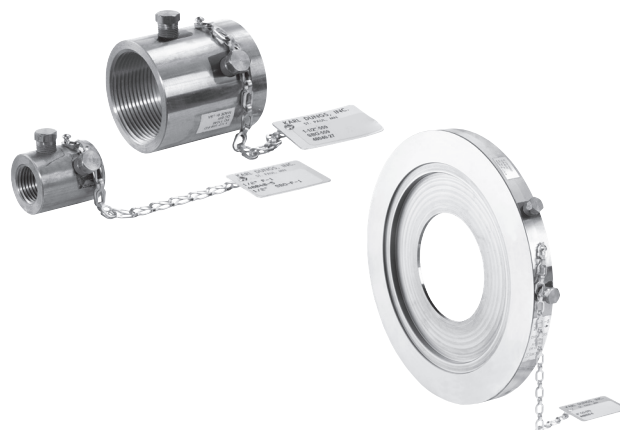


Table of Contents

Table of Contents	Page 1
Attention	Page 1
Screwed Brass Orifices (SBO)	Page 2
Carbon Steel Orifices (CO)	Page 2
Sizing an Orifice	Page 3
Screwed Brass Orifices (SBO)	Page 3
Screwed Brass Orifices (SBO)	Page 4
Carbon Steel Orifices	Page 5
Carbon Steel Orifices	Page 6
Correction Factor Calculation	Page 6
Installation of SBO Orifices	Page 7
Installation of CO Orifices	Page 7
Requirements for Straight Pipe Lengths	Page 8



Attention



The installation and maintenance of this product must be done under the supervision of an experienced and trained specialist. Never perform work if gas pressure or power is applied, or in the presence of an open flame.



Check the ratings in the specifications to make sure that they are suitable for your application.



Please read the instruction before installing or operating. Keep the instruction in a safe place. You find the instruction also at www.dungs.com. If these instructions are not heeded, the result may be personal injury or damage to property.



On completion of work on the SBO and CO Gas Orifices, perform a leakage test.

Explanation of symbols

- 1, 2, 3 ... = Action
- = Instruction

Screwed Brass Orifices (SBO)

1/2 - 2" NPT; rated 250 PSI

- Low cost metering device permits accurate setting of burner air and gas flow for optimum efficiency.
- +/- 1 % accuracy depending on location, measurement accuracy and proper use of correction factors.
- One piece machined brass connection
- Includes brass hex-head screws to plug holes when measurements are not being taken.
- Metal tag chained to orifice clearly shows orifice pipe size and part number.
- For temperatures up to 300 °F.
- 1/8" NPT pressure taps.



Carbon Steel Orifices (CO)

2 1/2 - 24"; rated 250 PSI

- Low cost metering device permits accurate setting of burner air and gas flow for optimum efficiency.
- Can be socket-welded to pipes or mounted between flanges (Karl Dungs does not sell mating flanges).
- +/- 1 % accuracy depending on location, measurement accuracy and proper use of correction factors.
- One piece zinc-plated, carbon steel.
- Includes brass hex-head screws to plug holes when measurements are not being taken.
- Metal tag chained to orifice clearly shows orifice pipe size and part number.
- For temperatures up to 1200 °F.
- 1/8" NPT pressure taps.
- Fits to ANSI Class 150 & 300 Flanges.



Sizing an Orifice

- Use the tables on pages 3 and 4 for sizing a threaded orifice. Use the tables on page 5 and 6 for sizing a flanged, carbon steel orifice.
- The tables show the air flow in SCFH in hundreds and the corresponding pressure drop in In. W.C.
- Select the orifice by either pressure drop or by flow. Apply correction factors where needed.

Screwed Brass Orifices (SBO)

Pipe Size NPT	Model Number		Pressure Drop ("W.C.)									
			1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
1/2"	SBO-G-3	Flow CFH of Air in Hundreds	0.33	0.46	0.56	0.65	0.73	0.80	0.86	0.92	0.98	1.03
1/2"	SBO-H-1		0.54	0.76	0.94	1.08	1.21	1.32	1.43	1.53	1.62	1.71
1/2"	SBO-I-5		0.87	1.22	1.50	1.73	1.93	3.12	2.29	2.45	2.60	2.74
1/2"	SBO-J-7		2.14	3.02	3.70	4.27	4.77	5.23	5.65	6.04	6.41	6.75
1/2"	SBO-F-1		3.60	5.09	6.24	7.20	8.05	8.82	9.52	10.18	10.80	11.38
3/4"	SBO-K-1		0.16	0.22	0.27	0.31	0.35	0.38	0.41	0.44	0.47	0.49
3/4"	SBO-J-3		0.31	0.44	0.54	0.62	0.69	0.76	0.82	0.88	0.93	0.98
3/4"	SBO-A-1		0.52	0.73	0.89	1.03	1.15	1.26	1.36	1.46	1.55	1.63
3/4"	SBO-B-5		0.82	1.15	1.41	1.63	1.82	2.00	2.16	2.31	2.45	2.58
3/4"	SBO-C-3		1.19	1.68	2.06	2.38	2.66	2.91	3.15	3.37	3.57	3.76
3/4"	SBO-D-7		1.65	2.33	2.86	3.30	3.69	4.04	4.37	4.67	4.95	5.22
1"	SBO-X-1		1.59	2.25	2.75	3.18	3.56	3.89	4.21	4.50	4.77	5.03
1"	SBO-B-9		2.75	3.88	4.75	5.49	6.14	6.72	7.26	7.76	8.24	8.68
1"	SBO-C-5		3.85	4.92	6.03	6.96	7.78	8.52	9.21	9.84	10.44	11.00
1"	SBO-D-11		4.50	6.36	7.78	9.00	10.06	11.02	11.91	12.73	13.50	14.23
1"	SBO-E-3		5.76	8.15	9.89	11.52	12.88	14.11	15.24	16.29	17.28	18.21
1"	SBO-F-13		7.20	10.18	12.47	14.40	16.10	17.64	19.05	20.36	21.60	22.77
1 1/4"	SBO-396		2.90	4.09	5.01	5.79	6.47	7.09	7.66	8.19	8.69	9.15
1 1/4"	SBO-478		4.38	6.19	7.59	8.76	9.79	10.73	11.59	12.39	13.14	13.85
1 1/4"	SBO-585		7.00	9.90	12.12	14.00	15.65	17.15	18.52	19.80	21.00	22.14
1 1/4"	SBO-667		10.30	14.57	17.84	20.60	23.03	25.23	27.25	29.13	30.90	32.57
1 1/2"	SBO-440		3.55	5.02	6.15	7.10	7.94	8.70	9.39	10.04	10.64	11.23
1 1/2"	SBO-559		8.06	11.40	13.96	16.12	18.02	19.74	21.32	22.80	24.18	25.49
1 1/2"	SBO-628		10.84	15.33	18.78	21.68	24.24	26.55	28.68	30.66	32.52	34.28
1 1/2"	SBO-685		13.80	19.52	23.90	27.60	30.86	33.80	36.51	39.03	41.40	43.64
1 1/2"	SBO-722		16.80	23.76	29.10	33.60	37.57	41.15	44.45	47.52	50.40	53.13
2"	SBO-369		6.50	9.19	11.26	13.00	14.53	15.92	17.20	18.38	19.50	20.55
2"	SBO-448		7.94	11.23	13.75	15.88	17.75	19.45	21.01	22.46	23.82	25.11
2"	SBO-551		12.59	17.80	21.80	25.17	28.14	30.83	33.30	35.60	37.76	39.80
2"	SBO-621		16.89	23.88	29.25	33.77	37.76	41.36	44.67	47.76	50.66	53.40
2"	SBO-677		23.50	33.23	40.70	47.00	52.55	57.56	62.18	66.47	70.50	74.31

Flows for all are air (1.0 S.G.) at 60 °F. seal level (14.7 PSI) with a supply pressure to the orifice of 1 PSIG.
See Correction Factor Calculation on page 5 for other pressures and temperatures.

Screwed Brass Orifices (SBO)

Pipe Size NPT	Model Number	Pressure Drop ("W.C.)						Beta Ratio	Head Loss	Bore Diameter (in) +/- 0.001
		12.0	14.0	16.0	18.0	20.0				
1/2"	SBO-G-3	1.13	1.22	1.30	1.38	1.45		0.301	89 %	0.1875
1/2"	SBO-H-1	1.87	2.02	2.16	2.29	2.41		0.402	87 %	0.2500
1/2"	SBO-I-5	3.00	3.24	3.46	3.67	3.86		0.500	85 %	0.3125
1/2"	SBO-J-7	7.40	7.99	8.54	9.06	9.55		0.703	73 %	0.4375
1/2"	SBO-F-1	12.47	13.47	14.40	15.27	16.10		0.804	63 %	0.5000
3/4"	SBO-K-1	0.54	0.58	0.62	0.66	0.69		0.152	90 %	0.1250
3/4"	SBO-J-3	1.07	1.16	1.24	1.32	1.39		0.227	90 %	0.1875
3/4"	SBO-A-1	1.78	1.93	2.06	2.18	2.30		0.300	89 %	0.2500
3/4"	SBO-B-5	2.82	3.05	2.26	3.46	3.64		0.380	87 %	0.3125
3/4"	SBO-C-3	4.12	4.45	4.76	5.05	5.32		0.455	85 %	0.3750
3/4"	SBO-D-7	5.72	6.17	6.60	7.00	7.38		0.531	83 %	0.4375
1"	SBO-X-1	5.51	5.95	6.36	6.75	7.11		0.417	80 %	0.4375
1"	SBO-B-9	9.51	10.27	10.98	11.65	12.28		0.536	79 %	0.5625
1"	SBO-C-5	12.06	13.02	13.92	14.76	15.56		0.596	76 %	0.6250
1"	SBO-D-11	15.59	16.84	18.00	19.09	20.12		0.655	73 %	0.6875
1"	SBO-E-3	19.95	21.55	23.04	24.44	25.76		0.715	65 %	0.7500
1"	SBO-F-13	24.94	26.94	28.80	30.55	32.20		0.775	58 %	0.8125
1 1/4"	SBO-396	10.03	10.83	11.58	12.28	12.95		0.430	82 %	0.5940
1 1/4"	SBO-478	15.17	16.39	17.52	18.58	19.59		0.520	76 %	0.7170
1 1/4"	SBO-585	24.25	26.19	28.00	29.70	31.30		0.634	65 %	0.8750
1 1/4"	SBO-667	35.68	38.54	41.20	43.70	46.06		0.725	55 %	1.000
1 1/2"	SBO-440	12.30	13.28	14.20	15.06	15.88		0.410	78 %	0.6600
1 1/2"	SBO-559	27.92	30.16	32.24	34.20	36.05		0.602	67 %	0.9700
1 1/2"	SBO-628	37.55	40.56	46.36	45.99	48.48		0.677	58 %	1.0900
1 1/2"	SBO-685	47.80	51.63	55.20	58.55	61.72		0.738	47 %	1.1875
1 1/2"	SBO-722	58.20	62.86	67.20	71.28	75.13		0.776	42 %	1.2500
2"	SBO-369	22.52	24.32	26.00	27.58	29.07		0.392	84 %	0.8110
2"	SBO-448	27.50	29.71	31.76	33.69	35.51		0.479	78 %	0.9900
2"	SBO-551	43.60	47.09	50.34	53.39	56.28		0.590	68 %	1.2200
2"	SBO-621	58.49	63.18	67.54	71.64	75.51		0.665	60 %	1.3750
2"	SBO-677	81.41	87.93	94.00	99.40	105.10		0.725	48 %	1.5000

Flow CFH of Air in Hundreds

Head loss is the pressure loss caused by the orifice as a percentage of the measured pressure drop.

Flows for all are air (1.0 S.G.) at 60 °F. seal level (14.7 PSI) with a supply pressure to the orifice of 1 PSIG.
See Correction Factor Calculation on page 6 for other pressures and temperatures.

$$\text{Beta} = \frac{\text{Bore Diameter}}{\text{Pipe OD}}$$

Carbon Steel Orifices

Pipe Size NPT	Model Number		Pressure Drop ("W.C.)									
			1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
2 1/2"	CO-708-2.5	Flow CFH of Air in Hundreds	29.40	41.60	50.90	58.80	65.70	72.00	77.80	83.20	88.20	93.00
2 1/2"	CO-810-2.5		44.40	62.80	76.90	88.80	99.30	108.80	117.50	125.60	133.20	140.40
3"	CO-653-3		36.50	51.60	63.20	73.00	81.60	89.40	96.60	103.20	109.50	115.40
3"	CO-734-3		49.80	70.40	86.30	99.60	111.40	122.00	131.80	140.90	149.40	157.50
3"	CO-794-3		64.20	90.80	111.20	128.40	143.60	157.30	169.90	181.60	192.60	203.00
4"	CO-619-4		56.40	79.80	97.70	112.80	126.10	138.20	149.20	159.50	169.20	178.40
4"	CO-712-4		80.40	113.70	139.30	160.80	179.80	196.90	212.70	227.40	241.20	254.20
4"	CO-804-4		115.20	162.90	199.50	230.40	257.60	282.20	304.80	325.80	345.60	364.30
5"	CO-750-5		146.50	207.20	253.70	293.00	327.60	358.90	387.60	414.40	439.50	463.30
6"	CO-575-6		110.00	155.60	190.50	220.00	246.00	269.40	291.00	311.10	330.00	347.90
6"	CO-750-6		210.00	297.00	363.70	420.00	469.60	514.40	555.60	594.00	630.00	664.10
8"	CO-800-8		450.00	636.40	779.40	900.00	1,006.20	1,102.30	1,190.60	1,272.80	1,350.00	1,423.00
10"	CO-775-10		625.00	883.90	1,082.50	1,250.00	1,397.50	1,530.90	1,653.60	1,767.80	1,875.00	1,976.40
12"	CO-792-12		960.00	1,357.60	1,662.80	1,920.00	2,146.60	2,351.50	2,539.90	2,715.30	2,880.00	3,035.80
14"	CO-800-14		1,200.00	1,697.10	2,078.50	2,400.00	2,683.30	2,939.40	3,174.90	3,394.10	3,600.00	3,794.70
16"	CO-800-16		1,585.00	2,241.50	2,745.30	3,170.00	3,544.20	3,882.40	4,193.50	4,483.10	4,755.00	5,012.20
18"	CO-800-18		2,040.00	2,885.00	3,533.40	4,080.00	4,561.60	4,997.00	5,397.30	5,770.00	6,120.00	6,451.00
20"	CO-800-20		2,520.00	3,563.80	4,364.80	5,040.00	5,634.90	6,172.70	6,667.30	7,127.60	7,560.00	7,968.90
24"	CO-800-24		3,540.00	5,006.30	6,131.50	7,080.00	7,195.70	8,671.20	9,366.00	10,012.60	10,620.00	11,194.50

Carbon Steel Orifices

Pipe Size NPT	Model Number	Pressure Drop ("W.C.)								
		12.0	14.0	16.0	18.0	20.0		Beta Ratio	Head Loss	Bore Diameter (in) +/- 0.001
2 1/2"	CO-708-2.5	101.80	110.00	117.60	124.70	131.50	Flow CFH of Air in Hundreds	0.708	45 %	1.750
2 1/2"	CO-810-2.5	153.80	166.10	177.60	188.40	198.60		0.810	20 %	2.000
3"	CO-653-3	126.40	136.60	146.00	154.90	163.20		0.653	57 %	2.000
3"	CO-734-3	172.50	186.30	199.20	211.30	222.70		0.734	40 %	2.250
3"	CO-794-3	222.40	240.20	256.80	272.40	287.10		0.794	30 %	2.437
4"	CO-619-4	195.40	211.00	225.60	239.30	252.20		0.619	60 %	2.500
4"	CO-712-4	278.50	300.80	321.60	341.10	359.60		0.712	45 %	2.875
4"	CO-804-4	399.10	431.00	400.80	488.80	515.20		0.804	22 %	3.250
5"	CO-750-5	507.50	548.20	586.00	621.50	655.20		0.750	32 %	3.790
6"	CO-575-6	381.10	411.60	440.00	466.70	491.90		0.575	66 %	3.481
6"	CO-750-6	727.50	785.70	840.00	891.00	939.10		0.750	32 %	4.550
8"	CO-800-8	1,558.80	1,683.70	1,800.00	1,909.20	2,012.50		0.800	25 %	6.380
10"	CO-775-10	2,165.10	2,338.50	2,500.00	2,651.70	2,795.10		0.775	28 %	7.750
12"	CO-792-12	3,325.50	3,592.00	3,840.00	4,072.90	4,293.30		0.792	25 %	9.500
14"	CO-800-14	4,156.90	4,490.00	4,800.00	5,091.20	5,366.60		0.800	25 %	10.600
16"	CO-800-16	5,490.60	5,930.50	6,340.00	6,724.60	7,088.30		0.800	25 %	12.200
18"	CO-800-18	7,066.80	7,633.00	8,160.00	8,655.00	9,123.20		0.800	25 %	13.800
20"	CO-800-20	8,729.50	9,429.00	10,080.00	10,690.00	11,269.80		0.800	25 %	15.400
24"	CO-800-24	12,262.90	13,245.50	14,160.00	15,018.90	15,831.40		0.800	25 %	18.300

Head loss is the pressure loss caused by the orifice as a percentage of the measured pressure drop.

$$\text{Beta} = \frac{\text{Bore Diameter}}{\text{Pipe OD}}$$

Correction Factor Calculation

Flows in the table are for air (1.0 s.g.) at 60 °F, seal level (14.7 PSIG), with a supply pressure to the orifice of 1 PSIG. To correct to other conditions, use the following formula.

Flow value to size orifice the Tables = $\frac{\text{Flow of gas used (ft}^3\text{/hr) in the application}}{\sqrt{\frac{520}{460^\circ + ^\circ\text{F}} \times \frac{1}{\text{s.g.}} \times \frac{\text{PSIA} + \text{PSIG}}{15.7}}}$

°F = gas temp. through orifice
s.g. = specific gravity of gas used
PSIA = barometric pressure
PSIG = Supply pressure to orifice

Use these figure to estimate the barometric pressure at varous altitudes:

Sea Level	14.7 PSIA
1000'	14.2 PSIA
2000'	13.7 PSIA
3000'	13.2 PSIA
4000'	12.7 PSIA
5000'	12.2 PSIA
6000'	11.8 PSIA
7000'	11.3 PSIA

To correct for specific gravity only:

Multiple the flow from the table by:

Natural gas, 0.60 s.g.	1.29
Propane, 1.56 s.g.	0.80
Butane, 2.00 s.g.	0.71
Propane/Air, 1.29 s.g.	0.88

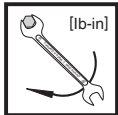
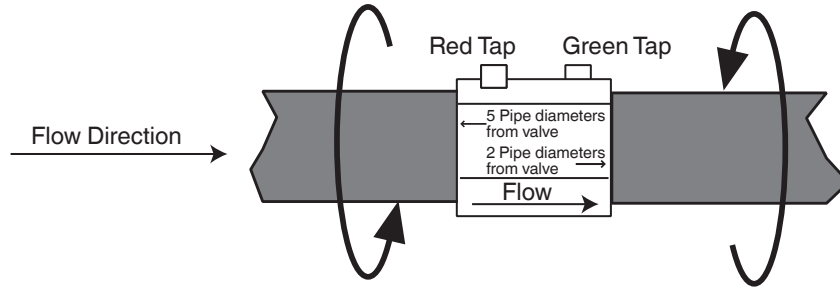
To correct for specific gravity only:

Multiple the flow from the table by:

Coke Oven gas, 0.45 s.g.	1.49
Hydrogen, 0.07 s.g.	3.78
Nitrogen, 0.80 s.g.	1.12

Installation of SBO Orifices

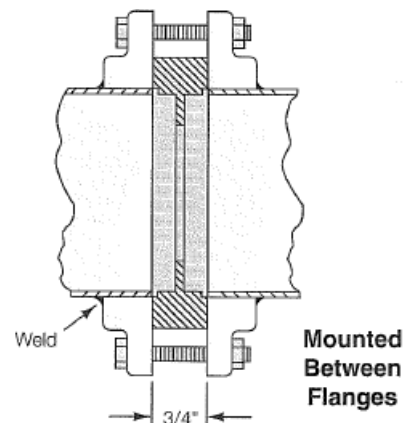
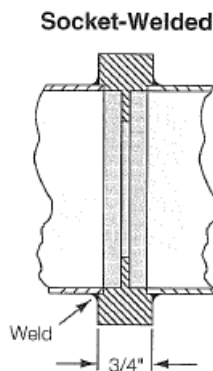
- Position the gas orifice so that the red pressure tap is on the high pressure side.
- For maximum accuracy, laminar flow (streamline flow) is required upstream the gas orifice. There is a minimum straight run of pipe required downstream the gas orifice. For $\pm 1\%$ accuracy, 1/4" to 4" orifices require a minimum length of 5 pipe diameters upstream and 2 pipe diameters downstream. For the 5" orifices and larger, the minimum is 10 pipe diameters upstream and 4 pipe diameters downstream. Slightly better greater accuracy can be achieved by using the information and charts on page 8.
- Use new, properly reamed and threaded pipe free of chips and debris (e.g. sand, dirt, water).
- Apply good quality pipe sealant, putting a moderate amount on the male threads only. Wipe away any excess after threading the pipe into the gas orifice. If using LP gas, use pipe sealant rated for use with LP gas.
- Do not thread pipe too far or overtighten the pipe. Follow the maximum torque values listed below. Distortion and/or leakage may result from excess pipe in the thread.
- After installation is complete, perform a leak test using soapy water.



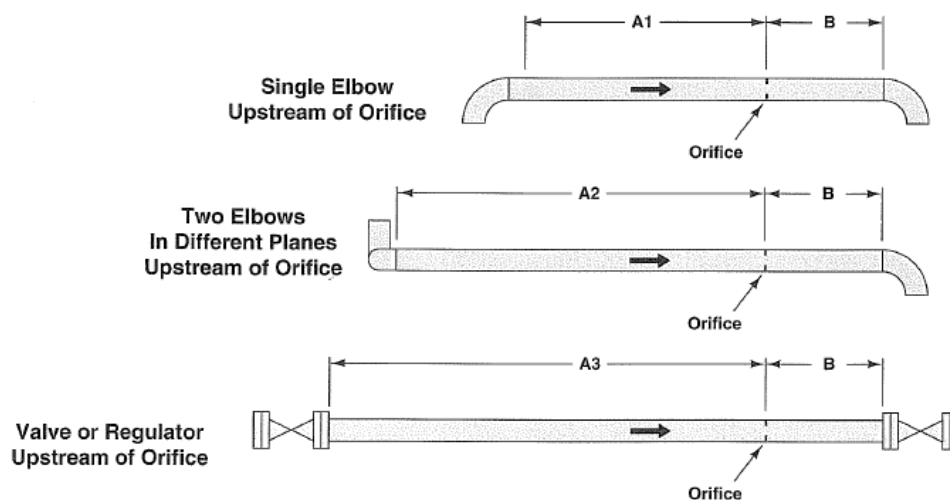
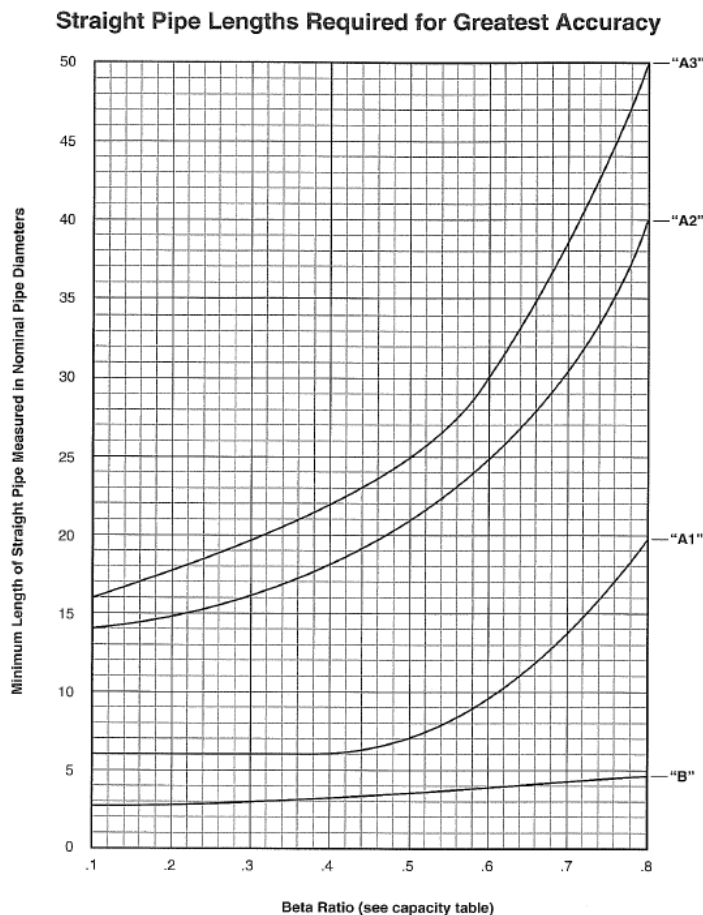
Recommended Torque for Piping	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	NPT pipe
	443	752	1106	1770	1991	2213	2876	[lb-in]

Installation of CO Orifices

- Position the gas orifice so that the red pressure tap is on the high pressure side.
- For maximum accuracy, there is a minimum straight run of pipe required upstream and downstream of the gas orifice. (See "Requirements for Straight Pipe Lengths")
- If welding the gas orifice directly to the pipe, apply the weld to the area as shown in the figure "socket weld".
- If mounting the gas orifice between two welded flanges, apply the weld to the area as shown in the figure "Mounted Between Flanges".
- Can be mounted to raised faced or flat faced flanges.



Requirements for Straight Pipe Lengths



We reserve the right to make modifications in the course of technical development.

Karl Dungs, Inc.
 3890 Pheasant Ridge Drive NE
 Suite 150
 Blaine, MN 55449, U.S.A.
 Phone 763 582-1700
 Fax 763 582-1799
 e-mail info@karldungsusa.com
 Internet <http://www.dungs.com/usa/>

Karl Dungs GmbH & Co. KG
 P.O. Box 12 29
 D-73602 Schorndorf, Germany
 Phone +49 (0)7181-804-0
 Fax +49 (0)7181-804-166
 e-mail info@dungs.com
 Internet <http://www.dungs.com>