



CITY OF PORTLAND, OREGON - BUREAU OF DEVELOPMENT SERVICES

1900 SW Fourth Avenue • Portland, Oregon 97201 • www.portlandonline.com/bds • 503-823-0652 • FAX 503-823-7425



Facilities Permit Plan Intake Form

FOR INTAKE, STAFF USE ONLY	Building/Mechanical <u>DAVE W ①</u>
Date Received <u>12/5/11</u>	Electrical _____
Building Registration # _____	Plumbing _____
Fixed Bid <u>NO</u>	Fire <u>Jeff ②</u>
Bin # <u>B1</u>	Planning _____
Building Permit # _____	BES _____
Mechanical # <u>11-199498 FA</u>	PDOT _____
Plumbing Permit # _____	Structural _____
Electrical Permit # _____	Other _____

Micro

11-199498 FA

APPLICANT: Complete all sections below that apply to the project. Please print legibly.

Print Name John Fogel Sign Name Diane Parke
 Street Address 16790 NE Mason Street, Suite 100
 City Portland State Oregon Zip Code 97230
 Day Phone 503.969.0333 FAX 503.331.6907 email johnfo@mckinstry.com

Plans / permits available for pick up at 1900 SW 4th Avenue, 5th floor between 8:00 am to 5:00 pm

Contact Name for plan/permit pick up Diane Parke, Project Coordinator
 Day Phone 503.331.2465 email dianep@mckinstry.com

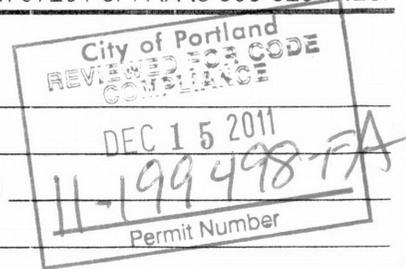
Project Building Name / # Lloyd 700 Building
 Project Address or Location 700 N.E. Multnomah
 Project Name and Description Chrome Systems T.I. Project - Suite 1430
McKinstry Job # 70699
 Total Project Value _____ Project Reference # 11-196927-FA
 Building Contractor _____ CCB # _____
 Mechanical Contractor Mckinstry Company, LLC CCB # 172811
 Electrical Contractor _____ CCB# _____ License # _____
 Plumbing Contractor Mckinstry Company, LLC CCB# _____ License # #37-22PB

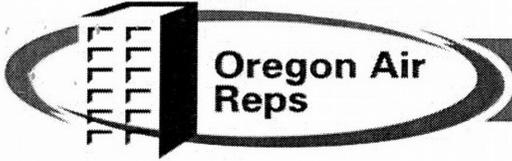
Building Permit [Y] [N] Alarms Required
 No. of Stories _____ [Y] [N] Smoke Det. Req'd
 Const. Type _____ [Y] [N] Sprinklers Req'd
 [Y] [N] Struct. Eng / Calcs Submitted

Electrical Permit
 Please provide a completed standard electrical permit application form. You may mail or deliver it to 1900 SW 4th Avenue, Portland, Oregon 97201 or FAX to 503-823-7425.

Mechanical Permit
 Mechanical Valuation 7,950.00
 Description Add (1) new VAV cooling box,
add (2) new supply diffusers,
add (1) return diffuser.

Plumbing Permit
 Number of Fixtures _____
 Back Flow Devices _____
 Water Service (# of Feet) _____
 Medical Gas _____
 Other _____





15860 SW Upper Boones Ferry Road
Lake Oswego, OR 97035-4066
P: 503-620-4300 F: 503-620-4238
www.oregonairreps.com

SUBMITTAL

November 28, 2011

Project: Chrome Systems
Portland, OR

Contractor: McKinstry
16790 N.E. Mason St Suite 100
Portland, OR 97230

Specification Section: Terminal Units

Manufacturer: Nailor

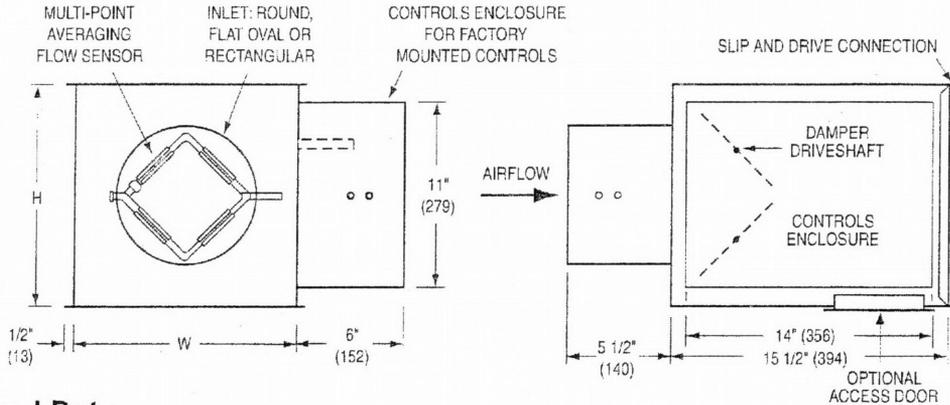
<u>Quantity</u>	<u>Model</u>
02	D3001

22 ga galvanized steel casing
Air flow velocity probe
Dual density fiberglass insulation with foil facing
Access door
Controls enclosure

Steve Patnode
Oregon Air Reps



SINGLE DUCT TERMINAL UNIT
 DIGITAL OR ANALOG CONTROLS
 PRESSURE INDEPENDENT
 VARIABLE OR CONSTANT VOLUME
 MODELS: D3001 AND A3001



Dimensional Data

Unit Size	Airflow Range cfm (l/s)	W	H	Inlet Size
4	0 - 180 (0 - 85)	10 (254)	10 (254)	3 7/8 (98) Round
5	0 - 325 (0 - 153)	10 (254)	10 (254)	4 1/2 (124) Round
6	0 - 450 (0 - 212)	10 (254)	10 (254)	5 1/4 (149) Round
7	0 - 650 (0 - 307)	12 (305)	12 1/2 (318)	6 1/2 (175) Round
8	0 - 900 (0 - 425)	12 (305)	12 1/2 (318)	7 1/4 (200) Round
9	0 - 1150 (0 - 543)	14 (356)	12 1/2 (318)	8 1/2 (225) Round
10	0 - 1500 (0 - 708)	14 (356)	12 1/2 (318)	9 1/4 (251) Round
12	0 - 2050 (0 - 967)	18 (457)	12 1/2 (318)	12 1/2" x 9 1/2" (329 x 249) Oval
14	0 - 2550 (0 - 1203)	24 (610)	12 1/2 (318)	16 1/2" x 9 1/2" (408 x 249) Oval
16	0 - 3040 (0 - 1435)	28 (711)	12 1/2 (318)	19 1/2" x 9 1/2" (487 x 249) Oval
24 x 16	0 - 6800 (0 - 3209)	38 (965)	18 (457)	23 1/2" x 15 1/2" (606 x 403) Recl.



Standard Features:

- 22 ga. (0.86) zinc coated steel casing, mechanically sealed, low leakage construction.
- 16 ga. (1.63) corrosion-resistant steel inclined opposed blade damper with extruded PVC seals (single blade on size 4, 5, 6). 45° rotation, CW to close. Tight close-off. Damper leakage is less than 2% of the terminal rated airflow at 3" w.g. (750 Pa).
- 1/2" (13) dia. plated steel drive shaft. An indicator mark on the end of the shaft shows damper position.
- Multi-point averaging Diamond Flow Sensor. Aluminum construction. Supplied with balancing tees.

- Rectangular discharge with slip and drive cleat duct connection.
- Full NEMA 1 type controls enclosure for factory mounted controls.
- 3/4" (19), dual density insulation, exposed edges coated to prevent air erosion. Meets the requirements of NFPA 90A and UL 181.
- Right-hand controls location is standard (shown) when looking in direction of airflow. Optional left hand controls mounting is available.

Controls:

- Digital (by others).
 - Analog (by Nailor).
- See separate submittal.

Options and Accessories:

- Steri-liner.
- Fiber-free liner.
- Solid metal liner.
- Perforated Metal Liner.
- 1" (25) liner.
- Bottom access door.
- 24 VAC control transformer.
- Toggle disconnect switch.
- Hanger brackets.
- Controls enclosure for field mounted controls.
- Dust tight enclosure seal.
- 20 ga. (1.00) construction.
- Special Features: _____

SCHEDULE TYPE	
PROJECT	Crome
ENGINEER	
CONTRACTOR	

Page 1 of 2.
 Dimensions are in inches (mm).

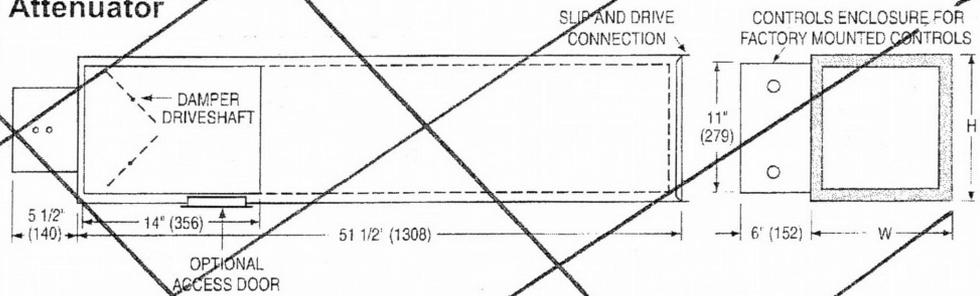
DATE	B SERIES	SUPERSEDES	DRAWING NO.
7 - 19 - 10	3000	8 - 3 - 09	D3001-1



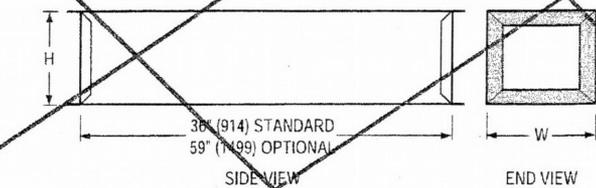
**SINGLE DUCT TERMINAL UNIT
ACCESSORIES**
DIGITAL OR ANALOG CONTROLS
PRESSURE INDEPENDENT
MODELS: D3001 AND A3001

Integral Sound Attenuator

- Single continuous length terminal construction minimizes casing leakage.
- Continuous internal insulation reduces insulation seams and minimizes airflow disturbance.
- Supplied with same liner as basic unit.

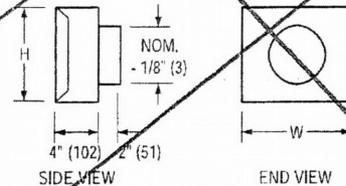


AT Discharge Sound Attenuator (loose)



- Shipped loose for field attachment.
 - Slip and drive connection.
 - Supplied as standard with same liner as basic unit.
- AT303 Standard.
 AT305 Optional.
 Special Features:

FF Round Discharge Collar



Dimensional Data

Unit Size	W	H	FF Outlet Size
4, 5, 6	10 (254)	10 (254)	4, 5, 6 (102, 127, 152)
7, 8	12 (305)	12 1/2 (318)	7, 8 (178, 203)
9, 10	14 (356)	12 1/2 (318)	9, 10 (229, 254)
12	18 (457)	12 1/2 (318)	12 (305)
14	24 (610)	12 1/2 (318)	14 (356)
16	28 (711)	12 1/2 (318)	16 (406)
24 x 16	38 (965)	18 (457)	-

SCHEDULE TYPE	
PROJECT	Crome
ENGINEER	
CONTRACTOR	

Page 2 of 2.
Dimensions are in inches (mm).

DATE	B SERIES	SUPERSEDES	DRAWING NO.
7 - 19 - 10	3000	8 - 3 - 09	D3001-1



Installation and Operation Manual Diamond Flow Sensor K-Factors for VAV Terminal Units

Model Series:

- 3000 Single Duct
- 3210 Dual Duct
- 35STL Series Fan Powered w/ O.A. Damper
- 38S Underfloor Fan Powered

Inlet Size	Type	Duct Area (sq. ft.)	K-Factor (cfm)	Velocity (fpm)	F-Factor (amp.)
4	ROUND	0.087	182	2092	3.67
5		0.136	325	2390	2.81
6		0.196	455	2321	2.98
7		0.267	657	2461	2.65
8		0.349	899	2576	2.42
9		0.442	1158	2620	2.34
10		0.545	1497	2747	2.13
12	OVAL	0.754	2058	2729	2.15
14		0.970	2554	2633	2.31
16		1.186	3035	2559	2.45
24 x 16	RECT.	2.667	6797	2549	2.47

Model Series:

36VRS Square/Retangular Retrofit

Unit Size	Type	Damper (valve) Size (Inches)	Damper (valve) Area (sq. ft.)	K-Factor (cfm)	Velocity (fpm)	F-Factor (amp.)
7	SQUARE OR RECT.	5 x 5	0.174	479	2753	2.12
8		6 x 6	0.250	689	2756	2.11
9		8 x 6	0.333	919	2760	2.11
10		10 x 8	0.555	1531	2759	2.11
11		14 x 8	0.778	2150	2763	2.10
11A		18 x 6	0.750	2068	2757	2.11
12		12 x 10	0.833	2297	2758	2.11
13		18 x 10	1.250	3446	2757	2.11
14		18 x 12	1.500	4135	2757	2.11
15		20 x 14	1.944	5360	2757	2.11
15A		30 x 12	2.500	6892	2757	2.11
16		22 x 16	2.444	6739	2757	2.11
17		24 x 18	3.000	8270	2757	2.11
18		30 x 20	4.167	11486	2756	2.11
19		40 x 20	5.555	15315	2757	2.11

Model Series:

- 3100 Single Duct
- 3230 Dual Duct
- 3240 "Blendmaster" Dual Duct
- 35N Parallel Fan Powered
- 35S Series Fan Powered
- 35SST "Stealth™" Series Fan Powered
- 36VRR Round Retrofit

Inlet Size	Type	Duct Area (Sq. ft.)	K-Factor (cfm)	Velocity (fpm)	F-Factor (amp.)
4	ROUND	0.087	182	2092	3.67
5		0.136	325	2390	2.81
6		0.196	455	2321	2.98
7		0.267	657	2461	2.65
8		0.349	899	2576	2.42
9		0.442	1158	2620	2.34
10		0.545	1497	2747	2.13
12		0.785	2048	2609	2.36
14		1.069	2742	2565	2.44
16		1.395	3683	2640	2.30
18	OVAL	1.683	4323	2569	2.43

Model Series:

- 37S Low Profile Fan Powered
- 37SST Low Profile "Stealth™" Fan Powered

Inlet Size	Type	Duct Area (Sq. ft.)	K-Factor (cfm)	Velocity (fpm)	F-Factor (amp.)
4	ROUND	0.087	182	2092	3.67
5		0.136	325	2390	2.81
6		0.196	455	2321	2.98
8		0.349	899	2576	2.42
10		0.545	1497	2747	2.13
14 x 10	RECT.	0.972	2417	2487	2.59

Equations:

$$Q = K \times \sqrt{\Delta P} \quad \Delta P = \left(\frac{Q}{K}\right)^2 \quad F = \left(\frac{4005 \times A}{K}\right)^2$$

Where: Q = Airflow Rate (cfm)

ΔP = Sensor Differential Pressure ("w.g.)

K = K-Factor Calibration Constant

F = Amplification Factor (sensor gain)

A = Nom. Duct Area (sq. ft.)

The K-Factors tabulated in the above tables are the airflow required to produce a 1.0" w.g. differential pressure at the Diamond Flow Sensor.

Model Series:
30HQX Single Duct Exhaust (Hospital Grade)
30X Single Duct Exhaust

Unit Size	Type	Valve Inlet Size (inches)	Valve Inlet Area (sq. ft.)	K-Factor (cfm)	Velocity (fpm)	F-Factor (amp.)
4		3.4 x 3.4	0.082	210	2561	2.44
5		4.3 x 4.3	0.128	345	2695	2.21
6		5.5 x 5.5	0.210	580	2762	2.10
7		5.8 x 6.3	0.254	680	2677	2.24
8	SQUARE	6.7 x 7.2	0.335	970	2896	1.91
9	OR	8.6 x 7.1	0.424	1209	2851	1.97
10	RECT.	9.5 x 8.0	0.528	1539	2915	1.89
12		13.6 x 8.1	0.765	2269	2966	1.82
14		12.9 x 10.8	0.968	2521	2604	2.36
16		18.3 x 10.8	1.410	3586	2543	2.48
24 x 16		26.1 x 16.3	2.954	7009	2373	2.85

Equations:

$$Q = K \times \sqrt{\Delta P} \quad \Delta P = \left(\frac{Q}{K} \right)^2 \quad F = \left(\frac{4005 \times A}{K} \right)^2$$

Where: Q = Airflow Rate (cfm)

ΔP = Sensor Differential Pressure ("w.g.)

K = K-Factor Calibration Constant

F = Amplification Factor (sensor gain)

A = Nom. Duct Area (sq. ft.)

The K-Factors tabulated in the above tables are the airflow required to produce a 1.0" w.g. differential pressure at the Diamond Flow Sensor.



Houston, Texas
 Tel: 281-590-1172
 Fax: 281-590-3086

Las Vegas, Nevada
 Tel: 702-648-5400
 Fax: 702-638-0400

Toronto, Canada
 Tel: 416-744-3300
 Fax: 416-744-3360

Calgary, Canada
 Tel: 403-279-8619
 Fax: 403-279-5035



**VAV TERMINAL UNITS
LINER OPTIONS
TYPE: STERI-LINER**

INSULATION CHARACTERISTICS

Material: Rigid board form fiberglass with a thermosetting resin. Fire resistant reinforced aluminum foil-scrim-kraft (FSK) facing.

Thickness: 13/16" (21). (37S and 37SST Low Profile Fan Powered Terminal Units use 1/2" (13) material).

Density: 4.1 lbs/cu.ft. (66 kg/m³).

Thermal Conductivity: 0.23 BTU-in / hr-ft²-°F@75°F (0.033 W / m - °C@24°C). (K-Factor)

Thermal Resistance: 3.5 hr-ft²-°F / BTU (0.76m²-°C / W). (R-Value)

Flame Spread: 25

Smoke Density: 50

Mold Growth: None

STANDARD AND CODE COMPLIANCE

UL 181 / ASTM E84 and UL 723 (in accordance with ASTM C655)
NFPA 90A and 90B
ASTM C 1071

ACOUSTICAL PERFORMANCE

Correction factors to cataloged sound power level data (standard liner) are shown below.

Single Duct Terminal Units • 3000 Series Basic Unit • All sizes.

Octave Band	2	3	4	5	6	7	NC Impact (Average)
Center Frequency (Hz)	125	250	500	1000	2000	4000	
Discharge Sound	0	0	0	0	0	0	0
Radiated Sound	-1	-2	-2	-3	-3	-3	-2

Single Duct Terminal Units with Integral Attenuator • 3000 Series • All Sizes.

Octave Band	2	3	4	5	6	7	NC Impact (Average)
Center Frequency (Hz)	125	250	500	1000	2000	4000	
Discharge Sound	+2	+2	+3	+5	+7	+8	+3
Radiated Sound	-1	-2	-2	-3	-3	-3	-2

Fan Powered Terminal Units • 35N, 35S, 35P and 37S Series • All sizes.

Octave Band	2	3	4	5	6	7	NC Impact (Average)
Center Frequency (Hz)	125	250	500	1000	2000	4000	
Discharge Sound	0	0	0	0	0	0	0
Radiated Sound	+2	+3	+6	+11	+10	+3	+3

Fan Powered Terminal Units • 35SST and 37SST "Stealth" Series • All sizes.

Octave Band	2	3	4	5	6	7	NC Impact (Average)
Center Frequency (Hz)	125	250	500	1000	2000	4000	
Discharge Sound	0	0	0	0	0	0	0
Radiated Sound	-5	-4	-4	0	+3	+5	-4

SCHEDULE TYPE

PROJECT Crome

ENGINEER

CONTRACTOR

DATE

B SERIES

SUPERSEDES

DRAWING NO.

3 - 24 - 06

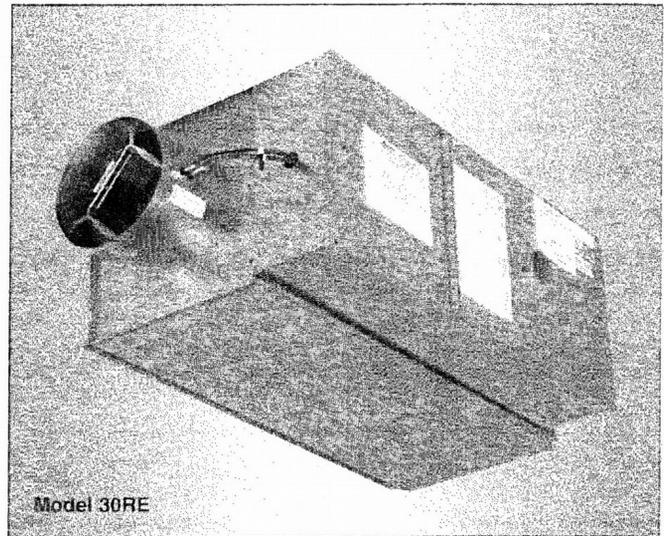
VAV.ACC.

11 - 17 - 03

VAV - SL

Recommended Airflow Ranges For Single Duct VAV Terminal Units

The recommended airflow ranges below are for terminal units with pressure independent controls and are based upon controller sensitivity limits as shown for each control type. For a given unit size, the minimum, auxiliary minimum (where applicable) and the maximum flow settings must be within the range limits to ensure pressure independent operation, accuracy and repeatability. The high end of the tabulated Total Airflow Range represents the Diamond Flow Sensor's differential pressure reading at 1" w.g. (250 Pa). This is a common high limit for many VAV controllers, whether pneumatic or analog/DDC transducers. For these reasons, factory settings will not be made outside these ranges. A minimum setting of zero (shut-off) is also available. Where an auxiliary setting is specified, the value must be greater than the minimum setting.



ARI Standard 880 "Air Terminal Units" is the method of test for the certification program. The "standard rating condition" (certification rating point) airflow volumes for each terminal unit size are tabulated below. These air volumes equate to an approximate inlet velocity of 2000 fpm (10.2 m/s)

When digital or other controls are mounted by Nailor, but supplied by others, these values are guidelines only, based upon experience with the majority of controls currently available. Controls supplied by others for factory mounting are configured and calibrated in the field.

Imperial Units, Cubic Feet per Minute

Unit Size	Total Airflow Range cfm	Airflow at 2000 fpm Inlet Velocity (nom.) cfm	Range of Minimum and Maximum Settings, cfm		
			Pneumatic 3000 Controller	Analog Electronic Controls	Digital Controls
			Min. - Max.	Min. - Max.	Min. - Max.
4	0 - 215	150	30 - 215	25 - 215	25 - 215
5	0 - 310	250	55 - 310	45 - 310	45 - 310
6	0 - 500	400	85 - 500	70 - 500	70 - 500
8	0 - 710 0 - 1000 0 - 1300	550 700 900	125 - 710 180 - 1000 210 - 1300	100 - 710 150 - 1000 170 - 1300	100 - 710 150 - 1000 170 - 1300
10	0 - 1435	1100	250 - 1435	205 - 1435	205 - 1435
12	0 - 2185	1600	320 - 2185	260 - 2185	260 - 2185
14	0 - 2745	2100	470 - 2745	380 - 2745	380 - 2745
16	0 - 3730	2800	590 - 3730	480 - 3730	480 - 3730
24 x 16	0 - 6435	5350	1005 - 6435	810 - 6435	810 - 6435

Metric Units, Liters per Second

Unit Size	Total Airflow Range l/s	Airflow at 10.2 m/s Inlet Velocity (nom.) l/s	Range of Minimum and Maximum Settings, l/s		
			Pneumatic 3000 Controller	Analog Electronic Controls	Digital Controls
			Min. - Max.	Min. - Max.	Min. - Max.
4	0 - 101	71	14 - 101	12 - 101	12 - 101
5	0 - 146	118	26 - 146	21 - 146	21 - 146
6	0 - 236	189	40 - 236	33 - 236	33 - 236
7	0 - 335	260	59 - 335	47 - 335	47 - 335
8	0 - 472	330	85 - 472	71 - 472	71 - 472
9	0 - 614	425	99 - 614	80 - 614	80 - 614
10	0 - 677	519	118 - 677	97 - 677	97 - 677
12	0 - 1031	755	151 - 1031	123 - 1031	123 - 1031
14	0 - 1296	991	222 - 1296	179 - 1296	179 - 1296
16	0 - 1761	1322	278 - 1761	227 - 1761	227 - 1761
24 x 16	0 - 3037	2525	474 - 3037	382 - 3037	382 - 3037

Receiving Inspection

After unpacking the assembly check it for shipping damage. If any shipping damage is found, report it immediately to the delivering carrier. During unpacking and installation do not handle by the inlet velocity sensor or the control package.

Determine Position Of the Control Enclosure

The control enclosure can be installed on either side of the ductwork by flipping the VAV unit over 180 degrees. Unit with mercury contactors, pneumatic controls, and digital controls (DDC) need to be inspected before installing.

Important: Unit with mercury contactors is position sensitive. As the result, before installing unit with mercury contactors, inspect the position of the mercury contactors in the control enclosure. Mercury contactors must be heading up 90 degrees vertically. If they are heading down, unscrew the mercury contactors, rotate 180 degrees, and reinstall them.

If unit is equipped with pneumatic controls, it should be mounted right side up and level within ± 10 degrees of horizontal, and parallel to the airflow. The first letter in the model number indicates control type (P is for pneumatic). If the unit is mounted upside down, the controller will have to be re-positioned, re-piped, and re-calibrated. Analog control units (A-analog model number pre-fix) may be installed in any orientation. Some Digital (DDC) controls (D-digital model number pre-fix) are position sensitive dependent on the airflow sensor transducer. Check with the controls manufacturer for verification.

Supporting the Assembly

Although the basic unit is light enough that it can be supported by the ductwork itself, we recommend that it be independently supported, especially when accessory modules, such as coils, attenuators, or multiple outlets are present. When requested, unit is supplied with field mounted hanger brackets for use with hanger rod up to 3/8" (9.5) dia. Hanger brackets should be screwed into the top of the unit casing. Hanger straps may alternatively be used and screwed directly into the sides or bottom of the unit casing. Use the support method prescribed for the rectangular duct in the job specifications.

Duct Connections

Slip each inlet duct over the inlet collar of the terminal. Fasten and seal the connection as described in the job specification. The diameter of the inlet duct for round inlets (unit size 4 through 10) must be equal to the listed size of the terminal. The inlet collar of the terminal is made 1/8" (3) smaller than listed size in order to fit inside the duct (see figure 1). Unit size 12 through 16 utilize flat oval inlet collars and unit size 24 x 16 has a rectangular inlet collar. The flat oval inlets are undersized for flexible duct connection. For hard inlet duct connections, refer to submittal drawing for dimensional data.

Important: Do not insert ductwork inside the inlet collar of the assembly. For optimum performance, 2 to 3 equivalent diameters of straight duct should be installed prior to the inlet of the unit. All ducts should be installed in accordance with SMACNA guidelines. The outlet end of the terminal is designed for use with slip and drive duct connections. A rectangular duct the size of the terminal outlet should be attached.

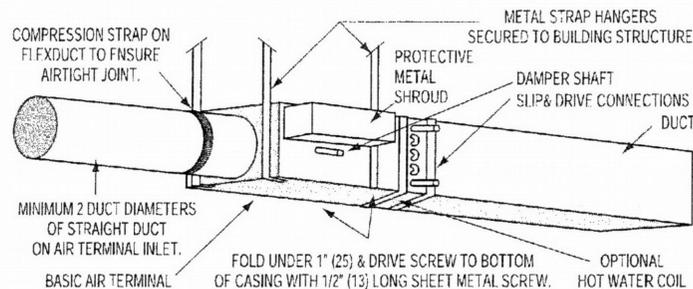


Figure 1: Single Duct VAV Terminal Unit w/ Hot Water Heat Support Using Hanger Straps.

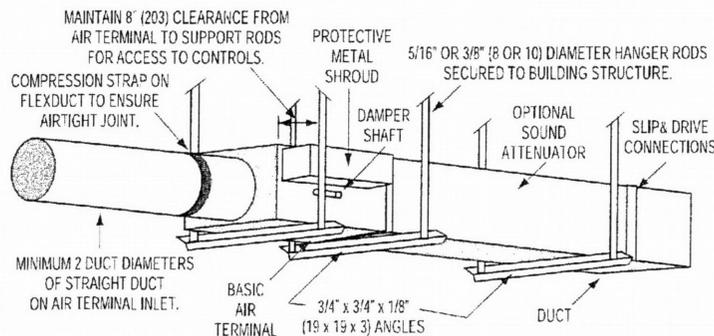
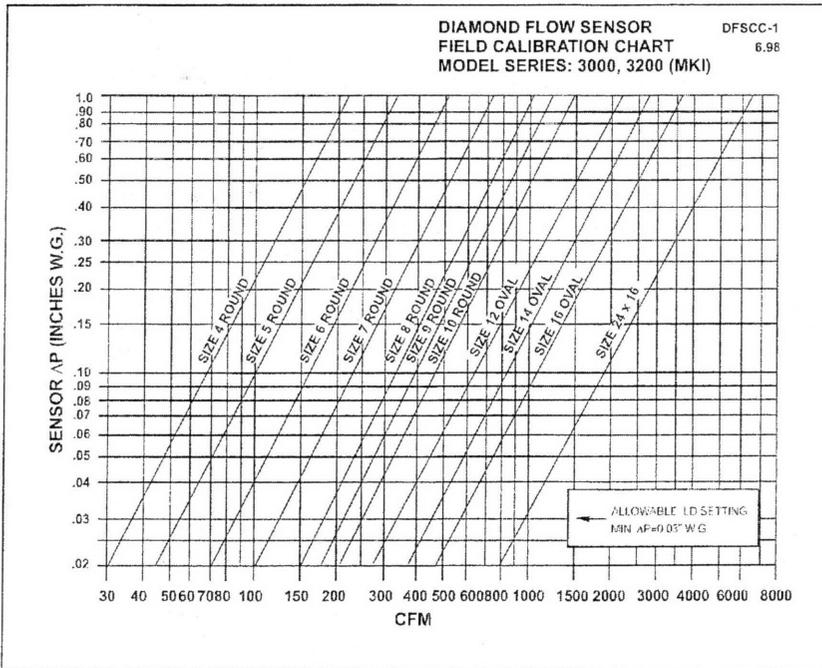


Figure 2: Single Duct Terminal Unit w/ attenuator Support Using Hanger Brackets and Rods.

3) **Sample Calibration Label** – affixed near the control mounting panel. Shows airflow calibration data.



Replacement Parts

Primary Damper Valve

Size 4", 5", 6"
Size 7", 8"
Size 9", 10"
Size 12"
Size 14"
Size 16"
Size 24"x16"

Part Number

VB3-231
VB3-233
VB3-234
VB3-235
VB3-236
VB3-237
VB3-238

Diamond Flow Sensor

Inlet Size

4"
5"
6"
7"
8"
9"
10"
12"
14"
16"
24"x 16"

3/16" O.D. tube
3/16" O.D. tube

Part Number

V1104
V1105
V1106
V1107
V1108
V1109
V1110
V1112
V1114
V1116
V1124

Pneumatic FR Tubing (1/4" O.D.)

Black
Blue stripe
Red stripe

VB3-066
VB3-068
VB3-067

Control Components

Digital - See Digital Operation Manual
Analog - See Analog Operation Manual
Pneumatic - See Pneumatic Operation Manual

Tee for Sensor Tap

Barbed, 1/8"

VB3-058

Cap for Sensor Tee

Rubber, for 1/8" Tee

VB3-059

Recommended Maintenance

Single Duct Terminal Units supplied with stainless steel construction are supplied with Celcon® bearings as standard. Bronze oil impregnated bearings and 316 stainless steel bearings are optional for certain applications. It is recommended that those units equipped with 316 stainless steel bearings be lubricated periodically as required by the application and environment.

A Silicone based lubricant such as DuPont™ Pure Silicone Lubricant with KRYTOX® PTFE or equivalent should be applied to the shaft between the shaft and the bearing surface to prevent excessive wear. This can be done without removal of the shaft by pushing or pulling the shaft in one direction while using a spray applicator tube to inject lubricant into the small gap formed on the opposite side.



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