

# NOISE REDUCTION

# NOISE SUPPRESSOR

SERVICE to 500°F

- Standard sizes 3/8" to 8". Consult Factory for additional sizes
- Effective over a broad frequency band (up to 12,000 Hz)
- Noise attenuation up to 26 dBA
- Expansion fittings not required
- Straight through design minimizes pressure drop, permitting normal valve sizing

Canadian Registration # OH 6266.51C



NOISE SUPPRESSORS

DIMENSIONS inches (mm) AND WEIGHTS pounds (kg)  
INLET SIZE 2 1/2" TO 8"

## APPLICATION DATA

- Steam Pressure Reduction Stations where Noise Reduction is Desired

## SUPPRESSOR ENDS

INLET ANSI	OUTLET ANSI
NPT	NPT
NPT	150#
NPT	300#
150#	150#
300#	150#
300#	300#

NOTE: ANSI 150# Flanges are flat faced.

It is recommended that the Noise Suppressor be insulated to reduce condensation formation in the acoustic material.

SIZING INFO  
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NOMINAL PIPE SIZE			D* — INSTALLED LENGTH			APPROX. WEIGHT			Average Attenuation dBa <sup>†</sup>
A INLET	B OUTLET	C SHELL	150# X 150#	300# X 150#	300# X 300#	150# X 150#	300# X 150#	300# X 300#	
2 1/2 (65)	4 (100)	5 (125)	39 3/4 (1010)	40 (1016)	40 3/8 (1025)	73 (33)	75 (34)	85 (39)	12
2 1/2 (65)	5 (125)	6 (150)	47 1/4 (1200)	47 1/2 (1207)	47 7/8 (1216)	105 (48)	108 (49)	123 (56)	16
3 (80)	4 (100)	5 (125)	39 3/4 (1009)	40 1/8 (1019)	40 1/2 (1028)	76 (35)	82 (37)	91 (41)	10
3 (80)	5 (125)	6 (150)	47 1/4 (1200)	47 5/8 (1210)	48 (1219)	108 (49)	114 (52)	129 (59)	14
3 (80)	6 (150)	8 (200)	58 1/4 (1480)	58 5/8 (1489)	59 (1499)	174 (798)	180 (82)	199 (90)	19
4 (100)	5 (125)	6 (150)	47 1/2 (1206)	47 7/8 (1216)	48 1/4 (1225)	113 (51)	123 (56)	138 (63)	12
4 (100)	6 (150)	8 (200)	54 1/2 (1384)	54 7/8 (1393)	55 1/4 (1403)	175 (80)	185 (84)	204 (93)	15
4 (100)	8 (200)	10 (250)	66 (1676)	66 3/8 (1686)	66 3/4 (1695)	284 (129)	294 (134)	321 (146)	21
5 (125)	6 (150)	8 (200)	55 (1397)	55 3/8 (1406)	55 3/4 (1416)	180 (82)	195 (87)	214 (97)	14
5 (125)	8 (200)	10 (250)	66 1/2 (1689)	66 7/8 (1698)	67 1/4 (1708)	289 (131)	304 (138)	331 (150)	19
5 (125)	10 (250)	12 (300)	89 (2261)	89 3/8 (2280)	90 (2286)	455 (207)	470 (214)	516 (235)	26
6 (150)	8 (200)	10 (350)	66 1/2 (1689)	66 7/8 (1698)	67 1/4 (1708)	295 (134)	314 (143)	341 (155)	17
6 (150)	10 (250)	12 (300)	83 1/2 (2121)	83 7/8 (2130)	84 1/2 (2146)	451 (205)	470 (214)	516 (235)	24
8 (200)	10 (250)	12 (300)	84 (2134)	84 3/8 (2143)	85 (2159)	468 (213)	495 (225)	541 (246)	21

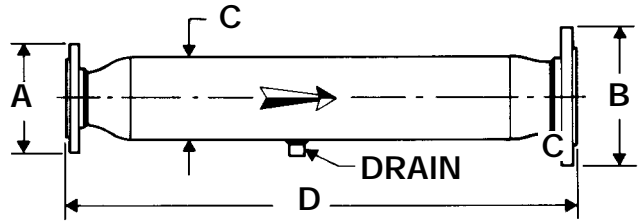
\* ±1/4" for 8" Shell and under, otherwise ± 3/8".

† Consult factory for specifics.

# NOISE SUPPRESSOR

## SPECIFICATION

Noise Suppression equipment shall be of the dissipative reactive type. Suppressor shall not induce back pressure. It shall have expanded outlet flange for attachment to downstream piping. Equipment shall provide a minimum of 10 dBA reduction in noise. Installation must be insulated.



## MATERIALS OF CONSTRUCTION

Pressure Shell .....Welded Steel Components  
Acoustic Material .....Stainless Steel

### MAXIMUM VELOCITY

feet per minute  
(meters per minute)

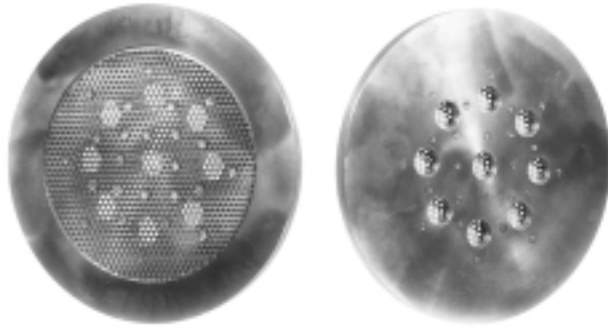
NOMINAL PIPE SIZE	MAXIMUM VELOCITY
0 - 2 (0 - 51)	17,000 (5182)
2 1/2 - 8 (64 - 203)	11,000 (3353)
>8 (>203)	9,000 (2734)

### DIMENSIONS inches (mm) AND WEIGHTS pounds (kg) INLET SIZES 3/8" TO 2"

NOMINAL PIPE SIZE			D* — INSTALLED LENGTH			APPROX. WEIGHT						Average Attenuation dBa†
A INLET	B OUTLET	C SHELL	NPTxNPT NPTx300# 300#x300#	NPTx150# 300#x150#	150#x150#	NPT x NPT	NPT x 150#	NPT x 300#	150# x 150#	300# x 150#	300# x 300#	
3/8 (10)	3/4 (20)	2 (50)	19 1/16 (502)	19 5/8 (498)	—	8 (3.6)	9 (4.1)	10 (4.5)	—	—	—	16
3/8 (10)	1 (25)	2 (50)	20 (508)	19 3/4 (502)	—	8 (3.6)	10 (4.5)	11 (5)	—	—	—	16
3/8 (10)	1 1/2 (40)	2 1/2 (65)	22 3/4 (578)	22 1/2 (572)	—	12 (5.4)	15 (6.8)	18 (8.2)	—	—	—	19
1/2 (15)	1 (25)	2 (50)	20 (508)	19 3/4 (502)	19 9/16 (140)	8 (3.6)	10 (4.5)	11 (5)	12 (5.4)	12 (5.4)	13 (5.9)	13
1/2 (15)	1 1/4 (32)	2 1/2 (65)	22 5/8 (574)	22 5/16 (565)	22 1/8 (562)	12 (5.4)	13 (5.9)	16 (7.3)	15 (6.8)	15 (6.8)	17 (7.7)	16
1/2 (15)	1 1/2 (40)	2 1/2 (65)	22 3/4 (578)	22 1/2 (572)	22 5/16 (565)	12 (5.45)	15 (6.8)	18 (8.2)	16 (7.3)	16 (7.3)	19 (8.6)	16
3/4 (20)	1 1/4 (32)	2 1/2 (65)	23 5/16 (591)	23 (584)	22 13/16 (578)	12 (5.4)	14 (6.4)	16 (7.3)	15 (6.8)	16 (7.3)	18 (8.2)	12
3/4 (20)	2 (50)	3 (80)	26 1/2 (673)	26 1/4 (667)	26 1/16 (664)	16 (7.3)	21 (9.5)	23 (10.4)	22 (10)	23 (10.4)	25 (11.4)	16
1 (25)	1 1/2 (40)	2 1/2 (65)	21 1/8 (537)	20 7/8 (530)	20 5/8 (524)	13 (5.9)	16 (7.3)	19 (8.6)	18 (8.2)	19 (8.6)	22 (10)	9
1 (25)	2 (50)	3 (80)	23 11/16 (603)	26 7/16 (683)	26 3/16 (666)	16 (7.3)	21 (9.5)	23 (10.4)	23 (10.4)	24 (10.9)	26 (11.8)	12
1 1/4 (32)	2 (50)	3 (80)	24 5/16 (616)	24 1/16 (613)	23 3/4 (603)	16 (7.3)	21 (9.5)	23 (10.4)	23 (10.4)	25 (11.4)	27 (12.3)	9
1 1/4 (32)	3 (80)	4 (100)	34 11/16 (882)	34 5/16 (879)	34 (864)	—	40 (18)	47 (21.4)	42 (19)	45 (20.5)	51 (23)	15
1 1/2 (40)	3 (80)	4 (100)	31 13/16 (807)	31 7/16 (800)	31 3/16 (791)	—	39 (17.7)	44 (20)	43 (19.5)	46 (21)	52 (23.6)	13
2 (50)	3 (80)	4 (100)	31 7/8 (810)	31 1/2 (800)	31 1/4 (794)	—	40 (18)	46 (21)	45 (20.5)	47 (21.4)	53 (24)	10
2 (50)	4 (100)	5 (125)	40 7/8 (1019)	39 3/4 (1010)	39 1/2 (1003)	—	66 (30)	76 (34.5)	72 (32.7)	74 (33.6)	84 (38.2)	14

\* ± 1/4" for 8" Shell and under, otherwise ± 3/8".

† Consult factory for specifics.



INLET                      OUTLET  
MUFFLING ORIFICE

# MUFFLING ORIFICE PLATES (MOPS)

- Reduces noise by 6 dBA to 12 dBA
- Engineered for each application
- Designed to fit between ANSI flanges (DIN upon request)
- For noise reduction estimates, consult your Representative.

Canadian Registration # OH 6265.51a

## MATERIALS OF CONSTRUCTION

Plate .....Steel ASTM A285-78 Gr. C.  
Disc .....St. St. 302-2B

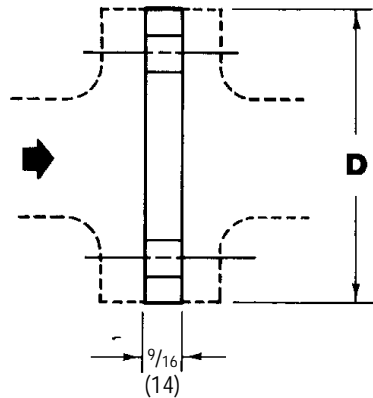
## APPLICATION DATA

- Spence Pressure Regulators or Control Valves where noise reduction is desired

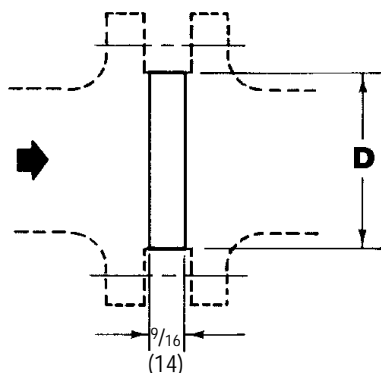
SIZING INFO  
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## SPECIFICATION

A Muffling Orifice Plate to be constructed of materials suitable for the installation and compatible with the piping. Generally, it is to be of steel construction with stainless steel plate welded to the primary plate. The orifices are to be on the stainless steel plate. Orifice plates are to be designed for installation between two ANSI flanges in the enlarged piping downstream of the regulator or noise suppressor. Muffling Orifice Plates are to be designed to provide between 6 to 12 dBA of noise reduction on a high flow PRV.



ANSI 125 & 150 FLANGED



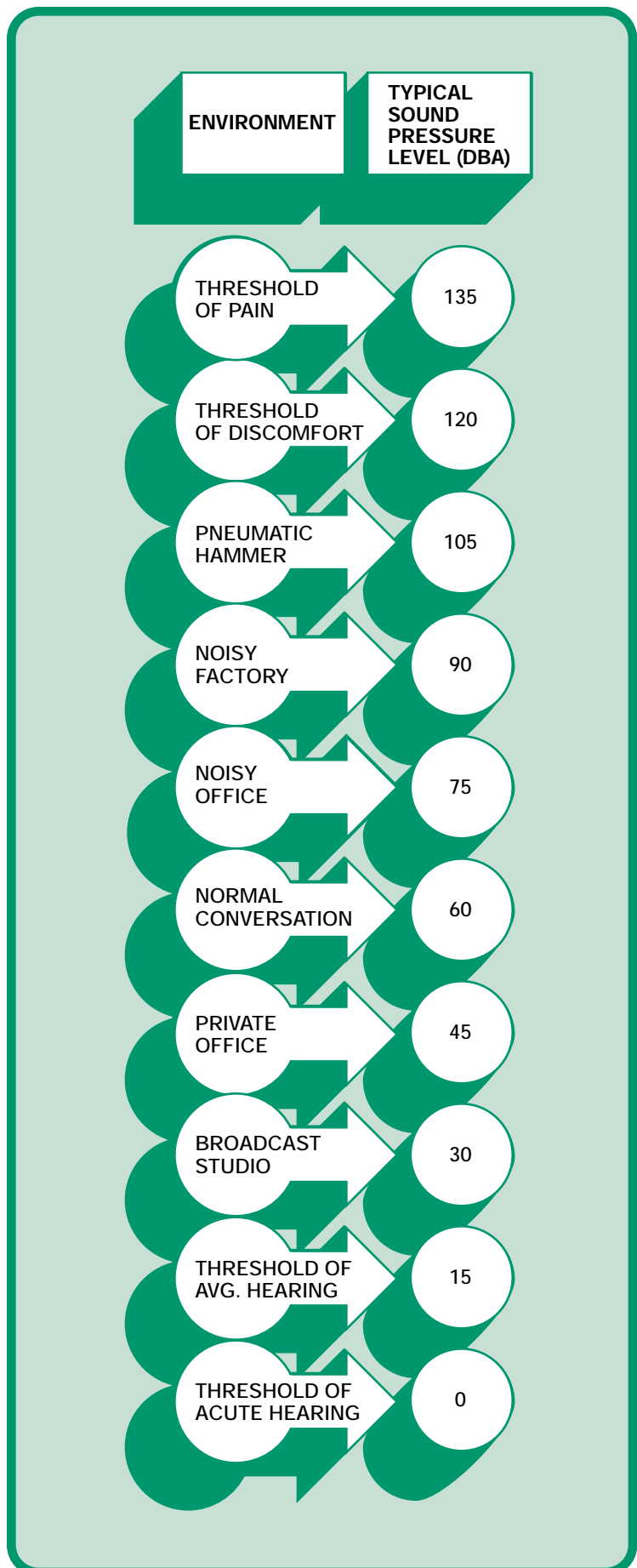
ANSI 250, 300 & 600 FLANGED

## DIMENSIONS inches (mm)

NOMINAL PIPE SIZE	DIMENSION D		
	ANSI 125 150	ANSI 250 300	ANSI 600
2 (50)	6 (152)	4 <sup>3</sup> / <sub>16</sub> (106)	3 <sup>5</sup> / <sub>8</sub> (92)
2½ (65)	7 (178)	4 <sup>15</sup> / <sub>16</sub> (126)	4 <sup>1</sup> / <sub>8</sub> (105)
3 (75)	7½ (190)	5 <sup>1</sup> / <sub>16</sub> (146)	5 (127)
4 (100)	9 (229)	6 <sup>15</sup> / <sub>16</sub> (178)	6 <sup>3</sup> / <sub>16</sub> (156)
5 (125)	10 (254)	8 <sup>5</sup> / <sub>16</sub> (210)	7 <sup>5</sup> / <sub>16</sub> (184)
6 (150)	11 (279)	9 <sup>1</sup> / <sub>16</sub> (247)	8½ (216)
8 (200)	13½ (343)	11 <sup>15</sup> / <sub>16</sub> (305)	10 <sup>5</sup> / <sub>8</sub> (270)
10 (250)	16 (406)	14 <sup>1</sup> / <sub>16</sub> (357)	12 <sup>3</sup> / <sub>4</sub> (324)
12 (300)	19 (483)	16 <sup>7</sup> / <sub>16</sub> (419)	15 (381)
14 (350)	21 (533)	18 <sup>15</sup> / <sub>16</sub> (481)	16 <sup>1</sup> / <sub>4</sub> (413)
16 (400)	23½ (597)	21 <sup>1</sup> / <sub>16</sub> (534)	18½ (470)
18 (450)	25 (635)	23 <sup>5</sup> / <sub>16</sub> (591)	21 (533)

MUFFLING ORIFICE

# STEAM PRESSURE REDUCING STATION NOISE REDUCTION



NOISE REDUCTION

# INTRODUCTION TO NOISE REDUCTION

## WHY IS NOISE IMPORTANT?

Excessive noise is stressful to the human body and constitutes a serious health hazard. The Walsh-Healy Public Contracts Act and the Occupational Safety and Health Act have prompted system designers to pay careful attention to the noise generated by pressure reducing stations.

OSHA has established limits on the length of time any employee may be exposed to various sound levels. These limits are shown in Figure 1 below. For a typical eight hour working day, the limit is 90 dBA. OSHA does not provide sound level limits for periods longer than eight hours. Figure 1 extrapolates the OSHA limits to a full 24 hour day.

When daily exposure is composed of two or more at differing sound levels, their combined effect must be considered. In such cases, the sum of the ratios of actual to permissible exposure times must not exceed unity, that is:

$$\frac{t_1}{T_1} + \frac{t_2}{T_2} = \dots = \frac{t_n}{T_n} \leq 1$$

Where:

**T** = permissible time at specified noise level

**t** = actual time at specified noise level

**1, 2, ..., n** = differing noise levels

FIGURE 1: OSHA MANDATED NOISE EXPOSURE LIMITS\*

SOUND PRESSURE LEVEL (DBA)	115	110	105	100	95	90	85	82
PERMISSIBLE EXPOSURE (HOURS PER DAY)	1/4	1/2	1	2	4	8	12	24

\* Values for 12 and 24 hour per day exposure are extrapolated.

NOTE: Ear protection must be worn above 90 dBA.

## WHAT IS A DBA?

Sound results from pressure fluctuations in the air. The sound pressure level which the most sensitive listener can detect is about  $20\mu\text{N}/\text{m}^2$ . This level is normally taken as the reference point for the measurement of sound pressure levels.

Sound pressure level cover an enormous range of values. In order to compress this range, sound levels are usually expressed in decibels. A decibel (dB) is simply the logarithm of the ratio of two quantities. In this case, the two quantities are the sound

pressure level being measured and the reference level. The reference level is, by definition, 0 dB.

The human ear does not respond equally to all frequencies. It tends to be insensitive to very low and very high frequencies. Standard sound level meters are equipped with a scale which approximates the human ear's response. Sounds measured on this scale are expressed as A-weighted decibels (dBA). The dBA is commonly used in engineering work.

# IMPORTANT CHARACTERISTICS OF DECIBELS

## ADDING SOUND LEVELS

Since decibels express a logarithmic ratio, they cannot simply be added or subtracted. Figure 2 below provides a means of adding decibels without lengthy calculations.

To add two sound levels:

1. Determine difference between sound level
2. Find correction from Figure 2.
3. Add the correction to the **higher** sound level.

DECIBEL DIFFERENCE	0	1	2	3	4	5	6	7	8	9	10
DECIBEL CORRECTION	3.0	2.6	2.1	1.8	1.5	1.2	1.0	0.8	0.6	0.5	0.4

FIGURE 2

## SOUND LEVEL REDUCTIONS

Similarly, a 10% reduction in the decibel level does not represent a 10% reduction in absolute sound pressure level. For example, a reduction from 60 dB to 54 dB (a 10% dB reduction) produces a 50% reduction in the absolute sound pressure level. A

6 dB reduction always cuts the absolute sound pressure in half. The relationship between decibel and absolute sound pressure level reductions is summarized in Figure 3.

RELATIVE REDUCTION (dB)	1	2	3	4	5	6	10	20	40
ABSOLUTE REDUCTION (%)	11	21	29	37	44	50	68	90	99

FIGURE 3

## SOUND LEVELS DECREASE WITH DISTANCE

Sound ratings for reducing valves are conventionally established at a point three feet downstream from the valve's outlet and three feet from the outlet pipe's surface. At further distances from the pipe surface, the radiated sound drops off in intensity. Some typical values are shown below in Figure 4.

The values shown in Figure 4 assume that the valve is acoustically isolated from the surrounding structure. Sound can be transmitted throughout the structure with little attenuation if the piping system is not properly isolated or if surroundings are acoustically "hard". The piping system itself can also act as a conduit for sound.

DISTANCE FROM PIPE	3 Ft.	6 Ft.	12 Ft.	25 Ft.	50 Ft.
SOUND REDUCTION	0 dBA	3 dBA	6 dBA	9 dBA	12 dBA

FIGURE 4

# NOISE REDUCTION DESIGN GUIDELINES

1. Size the regulator to provide a maximum inlet velocity of about 10,000 FPM.
2. Determine the regulator outlet velocity. If it would exceed 30,000 FPM, use a Spence Muffling Orifice or a second stage regulator.
3. Expand regulator outlet piping to limit discharge line velocity to about 10,000 FPM.
4. Avoid abrupt changes in pipe size. Limit pipe diameter changes to two pipe sizes per stage of expansion. Do not use eccentric reducers.
5. Directional changes in downstream piping should be made only after the line size has been increased. Use long radius fittings; avoid bullhead tee connections.
6. Provide as much straight run of pipe on both sides of the regulator as possible:
  - a. 10 pipe diameters minimum to the inlet.
  - b. 20 pipe diameters minimum of expanded line size from the outlet.
7. Size all piping components, including strainer and stop valves for a maximum flow velocity of about 10,000 FPM (Exception: An outlet stop valve mounted at the regulator outlet should be equal in size to the regulator.) In areas where low sound levels are specified, reduce this limit by 25% to 50%.
8. To limit noise transmission through the building's structure, keep the regulator and piping at least 3 feet away from solid surfaces. Use sound isolating piping supports.
9. Apply high density insulation to regulator body, piping and system components. Insulation reduces heat loss significantly and can provide moderate (3-6 dB) local noise attenuation. For greater noise reduction, use removable Spence Insulcap Jacket with lead lining on regulator body.
10. Use a Spence Noise Suppressor to reduce the propagation of noise via the downstream piping.

# SELECTING NOISE REDUCING DEVICES

## SOURCE TREATMENT

A Spence Muffling Orifice will reduce high flow pressure regulator noise by 6 to 10 dBA. Installed in the expanded down-

stream piping, the Muffling Orifice reduces the generation of noise at its source.

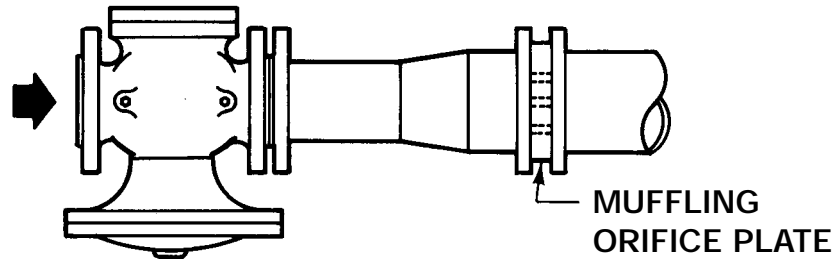


FIGURE 5A: SINGLE STAGE INSTALLATION WITH MUFFLING ORIFICE

## PATH TREATMENT

A Spence Noise Suppressor will reduce pipeline carried noise by 10 to 20 dBA. Installed at the regulator outlet, the

Suppressor absorbs noise generated by the pressure regulator and limits its propagation through the piping system.

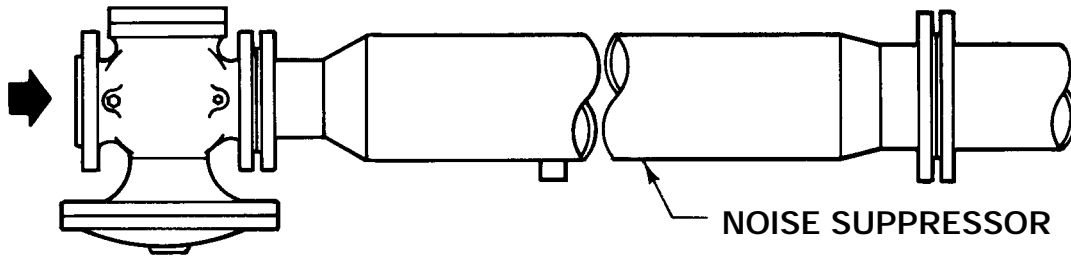


FIGURE 5B: SINGLE STAGE INSTALLATION WITH NOISE SUPPRESSOR

## SOURCE AND PATH TREATMENT

For maximum reduction of pipeline transmitted noise, the combined installation of a Spence Muffling Orifice and Spence Noise Suppressor will reduce the sound pressure level by 15 to 30 dBA.

Installation of a Spence Insulcap Jacket with lead lining on the regulator body will further reduce sound pressure levels.

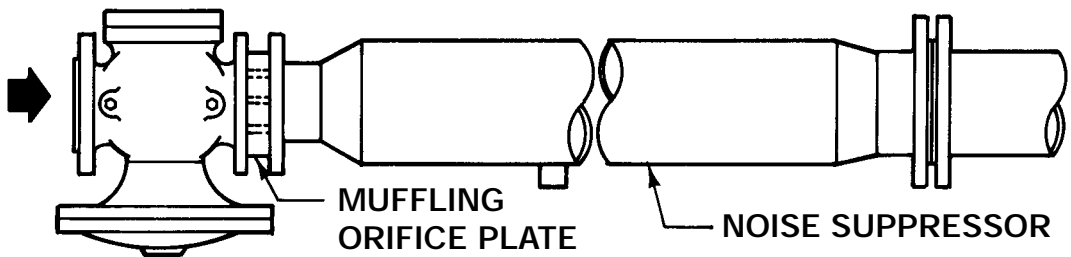


FIGURE 5C: SINGLE STAGE INSTALLATION WITH MUFFLING ORIFICE AND NOISE SUPPRESSOR

# SIZING NOISE REDUCTION COMPONENTS

## SELECTION OF SIZE AND TYPE OF COMPONENTS

### REGULATOR SIZE

1. Enter Saturated Steam Flow Table (opposite) at the specified **initial pressure**. Read across the first tabulated value which includes the specified steam flow. The regulator size at the head of this column is the minimum required to limit inlet velocity to 10,000 FPM.
2. Move up this column to the specified **reduced pressure** (chosen outlet pressure, if Muffling Orifice is used) and note the tabulated flow value. If the specified flow is more than three times the tabulated flow, the regulator's exit velocity will exceed 30,000 FPM. (Use a Spence Muffling orifice or a second stage reduction.)

### DELIVERY PIPE SIZE

Enter Saturated Steam Flow Table (opposite) at the specified reduced pressure. Read across to the first tabulated value which includes the specified steam flow. The pipe size at the head of this column is the minimum expanded pipe size to limit velocity to 10,000 FPM.

### MUFFLING ORIFICE SIZE

If a Noise Suppressor is installed, the Muffling Orifice size is the same as the regulator size. Otherwise, it is the same as the delivery pipe size.

### NOISE SUPPRESSOR SIZE

The inlet size of the Noise Suppressor is the same as the regulator size. The outlet size is the same as the delivery pipe size.

## EXAMPLE

### SPECIFIED CONDITIONS

Saturated Steam Flow = 5,000 lb/hr  
Initial Pressure = 100 PSIG  
Reduced Pressure = 15 PSIG

### REGULATOR SIZE

Entering Saturated Steam Flow Table (opposite) at 100 psig, the first tabulated value which includes 5,000 lb/hr is 5190 lb/hr. The head of this column indicates a 2½" regulator is required to limit inlet velocity to 10,000 FPM.

Moving up this column to 15 psig, the tabulated flow is 1440 lb/hr. Specified flow is 3.47 times the tabulated flow. The exit velocity for a 2½" regulator will be 34,700 FPM. The use of a Muffling Orifice is indicated.

### DELIVERY PIPE SIZE

Entering Saturated Steam Flow Table (opposite) at 15 psig, the first tabulated value which includes 5000 lb/hr is 6030 lb/hr. The delivery pipe size at the head of this column is 5". For this pipe size, flow velocity will be 8,290 FPM.

**ANSWER: 2½" SPENCE REGULATOR WITH MUFFLING ORIFICE,  
NOISE SUPPRESSOR AND 5" DELIVERY PIPE.**

NOTE: Regulators should always be protected by properly designed Strainers.

## CALCULATING VELOCITY

### VELOCITY FORMULA

The Saturated Steam Flow Tables (opposite) provide a convenient means of calculating flow velocity. The flows tabulated are based on 10,000 feet per minute (FPM) velocity. The velocities at other steam flows can be obtained by simple proportioning:

$$\text{Actual Velocity} = \frac{\text{Actual Flow}}{\text{Tabulated Flow}} \times 10,000 \text{ FPM}$$

### EXAMPLE

Pipe size = 5"  
Pressure = 15 psig  
Tabulated flow = 6,030 lb/hr  
Actual flow = 5,000 lb/hr

$$\text{Actual Velocity} = \frac{5,000}{6,030} \times 10,000 \text{ FPM} = 8,290 \text{ FPM}$$

# SATURATED STEAM FLOW TABLE

(LB/HR) AT 10,000 FPM

Based on Schedule 40 Pipe

## SIZES 3/8" THROUGH 4"

PRESS. (PSIG)	TEMP (°F)	REGULATOR or PIPE SIZE (inches)									
		3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
-10	160	10	15	27	43	75	102	168	239	370	637
-5	192	21	33	58	94	162	221	364	519	802	1381
0	212	30	47	83	134	233	317	522	744	1149	1979
5	228	40	63	111	179	310	422	696	993	1533	2641
10	240	49	78	136	221	382	520	858	1224	1890	3254
15	250	58	92	162	262	454	617	1018	1452	2242	3860
20	259	67	106	187	303	524	713	1176	1678	2591	4461
25	267	76	121	212	343	594	809	1333	1902	2936	5057
30	274	85	135	237	383	664	903	1489	2124	3280	5649
40	287	102	163	286	463	801	1090	1797	2564	3959	6818
50	298	120	190	334	542	937	1276	2103	3000	4632	7976
60	308	137	218	382	620	1073	1460	2406	3434	5302	9130
70	316	154	245	430	697	1205	1641	2704	3859	5958	10260
80	324	171	272	478	774	1340	1824	3007	4290	6624	11407
90	331	188	299	525	851	1473	2005	3305	4716	7282	12540
100	338	205	326	573	928	1606	2186	3604	5141	7939	13671
125	353	247	394	691	1119	1937	2637	4346	6201	9575	16488
150	366	289	460	808	1309	2266	3085	5084	7254	11201	19288
175	378	331	528	926	1500	2597	3534	5826	8312	12834	22101
200	388	373	594	1043	1691	2926	3982	6564	9366	14461	24903
250	406	457	728	1277	2070	3582	4875	8035	11465	17703	30484
300	422	545	867	1522	2466	4269	5810	9576	13664	21098	36331
400	448	710	1130	1984	3215	5564	7574	12484	17812	27502	47360
500	470	884	1407	2469	4001	6925	9425	15535	22166	34225	58936
600	489	1061	1688	2963	4801	8310	11310	18642	26599	41070	70724

## SIZES 5" THROUGH 24"

PRESS. (PSIG)	TEMP (°F)	REGULATOR or PIPE SIZE (inches)									
		5	6	8	10	12	14	16	18	20	24
-10	160	1001	1445	2502	3944	5599	6767	8839	11189	13903	20108
-5	192	2170	3133	5425	8552	12139	14671	19165	24258	30143	43597
0	212	3110	4492	7778	12260	17403	21033	27475	34778	43215	62503
5	228	4150	5993	10377	16357	23218	28061	36656	46398	57655	83388
10	240	5114	7385	12787	20156	28611	34578	45170	57175	71045	102755
15	250	6067	8761	15171	23913	33943	41023	53589	67831	84287	121908
20	259	7011	10124	17531	27633	39225	47406	61927	78386	97402	140876
25	267	7946	11475	19871	31321	44460	53732	70192	88847	110401	159677
30	274	8877	12820	22199	34990	49668	60027	78414	99255	123334	178382
40	287	10714	15473	26793	42231	59946	72449	94641	119795	148857	215297
50	298	12535	18102	31345	49407	70133	84760	110723	140151	174151	251881
60	308	14347	20719	35877	56551	80272	97014	126732	160414	199330	288298
70	316	16123	23284	40318	63551	90209	109024	142420	180272	224005	323986
80	324	17926	25887	44827	70658	100297	121215	158346	200431	249055	360217
90	331	19706	28458	49278	77674	110256	133251	174069	220332	273784	395983
100	338	21484	31025	53723	84680	120202	145271	189771	240207	298481	431704
125	353	25912	37419	64795	102132	144974	175210	228881	289712	359996	520675
150	366	30312	43773	75798	119476	169593	204964	267749	338910	421130	609095
175	378	34732	50157	86852	136900	194326	234855	306796	388335	482544	697921
200	388	39135	56515	97862	154253	218959	264625	345686	437560	543712	786390
250	406	47907	69182	119796	188827	268036	323938	423167	535634	665579	962649
300	422	57094	82449	142771	225041	319440	386063	504322	638359	793224	1147267
400	448	74426	107479	186112	293357	416413	503261	657420	832146	1034024	1495545
500	470	92620	133751	231607	365066	518202	626280	818123	1035560	1286785	1861122
600	489	111143	160501	277928	438079	621843	751536	981748	1242672	1544142	2233347

SATURATED STEAM FLOW TABLES

# NOISE REDUCTION COMPONENT FLOW COEFFICIENTS

1. Enter  $C_v$  Table below at the component's (regulator or orifice) **inlet pressure**. Read the tabulated value for  $W/C_v$  at the component's **outlet pressure**.

Note that the lowest outlet pressure listed for each inlet pressure corresponds to a critical pressure drop. An outlet pressure lower than this will not provide any further increase in flow.

2. Divide the specified steam flow by the tabulated  $W/C_v$  to obtain the regulator ( $C_{vR}$ ) or orifice ( $C_{vO}$ ) required flow coefficient.

Refer to Rated Steam Capacity Tables earlier in this Section for rated capacities and minimum pressure drops for Spence Regulators. The definition of component **inlet** and **outlet pressures** is below.

**FLOW FOR  $C_v = 1$  TABLE**  
( $W/C_v - \text{LB/HR}$ )

INLET PRESSURE (PSIG)	OUTLET PRESSURE (PSIG)	$W/C_v$	INLET PRESSURE (PSIG)	OUTLET PRESSURE (PSIG)	$W/C_v$	INLET PRESSURE (PSIG)	OUTLET PRESSURE (PSIG)	$W/C_v$	INLET PRESSURE (PSIG)	OUTLET PRESSURE (PSIG)	$W/C_v$
600	550	510	300	275	258	100	90	98.4	40	35	48.0
	500	706		250	357		80	136		33	56.2
	450	845		225	428		70	162		30	66.2
	400	953		200	483		60	183		25	79.0
	350	1040		175	527		55	191		20	88.8
	342	1050		168	538		52	196		17	93.6
550	500	488	250	225	236	90	80	93.8	30	25	43.1
	450	674		200	325		75	113		24	47.0
	400	805		175	388		70	129		22	53.6
	350	905		150	435		60	154		20	59.2
	325	947		145	433		50	173		15	70.2
	313	966		139	453		46	179		11	76.5
500	450	465	200	190	136	80	70	88.9	25	20	40.5
	400	640		175	211		60	122		19	44.1
	350	763		150	289		55	135		18	47.3
	325	812		125	342		50	145		15	55.3
	300	855		115	359		45	154		10	65.3
	284	881		110	367		40	162		8.3	67.9
450	400	440	175	165	128	70	60	83.8	20	15	37.7
	350	605		150	198		55	101		14	41.0
	325	666		125	270		50	115		13	43.9
	300	718		115	291		45	126		12	46.5
	275	763		100	317		40	136		10	51.2
	255	795		95	325		34	145		5.4	59.4
400	350	415	150	140	119	60	50	78.4	15	10	34.6
	325	500		125	183		45	94.3		9	37.6
	300	567		100	248		40	107		8	40.2
	275	623		90	267		35	117		7	42.6
	250	670		85	275		30	126		5	46.7
	226	709		81	282		29	128		2.5	50.8
350	300	387	125	115	109	50	45	52.4	10	5	31.3
	275	465		100	168		40	72.6		4	33.9
	250	527		90	194		35	87.0		3	36.2
	225	577		80	216		30	98.2		2	38.2
	200	619		75	225		25	107		0	41.7
	197	624		66	239		23	111		-0.4	42.3

NOISE REDUCTION FLOW COEFFICIENTS

## DEFINITION OF COMPONENT PRESSURE

COMPONENT	REGULATOR ONLY		REGULATOR PLUS ORIFICE	
	INLET PRESSURE	OUTLET PRESSURE	INLET PRESSURE	OUTLET PRESSURE
REGULATOR	Initial Pressure	Reduced Pressure	Initial Pressure	†
ORIFICE	N/A	N/A	†	Reduced Pressure

† Chosen regulator outlet/orifice inlet pressure. A rule of thumb is to chose this pressure so that regulator flow is barely subcritical.

# SOUND PRESSURE LEVEL (SPL) CALCULATIONS

## REGULATOR SOUND PRESSURE LEVEL

1. Enter Regulator Sound Pressure Level Chart  $L_1$  of SPLR at top of following page at the specified **initial pressure**. Move vertically to the specified **reduced pressure** (chosen outlet pressure, if Muffling Orifice is used). Read  $L_1$  to the left of this intersection.
2. Enter Regulator Sound Pressure Level Chart  $L_2$  of SPLR at bottom of following page at the required **regulator flow coefficient** ( $CV_R$ ). Move vertically to the delivery pipe size. Read  $L_2$  to the left of this intersection.
3. Regulator sound pressure level is:

$$SPLR = L_1 + L_2$$

NOTE: If SPLR exceeds specified limits, use a Muffling Orifice to reduce the regulator's pressure drop.

## MUFFLING ORIFICE SOUND PRESSURE LEVEL

1. Enter Muffling Orifice Sound Pressure Level Chart  $L_3$  of SPLO at top of following page at the chosen **orifice inlet** (regulator outlet) pressure. Move vertically to the specified **reduced pressure**. Read  $L_3$  to the left of this intersection.
2. Enter Muffling Orifice Sound Pressure Level Chart  $L_4$  of SPLO at bottom of following page at the required **orifice flow coefficient** ( $CV_O$ ). Move vertically to the orifice plate size. Read  $L_4$  to the left of this intersection.
3. Regulator sound pressure level is:

$$SPLO = L_3 + L_4$$

## COMBINED SOUND PRESSURE LEVEL

Combine **SPLO** and **SPLR** as follows:

1. Determine difference between **SPLO** and **SPLR**.
2. Find correction from dB Correction Table at right.
3. Add the correction to the **higher** SPL.

## EXAMPLE

### SPECIFIED CONDITIONS

Saturated Steam Flow = 5,000 lb/hr

Initial Pressure = 100 PSIG

Reduced Pressure = 15 PSIG

From the component sizing example on preceding pages, a 2½" regulator with a 5" Muffling Orifice is required. Choose an orifice inlet (regulator outlet) pressure of 55 PSIG (critical pressure is 52 PSIG).

Entering Flow for  $C_V=1$  Table on facing page at 100 PSIG,  $W/C_V = 191$  at 55 PSIG outlet pressure. Thus  $CVR = (5,000 \div 191) = 26.2$ .

Flow for  $C_V=1$  Table does not provide a listing for 55 PSIG inlet pressure. Using the critical pressures at both 60 PSIG and 50 PSIG, we estimate that  $W/C_V = (128 + 111) \div 2 = 120$ ; thus  $CV_O = (5,000 \div 120) = 41.7$ .

Entering  $L_1$  of SPLR Chart on following page at 100 PSIG,  $L_1 = 41$  at 55 PSIG outlet pressure. Entering  $L_2$  of SPLR Chart at  $CV_R = 26.2$ ,  $L_2 = 37$  at 5" pipe size. Thus  $SPLR = L_1 + L_2 = 78$  dBA.

Entering  $L_3$  of SPLO Chart on following page at 55 PSIG,  $L_3 = 52$  at 15 PSIG reduced pressure. Entering  $L_4$  of SPLO Chart at  $CV_O = 41.7$ ,  $L_4 = 16$  at 5" plate size. Thus  $SPLO = L_3 + L_4 = 68$  dBA.

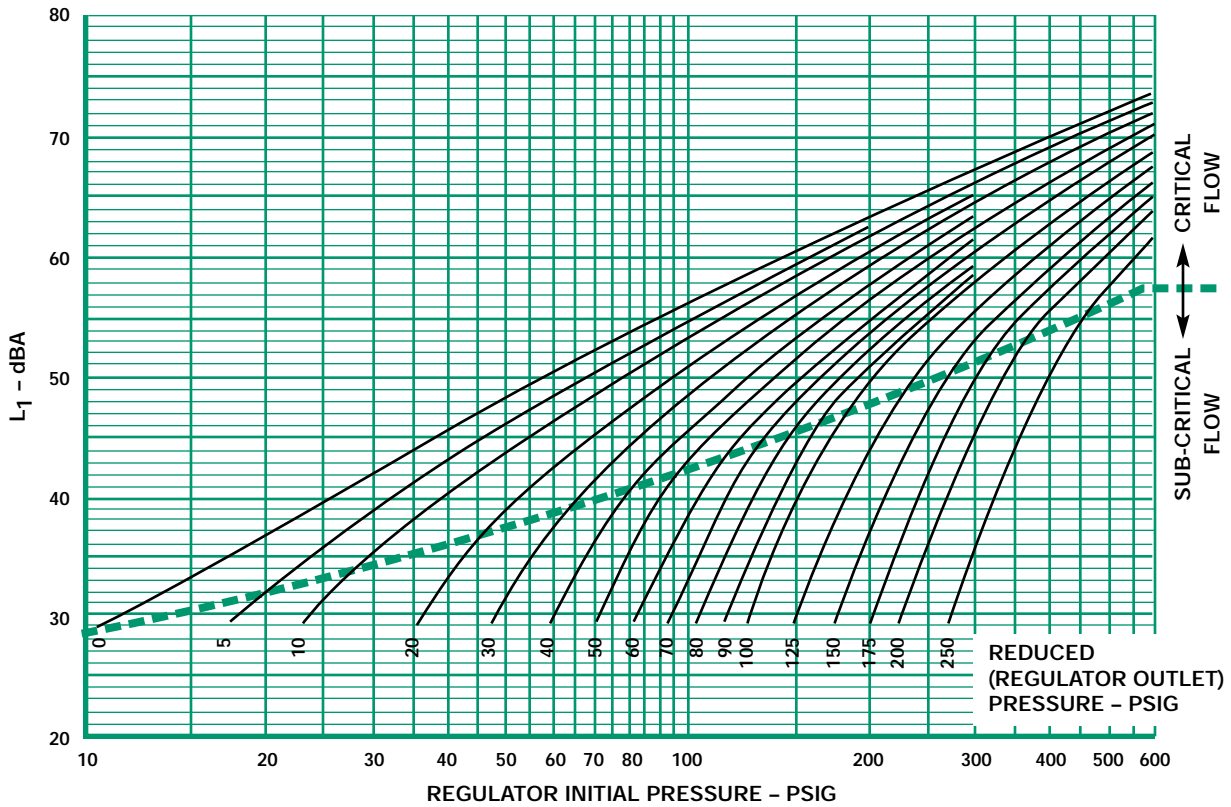
$SPLR - SPLO = 10$  dBA. From the dB Correction Table below, the decibel correction is 0.4 dB. Thus the combined SPL =  $SPLR + 0.4 = 78.4$  dBA.

**dB CORRECTION TABLE**

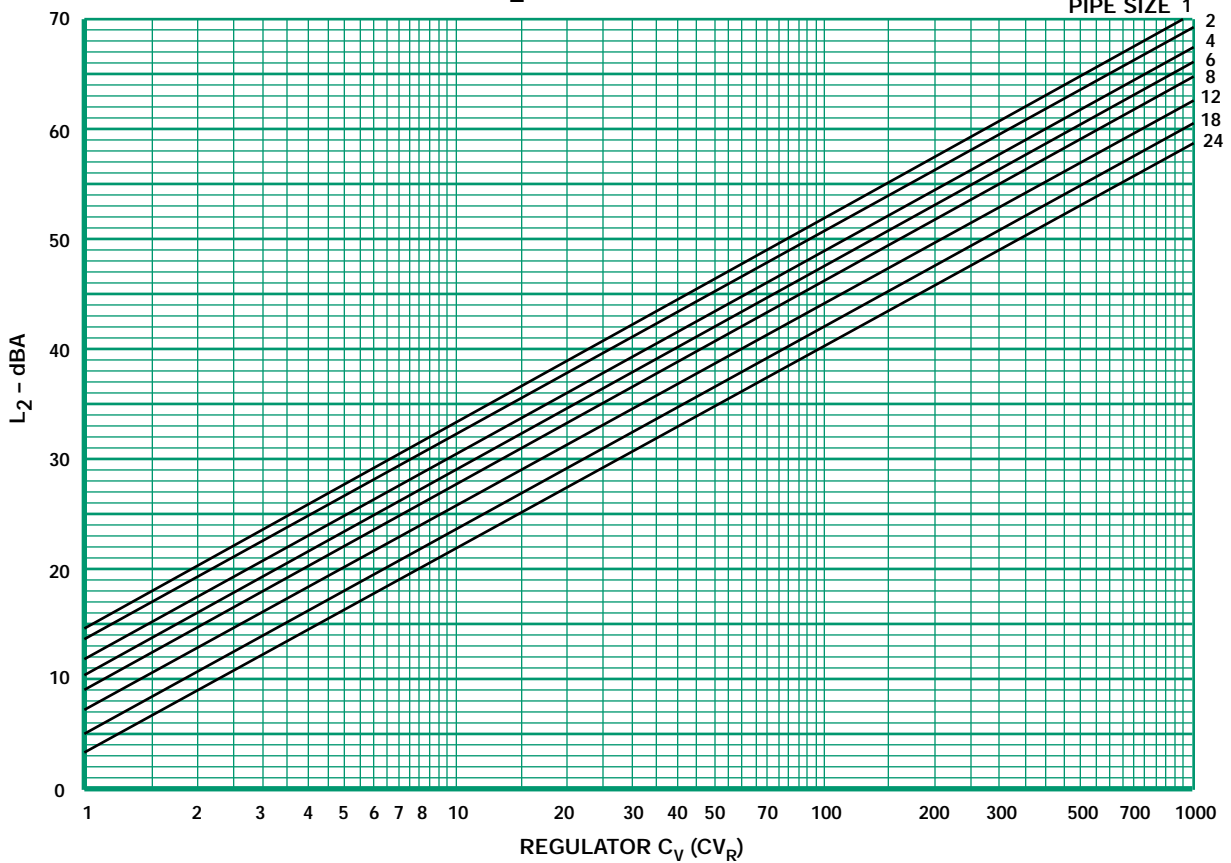
DECIBEL DIFFERENCE	DECIBEL CORRECTION
0	3.0
1	2.6
2	2.1
3	1.8
4	1.5
5	1.2
6	1.0
7	0.8
8	0.6
9	0.5
10	0.4

# REGULATOR SOUND PRESSURE LEVEL CHARTS

L<sub>1</sub> OF SPLR CHART



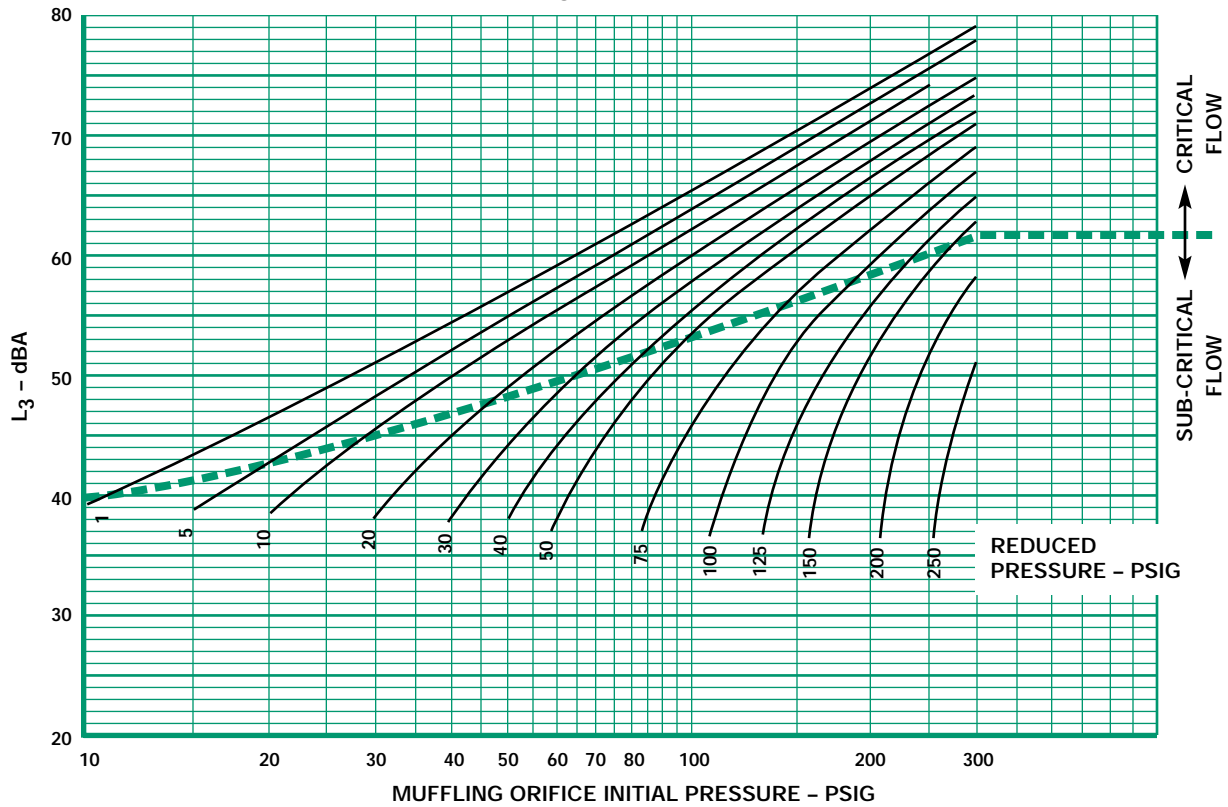
L<sub>2</sub> OF SPLR CHART



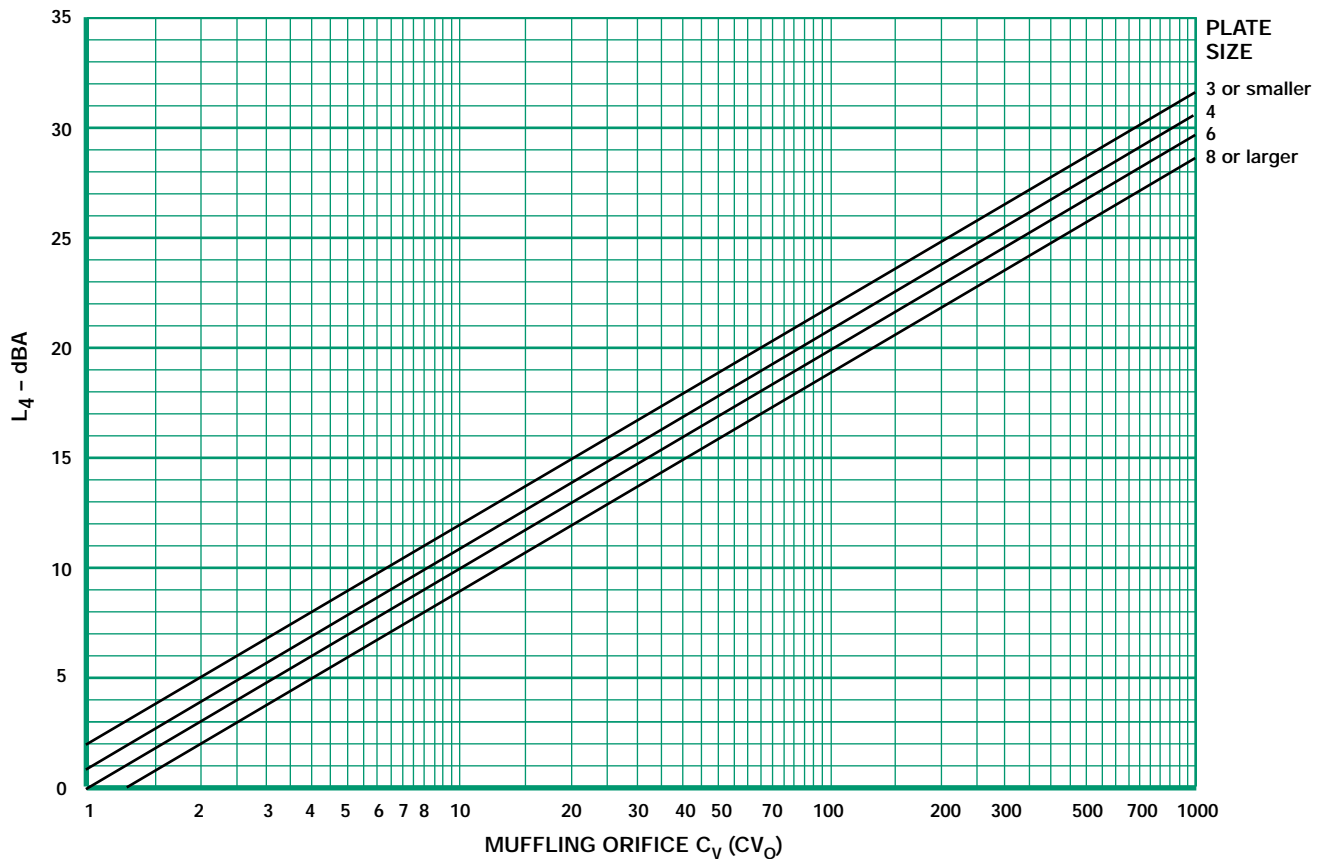
NOISE REDUCTION  
SPLR CHARTS

# MUFFLING ORIFICE SOUND PRESSURE LEVEL CHARTS

## L<sub>3</sub> OF SPLO CHART



## L<sub>4</sub> OF SPLO CHART



NOISE REDUCTION  
SPLO CHARTS