division 1, 1998 Edition

Component: 2:1 head
 Material specification: SA 182 F316L LOW <=5"
 Internal design pressure: P = 3000 psi @ 158 deg F
 Corrosion allowance: Inner C = 0 Outer = 0 in

PWHT is not performed

Radiography: Category A joints - Seamless NO X-Ray
 Head to shell seam - None UW-11(c) type 1

Estimated weight: new = 8.7 corr = 8.7 lb
 capacity: new = .1 corr = .1 US ga

OD = 4.5 t = .531 (min) flange = 1.5 forming = 0 in (new)

Design thickness: (At 158 deg F) Appendix 1-4(c)

$$t = P \cdot D_o \cdot K / (2 \cdot S \cdot E + 2 \cdot P \cdot (K - 0.1)) + \text{Corrosion} + f_a$$

$$= 3000 \cdot 4.5 \cdot 1 / (2 \cdot 15192 \cdot 0.85 + 2 \cdot 3000 \cdot (1 - 0.1)) + 0 + 0$$

$$= 0.4323 \text{ in}$$

MAP: (New & at 70 deg F) Appendix 1-4(c)

$$P = 2 \cdot S \cdot E \cdot t / (K \cdot D_o - 2 \cdot t \cdot (K - 0.1)) - P_s$$

$$= 2 \cdot 16700 \cdot 0.85 \cdot 0.531 / (1 \cdot 4.5 - 2 \cdot 0.531 \cdot (1 - 0.1)) - 0$$

$$= 4253.454 \text{ psi}$$

MAWP: (Corroded & at 158 deg F) Appendix 1-4(c)

$$P = 2 \cdot S \cdot E \cdot t / (K \cdot D_o - 2 \cdot t \cdot (K - 0.1)) - P_s$$

$$= 2 \cdot 15192 \cdot 0.85 \cdot 0.531 / (1 \cdot 4.5 - 2 \cdot 0.531 \cdot (1 - 0.1)) - 0$$

$$= 3869.369 \text{ psi}$$

UG-32(l) Minimum Straight Flange Thickness

Design thickness: (At 158 deg F) Appendix 1-1(a)

$$t = P \cdot R_o / (S \cdot E + 0.4 \cdot P) + \text{Corrosion}$$

$$= 3869.369 \cdot 2.25 / (15192 \cdot 0.85 + 0.4 \cdot 3869.369) + 0$$

$$= 0.602 \text{ in}$$

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SHELLASME Section VIII Division 1, 1998 Edition

Component: Cylinder
 Material specification: SA 312 TP316L SMLS LOW (pipe)
 Internal design pressure: $P = 3000$ psi @ 158 deg F
 Corrosion allowance: Inner $C = 0$ Outer = 0 in

PWHT is not performed

Radiography: Category A joints - Seamless NO X-Ray
 Category B joints - None UW-11(c) type 1

Estimated weight: new = 60.5 corr = 60.5 lb
 capacity: new = 1.162 corr = 1.162 US ga

OD = 4.5 length $L_c = 30$ $t = 0.5625$ in (nominal, new)

Design thickness: (At 158 deg F) Appendix 1-1(a)

$$t = \frac{P \cdot R_o}{(S \cdot E + 0.4 \cdot P)} + \text{Corrosion}$$

$$= \frac{3000 \cdot 2.25}{(15192 \cdot 0.85 + 0.4 \cdot 3000)} + 0$$

$$= 0.4783 \text{ in}$$

MAP: (New & at 70 deg F) Appendix 1-1(a)

$$P = \frac{S \cdot E \cdot t}{(R_o - 0.4 \cdot t)} - P_s$$

$$= \frac{16700 \cdot 0.85 \cdot 0.4921875}{(2.25 - 0.4 \cdot 0.4921875)} - 0$$

$$= 3402.911 \text{ psi}$$

MAWP: (Corroded & at 158 deg F) Appendix 1-1(a)

$$P = \frac{S \cdot E \cdot t}{(R_o - 0.4 \cdot t)} - P_s$$

$$= \frac{15192 \cdot 0.85 \cdot 0.4921875}{(2.25 - 0.4 \cdot 0.4921875)} - 0$$

$$= 3095.63 \text{ psi}$$

BOTTOM HEADASME Section VIII Division 1, 1998 Edition

Component: 2:1 head
 Material specification: SA 182 F316L LOW <=5"
 Internal design pressure: P = 3000 psi @ 158 deg F
 Corrosion allowance: Inner C = 0 Outer= 0 in

PWHT is not performed

Radiography: Category A joints - Seamless NO X-Ray
 Head to shell seam - None UW-11(c) type 1

Estimated weight: new = 8.7 corr = 8.7 lb
 capacity: new = .1 corr = .1 US ga

OD = 4.5 t = .531 (min) flange= 1.5 forming= 0 in (new)

Design thickness: (At 158 deg F) Appendix 1-4(c)

$$t = P \cdot D_o \cdot K / (2 \cdot S \cdot E + 2 \cdot P \cdot (K - 0.1)) + \text{Corrosion} + f_a$$

$$= 3000 \cdot 4.5 \cdot 1 / (2 \cdot 15192 \cdot 0.85 + 2 \cdot 3000 \cdot (1 - 0.1)) + 0 + 0$$

$$= 0.4323 \text{ in}$$

MAP: (New & at 70 deg F) Appendix 1-4(c)

$$P = 2 \cdot S \cdot E \cdot t / (K \cdot D_o - 2 \cdot t \cdot (K - 0.1)) - P_s$$

$$= 2 \cdot 16700 \cdot 0.85 \cdot 0.531 / (1 \cdot 4.5 - 2 \cdot 0.531 \cdot (1 - 0.1)) - 0$$

$$= 4253.454 \text{ psi}$$

MAWP: (Corroded & at 158 deg F) Appendix 1-4(c)

$$P = 2 \cdot S \cdot E \cdot t / (K \cdot D_o - 2 \cdot t \cdot (K - 0.1)) - P_s$$

$$= 2 \cdot 15192 \cdot 0.85 \cdot 0.531 / (1 \cdot 4.5 - 2 \cdot 0.531 \cdot (1 - 0.1)) - 0$$

$$= 3869.369 \text{ psi}$$

UG-32(1) Minimum Straight Flange Thickness

Design thickness: (At 158 deg F) Appendix 1-1(a)

$$t = P \cdot R_o / (S \cdot E + 0.4 \cdot P) + \text{Corrosion}$$

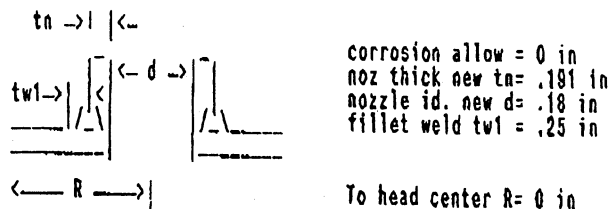
$$= 3869.369 \cdot 2.25 / (15192 \cdot 0.85 + 0.4 \cdot 3869.369) + 0$$

$$= 0.602 \text{ in}$$

NI

Opening NI Reinforcement Calculations Per UG-37

Located on: TOP HEAD
Local vessel thickness: .531 in
Liquid static head included: 0 psi
Flange description: Not installed
Nozzle material specification: SA 479 316L HIGH
Nozzle orientation: 0 degrees
End of nozzle to datum line: -4.5 in
Nozzle calculated as hillside: no
Projection outside vessel Lpr: 1.884711 in



Reinforcement Calculations For Nozzle MAWP

Limits of reinforcement UG-40

Parallel to the vessel wall $(R_n + t_n + t) = .812$ in
Normal to the vessel wall outside $2.5*(t_n - C_n) + t_e = .4775$ in
Normal to the vessel wall inside $2.5*(t_n - C_n - C) = .4775$ in

Nozzle required thickness

$$\begin{aligned} tr_n &= P \cdot R_n / (S_n \cdot E - 0.6 \cdot P) \\ &= 3000 \cdot 0.09 / (16700 \cdot 1 - 0.6 \cdot 3000) \\ &= 0.0181 \text{ in} \end{aligned}$$

Required thickness tr from UG-37(a)(3)

$$\begin{aligned} tr &= P \cdot K_1 \cdot D / (2 \cdot S \cdot E - 0.2 \cdot P) \\ &= 3000 \cdot 0.9 \cdot 3.438 / (2 \cdot 15192 \cdot 1 - 0.2 \cdot 3000) \\ &= 0.3117 \text{ in} \end{aligned}$$

Opening does not require reinforcement per UG-36(c)(3)(a)

Check the welds - From UW-16(c):

Fillet weld: $t_{min} = \text{lesser of } 0.75 \text{ or } t_n \text{ or } t, t_{min} = 0.191$ in
 $t_c(\text{min}) = \text{lesser of } 0.25 \text{ or } 0.7 \cdot t_{min}, t_c(\text{min}) = 0.1337$ in
 $t_c(\text{actual}) = 0.7 \cdot \text{Leg} = 0.7 \cdot 0.25 = 0.175$ in

The fillet weld size is satisfactory.

Weld strength calculations are not required for this detail which conforms to Fig. UW-16.1, sketch (a).

UG-45 Nozzle Neck Thickness Check

Wall thickness per UG-45(a): $tr_1 = 0.0181$ in ($E = 1$)
Wall thickness per UG-45(b)(1): $tr_2 = 0.3463$ in
Wall thickness per UG-16(b): $tr_3 = 0.0625$ in
Std pipe wall per UG-45(b)(4): $tr_4 = 0.079625$ in
The greater of tr_2 or tr_3 : $tr_5 = 0.3463$ in
The lesser of tr_4 or tr_5 : $tr_6 = 0.079625$ in

Req'd per UG-45 is the larger of tr_1 or $tr_6 = 0.079625$ in

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N1Available nozzle wall thickness new, $t_n = 0.191$ in

The nozzle neck thickness is adequate for MAWP.

Exempt from weld strength calculations per UW-15(b)(2)

VCR Fitting:

Nozzle Circ. Stress:

$$P = \frac{S \cdot E \cdot t}{R + .6 \cdot t}$$

$$P = \frac{(16700)(1)(.035)}{R + .6(.035)}$$

$$= 5266 \text{ psi} \quad > 3000 \text{ psi} \therefore \underline{\underline{\sigma_t}}$$

SA 479-316L

$$S = 16700 \text{ psi @ } 158^\circ \text{F}$$

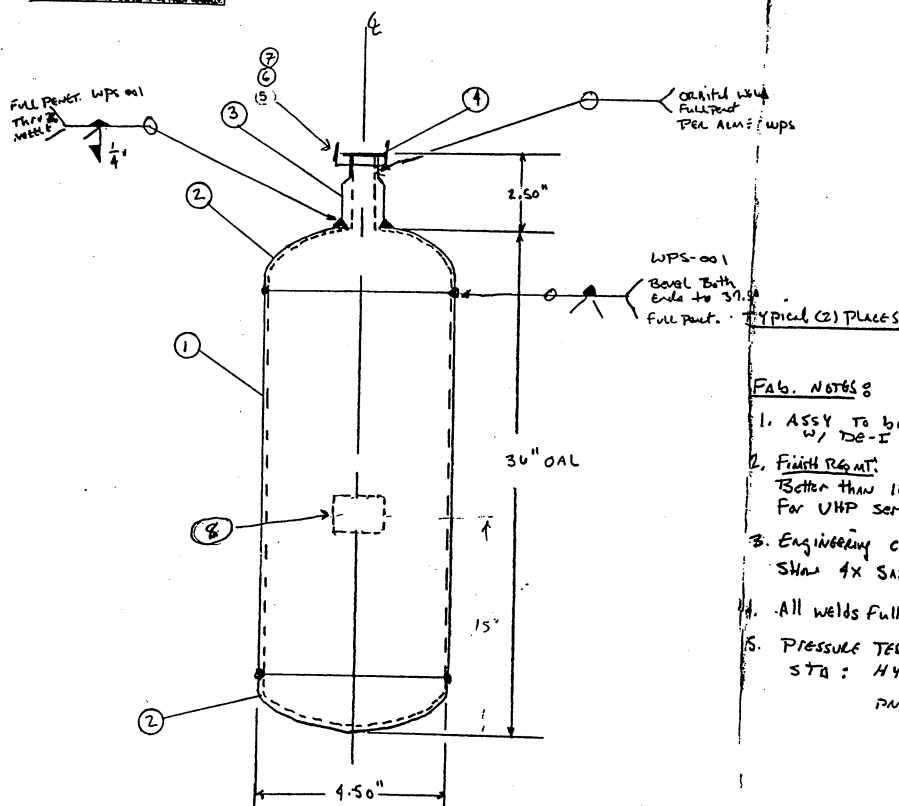
$$E = 1$$

$$t = .035''$$

$$R = .19/2 = .09$$

BILL OF MATERIALS				DWG. NO. 8-2	
ACME PART NO.	ITEM	QTY	UNITS	DESCRIPTION	MATERIAL
270-8M343	1	A/R	EA	PIPE 4" SCH 160 SMLS	SA312-316L
270-819204	2	2	EA	PIPE CAP, 3" SCH 160	SA192-F304
270-8M103.1	3	1	EA	WOTABLE TEE OM-3192ASA	SA479-316L
809-416502	4	1	EA	GRAND-VCR 1/2"	
272-414557	5	1	EA	MULT-VCR 1/8"	
809-416505	6	2		C-ASKET VCR 1/8" NICKEL	
812-414812	7	1	EA	PLUG VCR 1/8"	
Name Plate-ASME	8	1		Name Plate	

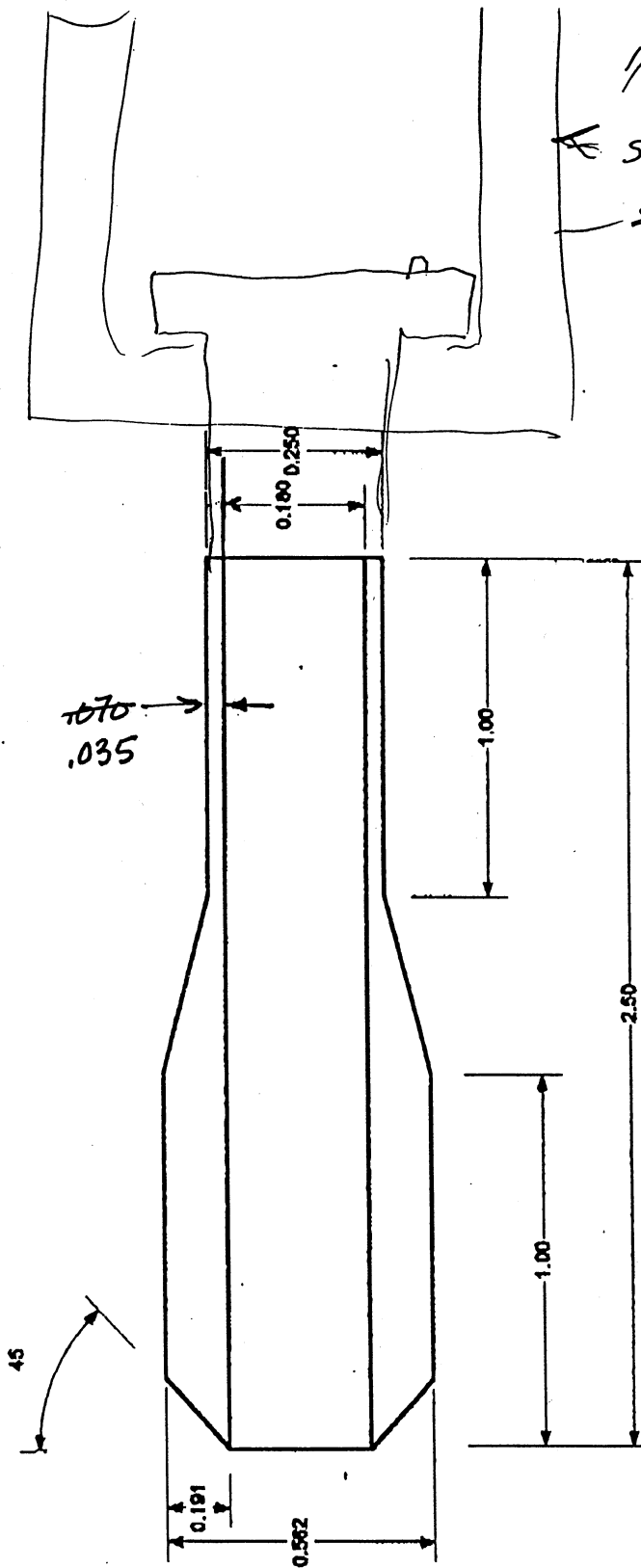
NOTES		
1.	OPERATING PRESSURE	PSIG 2,500 PSI
2.	OPERATING TEMPERATURE	°F 1800
3.	DESIGN PRESSURE, MAX	PSIG 3,000
4.	DESIGN TEMPERATURE, MAX	°F 1,800
5.	DESIGN TEMPERATURE, MIN	°F -300
6.	CONSTRUCTION SPEC. WITH DIV. 1	V.E.S.
7.	EXISTING ASIDE CODE	
8.	STAIN	N/A
9.	CORROSION ALLOWANCE	1/8"
10.	X-RAY INSPECTION	N/A
11.	STRESS RELIEVING	AS SPECIFIED
12.	EFFICIENCY-LONGITUDINAL JOINTS	90%
13.	- OTHER	90%
14.	MAXIMUM ALLOWABLE PRESSURE	2,500 PSI
15.	NEW AND OLD	
16.	TESTED BY	760
17.	MAXIMUM ALLOWABLE WORKING PRESSURE	2,500 PSI
18.	U.S. B. QUANTITY	12
19.	HYDROSTATIC TEST PRESSURE, PSIG	2,500
20.	HYDROSTATIC TEST PRESSURE, PSI	2,500
21.	PAINT	217
22.	PURCHASER'S SPECIFICATIONS	217
23.	INSPECTIONS	217
24.	PURCHASER	217
25.	INSURANCE COMPANY	217
26.	TEST PROGRAMS	217
27.	AS TEST PROGRAMS	217
28.	ALL METALS AND WELDS TO BE	760
29.	STAINLESS STEEL VESSEL CONTAINING	
30.	ALL CONNECTIONS TO BE BLANKED	YES
31.	BY WELD	
32.	HYDROGENATION REGENERATION	YES
33.	DRIFT TESTS	N/A
34.	CAPACITY IN GALLONS	217



1. ASSEY TO BE CLASS "A" OR CLEANER & Bigger W/ DE-I WASH to ALME STA.
2. Finish REQUIR.
Better than 10 finish, worse ONLY (electropolished)
For UHP service.
3. Engineering calc must be Provided to show 4X SAFETY FACTOR ON DESIGN.
4. All welds Full penetration
5. PRESSURE TEST ASS'Y PER ALME
STA : HYDRO. @ 7500 PSI
 or
 PNEUM. @ 3750 PSI

[illegible]

ITEM #3



INTERIOR FINISH 20RA MAX

MATERIAL: 316L STAINLESS STEEL

SCHEDULE NUMBER and/or WEIGHT*	WALL THICK- NESS Inches t	INSIDE DIAM- ETER Inches d	FIFTH POWER of ID In ⁵ d ⁵	AREAS and WEIGHTS						RADIUS of GYRA- TION Inches r _g	MOMENT of INERTIA in ⁴ I	SEC- TION MOD- ULUS in ³ Z	PRESSURE/STRESS MODULI† for				
				SURFACE AREA		Cross-Sectional		WEIGHT of					BOILER CODE POWER DISTR. HEAT'G. & REFR. PIPING c ₁	OIL PIPING (based on LAME FORM.) c ₂	GAS & AIR PIPING		
				OUT- SIDE sq ft per ft A _o	IN- SIDE sq ft per ft A _i	METAL AREA sq in. A	FLOW AREA sq in. A _f	PIPE lb per ft w	WATER lb per ft w _w						DIV. 1 c ₃	DIV. 2 c ₄	
3" NOMINAL SIZE (cont'd) (OUTSIDE DIAMETER D=3.500)																	
80 XS 80S 160 XX	.241	3.018	250	.916	.790	2.467	7.15	8.39	3.10	1.155	3.29	1.883	.0862	.0961	.0948	.0992	
	.254	2.992	240	.916	.783	2.590	7.03	8.81	3.04	1.151	3.43	1.962	.0932	.1032	.1013	.1045	
	.289	2.922	213	.916	.765	2.915	6.71	9.91	2.90	1.140	3.79	2.165	.1122	.1226	.1188	.1189	
	.300	2.900	205	.916	.759	3.016	6.60	10.25	2.86	1.136	3.90	2.226	.1182	.1287	.1243	.1234	
	.312	2.875	196	.916	.753	3.129	6.49	10.64	2.81	1.132	4.01	2.294	.1248	.1355	.1303	.1284	
	.406	2.687	140	.916	.703	3.950	5.67	13.43	2.46	1.103	4.81	2.748	.1776	.1894	.1773	.1670	
	.437	2.626	125	.916	.687	4.205	5.42	14.30	2.35	1.094	5.03	2.876	.1956	.2076	.1928	.1798	
	.600	2.300	64	.916	.602	5.466	4.15	18.58	1.80	1.047	5.99	3.425	.2937	.3065	.2743	.2468	
3½" NOMINAL SIZE (OUTSIDE DIAMETER D=4.000)																	
10S 40 ST 40S 80 XS 80S XX	.120	3.760	752	1.047	.984	1.463	11.10	4.97	4.81	1.372	2.76	1.378	.0202	.0279	.0300	.0432	
	.128	3.744	736	1.047	.980	1.557	11.01	5.29	4.77	1.370	2.92	1.461	.0237	.0315	.0335	.0461	
	.134	3.732	724	1.047	.977	1.628	10.94	5.53	4.74	1.368	3.04	1.522	.0264	.0342	.0361	.0482	
	.148	3.704	697	1.047	.970	1.791	10.78	6.09	4.67	1.363	3.33	1.664	.0327	.0405	.0422	.0533	
	.188	3.624	625	1.047	.949	2.251	10.31	7.65	4.47	1.349	4.10	2.050	.0508	.0589	.0598	.0677	
	.226	3.548	562	1.047	.929	2.680	9.89	9.11	4.28	1.337	4.79	2.394	.0682	.0766	.0764	.0814	
	.281	3.438	480	1.047	.900	3.283	9.28	11.16	4.02	1.319	5.71	2.855	.0938	.1027	.1004	.1012	
	.318	3.364	431	1.047	.881	3.678	8.89	12.51	3.85	1.307	6.28	3.141	.1114	.1206	.1166	.1145	
	.344	3.312	399	1.047	.867	3.951	8.62	13.43	3.73	1.298	6.66	3.331	.1238	.1333	.1280	.1238	
	.469	3.062	269	1.047	.802	5.203	7.36	17.69	3.19	1.259	8.25	4.127	.1855	.1961	.1827	.1688	
	.636	2.728	151	1.047	.714	6.721	5.84	22.85	2.53	1.210	9.85	4.925	.2725	.2840	.2558	.2290	
	4" NOMINAL SIZE (OUTSIDE DIAMETER D=4.500)																
	10S 40 ST 40S 80 XS 80S 120 160 XX	.120	4.260	1403	1.178	1.115	1.651	14.25	5.61	6.17	1.549	3.96	1.762	.0179	.0247	.0267	.0384
		.128	4.244	1377	1.178	1.111	1.758	14.15	5.98	6.13	1.546	4.21	1.869	.0211	.0279	.0298	.0410
		.134	4.232	1358	1.178	1.108	1.838	14.07	6.25	6.09	1.544	4.38	1.949	.0234	.0303	.0321	.0429
		.142	4.216	1332	1.178	1.104	1.944	13.96	6.61	6.04	1.542	4.62	2.054	.0266	.0335	.0352	.0454
.165		4.170	1261	1.178	1.092	2.247	13.66	7.64	5.91	1.534	5.29	2.350	.0358	.0428	.0442	.0528	
.188		4.124	1193	1.178	1.080	2.55	13.36	8.66	5.78	1.526	5.93	2.64	.0450	.0522	.0531	.0602	
.205		4.090	1144	1.178	1.071	2.77	13.14	9.40	5.69	1.520	6.39	2.84	.0519	.0592	.0597	.0656	
.237		4.026	1058	1.178	1.054	3.17	12.73	10.79	5.51	1.510	7.23	3.22	.0649	.0724	.0722	.0758	
.250		4.000	1024	1.178	1.047	3.34	12.57	11.35	5.44	1.505	7.56	3.36	.0702	.0778	.0772	.0800	
.271		3.958	971	1.178	1.036	3.60	12.30	12.24	5.33	1.498	8.08	3.59	.0789	.0866	.0854	.0867	
.281		3.938	947	1.178	1.031	3.74	12.18	12.72	5.27	1.495	8.33	3.70	.0831	.0908	.0893	.0899	
.300		3.900	902	1.178	1.021	3.96	11.95	13.46	5.17	1.489	8.78	3.90	.0910	.0989	.0867	.0960	
.312		3.876	875	1.178	1.015	4.10	11.80	13.96	5.11	1.485	9.05	4.02	.0960	.1040	.1013	.0998	
.337		3.826	820	1.178	1.002	4.41	11.50	14.99	4.98	1.477	9.61	4.27	.1065	.1147	.1111	.1078	
.375		3.750	742	1.178	.982	4.86	11.04	16.52	4.78	1.464	10.42	4.63	.1227	.1312	.1258	.1200	
.437		3.626	627	1.178	.949	5.58	10.33	18.96	4.47	1.445	11.65	5.18	.1495	.1585	.1499	.1398	
.500	3.500	525	1.178	.916	6.28	9.62	21.36	4.17	1.425	12.77	5.67	.1773	.1868	.1744	.1600		
.531	3.438	480	1.178	.900	6.62	9.28	22.51	4.02	1.416	13.27	5.90	.1912	.2009	.1865	.1699		
.674	3.152	311	1.178	.825	8.10	7.80	27.54	3.38	1.374	15.29	6.79	.2573	.2676	.2421	.2157		
5" NOMINAL SIZE (OUTSIDE DIAMETER D=5.563)																	
40 ST 40S 80 XS 80S 120 160 XX	.134	5.295	4162	1.456	1.386	2.29	22.02	7.77	9.53	1.920	8.43	3.03	.0189	.0245	.0260	.0347	
	.258	5.047	3275	1.456	1.321	4.30	20.01	14.62	8.66	1.878	15.17	5.45	.0592	.0652	.0650	.0688	
	.352	4.859	2708	1.456	1.272	5.76	18.54	19.59	8.03	1.847	19.65	7.07	.0905	.0970	.0946	.0911	
	.375	4.813	2583	1.456	1.260	6.11	18.19	20.78	7.88	1.839	20.68	7.43	.0983	.1050	.1018	.0971	
	.437	4.688	2264	1.456	1.227	7.04	17.26	23.95	7.47	1.819	23.31	8.38	.1196	.1266	.1213	.1131	
	.500	4.563	1978	1.456	1.194	7.95	16.35	27.04	7.06	1.799	25.74	9.25	.1415	.1489	.1411	.1294	
	.625	4.313	1492	1.456	1.129	9.70	14.61	32.97	6.33	1.760	30.03	10.80	.1862	.1943	.1804	.1618	
	.750	4.063	1107	1.456	1.064	11.40	12.97	38.77	5.61	1.722	33.64	12.10	.2323	.2410	.2202	.1941	

CAPS

Schedule 160†



Part No. 84

Seamless Steel TUBE-TURN Welding Fittings

NOMINAL PIPE SIZE	OUTSIDE DIAMETER O.D.	INSIDE DIAMETER I.D.	WALL THICKNESS T	LENGTH E	TANGENT S	DISH RADIUS R†	KNUCKLE RADIUS r†	APPROXIMATE WEIGHT IN POUNDS	LIST PRICE
1	1.315	.815	.250	1½	1.05	.71	.14	.39	\$ 8.50
1¼	1.660	1.160	.250	1½	.96	1.00	.20	.54	8.50
1½	1.900	1.338	.281	1½	.88	1.17	.22	.68	8.50
2	2.375	1.689	.343	1¾	.98	1.47	.28	1.19	18.00
2½	2.875	2.125	.375	2	1.09	1.90	.35	1.96	24.20
3	3.500	2.626	.437	2½	1.41	2.29	.44	3.52	24.20
4	4.500	3.438	.531	3	1.61	3.02	.57	6.54	28.00
5	5.563	4.313	.625	3½	1.80	3.77	.72	11.0	39.70
6	6.625	5.189	.718	4	1.98	4.54	.86	17.5	50.00
8	8.625	6.813	.906 ⁽¹⁾	5	2.39	5.96	1.14	32.0	60.00
10	10.750	8.500	1.125 ⁽¹⁾	5½	2.25	7.43	1.42	54.1	105.00
12	12.750	10.126	1.312 ⁽¹⁾	6½	2.66	8.85	1.69	88.7	147.00

kinetics.

fluid systems
1463 centre pointe drive
milpitas, ca 95035

telephone 408.946.3100
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Mr. Daniel Archer, Ph.D.
Nuclear Physicist
Lawrence Livermore National Laboratory
7000 East Avenue
Livermore, CA 94551

APPENDIX D

Dear Dan,

Per your request, this letter outlines the manufacturing techniques and industry standards Kinetics Fluid Systems (formerly Insync) used to fabricate the Xenon Delivery System specified and purchased by Lawrence Livermore National Laboratory.

Insync Job # U0898 (1/8/99)
Insync Item # 870LLL-0001-U0898
Description: 10-E0804 REV. X1, Xenon Delivery System
LLNL PO # B502632
Ship Date: 3/23/98

Overview:

The design rules, materials of construction, welding methods and assembly techniques used on the Xenon delivery system are consistent with the standards used in low pressure (<250psig) and high pressure (250-3000psig) ultra high purity gas delivery systems for the semiconductor manufacturing industry. These industry standards are extremely rigorous due to the susceptibility to microcontamination and the highly toxic, flammable and corrosive gases used in semiconductor manufacturing.

Below, please find the material specifications and industry standards used for this project. Note that the SEMI (Semiconductor Equipment and Materials International) standards each reference other standards including ASME, ASTM, FED-STD, IES, ISO, SEMI, etc. The texts of the specific documents are available from each of the respective organizations.

Panel design and construction:

The following standards were used as general design rules for the Xenon delivery system.

System Design:

SEMI E49.9 'Guide for ultra-high purity gas distribution systems in semiconductor manufacturing equipment'

Materials:

SEMI F20

Assembly/Test:

SEMI E49.6 'Guide for subsystem assembly and testing procedures-stainless steel systems'

Leak Testing:

SEMI F1 'Specification of for leak integrity of toxic gas piping systems'

Tubing:

All tubing used in this system is manufactured by Valex and conforms to the following standards:

Tubing specifications		
Component	Materials	Application Specifications
1/4" O.D. Tubing P/N T40-VS-.25-035A5	T316L Stainless Steel	ASTM A 269, ASTM A632 MSWP 4,142 psi, TBP 17,355psi
3/8" O.D. Tubing P/N T40-VS-.375-035A5	T316L Stainless Steel	ASTM A 269, ASTM A632 MSWP 2,776 psi, TBP 11,631psi
1/2" O.D. Tubing T40-VS-.5-049A5	T316L Stainless Steel	ASTM A 269, ASTM A632 MSWP 2,917 psi, TBP 12,222psi

MSWP=maximum safe working pressure TBP=theoretical burst pressure

Fittings, glands and gaskets:

The fittings, glands and gaskets used in this system are manufactured by Swagelok or Parker and conform to the following standards:

Fitting, gland and gasket standards		
Materials	Component	Application Specifications
316SS	Bodies, Nuts Gaskets, Forged Shapes	ASME SA479, ASTM A276 ASME A240, ASTM A167 ASME SA182, ASTM A314
316L VAR	TB Glands	ASME SA479, ASTM A276
200 Nickel	Gaskets	ASTM B162

Gasket seal integrity specifications			
Gasket	Leak rate, std cm³/s		
	Inboard	Outboard	
	At 10 ⁻⁵ torr	At 5000 psig	Extrapolated to vacuum
(Nickle) VS unplated	<4 x 10 ⁻¹¹	<5.5 x 10 ⁻¹⁰	<4 x 10 ⁻¹⁵

Please call if you have any additional questions or require further clarifications. Thank you again for the opportunity.

Sincerely,

Kinetics Fluid Systems
Ed Poe

INSYNC Systems, Inc.
1463 Centre Pointe Drive
Milpitas, CA 95035
408-946-3100
Fax 408-934-6301

APPENDIX E

SYSTEM LEAK CHECK AND CONFORMANCE CERTIFICATION

Ser. # 003707, 003708, 003709, 003710

System Number: 10-E0804 _____ Rev.: B Qty: 1 set _____

INSYNC System Job Number: U0898 _____

Description: Xenon Delivery System _____

Technician: Sid Cropper _____ Date: 3/22/1999 _____

We certify this panel was Helium leak checked and is certified with a Helium Mass Spectrometer with a leak rate sensitivity of less than 1×10^{-9} atm.cc He/sec. with the following:

(X) Alcatel 181 td

And passed with the following exceptions:

Four 2" rupture disc assemblies passed at; 1.0×10^{-8} atm, 2.4×10^{-8} atm,
 5.0×10^{-7} atm, 3.0×10^{-5} atm

Four 1/2" rupture disc assemblies passed at 1.0×10^{-8} atm

Signature: _____

Date: 3/25/99

INSYNC PARENT #: 10-E0804
DESCRIPTION: Xenon Delivery System
WELD COUNT: 74

REV: X1
REV DESC: Initial Release
ENG: GPM
DATE: 12/22/98

ITEM #	DESCRIPTION	QTY	MFR	MFR PART #	CUSTOMER/ D REV	Max psi
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Weldments

14	Tube Assy, Supply, Inlet	3	Insync ✓	30-E1873, Rev A		
15	Tube Assy, Reclaim, Divert	1	Insync	30-E1874, Rev B		
16	Tube Assy, Main Outlet	1	Insync	30-E1875, Rev B		
17	Tube Assy, Supply, Divert Manifold	1	Insync	30-E1876, Rev A		
18	Tube Assy, Supply, Purge Manifold	1	Insync	30-E1877, Rev A		
19	Tube Assy, Supply Outlet	1	Insync	30-E1878, Rev B		
20	Tube Assy, Oxisorb Line	2	Insync	30-E1879, Rev A		
21	Tube Assy, Reclaim Outlet	4	Insync	30-E1880, Rev B		
22	Tube Assy, Reclaim Inlet, Rt	1	Insync	30-E1881, Rev A		
23	Tube Assy, Reclaim Diver Outlet	4	Insync	30-E1882, Rev A		
24	Tube Assy, Reclaim Inlet, Left	1	Insync	30-E1883, Rev B		
25	Tube Assy, Reclaim Divert Manifold	2	Insync	30-E1884, Rev A		
26	Tube Assy, Supply, Spool	3	Insync	30-E1887, Rev A		
27	Tube Assy, Chamber Manifold	1	Insync	30-E1888, Rev A		
28	Tube Assy, Main Divert Manifold	1	Insync	30-E1889, Rev A		
29	Tube Assy, Main, Getter Divert	1	Insync	30-E1890, Rev A		
30	Tube Assy, Main, Inlet Manifold	1	Insync	30-E1891, Rev A		
31	Tube Assy, Getter Inlet Line	1	Insync	30-E1895, Rev A		
32	Tube Assy, Getter Line	1	Insync	30-E1896, Rev A		
55	Tube Assy, Adapter, F/F	4	Insync			

Ed Poe
800-672-4363

Purchased Components

Clean Valves

33	Valve, High-Pressure Bellows, M/M	39	Nupro ✓	SS-HBVCR4-P-C		3500
34	Valve, All-Metal Bellows, 1/2", M/M	7	Nupro ✓	SS-8BG-VCR-3C		1000

Regulators

35	Regulator, Adjustable, M/M	6	Tescom ✓	64-2663KRA10		3500
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10-113150-00 X1

APPENDIX F

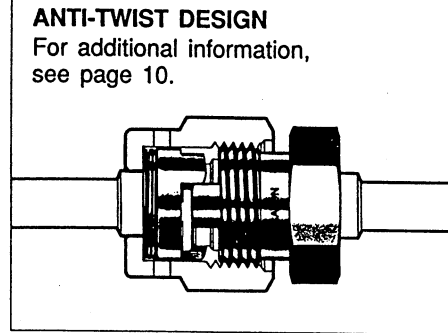
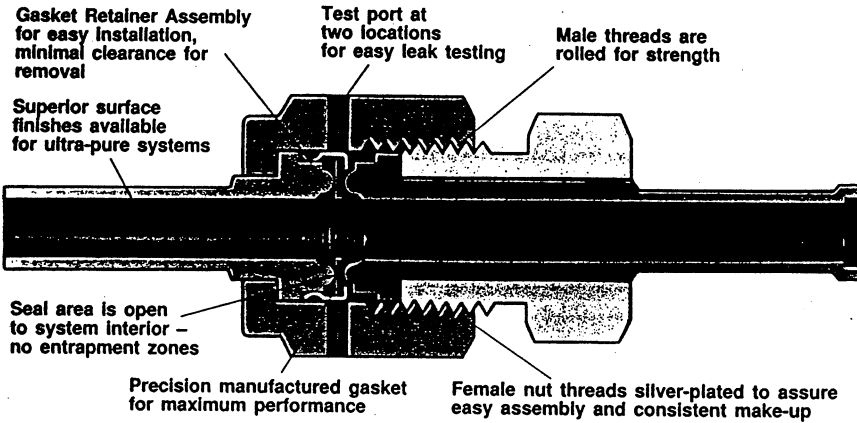
36 Regulator, Adjustable, 4 port F/F					
37 Gauge, Pressure	3 Tescom	64-2663KRH19			3500
38 Gauge, Pressure	3 Tescom	4802-3000M			n/a
Pressure Monitoring	3 Tescom	4802-0200M			n/a
39 Transducer, Pressure, FVCR, Bendix	4 Setra ✓	C2143000C-834-655			10000 burst
40 Display, Pressure, Bendix	4 Setra	3301C4CLC			n/a
62 Transducer, Pressure, FVCR, Bendix	2 Setra ✓	C214250C-834-655			5000 burst
63 Display, Pressure, Bendix	2 Setra	3301C7CLC			n/a
Getter Materials					
41 Oxisorb Getter	1 Oxisorb ✓	S511-HV			150
42 Saes Getter	1 Saes ✓	Monotorr Phase 1			150
Flow Controller					
43 MFC, 20 SLM Ar, D-sub	1 Brooks ✓	5964C4MAP35KA			1500
44 MFC, Controller	1 Brooks	0151AAD2A11A			n/a
Pneumatics and Misc					
45 Tubing, Poly, 1/8 x 1/16	34 Bay Pneum	1C-013-10			n/a
50 Fitting, male 1/8 npt, 1/8t elbow	46 SMC	KJL01-34S			n/a
46 Screw, 8-32 x 3/8, SS, Button Hd	4 Pro-Fastener				n/a
47 Screw, 10-32 x 3/8, SS, Button Hd	76 Pro-Fastener				n/a
52 Schematic, Gas Box	0 Insync	20-E0804			n/a
53 Toggle, Pneum Valve	46 Clippard	MTV-3P			n/a
54 Indicator, Pressure	46 Clippard	IND-3			n/a
VCR Components					
48 Plug, 1/4" VCR	14 Cajon	SS-4-VCR-P			
49 Gasket, 1/4" VCR, Unplated Nickel	183 Cajon	NI-4-VCR-2-GR-VS			
51 Cap, 1/4" VCR	3 Cajon	SS-4-VCR-CP			
60 Cap, 1/2" VCR	5 Cajon	SS-8-VCR-CP			
Rupture Disks					
Union Holder, 1/2 Tube Stub	7 InSync	6U 1/2 UNION HOLDER			
Rupture Disk, #306546	3 Zook				157
Rupture Disk, #306953	4 Zook				2230
Rupture Disk	BS&B				
Rupture Disk	BS&B				
Rupture Disk	BS&B				

n/a = pressure rating not needed



GENERAL INFORMATION

APPENDIX G



VCR® Components offer the high purity of a metal-to-metal seal, providing leak-free service from critical vacuum to positive pressure.
The seal on a VCR® assembly is made when the gasket is compressed by two highly polished beads during the engagement of a male nut or body hex and a female nut.

MATERIALS (designators)

Bodies, Glands and Nuts:
316 stainless steel (SS)
316L stainless steel (316L)
316L VAR – Vacuum Arc Remelt stainless steel (6LV)

HIGH PURITY

A variety of VCR Face Seal Fittings are available with controlled surface finishes, electropolished and specially cleaned to meet Ultra-Pure system requirements. (For more information refer to SWAGELOK Specification SC-01.)

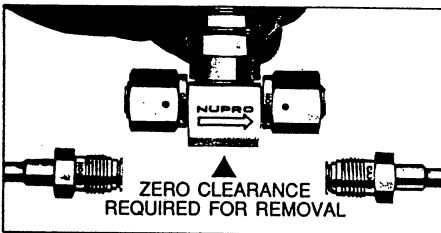
TESTING

The VCR® assembly with a standard gasket design has been helium leak tested to a rate of 4×10^{-9} std cm³/s and the VS gasket design to a rate of 5×10^{-11} std cm³/s without leakage.

DIMENSIONS

- Dimensions are in inches, for reference only, subject to change
- E dimension references the smallest nominal inside diameter of the part

CAUTION: Do not mix or interchange parts with those of other manufacturers



PRESSURE RATINGS

- Calculations based on allowable stress value of 20,000 psi for stainless steel at ambient temperature, per ANSI Code for Pressure Piping B31.3.
- To determine pressure ratings in accordance with ANSI B31.1, multiply psig rating by 0.94.

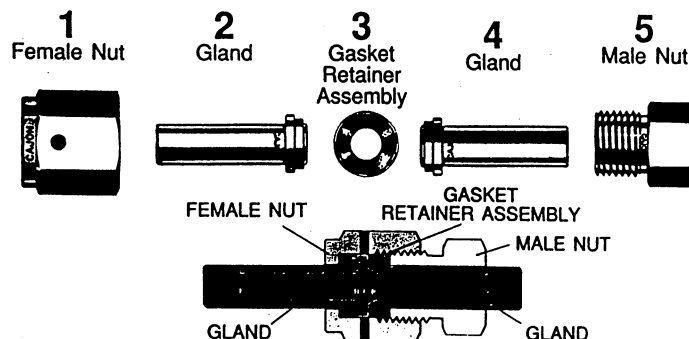
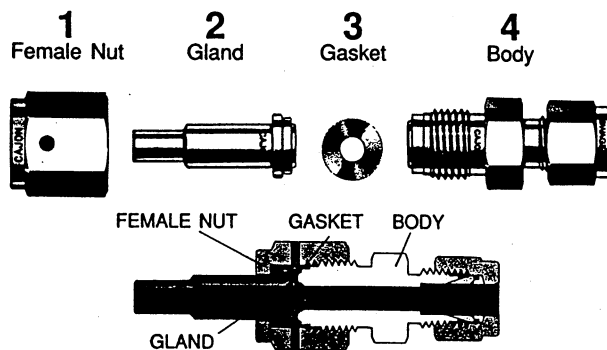
TEMPERATURE RATINGS

Components	Material	Temperature	
		°F	°C
Fittings	316 Stainless Steel	1000	538
	316L Stainless Steel	1000	538
	316LV Stainless Steel	1000	538
Gaskets	316 Stainless Steel	1000	538
	Nickel	600	316
	Copper	400	204
	Aluminum®	400	204

®Not suggested for vacuum service.

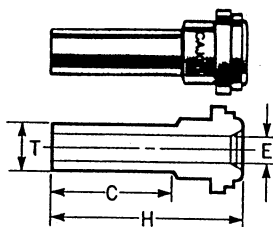
TYPICAL VCR® ASSEMBLY

VCR® Assemblies are made up of four or five basic components.



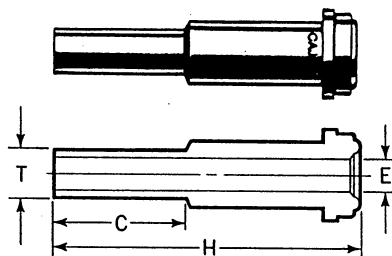
GLANDS

Short Tube Butt Weld



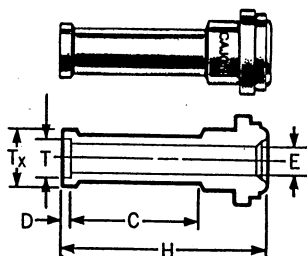
T Tube O.D.	ORDERING NUMBER	C	E	H	Nominal Wall Thickness	Working Pressure	
						psig	bar
1/8	316L-2-VCR-3S-2TB7	.75	.06 [Ⓢ]	1.08	.028	8500	585
1/4	6LV-4-VCR-3S-4TB2 [Ⓢ]	.25	.18	.60	.035	5100	351
1/4	316L-4-VCR-3S-4TB3	.38	.18	.72	.035	5100	351
1/4	6LV-4-VCR-3S-4TB7 [Ⓢ]	.75	.18	1.10	.035	5100	351
1/4	6LV-8-VCR-3S-4TB7	.75	.18	1.12	.035	5100	351
3/8	6LV-8-VCR-3S-6TB2	.25	.31	.62	.035	3300	227
3/8	6LV-8-VCR-3S-6TB7 [Ⓢ]	.75	.31	1.12	.035	3300	227
1/2	6LV-8-VCR-3S-8TB2	.25	.40	.62	.049	3500	241
1/2	316L-8-VCR-3S-8TB3	.38	.40	.74	.049	3500	241
1/2	6LV-8-VCR-3S-8TB7 [Ⓢ]	.75	.40	1.12	.049	3500	241

Long Tube Butt Weld



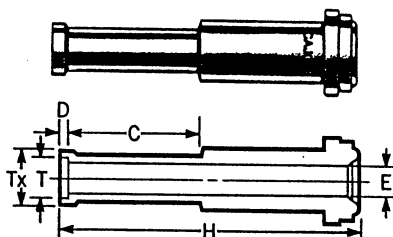
T Tube O.D.	ORDERING NUMBER	C	E	H	Nominal Wall Thickness	Working Pressure	
						psig	bar
1/8	316L-2-VCR-3-2TB7	.75	.06 [Ⓢ]	1.42	.028	8500	585
1/4	6LV-4-VCR-3-4TB2	.25	.18	1.20	.035	5100	351
1/4	316L-4-VCR-3-02205	.36	.18	1.31	.035	5100	351
1/4	6LV-4-VCR-3-4TB3	.38	.18	1.32	.035	5100	351
1/4	6LV-4-VCR-3-4TB7 [Ⓢ]	.75	.18	1.70	.035	5100	351
1/4	6LV-8-VCR-3-4TB7	.75	.18	1.80	.035	5100	351
3/8	6LV-8-VCR-3-6TB2	.25	.31	1.29	.035	3300	227
3/8	6LV-8-VCR-3-6TB7	.75	.31	1.79	.035	3300	227
1/2	316L-8-VCR-3-8TB2	.25	.40	1.29	.049	3500	241
1/2	316L-8-VCR-3-8TB3	.38	.40	1.41	.049	3500	241
1/2	6LV-8-VCR-3-8TB7	.75	.40	1.79	.049	3500	241
3/4	316L-12-VCR-3-12TB7	.75	.65	2.03	.049	2400	165
1	316L-16-VCR-3-16TB7	.75	.87	2.32	.065	2400	165

Short Automatic Tube Weld



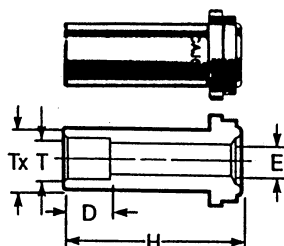
T Tube Size	ORDERING NUMBER	C	D	E	H	Tx	Nominal Wall Thickness	Working Pressure	
								psig	bar
1/4	316L-4-VCR-3AS	.75	.02	.18	1.12	.29	.035	5100	351
1/2	316L-8-VCR-3AS	.75	.04	.40	1.16	.55	.049	3500	241
3/8	316L-8-VCR-3AS6	.75	.03	.31	1.15	.41	.035	3300	227

Long Automatic Tube Weld



T Tube Size	ORDERING NUMBER	C	D	E	H	Tx	Nominal Wall Thickness	Working Pressure	
								psig	bar
1/4	316L-4-VCR-3A	.75	.02	.18	1.72	.29	.035	5100	351
1/4	316L-8-VCR-3A4	.75	.02	.18	1.82	.29	.035	5100	351
3/8	316L-8-VCR-3A6	.75	.03	.31	1.82	.41	.035	3300	227
1/2	316L-8-VCR-3A	.75	.04	.40	1.83	.55	.049	3500	241
3/4	316L-12-VCR-3A	.75	.04	.65	2.07	.80	.049	2400	165
1	316L-16-VCR-3A	.96	.04	.87	2.57	1.06	.065	2400	165

Short Socket Weld



T Tube Socket	ORDERING NUMBER	D	E	H	Tx	Working Pressure	
						psig	bar
1/4	SS-4-VCR-3-.50LG	.28	.18	.50	.35	5200	358
1/4	SS-4-VCR-3-.75LG	.28	.18	.75	.35	5500	378

[Ⓢ]Also available in Alloy C-22 (HC22) material.

[Ⓢ]VCR Face Seal end of the gland may be back-drilled to a larger I.D.

Features

Compact design

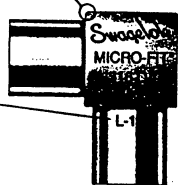
- accommodates tubing systems requiring miniaturization.
- allows close component spacing.
- provides flow and service ratings equal to larger weld fittings designed for the same size tubing.

Rounded body block prevents injury or damage to other components during system fabrication or maintenance.

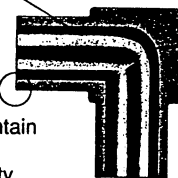
Material heat code is roll stamped during first manufacturing operation to ensure raw material traceability.

Standard Surface finish is a maximum 11 μin . R_a

Square, sharp, burr-free tube weld ends enhance alignment, maintain tube wall uniformity, and promote weld repeatability.



Laser etch marking identifies manufacturer, material, and when applicable, the appropriate process designator according to Swagelok Specification SC-01.



Radius junction allows for a smooth flow transition and is designed to eliminate pockets and entrapment zones.

Material

- 316L VAR (vacuum arc remelt) or 316L stainless steel
- some configurations are available in Alloy C-22

Ultra-High-Purity

A variety of Micro-Fit weld fittings are available with controlled surface finishes, electropolished and specially cleaned to meet Ultra-High-Purity system requirements. For more information refer to Swagelok Specification SC-01.

Ordering Information

To order fittings manufactured according to Swagelok Specification SC-01 use the following Designator codes as a suffix to the Ordering Number.

Example: 6LV-4MW-9P

Designator	Surface Finish (R_a)	
	Average	Maximum
P	5 μin (0.13 μm)	10 μin (0.25 μm)
PX	4 μin (0.10 μm)	7 μin (0.18 μm)

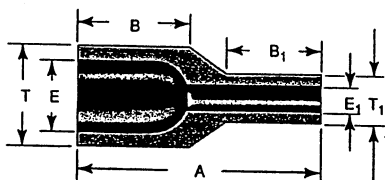
Technical Data

Size	Pressure Rating ^①		Nominal Wall Thickness
	psig	bar	
1/8 in.	8500	580	0.028 in.
1/4 in.	5100	350	0.035 in.
3/8 in.	3300	220	0.035 in.
1/2 in.	3500	240	0.049 in.
6 mm	6600	460	1 mm

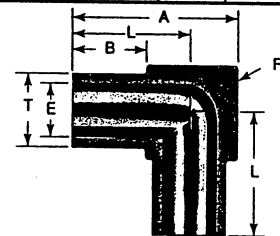
^① Pressure ratings are calculated in accordance with ANSI B31.3, based on equivalent wall ASTM A269 tubing and an allowable stress value of 20 000 psi.

Dimensions/Ordering Information

Reducing Union



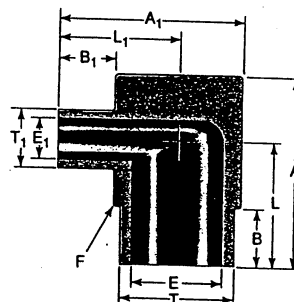
T Tube OD	T1 Tube OD	Ordering Number	Inches (mm)				
			A	B	B1	E	E1
1/4	1/8	6LV-4MW-6-2	0.75 (19.1)	0.41 (10.4)	0.25 (6.4)	0.18 (4.6)	0.06 (1.5)
3/8	1/4	6LV-6MW-6-4	0.75 (19.1)	0.41 (10.4)	0.25 (6.4)	0.31 (7.9)	0.18 (4.6)
1/2	1/4	6LV-8MW-6-4 ^②	0.75 (19.1)	0.41 (10.4)	0.25 (6.4)	0.40 (10.2)	0.18 (4.6)
1/2	3/8	6LV-8MW-6-6 ^②	0.75 (19.1)	0.41 (10.4)	0.25 (6.4)	0.40 (10.2)	0.31 (7.9)



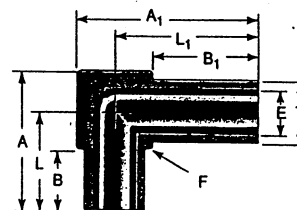
90° Union Elbow

T Tube OD	Ordering Number	Inches (mm)				
		A	B	E	F Body Cube	L
1/8	6LV-2MW-9	0.56 (14.2)	0.25 (6.4)	0.06 (1.5)	5/16	0.41 (10.4)
1/4	6LV-4MW-9 ^②	0.56 (14.2)	0.25 (6.4)	0.18 (4.6)	5/16	0.41 (10.4)
3/8	6LV-6MW-9 ^②	0.69 (17.5)	0.25 (6.4)	0.31 (7.9)	7/16	0.47 (11.9)
1/2	6LV-8MW-9	0.81 (20.6)	0.25 (6.4)	0.40 (10.2)	9/16	0.53 (13.5)
6 mm	6LV-6MMW-9	0.56 (14.2)	0.25 (6.4)	0.16 (4.0)	5/16	0.41 (10.4)

Reducing Elbow



T Tube OD	T1 Tube OD	Ordering Number	Inches (mm)							
			A	A1	B	B1	E	E1	F Body Cube	L L1
3/8	1/4	6LV-6MW-9-4	0.69 (17.5)	0.69 (17.5)	0.25 (6.4)	0.25 (6.4)	0.31 (7.9)	0.18 (4.6)	7/16	0.47 (11.9) 0.47 (11.9)
1/2	1/4	6LV-8MW-9-4	0.81 (20.6)	0.81 (20.6)	0.25 (6.4)	0.25 (6.4)	0.40 (10.2)	0.18 (4.6)	9/16	0.53 (13.5) 0.53 (13.5)
1/2	3/8	6LV-8MW-9-6	0.81 (20.6)	0.81 (20.6)	0.25 (6.4)	0.25 (6.4)	0.40 (10.2)	0.31 (7.9)	9/16	0.53 (13.5) 0.53 (13.5)

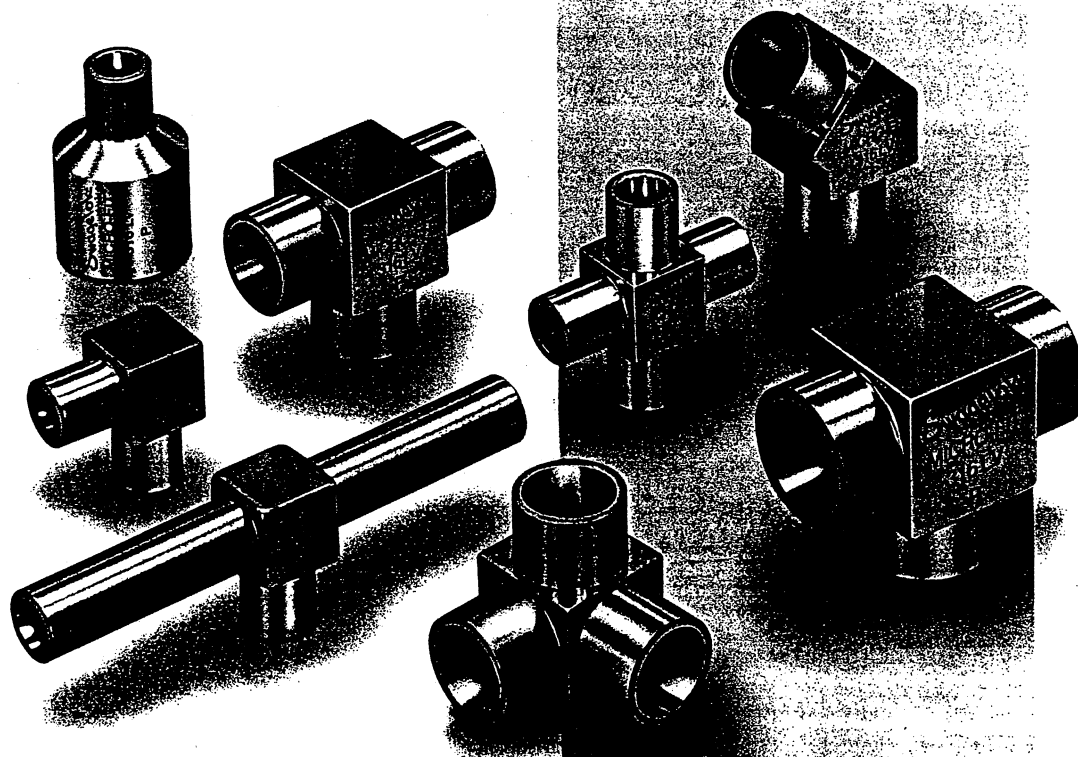
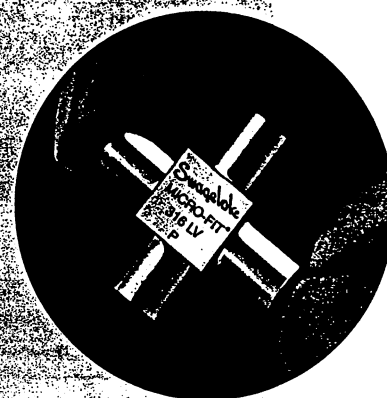


Extended Leg 90° Union Elbow

T Tube OD	Ordering Number	Inches (mm)							
		A	A1	B	B1	E	F Body Cube	L	L1
1/4	6LV-4MW-9-03442	0.56 (14.2)	0.76 (19.3)	0.25 (6.4)	0.45 (11.4)	0.18 (4.6)	5/16	0.41 (10.4)	0.61 (15.5)
1/4	6LV-4MW-9-03443	0.56 (14.2)	0.81 (20.6)	0.25 (6.4)	0.50 (12.7)	0.18 (4.6)	5/16	0.41 (10.4)	0.66 (16.8)
1/4	6LV-4MW-9-03444	0.76 (19.3)	0.76 (19.3)	0.45 (11.4)	0.45 (11.4)	0.18 (4.6)	5/16	0.61 (15.5)	0.61 (15.5)
1/4	6LV-4MW-9-03445	0.81 (20.6)	0.81 (20.6)	0.50 (12.7)	0.50 (12.7)	0.18 (4.6)	5/16	0.66 (16.8)	0.66 (16.8)

^② Also available in alloy C-22 (HC22) material
Dimensions are for reference only, subject to change.

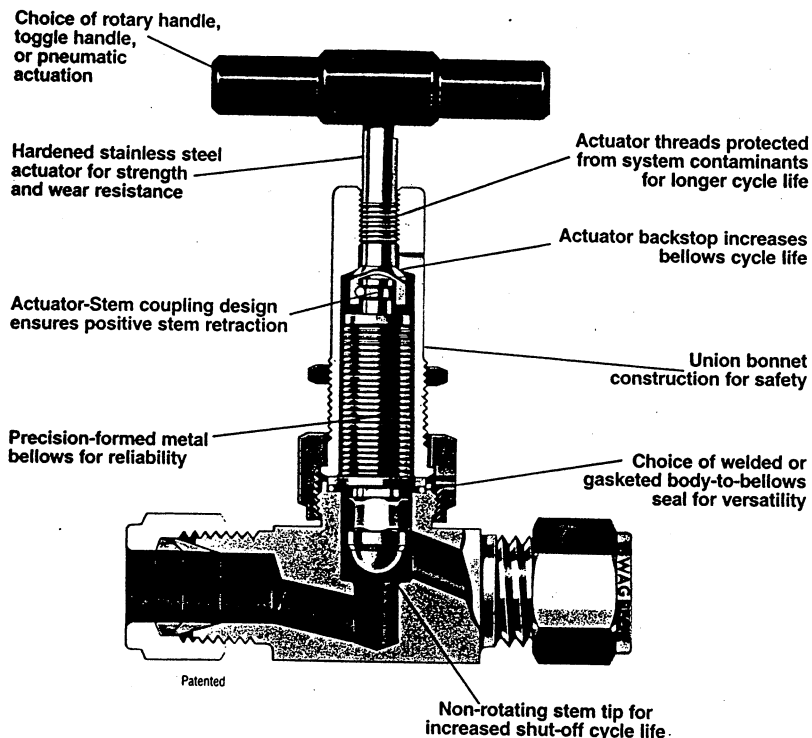
MICRO-FIT® Weld Fittings



Swagelok

Cajon Company
Macedonia, Ohio 44056 U.S.A.

FEATURES/BENEFITS



- Pressures to 1000 psig (68 bar)
- Temperatures to 900°F (482°C)
- Choice of materials: brass, 316 stainless steel, and alloy 400
- Flow Coefficients (C_v) from 0.36 to 1.2
- Gageable SWAGELOK® Tube Fitting ends 1/4" to 1/2" and 6mm to 12mm
- Tube socket weld ends: 1/4" to 1/2"
- Tube butt weld ends: 3/8" to 3/4"
- Tube extensions: 1/4" to 3/4" O.D. x 3" long
- CAJON® Male VCR® Metal Gasket Face Seal Fitting ends: 1/4" and 1/2"
- Choice of stem insert materials for shut-off and regulating service
- Panel mounting and bottom mounting
- Every valve is factory tested

TECHNICAL DATA

VALVE SIZE/SERIES	STEM TYPE	FLOW COEFFICIENT (Cv)	MAXIMUM PRESSURE RATING			MAXIMUM TEMPERATURE RATING		
			BRASS	316SS	ALLOY 400	BRASS	316SS	ALLOY 400
			Vacuum to					
-4BG-	Metal	0.39	1000 psig (68 bar)	1000 psig (68 bar)	700 psig (48 bar)	400°F (204°C)	600°F (315°C)	500°F (260°C)
-4BK-	Kel-F		0.36	100 psig (6.8 bar)			200°F (93°C)	200°F (93°C)
-4BKT-	Kel-F	0.39					N/A	
-4BW-	Metal		450 psig (31 bar)	1000 psig (68 bar)	700 psig (48 bar)	400°F (204°C)		
-4BRG-	Regulating	N/A	400°F (204°C)			200°F (93°C)	200°F (93°C)	
-4BRW-	Regulating	1.0	1000 psig (68 bar)	N/A	900°F (482°C)			500°F (260°C)
-6BG-	Metal	1.0	1000 psig (68 bar)			N/A	900°F (482°C)	
-6BK-	Kel-F		N/A	400°F (204°C)	600°F (315°C)			200°F (93°C)
-6BW-	Metal	1.2	1000 psig (68 bar)	N/A		900°F (482°C)	500°F (260°C)	
-8BG-	Metal		1000 psig (68 bar)		N/A			900°F (482°C)
-8BK-	Kel-F	N/A	N/A	900°F (482°C)		500°F (260°C)		
-8BW-	Metal	N/A			N/A		900°F (482°C)	500°F (260°C)

① Due to the strength of brass threads, the cycle life of brass valves will be limited when operated frequently at pressures above 450 psig (31 bar).

Internal Volume

SERIES	INTERNAL VOLUME (approx.) ^②
4B	0.10 in. ³ (1.6 cm ³)
4BKT	0.11 in. ³ (1.8 cm ³)
4BR	0.16 in. ³ (2.6 cm ³)
6B	0.24 in. ³ (3.9 cm ³)
8BKT	0.26 in. ³ (4.3 cm ³)

Temperature Gradient 316 Stainless Steel Valves

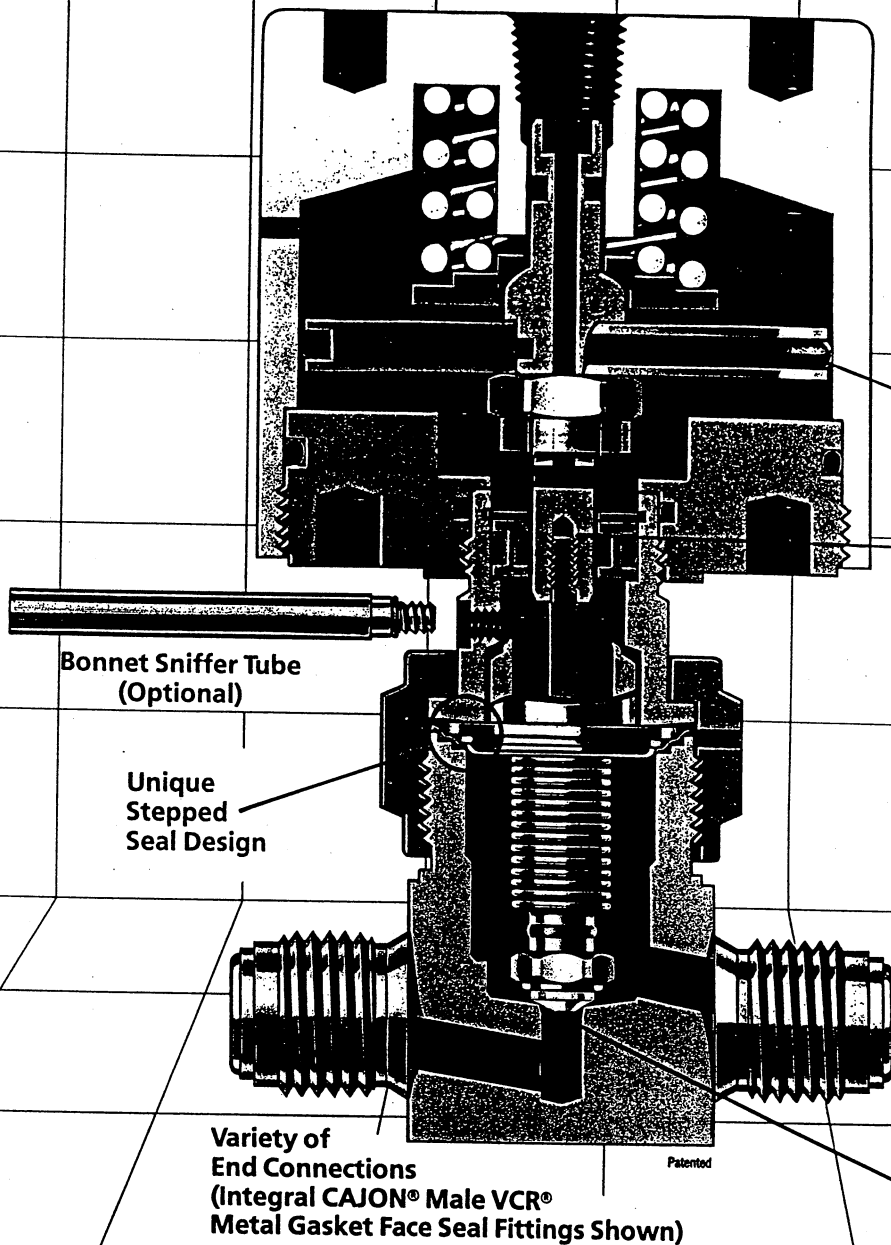
WHEN VALVE SEATS	VALVE HANDLE IS
600°F (315°C)	195°F (91°C)
900°F (482°C)	275°F (135°C)

② Determined using SWAGELOK ended valves.

HB Series Air Actuated High Pressure Bellows Valve

VALVE FEATURES

- Choice of Normally Closed and Normally Open Modes
- Low actuation pressure of 75 psig (5 bar)
- Full pressure rating in either flow direction
- Positive stem retraction
- Easily purged
- Specially cleaned to SWAGELOK Specification SC-11
- Optional high-purity processing to SWAGELOK Specification SC-01 available
- 100% helium leak-tested
- Optional bonnet Sniffer Tube available



Technical Data

Orifice Size		Flow ^③ Coefficient Cv	Internal ^④ Volume (approx.)	Pressure Ratings at 70°F (20°C) ^⑥		Back Pressure Rating	Temperature Ratings ^①	
in.	mm			for Valve	for Air Actuator		for Valve	for Air Actuator
0.15	3.8	0.30	0.27 in. ³ (4.4 cm ³)	3500 psig ^② (240 bar) Maximum	30 to 110 psig ^② (2 to 8 bar) See Air Actuator Pressure at System Pressure graph.	3500 psig (240 bar)	with Kel-F Stem Insert: -40°F to 150°F (-40°C to 65°C) with Vespel Stem Insert: -40°F to 400°F (-40°C to 200°C)	-10°F to 400°F (-20°C to 200°C)



ZOOK®
ENTERPRISES, LLC
RUPTURE DISKS

16809 PARK CIRCLE DRIVE P.O. BOX 419
CHAGRIN FALLS, OHIO 44022
TOLL FREE: 800.543.1043
TEL: 440.543.1010
FAX: 440.543.4930
E-MAIL: zook@zookdisk.com
WEB URL: http://www.zookdisk.com

FAX TRANSMISSION SHEET

DATE: JUNE 25, 1999

TO: BOB PATERESON

COMPANY: LAWERNCE-LIVERMORE NATIONAL LAB.

FROM: ALAN KOHTA

SUBJECT: 1/2" - 2250 PSIG & 2" 150 PSIG RUPTURE DISKS

THE RUPTURE DISKS YOU RECEIVED ARE TESTED UNDER THE SAME
GUIDE LINES AS ASME RUPTURE DISKS.

DISK

SIZE:	1/2"	2"
TYPE:	Z	Z
S/N:	44786.010	44786.030
MATERIAL:	STAINLESS STEEL	STAINLESS STEEL
RATING	2250 PSIG	150 PSIG
TEMPERATURE:	72 DEG. F	72 DEG. F
MFG RANGE:	-3/+6%	-4/+7%
BURST TOL:	+/-5%	+/-5%

HOLDER

SIZE:	1/2"	2"
TYPE:	UNION 6U	UNION 6U
S/N:	44786.020	44786.040
MATERIAL:	STAINLESS STEEL	STAINLESS STEEL

ZOOK® Series Z

Forward Acting

Metal Rupture Disks

Bulletin no. 20100

Features:

- Forward acting tension type design without score lines
- Operates to 70% of the disk's rated burst pressure
- Sizes available from 1/4" thru 36" diameters
- Burst pressures range from 3 to 80,000 psig
- Temperature ratings up to 1000°F (538°C)
- Excels in liquid or gas applications

Options

Seating Configurations ZOOK's Series Z Rupture Disks come in two basic seating designs:

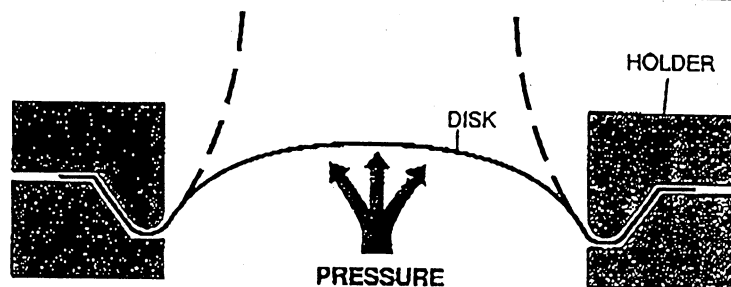
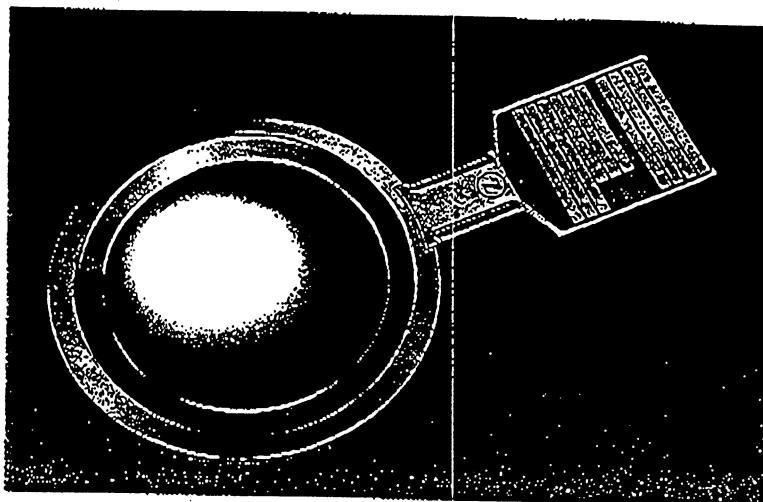
1. 30° angular *light-lip design* for normal operating pressures
2. 30° *heavy-lip design* for higher pressures.

Vacuum Supports Due to thinness of some disk materials, a vacuum support may be required. Vacuum supports are attached to a disk and allow the disk to support a full system vacuum. Consult ZOOK if back pressures are expected.

Liners/Coatings Provide additional protection from the effect corrosives might have on disk performance. Liners are made of TEFLON®. Teflon coatings also are used to protect the disk from atmospheric or corrosive media. Refer to *Table 2* for maximum temperature ratings for various disk, liner and coating materials.

Protective Rings Can be used with Series Z Disks made of thin materials or when delicate liners are used. These rings protect the rupture disk from foreign material in the sealing area where holders may be pitted or corroded from extended use.

Gaskets Can be used to provide additional sealing and prevent leakage through the seating area of a scratched or pitted holder. They are located on the process side of the disk and are usually made from Teflon. Other materials are available upon request.



Series Z Disks mount with the concave surface toward the process media. As pressure increases above the recommended operating pressure, the disk will bulge until it reaches the maximum tensile strength of the material. When the Series Z Disk bursts, it folds back against the holder. This results in a full-opening for optimal flow conditions.

Forward Acting Rupture Disk Cross-Reference

	ZOOK	OSCO	BS & B	GDC	FIKE
Forward Acting	Z	STD	B	STD	P
W/Vacuum Support	ZV	STDV	BV	STD-V	PV
W/Top Ring	RZ	RSTD	BR	R-STD	CP
W/Top & Bottom Ring	RZR	RSTDOR	BRR	R-STD-R	CPC
W/Ring & Vacuum Support	RZV	RSTDV	BRV	R-STD-V	CPV



ZOOK®
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16809 Park Circle Drive
Box 419
Chagrin Falls, OH 44022
Phone: (216) 543-1010
1-800-543-1043
FAX: (216) 543-4930

Table 1 – Minimum and Maximum Burst Pressures for Series Z Rupture Disks

Size	Minimum Burst Pressure (without liners)/Maximum Burst Pressure (with Teflon liners) psig @ 72°F												For Disks with Teflon Liners (Add to Disk Minimum Burst Pressure)		
	Aluminum		Silver		Nickel		Monel		Inconel		316SS		Inlet Only	Outlet Only	Both Sides
	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.			
1/4"	160	250	450	550	600	750	700	850	1120	1250	1550	1700	▲	▲	▲
1/2"	65	1500	220	2500	300	6000	350	6000	560	10000	760	10000	150	150	300
1"	29	1000	120	1800	150	3000	180	3000	250	5000	420	5000	50	50	100
1-1/2"	22	700	80	1200	100	2000	116	2000	160	3000	275	3000	35	35	70
2"	13	500	48	1000	60	1500	70	1500	110	2000	150	2000	25	25	50
3"	10	300	35	600	45	900	50	900	80	1500	117	1500	15	15	30
4"	7	225	26	425	35	650	40	650	70	1000	90	1000	11	11	22
6"	5	140	20	250	25	500	30	500	47	800	62	800	8	8	16
8"	4	100	15	200	20	350	23	350	34	600	51	600	6	6	12
10"	4	75	▲	▲	16	300	17	300	30	500	43	500	5	5	10
12"	3	60	▲	▲	13	250	15	250	25	400	36	400	4	4	8
14"	3	45	▲	▲	11	200	13	200	21	350	31	350	4	4	8
16"	3	▲	▲	▲	10	150	12	150	19	300	28	300	3	3	6
18"	3	▲	▲	▲	9	120	11	120	17	250	24	250	3	3	6
20"	3	▲	▲	▲	8	100	9	100	16	200	22	200	3	3	6
24"	3	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	2	2	4
30"	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
36"	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲

Protective Blings should be used when Burst Pressure is below the pressures shown (psig @ 72°F).

1/4"	▲	▲	▲	▲	▲	▲
1/2"	520	1300	2290	3000	3600	3700
1"	260	650	1145	1500	1800	1830
1-1/2"	180	450	790	1030	1240	1255
2"	110	280	485	635	760	775
3"	75	200	340	445	535	545
4"	60	150	270	350	420	430
6"	45	115	200	260	315	320
8"	35	85	155	200	240	245
10"	28	▲	125	160	195	200
12"	24	▲	105	135	160	165
14"	20	▲	90	115	140	140
16"	18	▲	80	100	120	125
18"	16	▲	70	90	110	110
20"	14	▲	62	80	100	100
24"	12	▲	52	68	80	85
30"	▲	▲	▲	▲	▲	▲
36"	▲	▲	▲	▲	▲	▲

(▲) = Consult ZOOK

Table 1 – notes

- Maximum burst pressures depend on disk size and application temperature. Pressures to 80,000 psig are available.
- Other material and sizes are available upon request.
- Other liner materials are available upon request. Minimum burst pressures will change with change in liner material.
- For larger sizes or sizes not shown, contact ZOOK.

Table 2

Maximum Temperature Ratings for Disk Materials	
Aluminum	260°F
Silver	260°F
Nickel	800°F
Monel	800°F
Inconel	1000°F
316 Stainless Steel	900°F
Maximum Temperature Ratings for Liners and Coatings	
Teflon	FEP 400°F
	TFE or PFA 500°F

Table 3

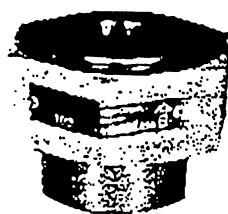
Manufacturing Range/Burst Tolerance @ 72°F			
Specified Burst Pressure Range psig	Manufacturing Range		Burst Tolerance
	Under	Over	
2-5	-40	+40	±2 psig
6-8	-40	+40	
9-12	-30	+30	
13-14	-10	+20	
15-19	-10	+20	
20-39	-4	+14	
40-50	-4	+14	±5%
51-100	-4	+10	
101-500	-4	+7	
501-up	-3	+6	

Table 3 – notes

- Special reduced manufacturing design ranges for the Series Z forward acting metal disk. 25%, 50% and 75% ranges are available upon request. Please consult ZOOK for additional information.
- Burst tolerances are the maximum expected variation from the disk's rated (stamped) burst pressure.
- ZOOK Series Z rupture disks can be manufactured to comply with ASME code requirements.

Union Holder for Standard or Composite Type Rupture Discs

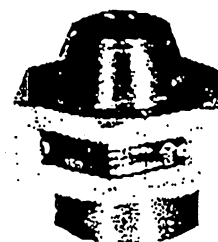
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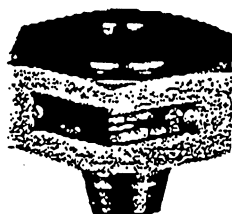
Assembly #1U
Free Outlet
Threaded Inlet



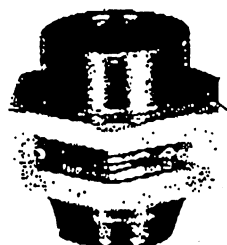
Assembly #2U
Threaded Outlet
Threaded Inlet



Assembly #3U
Welded Outlet
Threaded Inlet



Assembly #4U
Free Outlet
Welded Inlet



Assembly #5U
Threaded Outlet
Welded Inlet



Assembly #6U
Welded Outlet
Welded Inlet

Union type SAFETY CROWNS are provided in ½", 1", 1½" and 2" pipe sizes. Standard bore for welded connections in Assemblies 3U, 4U, 5U and 6U are as follows:

½", 1" and 1½" (either 3000 or 6000 psig. rating) - Schedule 80
2" (1200 psig. Maximum rating) - Schedule 40

These units are normally furnished constructed of carbon steel. However, all parts can be supplied from 300 series stainless steel or other machinable metal. Free outlets are sometimes supplied with threaded or welded connections at no additional charge.

All units are designed with 30 degree angular seating. When ordering standard or composite discs, please state that the disc is for a (UT) union type holder. By doing so, ~~ZOOK~~ will NOT attach the tags to the disc, and we will trim the disc OD to assure a perfect fit in the holder. The tags will ship with discs as a separate item. Holes have been punched in the corner of the tag, so they can be wired to the union during installation for positive disc identification.



Union assemblies #2U and #5U can be supplied with a muffled outlet. This prevents any fragments or product from dispersing direct from nozzle. Also, there is a reduction in the noise (db) level at burst of the disc.

Dimensions and maximum pressure ratings are listed on Page 2.

DIMENSIONS

PIPE SIZE	MAX RATING PSIG	HEX SIZE	OVERALL HEIGHT (Inches)					
			1U	2U	3U	4U	5U	6U
1/2"	3000	1-3/4"	1-5/8"	2-3/8"	2-1/4"	1-3/4"	2-3/8"	2-1/4"
1/2"	6000	2"	1-7/8"	2-5/8"	2-3/4"	2-3/16"	2-11/16"	2-3/16"
1"	3000	2-1/2"	2-1/8"	3-1/4"	3-1/4"	2-1/4"	3-1/4"	3-1/4"
1"	6000	3"	2-7/16"	3-3/8"	3-1/4"	2-5/8"	3-1/2"	3-3/8"
1-1/2"	3000	3-1/2"	2-7/16"	2-7/16"	3-6/16"	2-7/16"	3-7/16"	3-1/2"
2"	1200	4-1/2"	2-5/8"	4"	4"	2-5/8"	4"	4"

PRESSURE/TEMPERATURE RATINGS FOR UNION TYPE SAFETY CROWN FITTINGS

SERVICE TEMP. °F	MAXIMUM RATING					
	1200 psi ASSEMBLY MATERIAL		3000 psi ASSEMBLY MATERIAL		6000 psi ASSEMBLY MATERIAL	
	300 Ser.		300 Ser.		300 Ser.	
	C. Std	Stainless	C. Std	Stainless	C. Std	Stainless
100	1200	1200	3000	3000	6000	6000
200	1165	1165	2915	2915	5830	5830
300	1135	1135	2845	2845	5690	5690
400	1110	1110	2775	2775	5550	5550
500	1040	1040	2605	2605	5210	5210
600	925	925	2310	2310	4620	4620
700	785	825	1960	2055	3920	4110
800	610	750	1625	1865	3050	3730
900	370	670	925	1675	1855	3350
1000	140	595	355	1485	715	2975

To change inches to millimeters multiply inches by 25.40.

To change inches to centimeters multiply inches by 2.540.

To change PSIG to Kg-cms squared multiply PSIG by 0.3417.



ZOOK®
ENTERPRISES, LLC
RUPTURE DISKS

16809 PARK CIRCLE DRIVE • CHAGRIN FALLS, OHIO 44022 •
(440) 543-1010 • FAX (440) 543-4930

ASME Sect E Div 1
UG-127 or so

ZIG-6001

306546
306593
WARNING

SERIES 'Z' INSTALLATION GUIDE

IN ZA TYPE 30° SEAT, FULL BOLTED & UNION TYPE HOLDER

@ seat 2 for
agreed

740 psig ± 5%

USER SHOULD READ AND THOROUGHLY UNDERSTAND THESE INSTRUCTIONS BEFORE INSTALLING RUPTURE DISK. THESE INSTRUCTIONS DO NOT PURPORT TO ADDRESS ALL OF THE SAFETY FACTORS ASSOCIATED WITH THE RUPTURE DISK'S USE IN SERVICE. IT IS THE RESPONSIBILITY OF THE USER TO ESTABLISH APPROPRIATE SAFETY, HEALTH, AND TRAINING MEASURES FOR THEIR PERSONNEL INSTALLING, SERVICING, OR WORKING IN AN AREA WHERE RUPTURE DISK ASSEMBLIES ARE IN USE.

< 4 psig ± 2 psig

IT IS THE USER'S RESPONSIBILITY FOR DESIGN OF ADEQUATE VENTING AND INSTALLATION OF ADEQUATE VENT PIPING OR DIRECTIONAL FLOW AFTER RUPTURE OCCURS WITH THE RUPTURE DISK AS INTENDED. WHEN SIZE IS SPECIFIED, ZOOK ENTERPRISES ASSUMES THAT ADEQUATE PROVISIONS HAVE BEEN MADE BY PURCHASER FOR PROPER VENTING OF A SYSTEM TO RELIEVE THE SPECIFIC PRESSURE. LOCATE RUPTURE DISK WHERE PEOPLE OR PROPERTY WILL NOT BE EXPOSED TO THE SYSTEM DISCHARGE IN CASE OF RUPTURE. VENT TOXIC OR FLAMMABLE FUMES OR LIQUIDS TO A SAFE LOCATION TO PREVENT PERSONAL INJURY OR PROPERTY DAMAGE.

IT IS THE USER'S RESPONSIBILITY TO SPECIFY THE BURST PRESSURE RATING OF A RUPTURE DISK AT A COINCIDENT TEMPERATURE AT WHICH THE RUPTURE DISK IS TO BE USED. A RUPTURE DISK IS A TEMPERATURE SENSITIVE DEVICE. THE BURST PRESSURE OF THE RUPTURE DISK IS DIRECTLY AFFECTED BY ITS EXPOSURE TO THE COINCIDENT TEMPERATURE. GENERALLY, AS THE TEMPERATURE AT THE RUPTURE DISK INCREASES, THE BURST PRESSURE DECREASES; INVERSELY, AS THE TEMPERATURE AT THE RUPTURE DISK DECREASES, THE BURST PRESSURE MAY INCREASE. FAILURE TO PROPERLY UTILIZE A RUPTURE DISK AT THE SPECIFIED COINCIDENT TEMPERATURE COULD CAUSE PREMATURE FAILURE OR OVERPRESSURIZATION OF A SYSTEM.

THE INSTANTANEOUS RELEASE OF PRESSURE FROM THE RUPTURE DISK CAN CREATE VIOLENT NOISES DUE TO THE DISCHARGE AT SONIC VELOCITY. IT IS THE USER'S RESPONSIBILITY TO PROTECT AGAINST HEARING DAMAGE TO ANY BYSTANDERS.

PARTICLES MAY BE DISCHARGED WHEN THE RUPTURE DISK RUPTURES. THESE PARTICLES MAY BE PART OF THE RUPTURE DISK ITSELF, OR OTHER ENVIRONMENTAL MATTER IN THE SYSTEM. IT IS THE USER'S RESPONSIBILITY TO ASSURE THAT THESE PARTICLES ARE DIRECTED TO A SAFE AREA TO PREVENT PERSONAL INJURY OR PROPERTY DAMAGE.

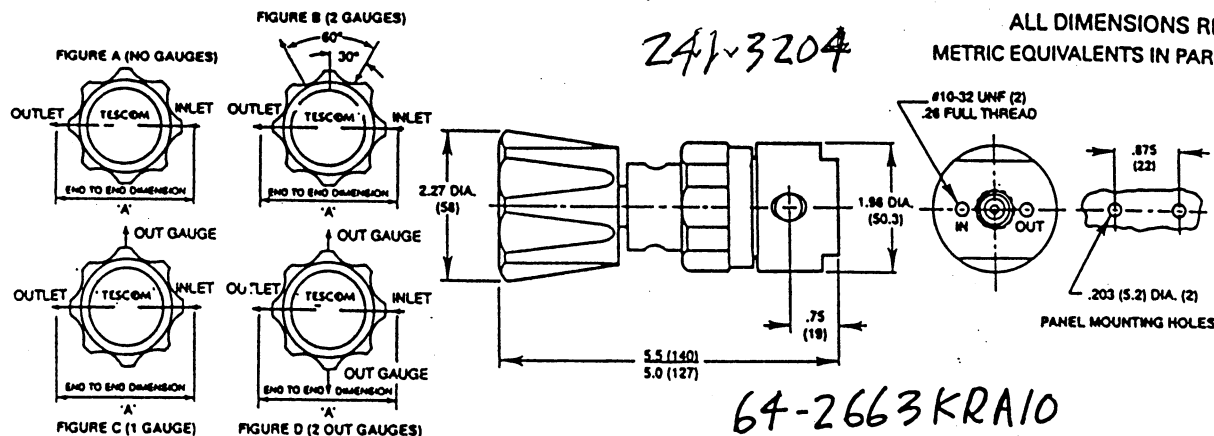
THERE IS NO GUARANTEE OF RUPTURE DISK LIFE. SUCH LIFE SPAN IS AFFECTED BY CORROSION, CREEP AND FATIGUE, AND PHYSICAL DAMAGE. THESE CONDITIONS WILL DERATE THE RUPTURE DISK TO A LOWER SET PRESSURE. THE CUSTOMER AND/OR USER SHOULD BE PREPARED TO HANDLE A PREMATURE FAILURE OF THE RUPTURE DISK. THE MEDIA OR OTHER ENVIRONMENTAL CONDITIONS SHOULD NOT ALLOW ANY BUILD-UP OR SOLIDIFICATION OF MEDIA TO OCCUR ON A RUPTURE DISK. THIS MAY INCREASE THE PRESSURE SETTING OF THE RUPTURE DISK.

CUSTOMER AND/OR ITS INSTALLER SHALL BE RESPONSIBLE FOR THE PROPER INSTALLATION OF SELLER'S HOLDERS AND RUPTURE DISKS INTO A SYSTEM. CUSTOMER AND/OR ITS INSTALLER SHALL BE RESPONSIBLE FOR IMPROPER INSTALLATION AND PHYSICAL DAMAGE RESULTING THEREFROM, INCLUDING, BUT NOT LIMITED TO, DAMAGE RESULTING FROM LEAKAGE, IMPROPER TORQUING, AND FAILURE TO FOLLOW INSTALLATION INSTRUCTIONS.

I. Safety Precautions Before Installation

1. The SERIES "Z" Type Rupture Disk is a precision instrument and must be handled with extreme care. Rupture disks should be installed only by qualified personnel familiar with rupture disks and proper piping practices.
2. Do not install rupture disk if there is any damage in the dome area. A damaged rupture disk is any rupture disk with visible nicks or dents in the dome.
3. Zook Enterprises does not recommend reinstalling a rupture disk that has been removed from the holder as reinstallation may adversely affect the joint sealing capabilities and/or performance of the rupture disk.

BS & B



64-2663KRA10
64-2663KRH19

SPECIFICATIONS

FLUID MEDIA — All gases corrosive or non-corrosive or those requiring high purity regulation compatible with materials of construction.
Maximum rated inlet pressure.....

3500 PSIG (238 bar)

Outlet pressure ranges..... 1-30, 1-60, 1-100 and 1-250 PSIG

600 PSIG (41 bar)

Design proof pressure..... 150% of maximum rated pressure

Design burst pressure..... 400% of maximum operating pressure

Materials:

Body..... 316L Stainless Steel

Seat..... Kel-F 81* or Teflon*

(Vespe® - optional for 3500 PSIG model only)

Diaphragm..... 316L Stainless Steel

Valve stem..... 316 Stainless Steel

Spring..... 316 Stainless Steel

Valve guide..... 316L Stainless Steel

Flow capacity..... Cv = .06 (3500 PSIG model)

Cv = .15 (600 PSIG model)

Porting..... Four High Purity Internal Connections (Style 'A')

Operating temperature..... Kel-F 81*: -40°F to +140°F (-40°C to +60°C)

Teflon*: -40°F to +160°F (-40°C to +71°C)

Vespe®: -40°F to +165°F (-40°C to +74°C)

Weight (w/o gauges)..... 2.0 lbs. (.9 kg.)

ORDERING INFORMATION

EXAMPLE: 64-2662KA410

BASIC SERIES	GAUGE PORT OPTION	NO. OF GAUGE PORTS
BODY MATERIAL	0 - None	0 (fig. A)
6 - 316L Stainless Steel	1 - 1/4" HPIC-A	1 (fig. C)
OUTLET PRESSURE RANGES	2 - 1/4" HPIC-A	2 (fig. B)
0 - 0-30 PSIG (0-2.1 bar)	3 - 1/4" HPIC-A	2 (fig. D)
1 - 0-60 PSIG (0-3.4 bar)	4 - 1/4" Male Swivel	2 (fig. D)
2 - 0-100 PSIG (0-7 bar)	5 - 1/4" Male Swivel	1 (fig. C)
3 - 0-250 PSIG (0-17 bar)	6 - 1/4" Male Swivel	2 (fig. B)
SEAT MATERIAL	7 - 1/4" Female Swivel	2 (fig. D)
K - Kel-F 81*	8 - 1/4" Female Swivel	1 (fig. C)
T - Teflon*	9 - 1/4" Female Swivel	2 (fig. B)
V - Vespe® (3500 PSIG models only)	S - 1/4" Fixed Male	2 (fig. B)
INLET & OUTLET PORT TYPE	T - 1/4" Fixed Male	1 (fig. C)
A - H.P.I.C.* Style 'A' (see below)	U - 1/4" Fixed Male	2 (fig. D)
R - Welded ** (see below)	MAXIMUM INLET PRESSURE	
	1 - 3500 PSIG (238 bar)	
	2 - 600 PSIG (41 bar)	
	INLET & OUTLET PORT SIZE	'A' ±.06"
	4 - 1/4" (HPIC only)	4.5"
	G - 1/4" Male Swivel	4.5"
	H - 1/4" Female Swivel	4.5"
	L - 1/2" Female Swivel	4.75"
	A - 1/4" Male Fixed	3.51"
	N - IN Port: 1/4" Male Swivel	4.5"
	OUT Port: 1/4" Female	4.5"
	R - IN Port: 1/4" Female	4.5"
	OUT Port: 1/4" Male Swivel	4.5"
	K - 1/2" Male Swivel	4.75"

*HIGH PURITY INTERNAL CONNECTIONS (H.P.I.C.)

Specify letter 'A' for Tescom High Purity Internal Connections. These are machined inside regulator body and are designed to be compatible with VCR® (or equivalent) male fittings — swivel only.

** WELDED FITTINGS — Optional at Additional Cost

Straight tubing or VCR® (or equivalent compatible) fittings welded to the regulator body. Consult factory for specific part number.

CLEANING: Tescom ES 500 DI water cleaning is performed on all 64-2600 models.

ADJUSTABLE STOP: This regulator incorporates an adjustable stop which allows the maximum outlet pressure to be limited to any value between the maximum rated value and 50% of the maximum rated value.

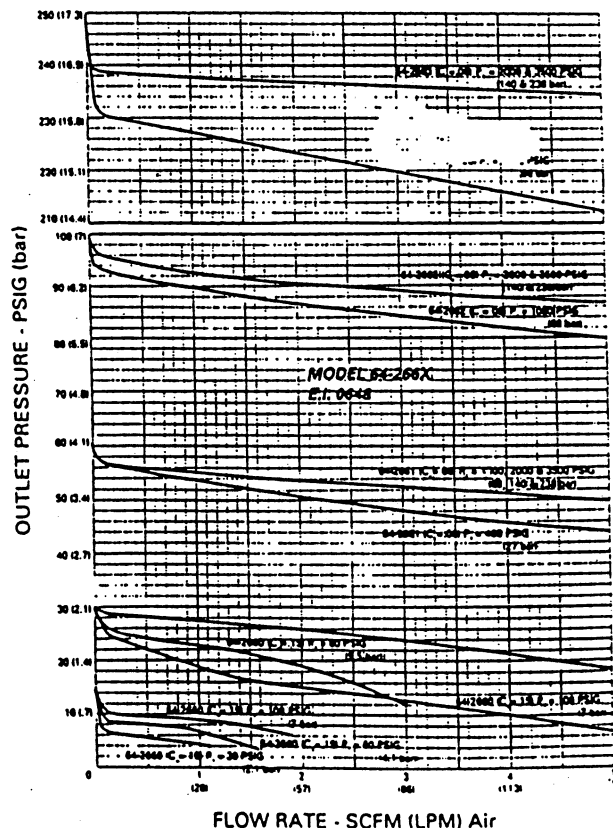
LEAK RATE CERTIFICATION To 1×10^{-9} atm cc/sec He available at extra cost. Consult factory.

ACCESSORIES (additional cost)

REPAIR KITS:

Model	Standard Repair Kit	Soft Goods Kit
64-266XXXX1X	P/N 389-3575	P/N 389-3572
64-266XXXX2X	P/N 389-3576	P/N 389-3573
64-266XTXX1X	P/N 389-3577	P/N 389-3574
64-266XTXX2X	P/N 389-3607	P/N 389-3606
64-266XVXX1X	P/N 389-3739	P/N 389-3738
64-266XVXX2X	P/N 389-3741	P/N 389-3740

Gauges: Consult GAUGES, section of catalog.

FLOW CHART (Metric units are in parenthesis)
REGULATOR DISCHARGE CHARACTERISTIC CURVES

SUGGESTED SOURCE OF SUPPLY
SPAN INSTRUMENTS

PRESSURE GAUGE

2.3 O.D. 316 SST BOURDON TUBE SOCKET
AND TIP WELDED

DIAL DATA

SIZE (FACE)-----2.0 INCH DIAMETER
RANGE-----REFERENCE TO TABLE 1
ARC OF CAL IB-----20°
ACCURACY-----1% OF SCALE
DIAL FACE-----DUAL SCALE PSI/BAR

MATERIALS

CASE,-----	316 55T
RING & WINDOW,-----	SAFETY GLASS
TUBE,-----	316 55T
SOCKET,-----	316 55T
MOVEMENT,-----	55T LINKS AND PINS

CONNECTION:-----SEE TABLE II
CLEANING:-----ANSI B40.1 LEVEL IV

NOTE:

1
SCALES DIFFERENT THAN THOSE SHOWN IN THE
TABULATION NOT PERMITTED.

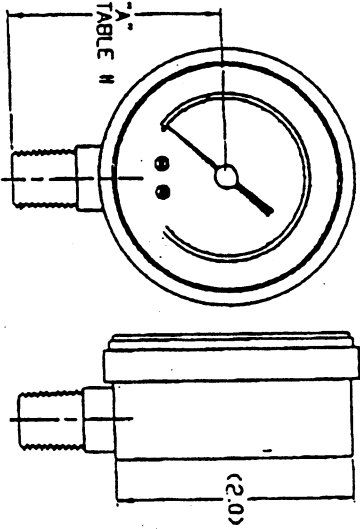
2. BEFORE BOXING GAUGES, CAP THE BOURDON TUBE FITTING OR SEAL IN PLASTIC BAG.

TABLE 11		
DASH NO.	CONNECTION TYPE	A REF.
N.	NP1	1.94
H	CAJON VCR (HALE) SWIVEL	2.24
R	CAJON VCR (FEMALE)	2.24

PART NUMBER DESIGNATION.

4802-0030N-C

CUSTOMER SUPPLIED
CONNECTION: (TABLE 11)
MAX. INDICATED PRESSURE
(TABLE 1)



4802

TABLE I

DASH NUMBER	PSIG	MAX. INDICATION	
		BAR EQUIVALENT	INCHES Hg
-0030	30	2	---
-0060	60	4	---
-0100	100	6.7	---
-0200	200	13.3	---
-0600	600	40	---
-1000	1000	66.7	---
-3000	3000	200	---
-4000	4000	266.7	---
-6000	6000	400	---
-V030	30	2	30/1
-V060	60	4	30/1
-V015	15	1.	30/1
-V100	100	6.7	---
-10000	10000	666.7	---
-0300	300	20.1	---
-0015	15	1	---
-5000	5000	333.3	---
-0160	160	10.7	---
-V200	200	13.8	30/1

[illegible]



File No. MESN99-038-0B
January 31, 2000

MECHANICAL ENGINEERING SAFETY NOTE

Gas Delivery System and Reclamation Cylinders for Gamma Ray
Imager, B Revision

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Purpose:

This revision has the purpose of permitting the addition of components to the time projection chambers (TPCs) in the Gamma Ray Imager.

Situation:

There are two time projection chambers which have been installed on the Gamma Ray Imager. They are covered by MESN99-020-0A which includes the following referenced drawings and which sanctions the use at an MAWP of 978 psig when used with the metal C-ring type blind flange (called a flat head in the safety note), as shown on AAA99-104243, on the main chamber flange, plus the conflat blind flange 4-5/8" D x 0.75 thick on the top chamber flange, plus the 1/2 D VCR plugs modified to give a 0.057 thick window in 5 of the 9 VCR chamber outlets and stock 1/2 D VCR plugs in the remaining outlets. The east chamber in this configuration has been pressure tested at 1470 psig and is tagged for 978 psig for reference and has a 978 psig rupture disc installed to protect this sanction.

The sanctioned MAWP for routine operations is 402 psig when used with the six-hole conflat type flange as shown on AAA99-104240 on the main chamber flange, plus the same conflat blind flange on the top chamber flange, plus the 5 and 4 VCR plugs in the 9 side outlets as above, plus a 2 3/4 D conflat blind flange, modified to give a 0.118 thick x 1.25 D gamma ray window, in the central hole of the six-holer and the five Ceramaseal part no. 19543-04-CF electrical feed thrus or the 1.33 D conflat blind flanges in the remaining five holes. The west chamber in this configuration has been pressure tested to 604 psig

and is tagged for 402 psig for reference and has a 402 psig rupture disc installed to protect this sanction.

The two chambers are connected to the gas handling system via V91, V93, V96 and V97 with Swagelok H016 flex hose rated at 1200 psig. The valves are NUPRO, p/n SS-8BGVCR3-C, rated at 1000 psig. The hoses connect from the valves to two VCRs on the 3 VCR side of the chambers.

The chambers are pressurized by filling with the appropriate measured mass of input gas at the chamber cryo leg temperature and then warming as required.

There is interest on the part of the experimenters in having flexibility in configuring the connections on the TPCs in various ways apart from the basic flex hose connection to the gas handling system. Examples include adding pressure gages and transducers, adding a quartz window, changing the Ceramaseal feedthrus and changing the rupture discs to match the pressure rating of these new components.

Plan:

The plan is very simple. Any departure from the sanctioned configurations shall be signed off by a pressure inspector and involve an independent pressure test of the proposed component(s) at 1.5X the desired MAWP and installation of a rupture disc within the subject circuit set at that MAWP. The proposed components must be used at an MAWP at or below their nameplate pressure rating as well as at or below the basic chamber MAWP. This pressure at the present time for routine operations is 402 psig.

All departures shall be entered in the TPC log in detail on each occasion and referenced on the following summary sheet in the TPC log.

Summary of Departures from Sanctioned Configuration:

<u>Brief Description</u>	<u>Page No.</u>	<u>New MAWP</u>	<u>Signed By</u>	<u>Date</u>
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