Control Damper Selection Guide for Air Handlers

GREENHECK
Building Value in Air.

BUILDING VALUE IN AIR.

Table of Contents

Section 1
Drawing Directory by Damper

Damper Models	VCD-20	VCD-20V	VCD-23	VCD-23V	FBH-23	FBV-23	SEVCD-23	VCD-33	VCD-33V	FBH-33	FBV-33
Blade Profile											
3V Blade	Figure 14							-			
Airfoil Blade	-							Figure 13			
Airfoil-Insulated	-										
Aluminum Airfoil	-										
Insulated & Thermally Broken	-										
Vertical Blade											
Thrust Washers	-	Figure 24	-	Figure 24	-				Figure 24	-	
Blade Action											
Opposed/Parallel	Figure 17										
Blade Seal											
TPE/Silicone	-		Figure 18								
Frame Types											
Channel	Figure 1										
Single Flange	Figure 2				-		Figure 2			-	
Reverse Flange	Figure 3				-		Figure 3			-	
Double Flange	Figure 4				-		Figure 4			-	
Quick-Connect	-										
Flange - Mounting Hole Pattern	Figure 30				-		Figure 30			-	
Insulated & Thermally Broken	-										
Face & Bypass	-				Figure 49	Figure 50	-			Figure 49	Figure 50
Jackshaft											
Height/Space Envelope	Figure 25										
Internal/External	Figures 26-29										
Section Sizing											
Section Size/Qty	Figure 31										
Drive Arrangements											
Internal	Figures 32-36										
External	Figures 37-41										
Accessories											
Sleeves	Figure 42				-		Figure 42			-	
Mounting Options											
Insert Mount	Figure 48										
Flange Mount	Figures 44 & 46				-		Figures 44 & 46			-	
Flange Insert Mount	Figures 43 & 45				-		Figures 43 & 45			-	
Double Flange Mount	Figure 47				-		Figure 47			-	

Damper Models	SEVCD-33	VCD-34	VCD-40	VCD-42	VCD-42V	VCD-43	VCD-43V	FBH-43	FBV-43	ICD-44	ICD-45
Blade Profile											
3V Blade	-										
Airfoil Blade	Figure 13	-									
Airfoil-Insulated	-	Not Shown	-								
Aluminum Airfoil	-		Figure 15							-	
Insulated & Thermally Broken	-									Figure 16	
Vertical Blade											
Thrust Washers	-				Figure 24	-	Figure 24	-			
Blade Action											
Opposed/Parallel	Figure 17										
Blade Seal											
TPE/Silicone	Figure 18										
Frame Types											
Channel	Figure 1					Figure 5				Figure 9	
Single Flange	Figure 2					Figure 6		-		Figure 10	
Reverse Flange	Figure 3					Figure 7		-		Figure 11	
Double Flange	Figure 4	-	Figure 4			-					
Quick-Connect	-					Figure 8		-		Figure 12	
Flange - Mounting Hole Pattern	Figure 30	-									
Insulated & Thermally Broken	-										Figure 23
Face & Bypass	-							Figure 49	Figure 50	-	
Jackshaft											
Height/Space Envelope	Figure 25										
Internal/External	Figures 26-29										
Section Sizing											
Section Size/Qty	Figure 31										
Drive Arrangements											
Internal	Figures 32-36										
External	Figures 37-41										
Accessories											
Sleeves	Figure 42	-	Figure 42					-			
Mounting Options											
Insert Mount	Figure 48										
Flange Mount	Figures 44 & 46							-		Figures 44 & 46	
Flange Insert Mount	Figures 43 & 45							-		Figures 43 & 45	
Double Flange Mount	Figure 47	-	Figure 47					-			

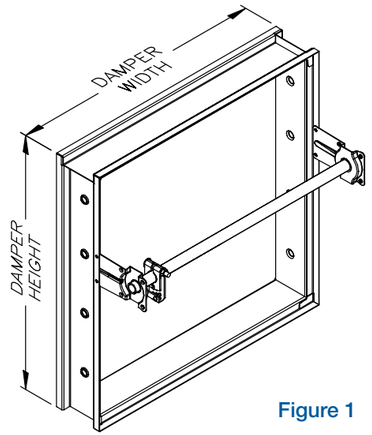
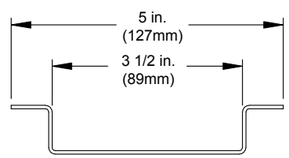


Figure 1

Channel



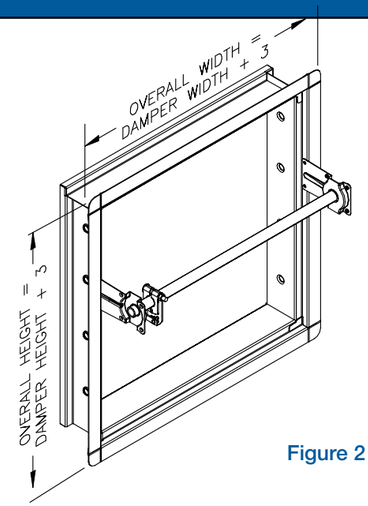
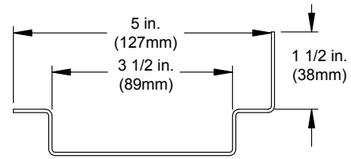


Figure 2

Single Flange



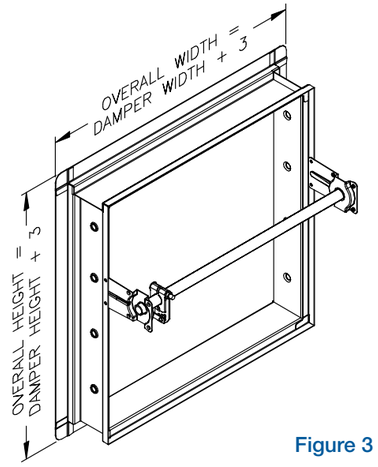
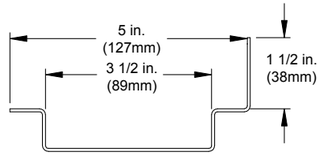


Figure 3

Reverse Flange



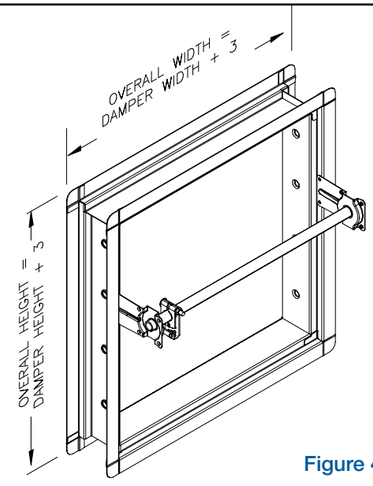
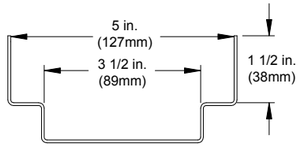


Figure 4

Double Flange



Note: Jackshaft shown for reference only.

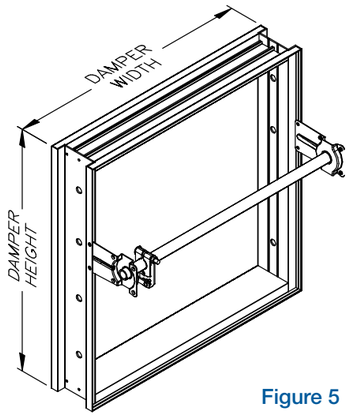


Figure 5

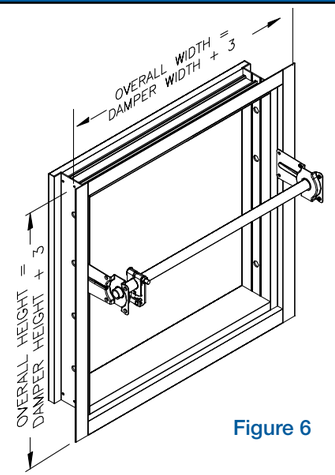
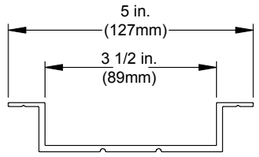
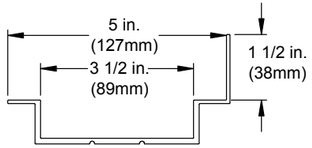


Figure 6

Channel



Single Flange



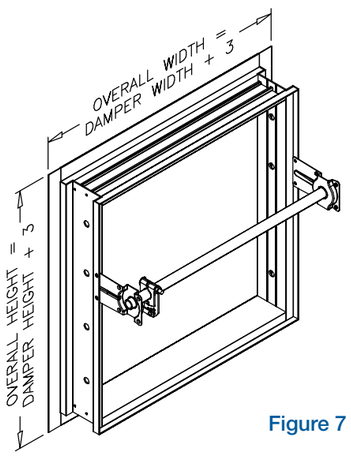


Figure 7

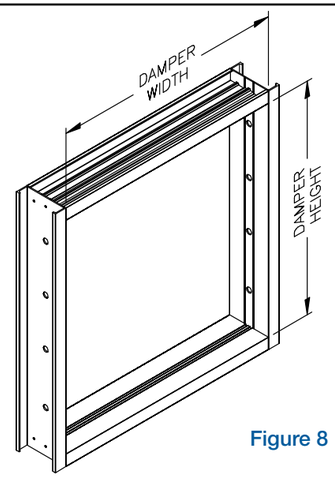
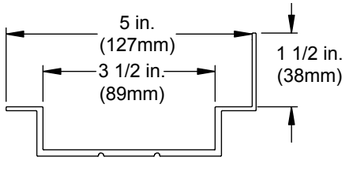
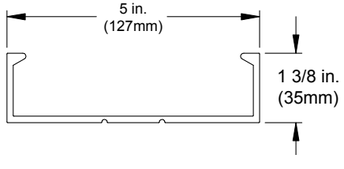


Figure 8

Reverse Flange



Quick Connect



Note: Jackshaft shown for reference only. Quick connect frame is actual inside dimensions.

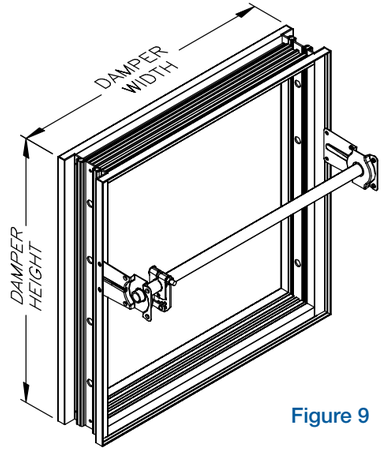


Figure 9

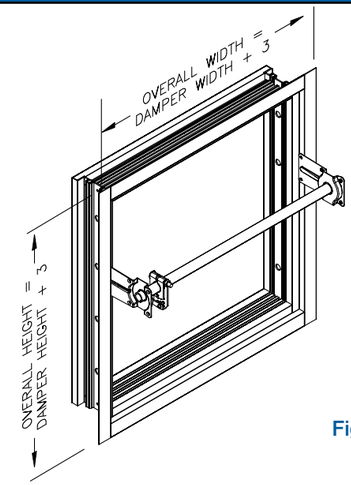
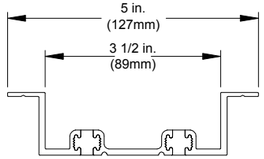
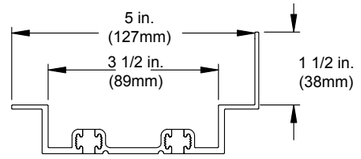


Figure 10

Channel



Single Flange



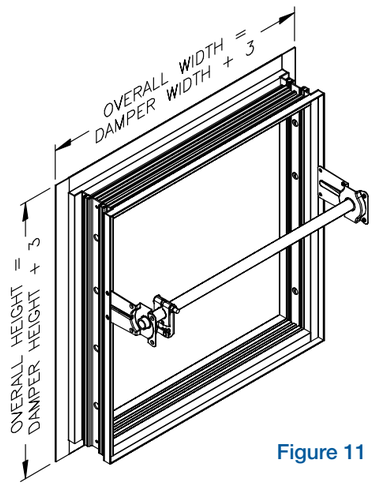


Figure 11

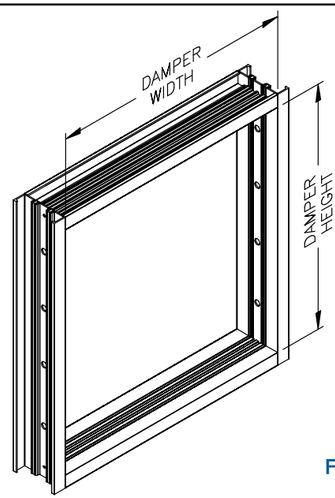
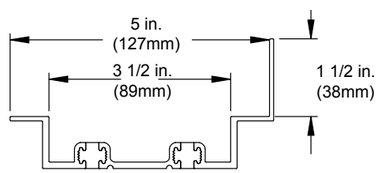
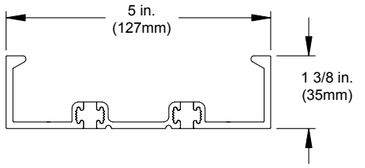


Figure 12

Reverse Flange



Quick Connect



Note: Jackshaft shown for reference only. Quick connect frame is actual inside dimensions.

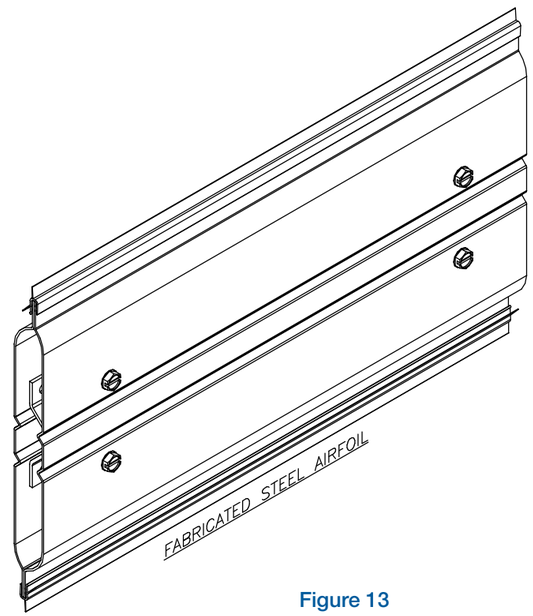


Figure 13

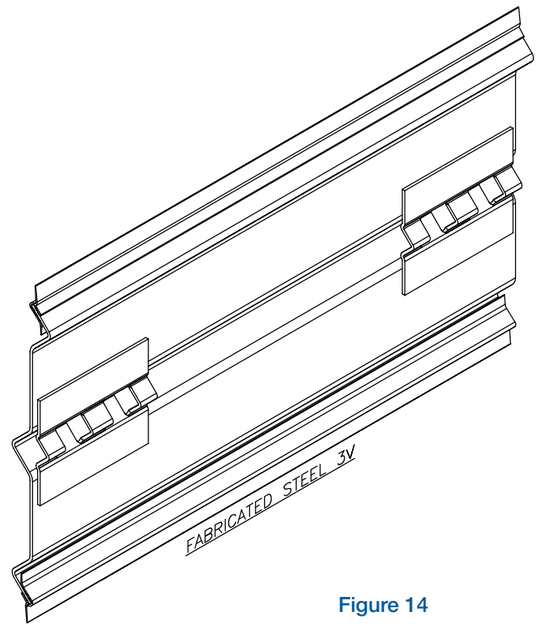


Figure 14

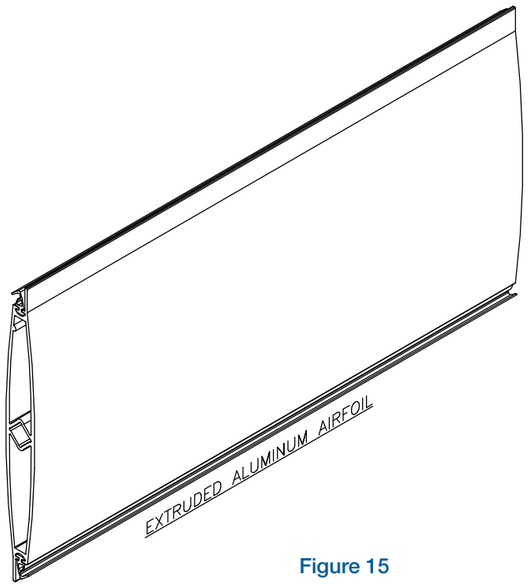


Figure 15

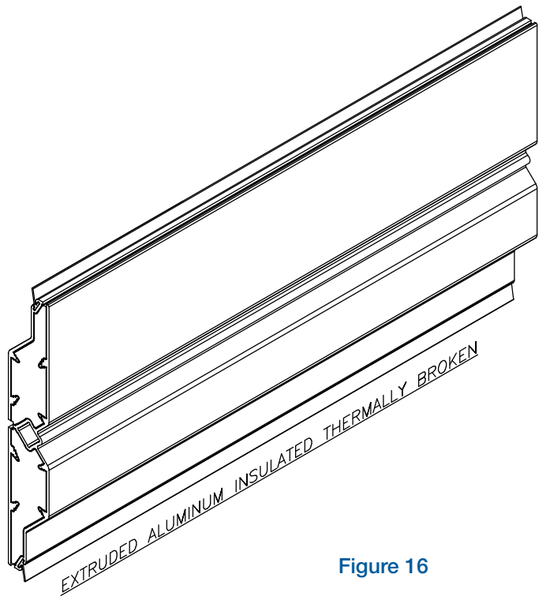


Figure 16

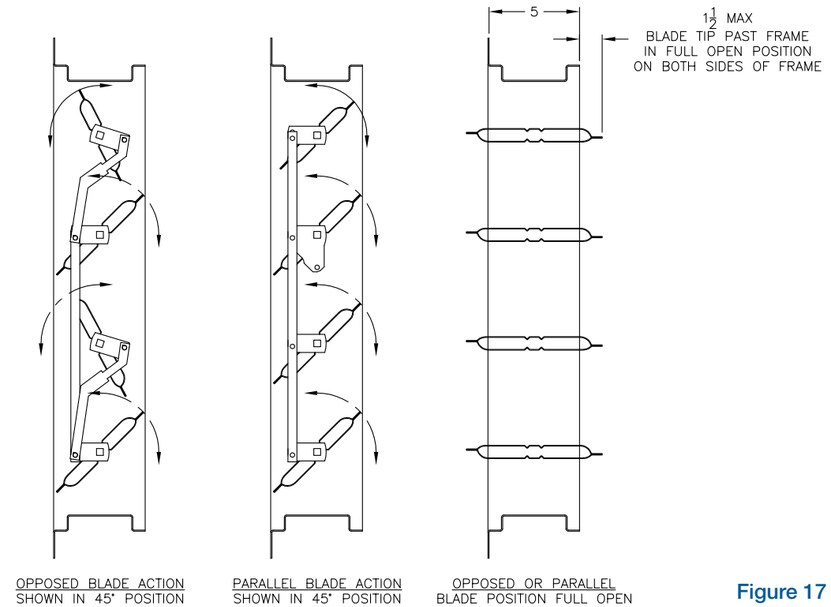


Figure 17

Blade and Sweep Seal Detail

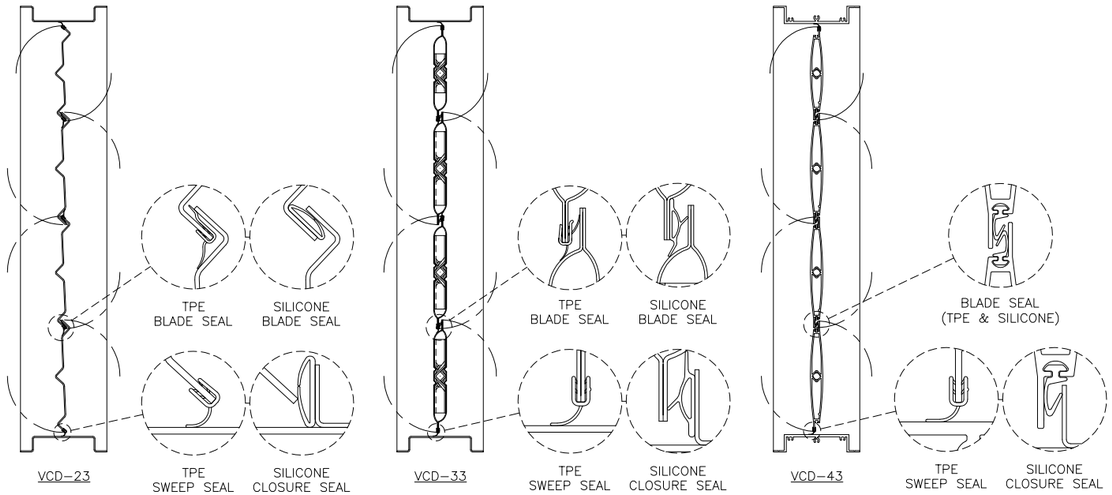


Figure 18

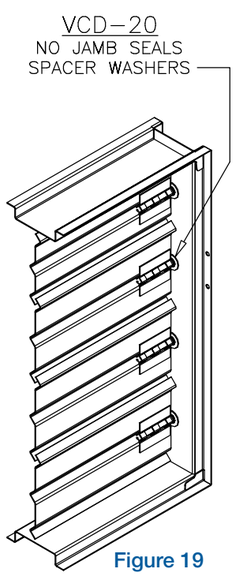


Figure 19

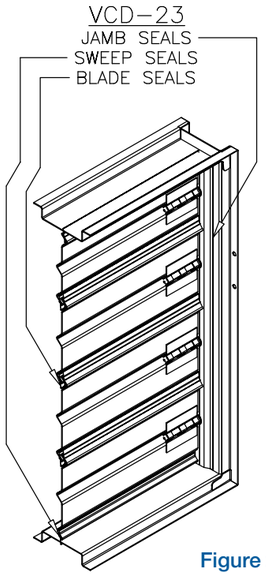


Figure 20

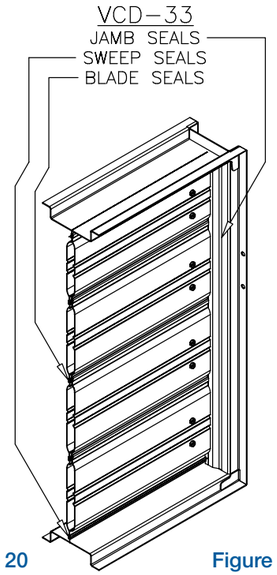


Figure 21

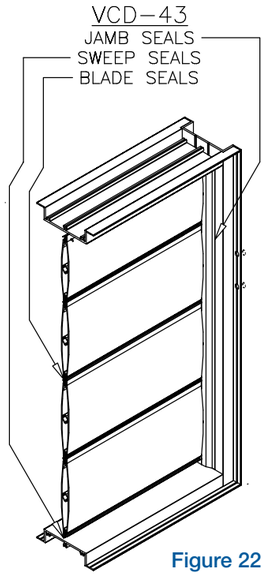


Figure 22

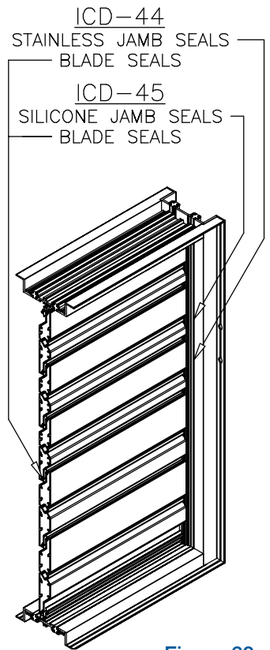
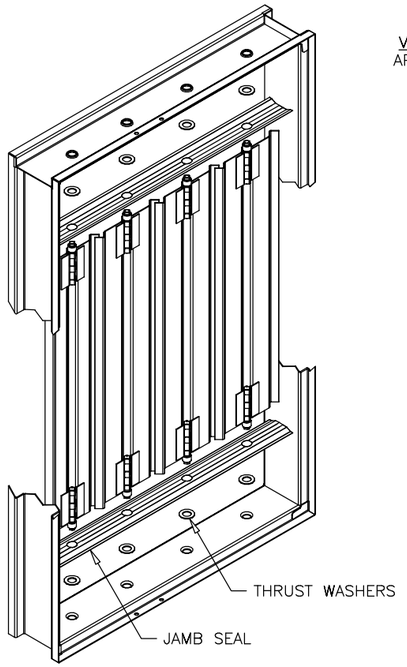


Figure 23



VERTICAL BLADE DETAIL
APPLICABLE ON MODELS:
VCD–20V
VCD–23V
VCD–33V
VCD–34V
VCD–42V
VCD–43V

Figure 24

Nominal Section Height	Actual Section Height	All VCD Models except VCD-40	VCD-40	All ICD Models
		Dim A		
6	5.75	2.88	2.88	-
7	6.75	3.38	3.38	3.88
8	7.75	3.88	3.88	4.88
9	8.75	4.38	3.03	5.38
10	9.75	2.88	3.00	3.88
11	10.75	3.38	3.50	4.88
12	11.75	3.38	4.00	4.88
13	12.75	3.88	10.66	5.38
14	13.75	3.88	10.63	5.38
15	14.75	4.38	11.13	11.88
16	15.75	4.38	11.63	12.88
17	16.75	4.88	10.78	13.88
18	17.75	13.88	10.75	14.88
19	18.75	14.38	11.25	15.38
20	19.75	15.88	11.75	12.88
21	20.75	16.38	10.91	13.88
22	21.75	16.88	10.88	14.88
23	22.75	18.38	11.38	15.38
24	23.75	18.88	10.53	15.38
25	24.75	15.88	11.03	13.88
26	25.75	16.38	11.00	14.88
27	26.75	16.38	11.50	15.38
28	27.75	17.38	18.16	15.38
29	28.75	18.38	18.13	15.38
30	29.75	18.88	18.63	14.88
31	30.75	18.88	19.13	15.38
32	31.75	16.38	18.28	15.38
33	32.75	16.38	18.25	15.38
34	33.75	16.38	18.75	15.38
35	34.75	18.38	19.25	15.38
36	35.75	16.88	18.41	15.38
37	36.75	18.88	18.38	15.38
38	37.75	18.88	18.88	15.38
39	38.75	16.38	18.03	15.38
40	39.75	17.38	18.53	15.38
41	40.75	18.38	18.5	15.38
42	41.75	18.88	19.00	15.38
43	42.75	18.88	18.16	15.38
44	43.75	18.88	18.66	15.38
45	44.75	18.88	18.63	15.38
46	45.75	16.38	19.13	15.38
47	46.75	18.38	18.28	1538
48	47.75	16.38	18.25	15.38
49	48.75	18.88	18.75	15.38
50	49.75	16.88	19.25	15.381

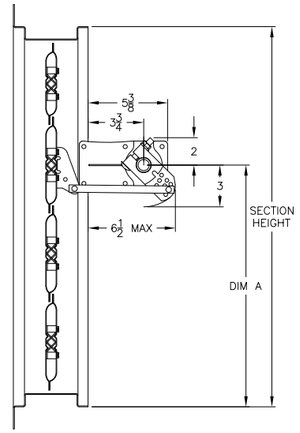


Figure 25

Note:
When the nominal section height is fractional, add 1/2 of the fraction amount ot "Dim A".

The nominal section height shown in table applies to the width on VCD-xxV models.

Example: A VCD-40 with nominal section height of 16.375.
0.188 + 11.63 = 11.818

Nominal Section Height	Actual Section Height	All VCD Models except VCd-40	VCD-40	All ICD Models
		Dim A		
51	50.75	18.88	18.41	15.38
52	51.75	18.88	18.38	15.38
53	52.75	16.38	18.88	15.38
54	53.75	16.38	18.53	15.38
56	55.75	16.38	18.50	15.38
57	56.75	18.88	19.00	15.38
58	57.75	18.88	18.16	15.38
59	58.75	18.88	18.13	15.38
60	59.75	16.38	18.63	15.38
61	60.75	18.88	19.13	15.38
62	61.75	16.38	18.28	15.38
63	62.75	18.88	18.25	15.38
64	63.75	16.88	18.75	15.38
65	64.75	18.88	19.25	15.38
66	65.75	18.88	18.41	15.38
67	66.75	18.88	18.38	15.38
68	67.75	18.88	18.88	15.38
69	68.75	18.88	18.03	15.38
70	69.75	18.88	18.00	15.38
71	70.75	18.88	18.50	15.38
72	71.75	18.88	19.00	15.38
73	72.75	18.88	18.16	15.38
74	73.75	16.38	18.13	15.38

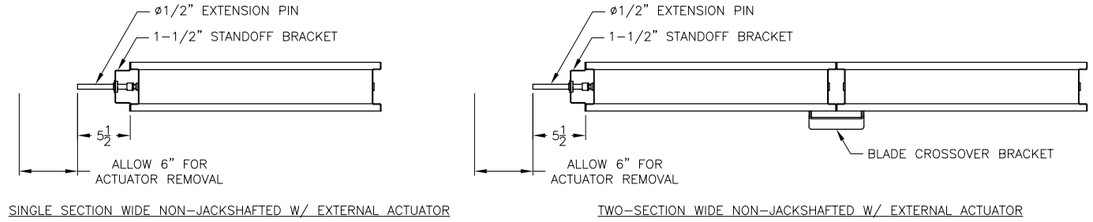


Figure 26

External vs. Internal Jackshaft for Actuator Mounting

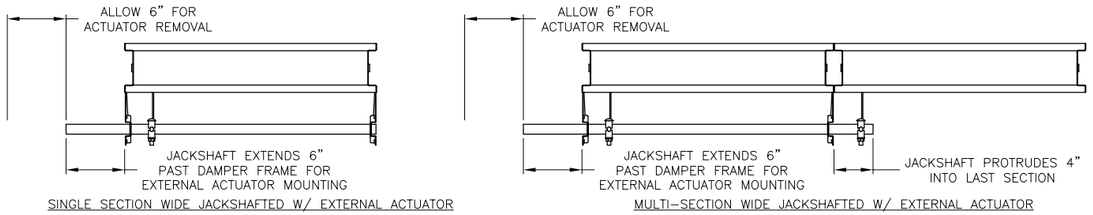
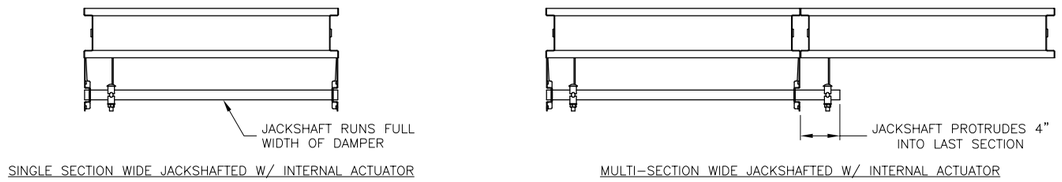


Figure 27



Note: All one section wide dampers with factory supplied actuators are built with 1/2 in. jackshaft. Dampers more than one section wide or dampers with customer supplied actuators are built with 1 in. jackshaft.

Figure 28

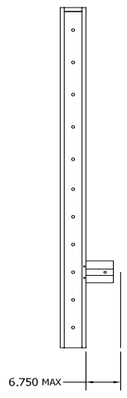


Figure 29

SINGLE SECTION WIDE NON-JACKSHAFTED W/ INTERNAL MOUNT (NO ACTUATOR PROVIDED)

Note: A damper with an internal mount without a jackshaft would just have a blade lever provided.

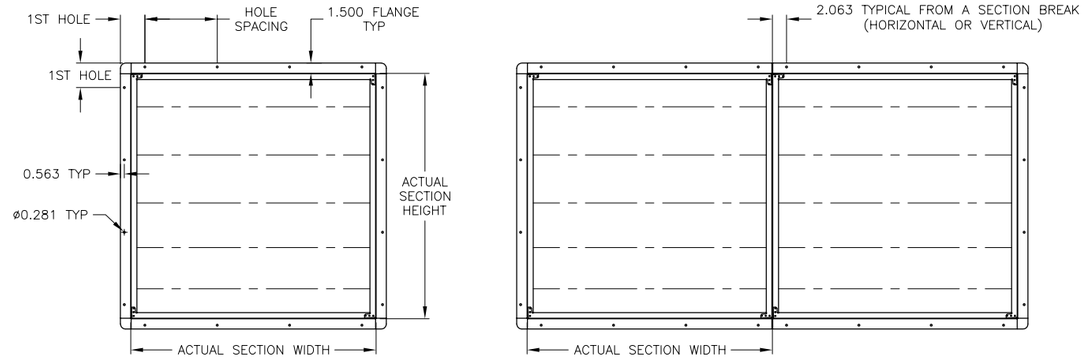


Figure 30

The same formula/locations are used in the horizontal & vertical directions	
Actual Section Dimension	**Flange Hole Quantity**
<7.75	1
>= 7.75 & < 24.75	2
>= 24.75 & < 40.75	3
>= 40.75 & < 56.75	4
>=56.75	5
Actual Section Dimension	**First Hole from Edge of Flange**
< 7.75	(Actual Section Dimension/2) + 1.5
>=7.75	3.563
Actual Section Dimension	**Hole Spacing**
<7.75	N/A
>=7.75	Holes evenly spaced across section

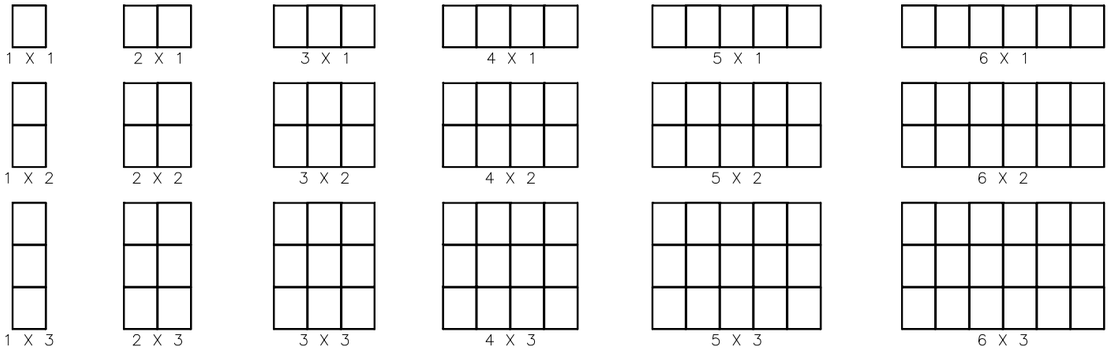


Figure 31

VCD-20V & VCD-23V			
		Maximum Nominal Damper Width (in.)	
		74	120
Maximum Nominal Damper Height (in.)	48	1 x 1	2 x 1
	72	1 x 2	2 x 2

VCD-33V & VCD-42V			
		Maximum Nominal Damper Width (in.)	
		74	120
Maximum Nominal Damper Height (in.)	60	1 x 1	2 x 1
	72	1 x 2	2 x 2

VCD-43V			
		Maximum Nominal Damper Width (in.)	
		74	120
Maximum Nominal Damper Height (in.)	60	1 x 1	2 x 1

ICD-44 & ICD-45				
		Maximum Nominal Damper Width (in.)		
		48	96	144
Maximum Nominal Damper Height (in.)	74	1 x 1	2 x 1	3 x 1
	148	1 x 2	2 x 2	3 x 2

VCD-20 & VCD-23							
		Maximum Nominal Damper Width (in.)					
		48	96	144	192	240	288
Maximum Nominal Damper Height (in.)	74	1 x 1	2 x 1	3 x 1	4 x 1	5 x 1	6 x 1
	148	1 x 2	2 x 2	3 x 2	4 x 2	5 x 2	6 x 2
	222	1 x 3	2 x 3	3 x 3	4 x 3	5 x 3	6 x 3

VCD-33, 34, 40, 42 & VCD-43							
		Maximum Nominal Damper Width (in.)					
		60	96	144	192	240	288
Maximum Nominal Damper Height (in.)	74	1 x 1	2 x 1	3 x 1	4 x 1	5 x 1	6 x 1
	148	1 x 2	2 x 2	3 x 2	4 x 2	5 x 2	6 x 2
	222	1 x 3	2 x 3	3 x 3	4 x 3	5 x 3	6 x 3

On multi-blade dampers (except vertical blade and Face & Bypass), they are given a drive arrangement code that helps describe the construction of the damper. The following breaks down what each number and letter represents.

22-2FEL-2

(1)(2) (3)(4) (5) (6) (7)

(1) Number of sections wide

(2) Number of sections high

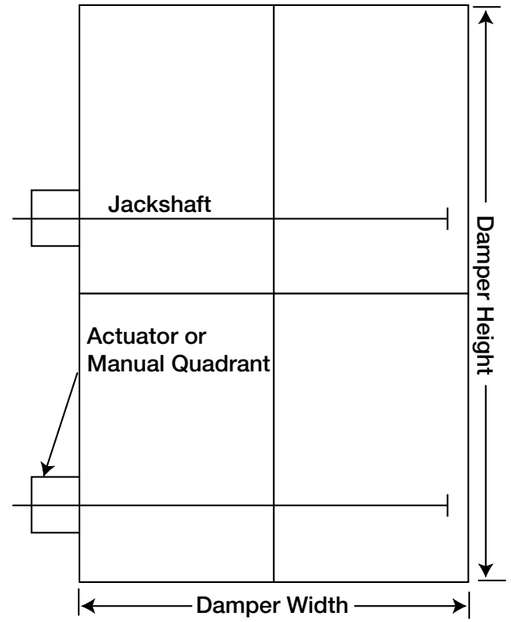
(3) Number of actuators or manual quadrants

(4) Who supplies the actuators or manual quadrants
- F - Factory
- C - Customer Supplied (field mounted)

(5) Actuator or manual quadrant mounting
- E - External
- I - Internal
- B - Both internal and external

(6) Actuator or manual quadrant location
- L - Left hand drive
- R - Right hand drive
- B - Both right and left

(7) Number of jackshafts



On vertical blade and face & bypass dampers, they are given a configuration ID number that helps describe the construction of the damper.

Drive Arrangements - Internal Mount Actuators

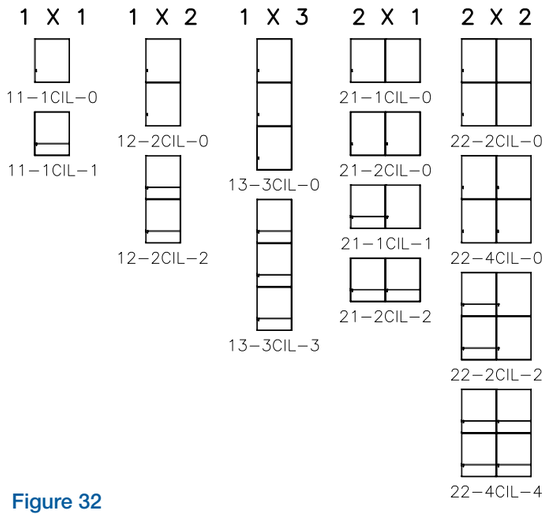
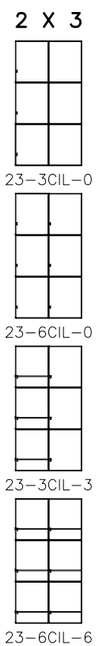
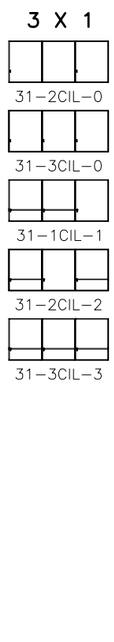
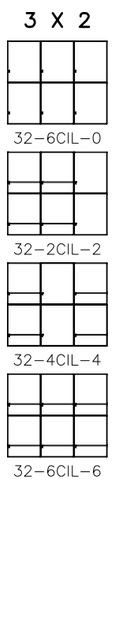


Figure 32

Sections Wide x Sections High







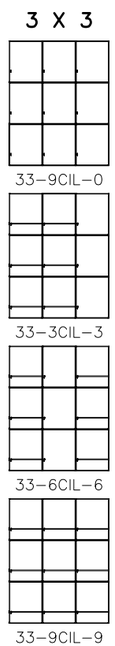
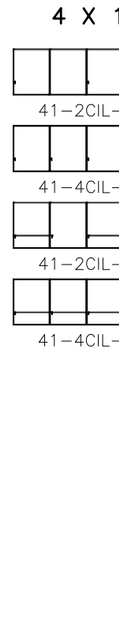
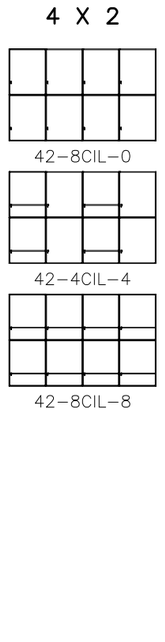


Figure 33





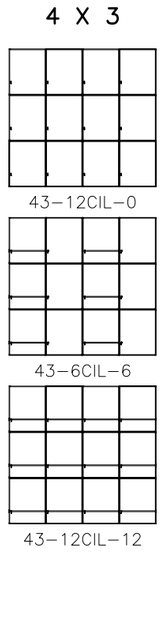
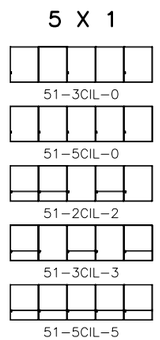
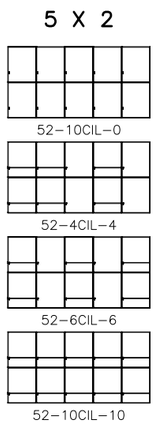


Figure 34





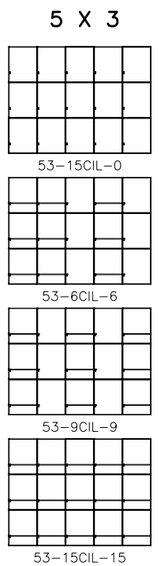
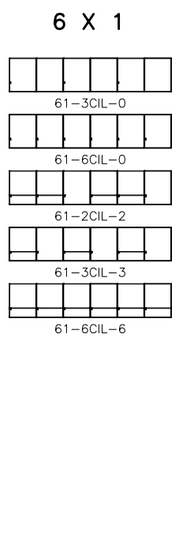
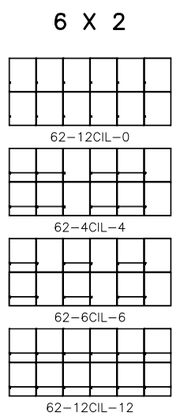


Figure 35





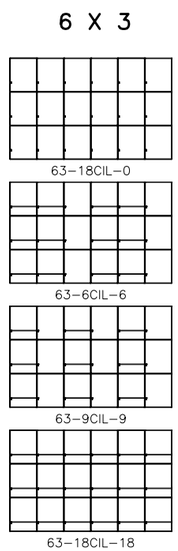
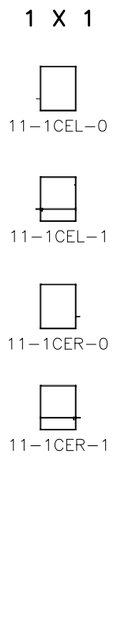
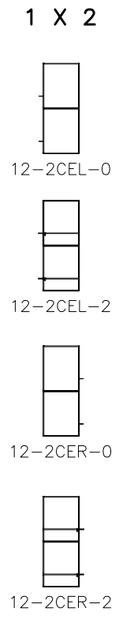
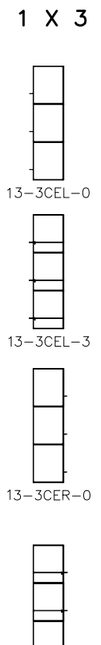


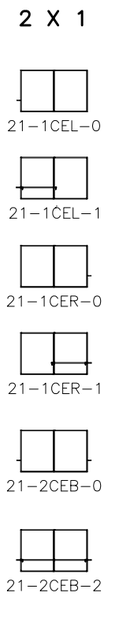
Figure 36

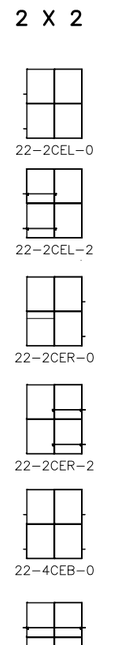
Sections Wide x Sections High

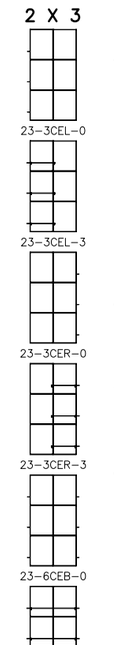


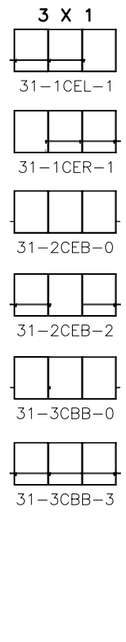


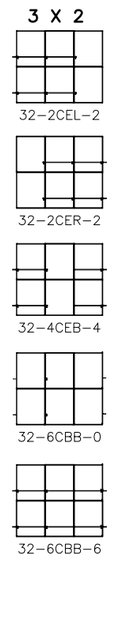












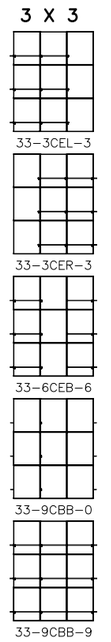
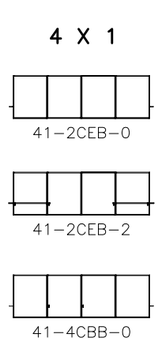
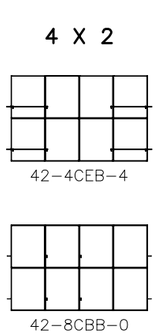
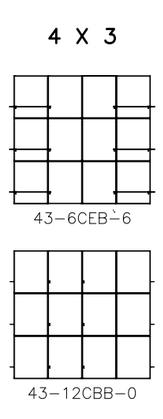


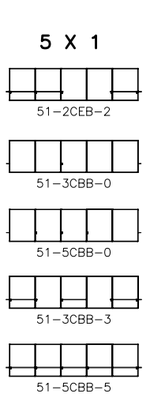
Figure 37

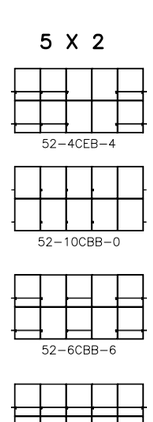
Figure 38











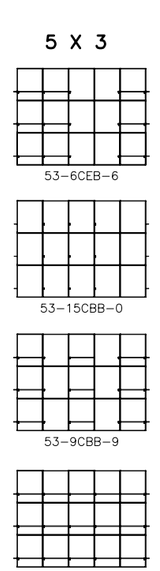


Figure 39

Figure 40

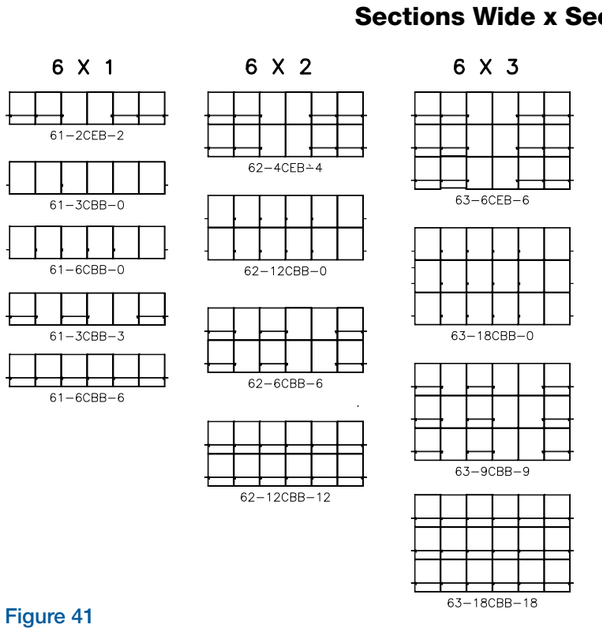


Figure 41

Sleeved Damper

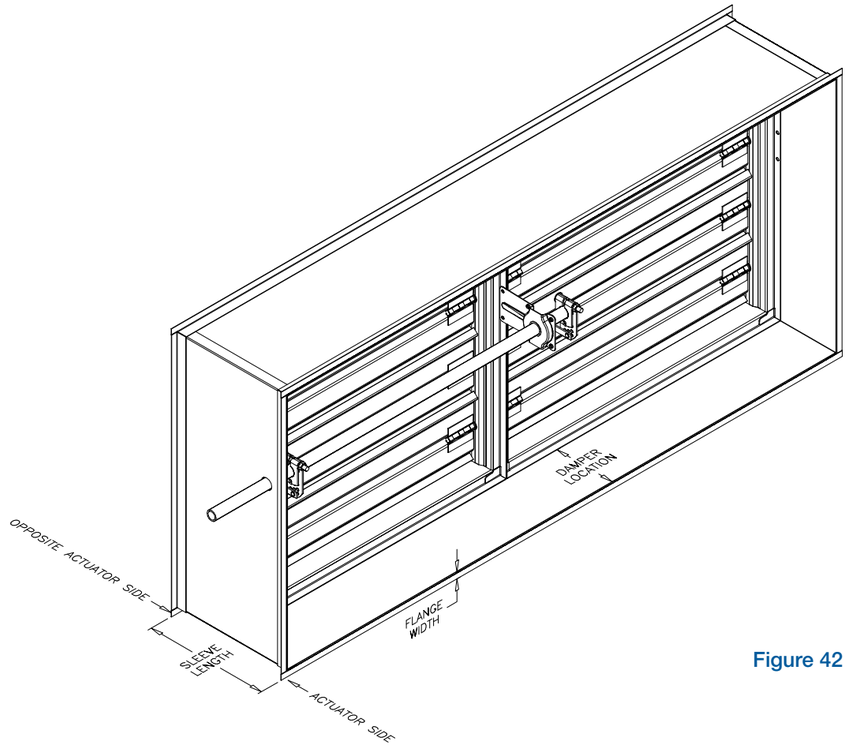


Figure 42

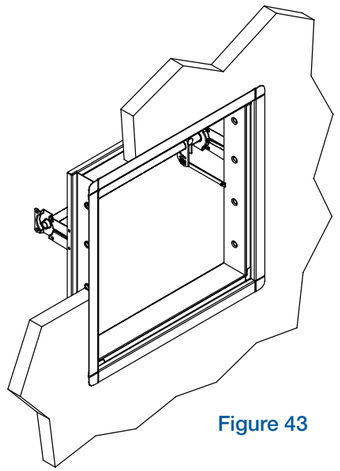


Figure 43

REVERSED FLANGE – INSERT MOUNT
INTERNAL MOUNTED ACTUATOR
REQUIRED FOR INSTALLATION

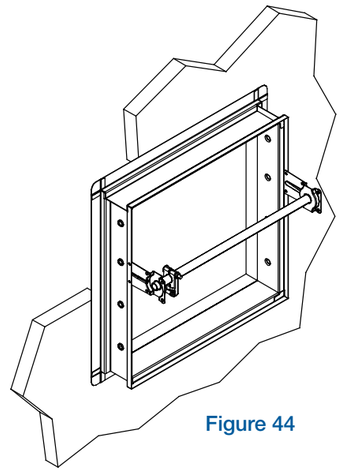


Figure 44

REVERSED FLANGE – FLANGE MOUNT
ANY JACKSHAFT AND ACTUATOR POSITION
WILL WORK FOR THIS INSTALLATION.

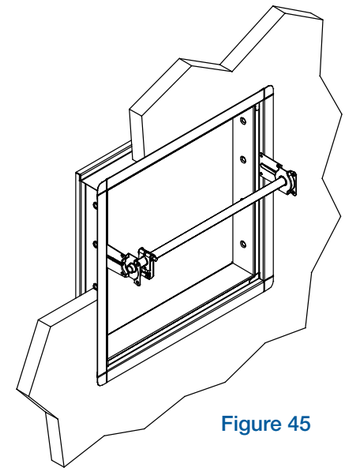


Figure 45

SINGLE FLANGE – INSERT MOUNT
JACKSHAFTING AND/OR INTERNAL MOUNTED
ACTUATOR REQUIRED FOR INSTALLATION.

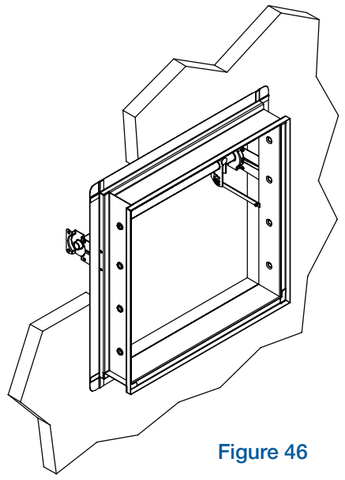


Figure 46

SINGLE FLANGE – FLANGE MOUNT
EXTERNAL JACKSHAFTED WILL NOT
WORK WITH THIS INSTALLATION.

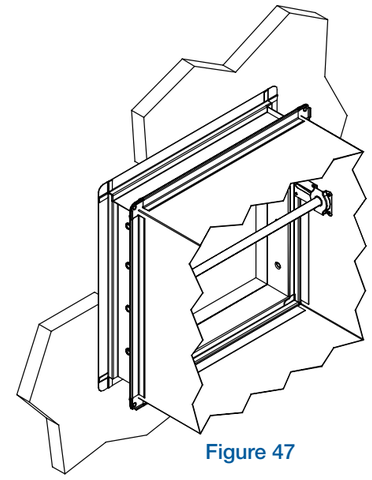


Figure 47

DOUBLE FLANGE – FLANGE MOUNT
INTERNAL MOUNTED ACTUATOR IS NOT
REQUIRED FOR THIS INSTALLATION.

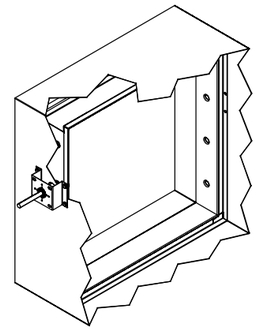


Figure 48

CHANNEL FRAME – INSERT MOUNT
SHOWN AS EXTERNAL NON–JACKSHAFT.
JACKSHAFTING AND INTERNAL
MOUNTED ACTUATOR IS OPTIONAL.

Horizontal

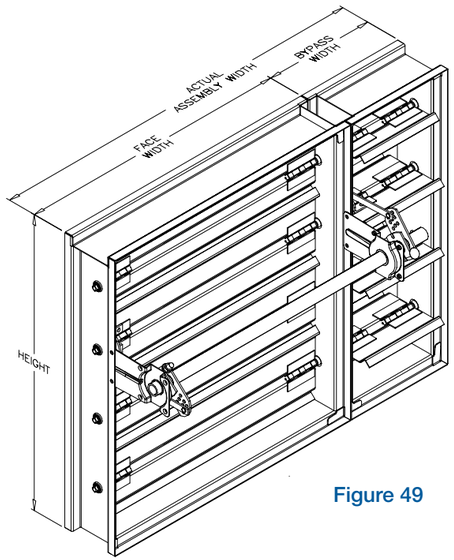


Figure 49

NOTE – DRAWING SHOWN WITH BYPASS DAMPER RIGHT OF FACE DAMPER.
BYPASS DAMPER LEFT OF FACE DAMPER IS OPTIONAL.
FACE & BYPASS HEIGHT AND WIDTH DIMENSIONS ARE ACTUAL.
FBV–33 (FABRICATED AIRFOIL BLADE) AND FBV–43 (ALUMINUM AIRFOIL BLADE) ALSO AVAILABLE.

Vertical

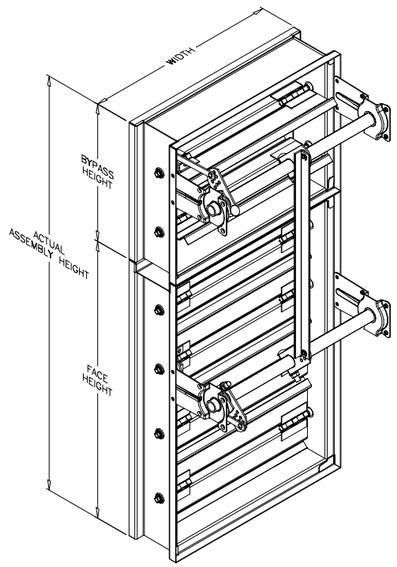


Figure 50

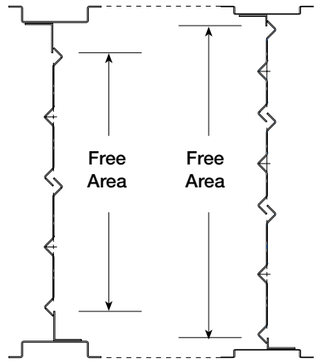
NOTE – DRAWING SHOWN WITH BYPASS DAMPER ABOVE FACE DAMPER.
BYPASS DAMPER BELOW FACE DAMPER IS OPTIONAL.
FACE & BYPASS HEIGHT AND WIDTH DIMENSIONS ARE ACTUAL.
FBV–33 (FABRICATED AIRFOIL BLADE) AND FBV–43 (ALUMINUM AIRFOIL BLADE) ALSO AVAILABLE.

Free Area

Greenheck employs a unique approach to damper manufacturing resulting in the most free area and as a result, the best cataloged and third party certified pressure drop in the industry, providing the customer the best performing dampers available.

Greenheck manufactures dampers with a variable blade spacing utilizing 4 blade widths, (4”, 5”, 6”, and 7”) to either eliminate closure strips or minimize the closure strip height and therefore; maintaining maximum free area.

Greenheck also utilizes “low profile” frames when the damper height is <= 17” which provides a .335” offset at the top and bottom of the damper frame vs. the typical 1” that most competitors use providing another full 1” of free area in the damper opening when the blades are full open. (See diagram below)



Competitor

Greenheck with low profile frame

Free area varies based on the size of the damper with the smallest damper sizes having a slightly smaller percentage of free area than larger sizes.

Select the model of damper you would like and if your damper size is in between what is published here, interpolate between sizes to approximate your free area percentage.

Free Area Percentage					
Damper Model					
Size W x H (inches)	VCD-20	VCD-23	VCD-33	VCD-42 & VCD-43	ICD-44 & ICD-45
12 x 12	67%	64%	67%	63%	73%
24 x 24	75%	73%	75%	74%	73%
36 x 36	78%	77%	79%	79%	74%
48 x 48	79%	78%	82%	81%	74%
48 x 74	80%	79%	82%	82%	75%
60 x 74	NA	NA	83%	83%	NA

Pressure Drop

Pressure drop testing was conducted in accordance with AMCA Standard 500-D using the three configurations shown. All data has been corrected to represent standard air at a density of.075 lb/ft^3 (1.2 kg/m^3).

Actual pressure drop found in an HVAC system is a combination of many factors. This pressure drop information, along with an analysis of other system influences should be used to estimate actual pressure losses for a damper installed in an HVAC system.

Figure 5.3 Illustrates a fully ducted damper. This configuration has the lowest pressure drop of the three test configurations because entrance and exit losses are minimized by straight duct runs upstream and downstream of the damper.

Figure 5.2 Illustrates a ducted damper exhausting air into an open area. This configuration has a lower pressure drop than Figure 5.5 because entrance losses are minimized by a straight duct run upstream of the damper.

Figure 5.5 Illustrates a plenum mounted damper. This configuration has the highest pressure drop because of high entrance and exit losses due to the sudden changes of area in the system.

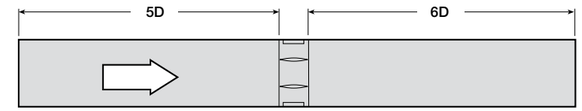


Figure 5.3

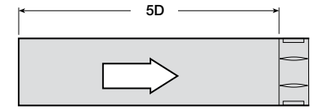


Figure 5.2

$$D = \sqrt{\frac{4\,(W)\,(H)}{3.14}}$$

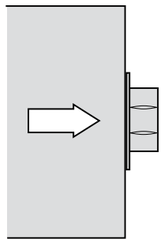


Figure 5.5

VCD-20 & 23

- Galvanized 3V blade
- Blade and jamb seals VCD-23

SEVCD-23

- 316 stainless steel 3V blade
- 316 stainless steel construction
- Blade and jamb seals

Models VCD-20, 23 & SEVCD-23

Dimension inches	12x12			24x24			36x36			12x48			48x12		
AMCA figure	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5
Velocity (ft/min)	Pressure Drop in. wg														
500	.01	.01	.03	.01	.01	.03	.01	.01	.02	.01	.01	.03	.01	.01	.03
1000	.05	.03	.13	.03	.02	.12	.02	.02	.10	.04	.03	.12	.03	.03	.12
1500	.11	.08	.30	.06	.04	.26	.05	.03	.22	.08	.07	.27	.07	.06	.28
2000	.19	.13	.53	.10	.07	.47	.09	.06	.40	.15	.12	.47	.12	.10	.49
2500	.29	.20	.82	.16	.11	.75	.14	.09	.62	.22	.18	.75	.18	.16	.77
3000	.41	.29	1.19	.23	.16	1.04	.19	.13	.90	.32	.26	1.07	.26	.22	1.12
3500	.55	.40	1.62	.30	.21	1.41	.27	.19	1.23	.43	.36	1.45	.36	.30	1.53
4000	.72	.51	2.10	.40	.28	1.90	.35	.25	1.62	.56	.46	1.91	.47	.39	2.01

VCD-20V & 23V

- Vertical 3V blade
- Blade and jamb seals VCD-23V

Models VCD-20V, 23V

Dimension inches	12x12			24x24			36x36			12x48			48x12		
AMCA figure	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5
Velocity (ft/min)	Pressure Drop in. wg														
500	.01	.01	.03	.01	.01	.03	.01	.01	.02	.01	.01	.03	.01	.01	.03
1000	.05	.03	.13	.03	.02	.12	.02	.02	.10	.03	.03	.12	.04	.03	.12
1500	.11	.08	.30	.06	.04	.26	.05	.03	.22	.07	.06	.28	.08	.07	.27
2000	.19	.13	.53	.10	.07	.47	.09	.06	.40	.12	.10	.49	.15	.12	.47
2500	.29	.20	.82	.16	.11	.75	.14	.09	.62	.18	.16	.77	.22	.18	.75
3000	.41	.29	1.19	.23	.16	1.04	.19	.13	.90	.26	.22	1.12	.32	.26	1.07
3500	.55	.40	1.62	.30	.21	1.41	.27	.19	1.23	.36	.30	1.53	.43	.36	1.45
4000	.72	.51	2.10	.40	.28	1.90	.35	.25	1.62	.47	.39	2.01	.56	.46	1.91

VCD-33 & 34

- Galvanized airfoil blade
- Insulated airfoil VCD-34
- Blade and jamb seals

SEVCD-33

- 316 stainless steel airfoil blade
- 316 stainless steel construction
- Blade and jamb seals

Models VCD-33, 34, & SEVCD-33

Dimension inches	12x12			24x24			36x36			12x48			48x12		
AMCA figure	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	.5.2	5.3	5.5
Velocity (ft/min)	Pressure Drop in. wg														
500	.01	.01	.03	.01	.01	.03	.01	.01	.02	.01	.01	.03	.01	.01	.03
1000	.03	.02	.12	.03	.01	.11	.02	.01	.09	.03	.02	.11	.02	.02	.11
1500	.07	.05	.27	.06	.03	.26	.04	.02	.21	.07	.04	.24	.04	.04	.24
2000	.13	.08	.48	.10	.05	.45	.07	.04	.38	.11	.08	.43	.08	.07	.44
2500	.19	.12	.74	.15	.09	.71	.11	.06	.58	.17	.12	.67	.12	.11	.68
3000	.26	.17	1.07	.21	.13	1.02	.15	.08	.85	.23	.17	.96	.16	.15	.97
3500	.35	.23	1.46	.28	.17	1.40	.20	.12	1.15	.31	.22	1.31	.21	.20	1.32
4000	.45	.30	1.91	.36	.22	1.89	.26	.15	1.52	.39	.29	1.71	.27	.25	1.73

Model VCD-33V

Dimension inches	12x12			24x24			36x36			12x48			48x12		
AMCA figure	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5
Velocity (ft/min)	Pressure Drop in. wg														
500	.01	.01	.03	.01	.01	.03	.01	.01	.02	.01	.01	.03	.01	.01	.03
1000	.03	.02	.12	.03	.01	.11	.02	.01	.09	.02	.02	.11	.03	.02	.11
1500	.07	.05	.27	.06	.03	.26	.04	.02	.21	.04	.04	.24	.07	.04	.24
2000	.13	.08	.48	.10	.05	.45	.07	.04	.38	.08	.07	.44	.11	.08	.43
2500	.19	.12	.74	.15	.09	.71	.11	.06	.58	.12	.11	.68	.17	.12	.67
3000	.26	.17	1.07	.21	.13	1.02	.15	.08	.85	.16	.15	.97	.23	.17	.96
3500	.35	.23	1.46	.28	.17	1.40	.20	.12	1.15	.21	.20	1.32	.31	.22	1.31
4000	.45	.30	1.91	.36	.22	1.89	.26	.15	1.52	.27	.25	1.73	.39	.29	1.71

VCD-33V

- Vertical galvanized airfoil blade
- Blade and jamb seals

Model VCD-40

Dimension inches	12x12			24x24			36x36			12x48			48x12		
AMCA figure	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5
Velocity (ft/min)	Pressure Drop in. wg														
500	.08	.05	.10	.01	.01	.03	.01	.01	.03	.01	.01	.03	.06	.03	.08
1000	.31	.20	.40	.05	.02	.12	.04	.02	.11	.05	.03	.12	.23	.13	.29
1500	.69	.45	.88	.11	.05	.29	.09	.04	.26	.11	.07	.27	.52	.29	.63
2000	1.19	.76	1.54	.19	.10	.52	.16	.07	.46	.20	.12	.49	.91	.51	1.12
2500	1.84	1.19	2.41	.30	.15	.80	.24	.10	.72	.30	.19	.76	1.43	.81	1.76
3000	2.67	1.7	3.45	.43	.22	1.14	.35	.15	1.04	.43	.26	1.11	2.05	1.16	2.52
3500	3.59	2.29	4.75	.58	.3	1.6	.48	.20	1.43	.59	.36	1.53	2.82	1.59	3.40
4000	4.64	2.97	6.09	.76	.40	2.14	.62	.27	1.87	.77	.46	2.00	3.69	2.09	4.52

VCD-40

- Extruded aluminum airfoil blade
- Blades contained within the frame
- Blade and jamb seals

Model VCD-42

Dimension inches	12x12			24x24			36x36			12x48			48x12		
AMCA figure	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5
Velocity (ft/min)	Pressure Drop in. wg														
500	.05	.03	.07	.01	.01	.04	.01	.01	.02	.01	.01	.03	.03	.02	.05
1000	.18	.12	.28	.05	.03	.17	.04	.02	.12	.01	.04	.18	.11	.06	.19
1500	.43	.28	.62	.12	.06	.37	.09	.05	.28	.14	.09	.40	.25	.14	.44
2000	.76	.49	1.11	.22	.11	.66	.17	.08	.50	.25	.16	.72	.44	.25	.78
2500	1.19	.77	1.73	.34	.17	1.04	.26	.13	.78	.39	.25	1.12	.69	.39	1.21
3000	1.71	1.11	2.50	.49	.24	1.50	.38	.19	1.13	.57	.36	1.62	1.0	.57	1.75
3500	2.33	1.51	3.41	.66	.33	2.04	.51	.26	1.53	.77	.49	2.21	1.36	.77	2.38
4000	3.04	1.98	4.45	.87	.43	2.66	.67	.34	2.01	1.01	.64	2.88	1.78	1.01	3.11

VCD-42

- Extruded aluminum airfoil blade
- Galvanized frame
- Blade and jamb seals

Model VCD-42V

VCD-42V
- Vertical extruded aluminum airfoil blade
- Galvanized frame
- Blade and jamb seals

Dimension inches	12x12			24x24			36x36			12x48			48x12		
AMCA figure	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5
Velocity (ft/min)	Pressure Drop in. wg														
500	.05	.03	.07	.01	.01	.04	.01	.01	.02	.03	.02	.05	.01	.01	.03
1000	.18	.12	.28	.05	.03	.17	.04	.02	.12	.11	.06	.19	.01	.04	.18
1500	.43	.28	.62	.12	.06	.37	.09	.05	.28	.25	.14	.44	.14	.09	.40
2000	.76	.49	1.11	.22	.11	.66	.17	.08	.50	.44	.25	.78	.25	.16	.72
2500	1.19	.77	1.73	.34	.17	1.04	.26	.13	.78	.69	.39	1.21	.39	.25	1.12
3000	1.71	1.11	2.50	.49	.24	1.50	.38	.19	1.13	1.0	.57	1.75	.57	.36	1.62
3500	2.33	1.51	3.41	.66	.33	2.04	.51	.26	1.53	1.36	.77	2.38	.77	.49	2.21
4000	3.04	1.98	4.45	.87	.43	2.66	.67	.34	2.01	1.78	1.01	3.11	1.04	.64	2.88

Model VCD-43

VCD-43
- Extruded aluminum airfoil blade
- Aluminum frame
- Blade and jamb seals

Dimension inches	12x12			24x24			36x36			12x48			48x12		
AMCA figure	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5
Velocity (ft/min)	Pressure Drop in. wg														
500	.01	.01	.04	.01	.01	.03	.01	.01	.03	.01	.01	.03	.01	.01	.03
1000	.06	.03	.14	.04	.02	.12	.03	.01	.10	.04	.03	.11	.03	.02	.11
1500	.13	.07	.31	.10	.04	.27	.06	.02	.22	.10	.06	.25	.06	.04	.26
2000	.23	.14	.55	.18	.08	.48	.12	.04	.39	.17	.11	.46	.10	.08	.46
2500	.35	.21	.86	.28	.13	.75	.18	.06	.61	.26	.17	.72	.16	.12	.72
3000	.50	.29	1.23	.40	.19	1.07	.26	.09	.87	.38	.25	1.05	.23	.18	1.02
3500	.68	.39	1.67	.54	.26	1.47	.35	.13	1.19	.52	.34	1.43	.30	.24	1.40
4000	.88	.51	2.19	.70	.34	1.91	.46	.17	1.56	.68	.45	1.87	.39	.31	1.83

Model VCD-43V

VCD-43V
- Vertical extruded aluminum airfoil blade
- Aluminum frame
- Blade and jamb seals

Dimension inches	12x12			24x24			36x36			12x48			48x12		
AMCA figure	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5
Velocity (ft/min)	Pressure Drop in. wg														
500	.01	.01	.04	.01	.01	.03	.01	.01	.03	.01	.01	.03	.01	.01	.03
1000	.06	.03	.14	.04	.02	.12	.03	.01	.10	.03	.02	.11	.04	.03	.11
1500	.13	.07	.31	.10	.04	.27	.06	.02	.22	.06	.04	.26	.10	.06	.25
2000	.23	.14	.55	.18	.08	.48	.12	.04	.39	.10	.08	.46	.17	.11	.46
2500	.35	.21	.86	.28	.13	.75	.18	.06	.61	.16	.12	.72	.26	.17	.72
3000	.50	.29	1.23	.40	.19	1.07	.26	.09	.87	.23	.18	1.02	.38	.25	1.05
3500	.68	.39	1.67	.54	.26	1.47	.35	.13	1.19	.30	.24	1.40	.52	.34	1.43
4000	.88	.51	2.19	.70	.34	1.91	.46	.17	1.56	.39	.31	1.83	.68	.45	1.87

Models ICD-44 & ICD-45

Dimension inches	12x12			24x24			36x36			12x48			48x12		
AMCA figure	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5
Velocity (ft/min)	Pressure Drop in. wg														
500	.03	.01	.05	.02	.01	.05	.01	.01	.03	.01	.01	.04	.03	.01	.05
1000	.11	.04	.23	.08	.03	.21	.05	.02	.14	.06	.02	.18	.14	.06	.22
1500	.25	.09	.52	.19	.08	.47	.11	.04	.33	.14	.06	.42	.32	.14	.51
2000	.45	.17	.93	.34	.14	.84	.21	.08	.58	.25	.10	.74	.57	.25	.90
2500	.71	.26	1.44	.53	.22	1.32	.33	.12	.91	.40	.17	1.16	.89	.40	1.41
3000	1.03	.38	2.08	.77	.32	1.90	.47	.18	1.31	.57	.24	1.68	1.29	.58	2.04
3500	1.40	.52	2.83	1.05	.43	2.59	.64	.24	1.79	.78	.33	2.28	1.76	.79	2.78
4000	1.83	.67	3.70	1.37	.57	3.39	.84	.32	2.34	1.02	.43	2.98	2.30	1.03	3.70

ICD-44/45
- Thermally broken extruded aluminum airfoil blade
- Thermally broken aluminum frame - ICD-45
- Blade and jamb seals

Models AMD-23/AMD-23-TD

Dimension inches	12 x 12			24 x 24			36 x 36			12 x 48			48 x 12		
AMCA figure	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5
Velocity (ft/min)	Pressure Drop in. wg														
500	.05	.04	.07	.03	.03	.05	.03	.03	.05	.04	.03	.06	.03	.03	.05
1000	.15	.12	.25	.10	.09	.20	.09	.07	.17	.11	.10	.20	.11	.09	.20
1500	.31	.24	.54	.21	.17	.41	.18	.14	.36	.23	.20	.43	.22	.19	.42
2000	.52	.40	.92	.36	.28	.71	.31	.23	.62	.39	.34	.74	.38	.33	.72
2500	.80	.60	1.41	.54	.43	1.10	.46	.35	.96	.58	.51	1.13	.57	.50	1.11
3000	1.12	.84	2.02	.76	.60	1.54	.64	.48	1.36	.81	.72	1.59	.79	.71	1.56
3500	1.51	1.12	2.73	1.01	.80	2.09	.86	.64	1.84	1.10	.97	2.14	1.06	.96	2.12
4000	1.92	1.44	3.53	1.32	1.03	2.76	1.12	.82	2.40	1.43	1.26	2.78	1.38	1.24	2.77

AMD-23/AMD-23-TD
- Air measuring station with a 3V blade control damper - AMD-23
- Thermal dispersion air measuring station with a 3V blade control damper - AMD-23-TD

Models AMD-33/AMD-33-TD

Dimension inches	12 x 12			24 x 24			36 x 36			12 x 48			48 x 12		
AMCA figure	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5
Velocity (ft/min)	Pressure Drop in. wg														
500	.04	.04	.07	.03	.03	.05	.03	.03	.05	.03	.03	.06	.04	.03	.05
1000	.13	.12	.24	.09	.09	.19	.08	.07	.16	.10	.10	.19	.10	.09	.19
1500	.27	.24	.50	.19	.17	.38	.16	.14	.34	.21	.20	.41	.21	.19	.41
2000	.44	.40	.86	.31	.28	.65	.26	.23	.57	.36	.34	.71	.36	.33	.71
2500	.66	.60	1.33	.47	.43	1.00	.39	.35	.88	.54	.51	1.09	.55	.50	1.10
3000	.93	.84	1.89	.65	.60	1.43	.53	.48	1.24	.76	.72	1.54	.77	.71	1.55
3500	1.25	1.12	2.57	.88	.80	1.9	.71	.64	1.67	1.02	.97	2.08	1.03	.96	2.10
4000	1.59	1.44	3.30	1.14	1.03	2.52	.91	.82	2.19	1.33	1.26	2.70	1.34	1.24	2.75

AMD-33/AMD-33-TD
- Air measuring station with a airfoil blade control damper - AMD-33
- Thermal dispersion air measuring station with a airfoil blade control damper - AMD-33-TD

AMD-42/AMD-42-TD

- Air measuring station with a airfoil blade control damper - AMD-42
- Thermal dispersion air measuring station with a airfoil blade control damper - AMD-42-TD

AMD-42/AMD-42-TD

Dimension inches	12 x 12			24 x 24			36 x 36			12 x 48			48 x 12		
AMCA figure	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5
Velocity (ft/min)	Pressure Drop in. wg														
500	.05	.03	.07	.01	.01	.04	.01	.01	.02	.01	.01	.03	.03	.02	.05
1000	.18	.12	.28	.05	.03	.17	.04	.02	.12	.01	.04	.18	.11	.06	.19
1500	.43	.28	.62	.12	.06	.37	.09	.05	.28	.14	.09	.40	.25	.14	.44
2000	.76	.49	1.11	.22	.11	.66	.17	.08	.50	.25	.16	.72	.44	.25	.78
2500	1.19	.77	1.73	.34	.17	1.04	.26	.13	.78	.39	.25	1.12	.69	.39	1.21
3000	1.71	1.11	2.50	.49	.24	1.50	.38	.19	1.13	.57	.36	1.62	1.00	.57	1.75
3500	2.33	1.51	3.41	.66	.33	2.04	.51	.26	1.53	.77	.49	2.21	1.36	.77	2.38
4000	3.04	1.98	4.45	.87	.43	2.66	.67	.34	2.01	1.01	.64	2.88	1.78	1.01	3.11

AMD-42V/AMD-42V-TD

- Air measuring station with a airfoil vertical blade control damper - AMD-42V
- Thermal dispersion air measuring station with a airfoil vertical blade control damper - AMD-42V-TD

AMD-42V/AMD-42V-TD

Dimension inches	12 x 12			24 x 24			36 x 36			12 x 48			48 x 12		
AMCA figure	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5	5.2	5.3	5.5
Velocity (ft/min)	Pressure Drop in. wg														
500	.05	.03	.07	.01	.01	.04	.01	.01	.02	.03	.02	.05	.01	.01	.03
1000	.18	.12	.28	.05	.03	.17	.04	.02	.12	.11	.06	.19	.01	.04	.18
1500	.43	.28	.62	.12	.06	.37	.09	.05	.28	.25	.14	.44	.14	.09	.40
2000	.76	.49	1.11	.22	.11	.66	.17	.08	.50	.44	.25	.78	.25	.16	.72
2500	1.19	.77	1.73	.34	.17	1.04	.26	.13	.78	.69	.39	1.21	.39	.25	1.12
3000	1.71	1.11	2.5	.49	.24	1.5	.38	.19	1.13	1.00	.57	1.75	.57	.36	1.62
3500	2.33	1.51	3.41	.66	.33	2.04	.51	.26	1.53	1.36	.77	2.38	.77	.49	2.21
4000	3.04	1.98	4.45	.87	.43	2.66	.67	.34	2.01	1.78	1.01	3.11	1.04	.64	2.88

Leakage

Most models of dampers have blade seals which seal with blade to blade contact as well as “sweep” blade to top (head) and blade to bottom (sill) of the damper. Most Greenheck damper models also have jamb seals which seal the end of the blade to the inside frame (jamb) of the damper. (See damper cutaway drawing, figures 19-24). The combination of blade seals, sweep seals, and jamb seals give applicable Greenheck damper models the Class 1A and Class 1 leakage rating on dampers built to the maximum section width.

Maximum Leakage cfm/sq. ft. (cmh/sq.m)		
Model	Pressure	
	@ 1 in. wg (.25 kPa)	@ 4 in. wg (1 kPa)
VCD-23V, 43V	Class 1A	Class 1
VCD-40	Class 1A	Class 1
VCD-33, 42, 42V	Class 1A	Class 1
VCDR-53	Class 1	Class 1
VCDRM-53	Class 1	Class 1

Maximum Leakage cfm/sq. ft. (cmh/sq.m)		
Model	Pressure	
	@ 1 in. wg (.25 kPa)	@ 4 in.wg (1 kPa)
AMD-42, AMD-42V, AMD-23-TD, AMD-33-TD, AMD-42-TD, AMD-42V-TD	Class 1A	Class 1

Air leakage is based on operation between 32° and 120°F (0 and 49°C).
Tested for leakage in accordance with ANSI/AMCA Standard 500-D, Figure 5.5.
Tested for air performance in accordance with ANSI/AMCA Standard 500-D, Figures 5.2, 5.3 and 5.5.

Torque
Data is based on a torque of 5.0 in-lb/ft² (0.56 N·m) applied to close and seat the damper during the test.

AMD-23	Leakage Class*	
Maximum Damper Width	1 in. wg (0.25 kPa)	4 in. wg (1 kPa)
48 in. (1219mm)	1A	1

VCD-23, SEVCD-23	Leakage Class*		
Maximum Damper Width	1 in. wg (0.25 kPa)	4 in. wg (1 kPa)	5 in. wg (1.2 kPa)
48 in. (1219mm)	1A	1	1

VCD-43	Leakage Class*			
Maximum Damper Width	1 in. wg (0.25 kPa)	4 in. wg (1 kPa)	8 in. wg (2 kPa)	10 in. wg (2.5 kPa)
60 in. (1524mm)	1A	1	1	1

Data is based on a torque of 7.0 in-lb/ft² (0.79 N·m) applied to close and seat the damper during the test.

VCD-33, 34 SEVCD-33	Leakage Class*			
Maximum Damper Width	1 in. wg (0.25 kPa)	4 in. wg (1 kPa)	8 in. wg (2 kPa)	10 in. wg (2.5 kPa)
60 in. (1524mm)	1A	1	1	1

AMD-33	Leakage Class*		
Maximum Damper Width	1 in. wg (0.25 kPa)	4 in. wg (1 kPa)	8 in. wg (2 kPa)
60 in. (1524mm)	1A	1	1

Data is based on a torque of 9.0 in-lb/ft² (0. N·m) applied to close and seat the damper during the test.

ICD-44, 45	Leakage Class*			
Maximum Damper Width	1 in. wg (0.25 kPa)	4 in. wg (1 kPa)	8 in. wg (2 kPa)	10 in. wg (2.5 kPa)
48 in. (1219mm)	1A	1	1	1

***Leakage Class Definitions**
The *maximum* allowable leakage is defined by AMCA as the following:

- Leakage Class 1A - 3 cfm/ft² @ 1 in. wg (Class 1A is only defined at 1 in. wg).
- Leakage Class 1 - 4 cfm/ft² @ 1 in. wg
  - 8 cfm/ft² @ 4 in. wg
  - 11 cfm/ft² @ 8 in. wg
  - 12.6 cfm/ft² @ 10 in. wg

When sizing the damper, with the exception of the "Quick Connect" frame style and damper flanges, the frame of the damper will be included in the selected dimensions. Quick connect frame uses inside dimension. (See Frame Design Drawing figures 1-12).

Frame Types

Greenheck has several damper frame types available to provide the user the ultimate in mounting flexibility and labor savings during installation. Select from one of the following frame types that best fits your needs (see figures 1-12) for available frame types and mounting styles.

A. Channel Frame – Designed to be insert mounted inside of a duct. (required when sleeve option is chosen)

B. Single Flange Frame – Either insert mounted for a clean framed look as well as space savings, or flange mounted against the wall when jackshaft orientation is not a concern, speed of mounting and exposed linkage is desired.

C. Reverse Flange Frame – Either insert mounted for a clean framed look (internal actuator mount) as well as space savings, or flange mounted against the wall when available space is not a concern, speed of mounting and exposed linkage is desired.

D. Double Flange Frame – Can be selected when flange mounting is required and the user is uncertain of the jackshaft (if required) orientation and left or right hand mount is required. The most forgiving flange frame type when a flange is required, but the user may not necessarily know the actuator location required.

E. Quick Connect Frame – Used when it is desired to flange mount a frame against a surface and connect a piece of ductwork utilizing TDC/TDF/ Ductmate or Dyn-o-mate) on the mating end of the ductwork. The frame is the mirror image of these duct connections and allows the damper frame to be "cleated" into place. This frame also provides maximum free area (best pressure drop) as the frame is designed to be completely out of the airstream.

Blade Types

Depending on the airflow velocity and static pressure of the application, Greenheck has numerous damper blade types available to meet the system requirements. Greenheck utilizes a new and unique approach to building a damper with a blade seal on the top blade that sweeps the top of the damper frame and the bottom of the damper frame on the bottom blade. This unique approach allows Greenheck VCD dampers to obtain third party certified ratings for each leakage class at full rated pressures on maximum section widths without shortening blade lengths like other manufacturers do. Greenheck will supply a better performing damper at a competitive price because the damper can be supplied in larger section sizes even at higher pressures. (See products selection chart figures 13-18).

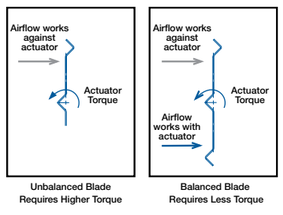
A. 3V Blade - They are used when the airstream velocities up to 3,000 fpm and 5 in. wg static pressure, but still allows a Class 1A and Class 1 leakage rating to be attained on the damper assembly for the VCD-23 model. Other 3V blade models are available without third party leakage and pressure drop certification. (See Blade Type drawing figure 14).

B Fabricated Airfoil Blade - This blade type is utilized when the mid-range performance requirement of airstream velocities up to 4,000 fpm and 10 in. wg pressure capabilities are necessary to meet system design criteria. This blade type has the best pressure drop performance and a Class 1A and Class 1 third party certified leakage rating. (See Blade Type drawing figure 13).

C. Extruded Aluminum Airfoil Blade - This blade type is utilized when high performance requirements of airstream velocities up to 6,000 fpm and 10 in. wg pressure capabilities are necessary to meet system design criteria. This blade type has excellent pressure drop performance, the highest velocity and pressure rating available as well as the Class 1A and Class 1 leakage rating up to the maximum single section size. This premium damper blade is utilized in the Greenheck VCD-42, and 43 models (See Blade Type drawing figure 15).

- Insulated and thermally broken extruded aluminum blade - This blade type is utilized in the Greenheck ICD-44 and 45 models. This blade type has excellent pressure drop performance, class 1A and Class 1 leakage ratings. The ICD-44 and 45 models have the highest Thermal Energy Efficiency Ratings in the industry. (See the damper submittal at www.greenheck.com) (See Blade Type drawing figure 16).

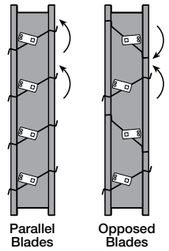
Greenheck damper blades are always symmetrical about the blade axle pivot points, so the dampers have an equal airflow to torque ratio regardless of airflow direction, and no specified top, bottom, front or back. Because of those attributes Greenheck dampers provide the ultimate in mounting flexibility. The only exception to the rule, is that of a "Vertical" blade model and is the only type of damper that allows the damper to be mounted so the blades run vertically when the damper is mounted in or against a wall. (See Vertical Blade Model Construction Drawing figure 24).



Parallel Versus Opposed Blade Operation

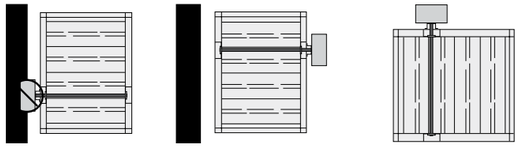
Greenheck control dampers are offered with either parallel or opposed blades. Each style has distinguishing characteristics in regard to the type of operation required.

- *Parallel blade operation* - This configuration requires the damper blades to rotate in the same direction, parallel to one another. Parallel blade orientation is typically used when the damper is utilized with the blades in either the full open or full close.
- *Opposed blade operation* - Adjacent damper blades rotate opposite one another under opposed blade configuration. Opposed blade configuration is typically used on dampers that modulate airflow.



No Top or Bottom

Greenheck's standard control dampers are designed for installation in any position with the blades horizontal. The damper can be turned over so the actuator is on the left or right side. Optional vertical blade models can be turned with the actuator at the top or bottom.



Standard Vertical Blade

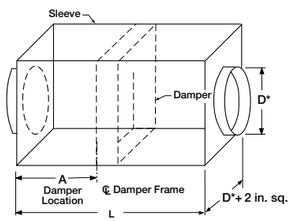
Seals

Greenheck dampers models with seals allow the user the option to select “Silicone” blade and sweep seals for applications where the damper will be exposed to temperatures between 200-250°F, or there is a desire to attach the seal to the blade with the pressure sensitive adhesive, both of which are attributes of the silicone seal option.

Factory Sleeve/Flange Option

Greenheck control dampers are available with factory sleeves installed in lengths up to 48 in. (1219 mm). Sleeves are constructed out of a material thickness selection of 20, 16, 14, & 10 gage. (.091 thru 3.25 mm) galvanized or stainless steel to match the selected damper frame and blade material. When dampers are installed in factory supplied sleeves, the “damper location” specifies the location of the damper from the end of the sleeve to the closest edge of the damper frame.

The factory supplied sleeves can also be selected with factory mounted flanges added to one or both ends of the sleeve. The optional flanges can be selected in dimensions of .75”, 1”, 1.5”, and 2” and will be attached flush to the end(s) of the sleeve as selected.



Extension pins & Standoff Brackets

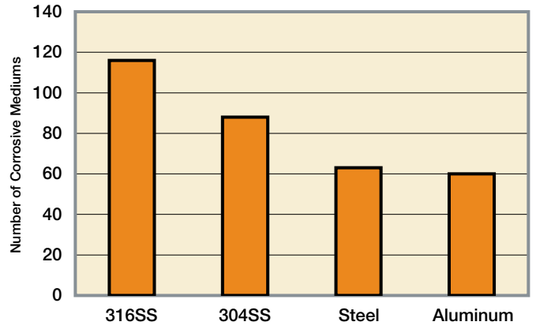
Extension pins and standoff brackets are utilized to drive a single section damper where a jackshaft is not necessary and cost prohibitive. Standoff brackets can be utilized to both ensure that the extension pin remains in place, as well as provide a surface to mount the actuator brackets for ease of actuator or manual hand quadrant installation.

304 or 316 Stainless Steel

Greenheck has stainless steel dampers available in both 304 and 316 stainless alloys depending on what level of corrosion resistance your application requires.

The 304 stainless steel material can be selected as an option to a standard commercial damper model where higher levels of corrosion resistance than can be obtained by using galvanized steel is required, but less than severe environments that require the use of 316 stainless steel.

The 316 stainless steel dampers are available to be utilized in “Severe Environment” applications where higher levels of corrosion resistance than can be obtained with either galvanized or 304 stainless steel, are required. Building specifications will normally tell you if this level of corrosion protection is required.



Open Close Indicator - OCI

The OCI contains two single pole, single throw switches used to indicate damper blade position. The switches provide positive open and closed signals when used in conjunction with remote indicator lights. Switches are physically linked to a damper blade and therefore give a true representation of the damper’s position.

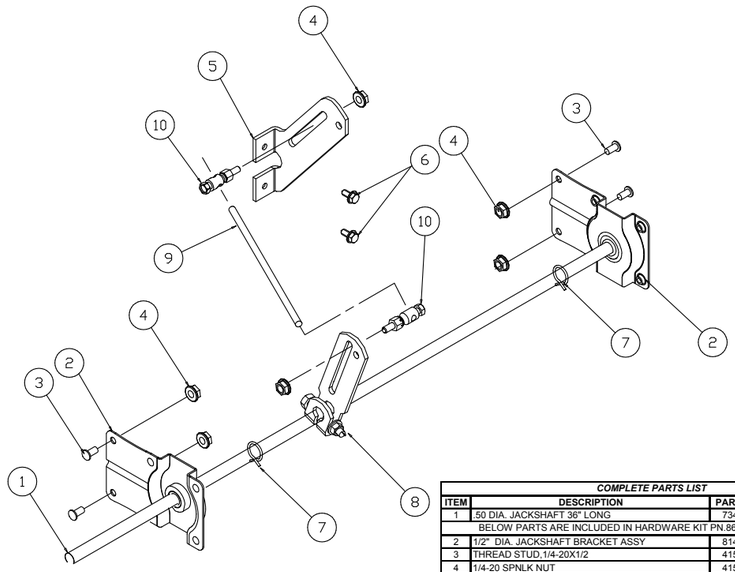
Paint Finishes

A wide variety of paint finishes are available including:

- Anodize
- Industrial Epoxy
- Baked Enamel
- Kynar®/Hylar®
- Epoxy
- Hi-Pro Polyester

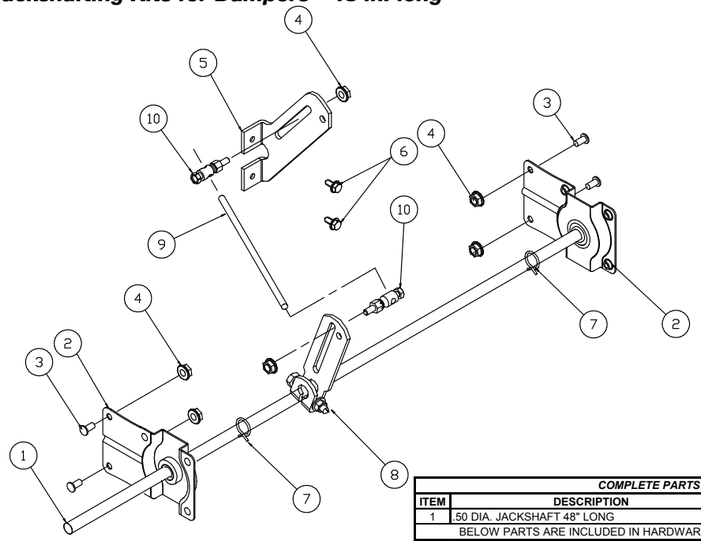
See color charts on www.greenheck.com for standard color offering.

1/2 in. Jackshafting Kits for Dampers - 36 in. long



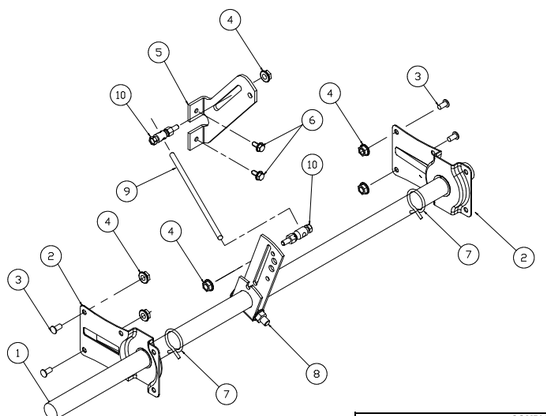
COMPLETE PARTS LIST				
ITEM	DESCRIPTION	PART NO.	DWG NO.	QTY
1	.50 DIA. JACKSHAFT 36" LONG	734097	322145	1
	BELOW PARTS ARE INCLUDED IN HARDWARE KIT PN.860057		DWG. 322146	
2	1/2" DIA. JACKSHAFT BRACKET ASSY	814968	D1140	2
3	THREAD STUD,1/4-20X1/2	415609		4
4	1/4-20 SPNLK NUT	415455		4
5	BLADE BRACKET	653629	D0276	1
6	MS 1/4- 20 x1/2" (HWH) TCS ZP	415264	-	2
7	.50 DIA HOSE CLAMPS	451786		2
8	.50 DIA CRANKARM ASSEMBLY	812097	D0721	1
9	5/16" DIA LINK ROD 18" LONG	656472	D0722	1
10	BALL SWIVEL	451554	-	2
11	SHIPPING BOX	445039		1

1/2 in. Jackshafting Kits for Dampers - 48 in. long



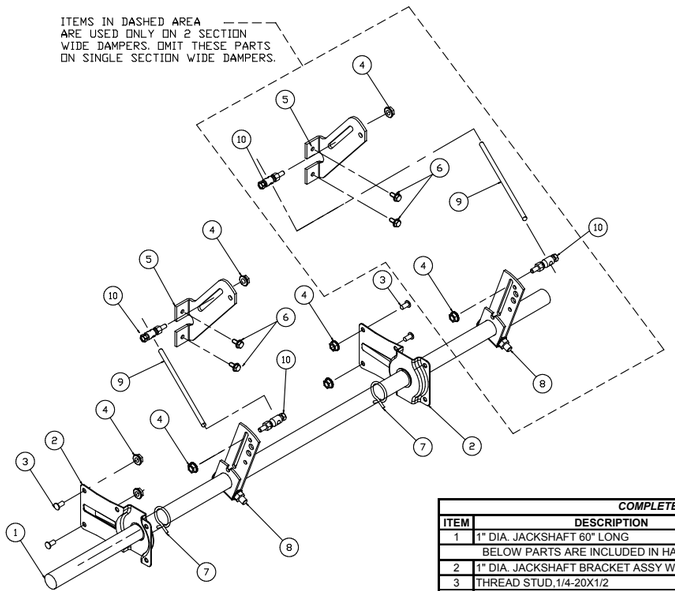
COMPLETE PARTS LIST				
ITEM	DESCRIPTION	PART NO.	DWG NO.	QTY
1	.50 DIA. JACKSHAFT 48" LONG	734096	322144	1
	BELOW PARTS ARE INCLUDED IN HARDWARE KIT PN.860057		DWG. 322146	
2	1/2" DIA. JACKSHAFT BRACKET ASSY	814968	D1140	2
3	THREAD STUD,1/4-20X1/2	415609		4
4	1/4-20 SPNLK NUT	415455		4
5	BLADE BRACKET	653629	D0276	1
6	MS 1/4- 20 x1/2" (HWH) TCS ZP	415264	-	2
7	.50 DIA HOSE CLAMPS	451786		2
8	.50 DIA CRANKARM ASSEMBLY	812097	D0721	1
9	5/16" DIA LINK ROD 18" LONG	656472	D0722	1
10	BALL SWIVEL	451554	-	2
11	SHIPPING BOX	445039		1

1 in. Jackshafting Kits for Dampers - 48 in. long



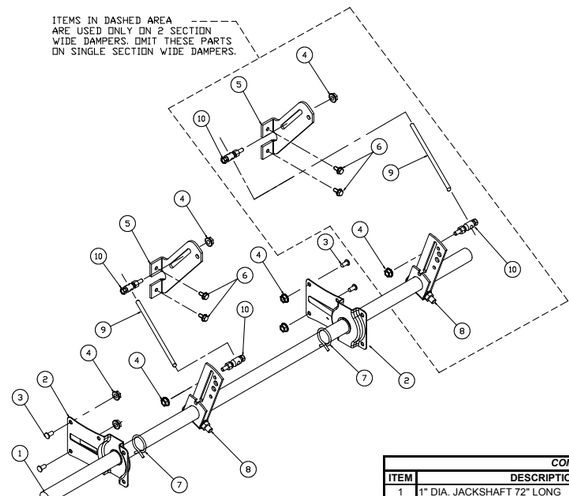
COMPLETE PARTS LIST				
ITEM	DESCRIPTION	PART NO.	DWG NO.	QTY
1	1" DIA. JACKSHAFT 48" LONG	734095	322142	1
	BELOW PARTS ARE INCLUDED IN HARDWARE KIT PN.860062		DWG. 322204	
2	1" DIA. JACKSHAFT BRACKET ASSY W NYLINER	834292	D142927	2
3	THREAD STUD,1/4-20X1/2	415609		4
4	1/4-20 SPNLK NUT	415455		4
5	BLADE BRACKET	653629	D0276	1
6	MS 1/4- 20 x1/2" (HWH) TCS ZP	415264	-	2
7	1" DIA HOSE CLAMPS	451809		2
8	1" CRANKARM ASSEMBLY	816252	D0721	1
9	5/16" DIA LINK ROD 18" LONG	656472	D0722	1
10	BALL SWIVEL	451554	-	2
11	SHIPPING BOX	445039		1

1 in. Jackshafting Kits for Dampers - 60 in. long



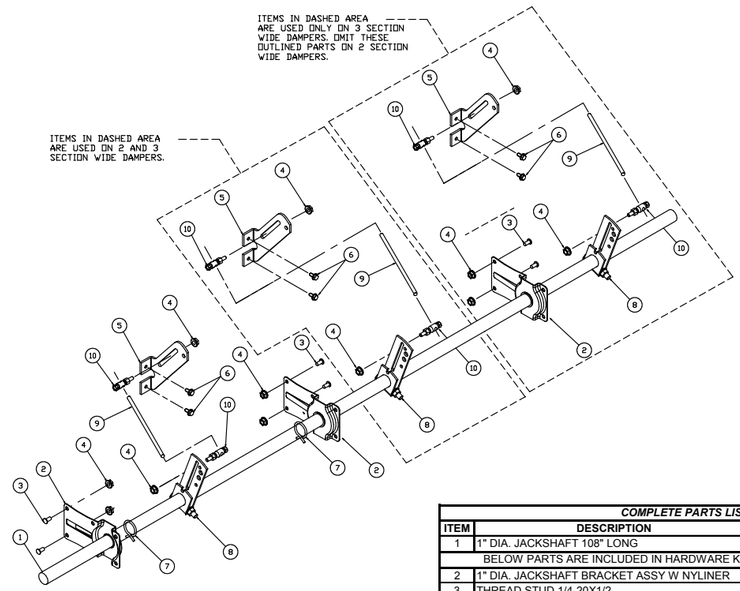
COMPLETE PARTS LIST				
ITEM	DESCRIPTION	PART NO.	DWG NO.	QTY
1	1" DIA. JACKSHAFT 60" LONG	733765	322085	1
	BELOW PARTS ARE INCLUDED IN HARDWARE KIT PN.850062		DWG. 322095	
2	1" DIA. JACKSHAFT BRACKET ASSY W NYLINER	834292	D142927	2
3	THREAD STUD,1/4-20X1/2	415609		4
4	1/4-20 SPNLK NUT	415455		8
5	BLADE BRACKET	653629	D0276	2
6	MS 1/4- 20 x1/2" (HWH) TCS ZP	415264	-	4
7	1" DIA HOSE CLAMPS	451809		2
8	1" CRANKARM ASSEMBLY	816252	D0721	2
9	5/16" DIA LINK ROD 18" LONG	656472	D0722	2
10	BALL SWIVEL	451554	-	4
11	SHIPPING BOX	445039	-	1

1 in. Jackshafting Kits for Dampers - 72 in. long



COMPLETE PARTS LIST				
ITEM	DESCRIPTION	PART NO.	DWG NO.	QTY
1	1" DIA. JACKSHAFT 72" LONG	733766	322088	1
	BELOW PARTS ARE INCLUDED IN HARDWARE KIT PN.850057		DWG. 322095	
2	1" DIA. JACKSHAFT BRACKET ASSY W NYLINER	834292	D142927	2
3	THREAD STUD,1/4-20X1/2	415609		4
4	1/4-20 SPNLK NUT	415455		8
5	BLADE BRACKET	653629	D0276	2
6	MS 1/4- 20 x1/2" (HWH) TCS ZP	415264	-	4
7	1" DIA HOSE CLAMPS	451809		2
8	1" CRANKARM ASSEMBLY	816252	D0721	2
9	5/16" DIA LINK ROD 18" LONG	656472	D0722	2
10	BALL SWIVEL	451554	-	4
11	SHIPPING BOX	445039		1

1 in. Jackshafting Kits for Dampers - 108 in. long



COMPLETE PARTS LIST				
ITEM	DESCRIPTION	PART NO.	DWG NO.	QTY
1	1" DIA. JACKSHAFT 108" LONG	733767	322090	1
	BELOW PARTS ARE INCLUDED IN HARDWARE KIT PN.860062		DWG. 322095	
2	1" DIA. JACKSHAFT BRACKET ASSY W NYLINER	834292	D142927	3
3	THREAD STUD,1/4-20X1/2	415609		6
4	1/4-20 SPNLK NUT	415455		12
5	BLADE BRACKET	653629	D0276	3
6	MS 1/4- 20 x1/2" (HWH) TCS ZP	415264	-	6
7	1" DIA HOSE CLAMPS	451809		2
8	1" CRANKARM ASSEMBLY	816252	D0721	3
9	5/16" DIA LINK ROD 18" LONG	656472	D0722	3
10	BALL SWIVEL	451554	-	6

Step 1

Determine if the actuators need to be electric, pneumatic, or manual.

Step 2

If the actuators are to be electric, determine what voltage (120 Vac, 24 Vac, etc.) and what Hertz (50 or 60 cycles/sec.) are required . If the voltage requirement is not the same as the actuator, (i.e. the motor is 120 Vac and the requirement is 460 Vac) a transformer is needed. Pneumatic actuators require 20 psi supply.

Step 3

If the actuator is manual, then refer to the 'Manual Hand Quadrant' section.

Step 4

If the actuator is either electric or pneumatic, then the operation type must be determined:

1) Two position – spring return *See tables on following pages*
2) Two position (power open – power closed) *See tables on following pages*
3) Floating (power open – power closed) *See tables on following pages*
4) Modulating – spring return *See tables on following pages*
5) Modulating (power open – power closed) *See tables on following pages*

1) **Two position – spring return:** This type of actuator will power to either the open or the closed position. When the power supply is removed (or turned off), the actuator will fail to the initial position by means of a spring.
2) **Two position (power open – power closed):** This type of actuator will power in either direction. When the power supply is removed (or turned off), the actuator will fail in place.
3) **Floating (power open – power closed):** This type of actuator is powered in both directions and will stop in any position. No spring is used.
4) **Modulating – spring return:** This type of actuator will power in either direction and will spring return upon power loss much like the two position actuators. The difference is that a control signal (4-20 mAdc, 0-10 Vdc, etc.) is used. The control signal acts much like a valve; as the signal is increased or decreased, the actuator will open or close or vice versa.
5) **Modulating (power open – power closed):** This type of actuator is the same as #3, except for its response to a control signal input (4-20 mAdc, 0-10 Vdc, etc.).

Step 5

If the actuator is pneumatic and needs to be modulating, a pilot positioner is required. A pilot positioner uses the control signal (usually 3-15 psi) to vary the amount of supply pressure entering the actuator. Please note that the use of a pilot positioner will decrease the square foot rating of the actuator by 20%. Consult factory.

Step 6

Once the actuator operation is determined, then the fail position must be known. There are two options:

1) Power open – fail close
2) Power close – fail open

* If a non-spring return actuator is required, then the fail positions above would become "fail in place."

Step 7

Auxiliary Switch – Separate switch in the actuator which can be wired to either make a circuit (Normally Open) or break a circuit (Normally Closed) when actuated.

Step 8

Determine if the actuator is to be:

1) Internally mounted: The actuator is mounted in the airstream.
2) Externally mounted: The actuator is mounted out of the airstream at factory in a sleeve or external sideplate
3) External kit: The actuator is installed out of the airstream in the field.

Step 9

At this point there may be more than one actuator from which to choose. So the final step is to determine which actuator will best operate the damper sizes needed. An actuator selection table is found on the following pages. If you need assistance, contact your local representative or Greenheck.

Section 4
Actuator Selection

Actuator Selection for Control Dampers

Model	Voltage	Frequency (Hz)	Torque (in. lbs.)	VCD Actuator Limitations* Maximum Damper Sq/Ft With Seals	VCD Actuator Limitations* Maximum Damper Sq/Ft Without Seals	VCDR Maximum Diameter (inches)	Description	Actuator Part #	External Mount Actuator Kit # (includes actuator)
Electric									
Two-position Spring Return*									
Belimo									
AFBUP	24 - 240	50/60	180	35	50	24		384376	863856
AFBUP-S			180	35	50	24	includes auxiliary SPDT end switches	384377	863857
TFB24 (TFB24-3)	24	50/60	22	4.5	6	24		384237	848933
TFB24-S (TFB24-3-S)	24	50/60	22	4.5	6	24	includes auxiliary SPDT end switches	384238	848934
FSLF24	24	50/60	30	7	12	24		383241	832778
FSLF24-S	24	50/60	30	7	12	24	includes auxiliary SPDT end switches	383394	832779
FSNF24	24	50/60	70	12	20	24		382889	834449
FSNF24-S	24	50/60	70	12	20	24	includes auxiliary SPDT end switches	382966	863862
LF24	24	50/60	35	7	12	24		381724	871844
LF24-S	24	50/60	35	7	12	24	includes auxiliary SPDT end switches	381725	871845
EFB24	24	50/60	270	35	50	24		475462	913978
EFB24-S	24	50/60	270	35	50	24	includes auxiliary SPDT end switches	475463	913980
EFB24-S N4	24	50/60	270	35	50	24	includes auxiliary SPDT end switches	475469	913981
TFB120	100 - 240	50/60	22	4.5	6	24		384241	848931
TFB120-S	100 - 240	50/60	22	4.5	6	24	includes auxiliary SPDT end switches	384236	848932
EFB120	100 - 240	50/60	270	35	50	24		475466	913975
EFB120-S	100 - 240	50/60	270	35	50	24	includes auxiliary SPDT end switches	475467	913976
EFB120-S N4	100 - 240	50/60	270	35	50	24	includes auxiliary SPDT end switches	475472	913977
EFCX120-S N4	100 - 240	50/60	270	35	50	24	includes auxiliary SPDT end switches	386345	913986
FSLF120	120	50/60	30	7	12	24		383242	832776
FSLF120-S	120	50/60	30	7	12	24	includes auxiliary SPDT end switches	383392	832777
FSNF120	120	50/60	70	12	20	24		382888	834450
FSNF120-S	120	50/60	70	12	20	24	includes auxiliary SPDT end switches	382965	834453
LF120	120	50/60	35	7	12	24		381722	876283
LF120-S	120	50/60	35	7	12	24	includes auxiliary SPDT end switches	381723	876284
FSLF230	230	50/60	30	7	12	24		383399	833249
FSLF230-S	230	50/60	30	7	12	24	includes auxiliary SPDT end switches	383400	833250
FSNF230	230	50/60	70	12	20	24		382963	834451
FSNF230-S	230	50/60	70	12	20	24	includes auxiliary SPDT end switches	382964	834454
Schneider Electric (formerly Invensys & TAC)									
MA6-318-500	24	60	60	25	50		Explosion proof enclosure with end switch	381661	868982
MA6-418-500	120	60	60	25	50		Explosion proof enclosure with end switch	380806	868983
MA6-419-500	240	60	60	25	50		Explosion proof enclosure with end switch	381595	868984
Consult factory for actuator applications on UL rated fire and smoke dampers.									

1 Unless otherwise specified, spring return actuators will be linked “power open - fail closed”, which is also called “normally closed” or “NC”. If “power closed - fail open” operation is desired, be sure to indicate this requirement. “Power closed - fail open” is also referred to as “normally open” or “NO”.

GREENHECK
Building Value in Air.

Actuator Selection for Control Dampers

Electric

Model	Voltage	Frequency (Hz)	Torque (in. lbs.)	VCD Actuator Limitations*			Description	Actuator Part #	External Mount
				Maximum Damper Sq/Ft		VCDR			
				With Seals	Without Seals	Maximum Diameter (inches)			Actuator Kit # (includes actuator)
Two-position Spring Return*									
Honeywell									
MS8104F1010/B	24	50/60	20	7	12	24		385162	870666
MS8104F1210/B	24	50/60	20	7	12	24	includes auxiliary SPDT end switches	385163	870667
MS8105A1130	24	50/60	44	9	12	24	includes auxiliary SPDT end switches	384189	849409
MS8109F1010/B	24	60	88	10	20	24		385168	870672
MS8109F1210/B	24	60	88	10	20	24	includes auxiliary SPDT end switches	385169	870673
MS8110A1206	24	50/60	88	17.5	20	24	includes auxiliary SPDT end switches	383818	849415
MS8120F1002	24	50/60	175	31	50	24		382824	880349
MS8120F1200	24	50/60	175	31	50	24	includes auxiliary SPDT end switches	383255	831682
MS4104F1010/B	120	60	20	7	12	24		385158	870662
MS4104F1210/B	120	60	20	7	12	24	includes auxiliary SPDT end switches	385159	870663
MS4109F1010/B	120	60	88	10	20	24		385164	870668
MS4109F1210/B	120	60	88	10	20	24	includes auxiliary SPDT end switches	385165	870669
MS4120F1006	120	60	175	31	50	24		382823	880347
MS4120F1204	120	60	175	31	50	24	includes auxiliary SPDT end switches	383024	831681
MS4604F1010/B	230	50/60	20	7	12	24		385160	870664
MS4604F1210/B	230	50/60	20	7	12	24	includes auxiliary SPDT end switches	385161	870665
MS4609F1010/B	230	60	88	10	20	24		385166	870670
MS4609F1210/B	230	60	88	10	20	24	includes auxiliary SPDT end switches	385167	870671
MS4620F1005	230	50/60	175	31	50	24		382825	880348
MS4620F1203	230	50/60	175	31	50	24	includes auxiliary SPDT end switches	383254	831683
Pneumatic									
Two-position Spring Return[1]									
331-4551	-	10	10	20	24			454130	868974
331-2976	-	30	25	50	24			454129	914987
331-2856	-	50	35	60	24			451919	914989
Modulating Spring Return[1]									
332-4551	-	10	8	20	24			457043	868975
332-2976	-	30	20	50	24			457384	914988
332-2856	-	50	35	60	24			457407	914990

Consult factory for actuator applications on UL rated fire and smoke dampers.

1 Unless otherwise specified, spring return actuators will be linked “power open - fail closed”, which is also called “normally closed” or “NC”. If “power closed - fail open” operation is desired, be sure to indicate this requirement. “Power closed - fail open” is also referred to as “normally open” or “NO”.

Model	Description	Part #
NEMA Housings		
Greenheck NEMA 4X housing kit (w/galv. mounting components)	Used on most brands of direct mount actuators	878264
Greenheck NEMA 4X housing kit (w/SS mounting components)	Used on most brands of direct mount actuators	878265
Greenheck NEMA 7 housing kit (for 1/2” jackshaft)	Used on most brands of direct mount actuators	878329
Greenheck NEMA 7 housing kit (for 1” jackshaft)	Used on most brands of direct mount actuators	878330
Transformers		
120V to 24V Transformer	Primary 120 VAC, secondary 24 VAC, Compatible on any 24 VAC actuator	385338
Multi-Voltage Transformer	Primary 480/277/240/208, secondary 120 VAC, Compatible on any 120 VAC actuator	385709

Section 4
Actuator Selection

GREENHECK
Building Value in Air.

Actuator Selection for Control Dampers

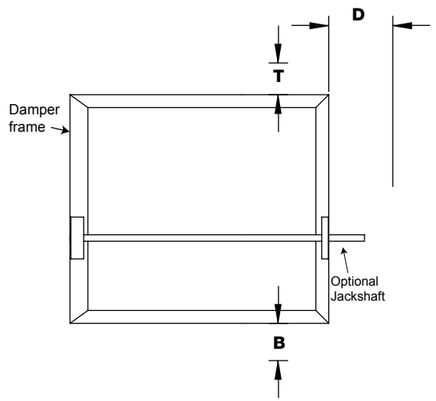
Electric

Model	Voltage	Frequency (Hz)	Torque (in. lbs.)	VCD Actuator Limitations			Description	Actuator Part #	External Mount
				Maximum Damper Sq/Ft		VCDR			
				With Seals	Without Seals	Maximum Diameter (inches)			Actuator Kit # (includes actuator)
Modulating Spring Return[1]									
Belimo									
AFB24-MFT	24	50/60	180	35	50	24		384374	863855
AFB24-MFT-S	24	50/60	180	35	50	24	includes auxiliary SPDT end switches	384375	863859
AFB24-SR	24	50/60	180	35	50	24		385250	872685
AFB24-SR-S	24	50/60	180	35	50	24	includes auxiliary SPDT end switches	385251	872686
LF24-SR	24	50/60	35	7	12	24		381737	833252
LF24-SR-S	24	50/60	35	7	12	24	includes auxiliary SPDT end switches	383011	833253
NFB24-SR	24	50/60	90	17.5	20	24		384372	863860
NFB24-SR-S	24	50/60	90	17.5	20	24	includes auxiliary SPDT end switches	384373	849251
TFB24-MFT	24	50/60	22	4.5	6	24		385997	878054
TFB24-MFT-S	24	50/60	22	4.5	6	24	includes auxiliary SPDT end switches	385998	878055
TFB24-SR	24	50/60	22	4.5	6	24		384239	848935
TFB24-SR-S	24	50/60	22	4.5	6	24	includes auxiliary SPDT end switches	384240	848936
EFB24-SR	24	50/60	270	35	50	24		475464	913982
EFB24-SR-S	24	50/60	270	35	50	24	includes auxiliary SPDT end switches	475465	913984
EFB24-SR-S N4	24	50/60	270	35	50	24	includes auxiliary SPDT end switches	475471	913985
Honeywell									
MS7505A2030	24	50/60	44	9	12	24		384187	849411
MS7505A2130	24	50/60	44	9	12	24	includes auxiliary SPDT end switches	384133	849410
MS7510A2008	24	50/60	88	17.5	20	24		383739	849413
MS7510A2206	24	50/60	88	17.5	20	24	includes auxiliary SPDT end switches	383213	849414
MS7520A2015 (/B)	24	50/60	175	31	50	24		383785	849417
MS7520A2213 (/B)	24	50/60	175	31	50	24	includes auxiliary SPDT end switches	383784	849416
Modulating NON Spring Return									
LMB24-SR	24	50/60	45	7	12	24		381728	833286
NMB24-SR	24	50/60	90	12	20	24		381138	833288
AMB24-SR	24	50/60	180	35	50	24		382131	833290
Floating PO/PC									
LMB24	24	50/60	45	7	12	24		381726	833284
LMB24-S	24	50/60	45	7	12	24	includes auxiliary SPDT end switches	381727	833285
AMB24-3	24	50/60	180	35	50	24		382132	833289
NMB24-3	24	50/60	90	12	20	24		381601	833287
Manual Hand Quadrant									
1/2 in. diameter shaft - For use on all VCD's								811518	815607
1 in. diameter shaft - For use on all VCD's								842633	813938

1 Unless otherwise specified, spring return actuators will be linked “power open - fail closed”, which is also called “normally closed” or “NC”. If “power closed - fail open” operation is desired, be sure to indicate this requirement. “Power closed - fail open” is also referred to as “normally open” or “NO”.

Space Envelopes

On dampers less than 18 in. (457mm) high, actuators may also require clearances above and/or below the damper frame. “B” and “T” ***dimensions are worst case clearance requirements for some dampers less than 18 in.*** (457mm) ***high***. All damper sizes under 18 in. (457mm) high do not require these worst case clearances. If space availability above or below the damper is limited, each damper size should be individually evaluated.



Actuator Type/Model	Height	T	B	D
	Inches (mm)	Inches (mm)		
AFBUP (-S) and FSNF Series, Belimo MSxx20 Series, Honeywell; 33x-2976 Series, Siemens	≥6 to <10	0	12.75	6
	≥10 to <18	0	2	6
	≥18	0	0	6
FSLF, LF and TFB Series, Belimo	≥6 to <10	0	3.5	6
	≥10	0	0	6
MSxx04 & MSxx09 Series, Honeywell	≥6 to <9	0	4.75	6
	≥9	0	0	6
MS75xx Series, Honeywell	≥6 to <10	0	12.75	6
	≥10 to <18	0	7	6
	≥18	0	0	6
33x-4551 Series, Siemens	≥6 to <10	0	7.5	6
	≥10 to <17	0	1.5	6
	≥17	0	0	6
331-2856, Siemens	≤12	N/A	N/A	N/A
	>12 to <18	0	2.5	9
	≥18	0	0	9

Section 5 – Damper Model Selection.

The following charts are designed to aid you the user in determining which model of Greenheck damper is required based on the blade and frame style, blade and frame material type and thickness, the required bearings, linkage, and seals, the maximum sizes, and most importantly the maximum pressure and velocity ratings.

Once the desired damper model is selected, than the specific frame type and accessories can be chosen to ensure the damper will be able to be mounted into your opening as required.

	X = Standard O = Optional	VCD-20	VCD-20V	VCD-23	VCD-23V	VCD-33	VCD-33V	VCD-34	VCD-40
Blade Profile	Single Blade								
	3V	X		X					
	3V-Vertical Blade		X		X				
	Airfoil					X			X
	Airfoil-Vertical Blade						X		
	Airfoil-Insulated							X	
Frame Material	Galvanized	X	X	X	X	X	X	X	
	304 Stainless Steel	0	0	0	0	0	0	0	
	316 Stainless Steel								
	Aluminum								X
Blade Material	Galvanized	X	X	X	X	X	X	X	
	304 Stainless Steel	0	0	0	0	0	0	0	
	316 Stainless Steel								
	Aluminum								X
Frame Gauge	20								
	16	X	X	X	X	X	X	X	
	12	0	0	0	0	0	0	0	
	Aluminum								.125 (3.2)
Blade Seals	TPE			X	X	X	X	X	X
	Silicone			0	0	0	0	0	0
Jamb Seals	Stainless Steel			X	X	X	X	X	X
	316 Stainless Steel								
Bearings	Synthetic	X	X	X	X	X	X	X	X
	316 Stainless Steel	0	0	0	0	0	0	0	0
Axles	Steel	X	X	X	X	X	X	X	X
	316 Stainless Steel	0	0	0	0	0	0	0	0
Linkage Material	Steel	X	X	X	X	X	X	X	X
	316 Stainless Steel	0	0	0	0	0	0	0	0
Accessories	Sleeves	0	0	0	0	0	0	0	
	Transitions	0	0	0	0	0	0	0	
	Actuators*	0	0	0	0	0	0	0	0
	Flanges**	0	0	0	0	0	0	0	0
	Retaining Angles	0	0	0	0	0	0	0	0
	Security Bars	0	0	0	0	0		0	
Sizing inches (mm)	Minimum Size	6x6 (152x152)	6x6 (152x152)	6x6 (152x152)	6x6 (152x152)	6x6 (152x152)	6x6 (152x152)	6x6 (152x152)	6x6 (152x152)
	Maximum Single Section Size	48x74 (1219x1880)	74x48 (1880x1219)	48x74 (1219x1880)	74x48 (1880x1219)	60x74 (1524x1880)	74x60 (1880x1524)	60x74 (1524x1880)	60x74 (1524x1880)
	Maximum Multi-Section Size	Unlimited	148x96 (3759x2438)	Unlimited	148x96 (3759x2438)	Unlimited	148x96 (3759x2438)	Unlimited	Unlimited
Ratings	Max. Velocity ft/min. (m/s)	3000 (15.2)	3000 (15.2)	3000 (15.2)	3000 (15.2)	4000 (20.3)	4000 (20.3)	4000 (20.3)	6000 (30.5)
	Max. Pressure in. wg (kPa)	5 (1.2)	5 (1.2)	5 (1.2)	5 (1.2)	10 (2.5)	10 (2.5)	10 (2.5)	6 (1.5)

*Actuators include manual, 24V, 120V, 240V, and pneumatic.

**Flanges include single, single reverse, and double flange.

***The inside of the blade is not painted on airfoil blade dampers.

	X = Standard O = Optional	VCD-42	VCD-42V	VCD-43	VCD-43V	SEVCD-23	SEVCD-33	VCDR-50	VCDR-53	VCDRM-50	VCDRM-53
Blade Profile	Single Blade							X	X		
	3V					X				X	X
	3V-Vertical Blade										
	Airfoil	X		X			X				
	Airfoil-Vertical Blade		X		X						
	Airfoil-Insulated										
Frame Material	Galvanized	X	X					X	X	X	X
	304 Stainless Steel							0	0	0	0
	316 Stainless Steel					X	X				
	Aluminum			X	X						
Blade Material	Galvanized							X	X	X	X
	304 Stainless Steel							0	0	0	0
	316 Stainless Steel					X	X				
	Aluminum	X	X	X	X						
Frame Gauge	20							X	X		
	16	X	X			X	X	0	0		
	14							0	0	X	X
	12	0	0								
	10									0	0
	Aluminum			.125 (3.2)	.125 (3.2)						
Blade Seals	EPDM								X		Vinyl
	TPE	X	X	X	X	X	X				
	Silicone	0	0	0	0	0	0		0		
Jamb Seals	Stainless Steel	X	X	X	X						X
	316 Stainless Steel					X	X				
Bearings	Synthetic	X	X	X	X						
	Bronze							X	X		
	316 Stainless Steel	0	0	0	0	X	X	0	0	X	X
Axles	Steel	X	X	X	X			X	X	X	X
	316 Stainless Steel	0	0	0	0	X	X	0	0	0	0
Linkage Material	Steel	X	X	X	X					X	X
	316 Stainless Steel	0	0	0	0	X	X			0	0
Accessories	Sleeves	0	0	0	0	0	0				
	Transitions	0	0			0	0				
	Actuators*	0	0	0	0	0	0	0	0	0	0
	Flanges**	0	0	0	0	0	0				
	Retaining Angles	0	0			0	0				
	Security Bars	0									
Sizing inches (mm)	Minimum Size	6x6 (152x152)	6x6 (152x152)	6x6 (152x152)	6x6 (152x152)	6x6 (152x152)	6x6 (152x152)	4 (102)	4 (102)	10 (254)	10 (254)
	Maximum Single Section Size	60x74 (1524x1880)	74x60 (1880x1524)	60x74 (1524x1880)	74x60 (1880x1524)	48x74 (1219x1880)	60x74 (1524x1880)	24 (610)	24 (610)	36 (914)	36 (914)
	Maximum Multi-Section Size	Unlimited	148x96 (3759x2438)	288 x 222 (7315 x 5639)	148x96 (3759x2438)	Unlimited	Unlimited	NA	NA	NA	NA
Ratings	Max. Velocity ft/min. (m/s)	6000 (30.5)	6000 (30.5)	6000 (30.5)	6000 (30.5)	3000 (15.2)	4000 (20.3)	3000 (15.2)	3000 (15.2)	2500 (12.7)	2500 (12.7)
	Max. Pressure in. wg (kPa)	6 (1.5)	6 (1.5)	10 (2.5)	6 (1.5)	5 (1.2)	10 (2.5)	4 (1)	4 (1)	5 (1.2)	5 (1.2)

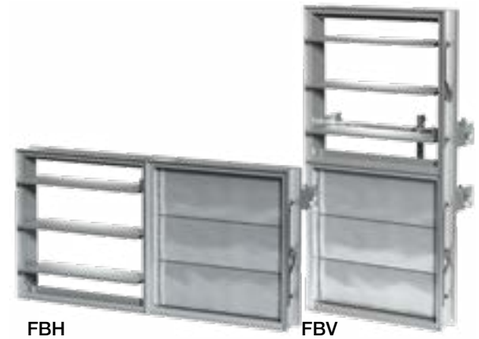
*Actuators include manual, 24V, 120V, 240V, and pneumatic.

**Flanges include single, single reverse, and double flange.

***The inside of the blade is not painted on airfoil blade dampers.

Face & Bypass Dampers

The face and bypass dampers are used in applications where two dampers are connected together allowing one damper to open while the other damper closes. The FBH series is horizontal style (side-by-side). The FBV series is vertical style (stacked).



FBH FBV

	X = Standard O = Optional	FBH-23	FBV-23	FBH-33	FBV-33	FBH-43	FBV-43
Style	Horizontal	X		X		X	
	Vertical		X		X		X
Blade Profile	3V	X	X				
	Airfoil			X	X	X	X
Frame Material	Galvanized	X	X	X	X		
	Aluminum					X	X
Blade Material	Galvanized	X	X	X	X		
	Aluminum					X	X
Frame Gauge	16	X	X	X	X		
	12	0	0	0	0		
	Aluminum					.125 (3.2)	.125 (3.2)
Blade Seals	TPE	X	X	X	X	X	X
	Silicone	0	0	0	0	0	0
Jamb Seals	Stainless Steel	X	X	X	X	X	X
Bearings	Synthetic	X	X	X	X	X	X
	316 Stainless Steel	0	0	0	0	0	0
Axles	Steel	X	X	X	X	X	X
	316 Stainless Steel	0	0	0	0	0	0
Linkage Material	Steel	X	X	X	X	X	X
	316 Stainless Steel	0	0	0	0	0	0
Accessories	Actuators	0	0	0	0	0	0
Sizing inches (mm)	Minimum Size	8x6 (203x152)	8x6 (203x152)	8x6 (203x152)	8x6 (203x152)	8x6 (203x152)	8x6 (203x152)
	Maximum Single Section Size	48x74 (1219x1880)	48x74 (1219x1880)	60x74 (1524x1880)	60x74 (1524x1880)	60x74 (1524x1880))	60x74 (1524x1880)
	Maximum Multi-Section Size	96x74 (2438X1880)	96x74 (2438X1880)	96x74 (2438X1880)	96x74 (2438x1880)	96x74 (2438x1880)	96x74 (2438x1880)
Ratings	Max. Velocity ft/min. (m/s)	3000 (15.2)	3000 (15.2)	4000 (20.3)	4000 (20.3)	6000 (30.5)	6000 (30.5)
	Max. Pressure in. wg (kPa)	5 (1.2)	5 (1.2)	10 (2.5)	10 (2.5)	6 (1.5)	6 (1.5)

*Actuators include manual, 24V, 120V, 240V, and pneumatic.

Features:

- 316 stainless steel construction is standard
- Blade styles
  - 3V (SEVCD-23). The 3V blades are fabricated from a single thickness of 316 stainless steel incorporating three lengthwise structural V grooves running the length of the blade.
  - Airfoil (SEVCD-33). The airfoil blades are constructed of double skin 316 stainless steel. This blade design presents a lower resistance to airflow.
- SEVCD-23
  - Minimum size: 6 x 6 in. *(152 x 152 mm)*
  - Maximum multi-section size: Unlimited
  - AMCA licensed to bear the AMCA Air Performance seal
  - Pressure up to 5 in. wg (*1.2 kPa*)
  - Velocity up to 3000 fpm (*1.52 m/s*)
- SEVCD-33
  - Minimum size: 6 x 6 in. *(152 x 152 mm)*
  - Maximum multi-section size: Unlimited
  - Pressure rating up to 10 in. wg (*2 kPa*)
  - Velocity up to 4000 fpm (*20.3 m/s*)

SEVCD-23

SEVCD-33

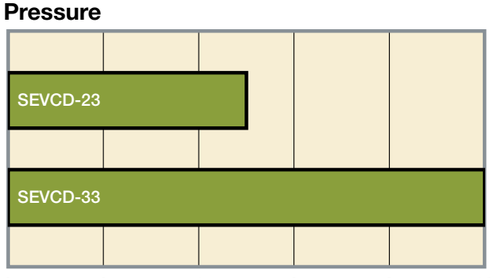
Available upon request:

- NEMA 4X housing for actuators
  - Watertight, corrosion-resistant, and dust tight indoor or outdoor enclosure
  - Plastic housing
- NEMA 7 housing for actuators
  - Explosion-proof enclosure
  - Cast aluminum housing

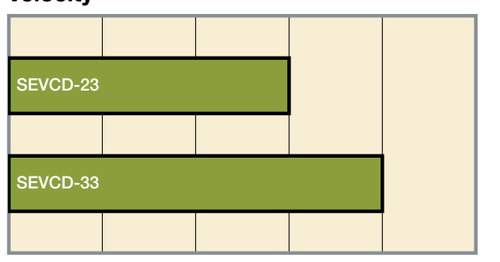
NEMA 4X

NEMA 7

Pressure



Velocity



Greenheck's ICD dampers were developed for applications where it is necessary to minimize the thermal transfer and reduce condensation. ICD series dampers meet Class 1A leakage of less than 3 cfm/sq. ft. @ 1 in. wg (55 cmh/m² @ .25 kPa). ICD series dampers can be used in applications down to -70°F (-56°C) and up to 200°F (93°C) for:

- Cold food storage warehouses
- Buildings/warehouse
- Rooftop intake or exhaust

		ICD-44	ICD-45
Maximum Velocity - ft/min. (m/s)		4000 (20.3)	4000 (20.3)
Maximum Pressure - in. wg (kPa)		8 (2)	8 (2)
Thermal Efficiency Ratio (E)		593%	941%
Temperature Range - °F (C°)		-70 to 200 (-56 to 93)	-70 to 200 (-56 to 93)
Frame	Insulated Thermally Broken Aluminum	-	X
	Aluminum	X	-
Frame Type	Channel	X	0
	Quick Connect	0	X
	Reverse Flange	0	0
	Single Flange	0	0
Blade Action	Parallel	0	0
	Opposed	X	X
Blade Type	Insulated Thermally Broken	X	X
Blade Material	Extruded Aluminum Airfoil	X	X
Blade Seal	Silicone	X	X
Jamb Seal	Stainless Steel	X	-
	Silicone	0	X

X = Standard 0 = Options

Energy Efficiency Performance

Greenheck Model ICD-44 has a Thermal Efficiency Ratio of 593%.

A damper's Thermal Efficiency Ratio (E) is a comparison of the thermal performance of the tested damper with that of a standard reference damper, which is a 3V blade damper with blade and jamb seals. A damper with the same thermal efficiency as the reference damper would have an E of 0%. A damper that is twice as efficient as the reference damper would have an E of 100%.

Test Information
Testing was conducted on a 36 in. x 36 in. (914mm x 914mm) sample in AMCA 500-D figure 5.10 per AMCA standard 500-D's Thermal Efficiency test.

Torque
Data are based on a torque of 9.0 in.lb./ft² (0.56 N·m) applied to close and seat the damper during the test.

Greenheck Model ICD-45 has a Thermal Efficiency Ratio of 941%.

Test Information
Testing was conducted on a 36"x36" sample in AMCA 500-D figure 5.10 per AMCA standard 500-D's Thermal Efficiency test.

Torque
Data are based on a torque of 9.0 in.lb./ft² (0.56 N·m) applied to close and seat the damper during the test.

Greenheck GREEN
Supporting Green Building Initiatives Worldwide

AMS Series

The AMS is an accurate airflow measuring station furnished with a properly sized pressure transducer that outputs a 0-10 VDC signal proportional to airflow. A field supplied controller can use the transducer's voltage signal along with the flow formula (provided) to control a modulating actuator to a target set point.

The AMS is available with a factory supplied controller that accepts a target flow set point (either analog or digital). 0-10 VDC outputs are available for actual airflow reading and modulation of an external airflow control device (such as a damper or VFD).

AMS

AMD Series

The AMD series combines the functionality of an accurate airflow measuring station and a low leakage control damper into one compact assembly that both measures and controls airflow volume to a target set-point. These models come standard with a modulating actuator and a properly sized pressure transducer that outputs a signal proportional to airflow. A field supplied controller can use the transducer's voltage signal along with the flow formula (provided) to regulate a modulating actuator to the target set point.

The AMD series is available with a factory supplied controller that accepts an analog input that is proportional to a target flow set point. The controller outputs a 0-10 VDC which is signal proportional to the airflow volume.

AMD-23

AMD-33-TD

AMD-TD Series

The AMD-TD series combines the functionality of a highly accurate thermal dispersion airflow station and a low leakage control damper to control airflow volumes to a target set-point. These models come standard with Vari-Green thermal dispersion probes factory installed in the damper sleeve, a modulating actuator and a Vari-Green airflow measurement transmitter that outputs a signal proportional to the airflow going through the unit. The transmitter and actuator are factory wired to a terminal block for easy single-point wiring.

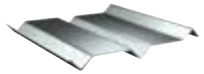
Factory supplied controllers configured for analog operation accept a 0-10 VDC setpoint signal proportional to the airflow going through the unit. The controllers can be configured with BACnet MS/TP communication capabilities. This option makes the AMD-TD series a turn-key solution for the measurement and control of airflow.

AMD-42V-TD

Blade Styles

3V blades are fabricated from a single thickness of galvanized steel incorporating three longitudinal V-type grooves running the full length of the blade to increase strength.

Airfoil blades are constructed of double-skin galvanized steel or extruded aluminum. This blade design results in lower resistance to airflow and increased strength for use in pressure systems.



3V Blade

AMD-23

AMD-23-TD

Fabricated Airfoil

AMD-33

AMD-33-TD

Extruded Airfoil

AMD-42

AMD-42V

AMD-42-TD

AMD-42V-TD

Blade Operation

Damper blades operate parallel to one another for precise airflow volume control.

No Field Calibration

Greenheck's AMD and AMD-TD series do not require field calibration. A label is provided on the AMD series that gives the formula to convert pressure to a flow value that you can program into your controller. The AMD-TD series has a transmitter that give the flow value.

AMD Label

		AMS	AMD-23 AMD-33	AMD-42	AMD-42V	AMD-23-TD AMD-33-TD	AMD-42-TD	AMD-42V-TD
Velocity range ft/min (m/s)	Minimum	300 (1.5)	300 (1.5)	300 (1.5)	300 (1.5)	0	0	0
	Maximum	2000 (10.2)	2000 (10.2)	3000 (10.2)	2000 (10.2)	2000 (10.2)	3000 (10.2)	3000 (10.2)
Accuracy		5%	5%	5%	5%	2-3%	2-3%	2-3%
Temperature range °F (°C)	Minimum	-20° (-29°)	-20° (-29°)	-20° (-29°)	-20° (-29°)	-20° (-29°)	-20° (-29°)	-20° (-29°)
	Maximum	180° (82°)	180° (82°)	180° (82°)	180° (82°)	140° (60°)	140° (60°)	140° (60°)
Ambient temperature readout						✓	✓	✓
Factory supplied transducer		✓	✓	✓	✓			
Factory supplied transmitter						✓	✓	✓
Factory supplied controller		O	O	O	O	O	O	O
Airflow straightener		✓	✓	✓	✓	O	O	O
Minimum Unit depth inches (mm)		8 (203)	12 (305)	12 (305)	12 (305)	16 (406)	16 (406)	16 (406)
Minimum Size inches (mm)		6 x 8 (152 x 203)	6 x 6 (152 x 152)					
Maximum size inches (mm)		60 x 48 (1524 x 1219)	144 x 148 (3658 x 3759)	144 x 148 (3658 x 3759)	74 x 48 (1880 x 1219)	120 x 120 (3048 x 3048)	120 x 120 (3048 x 3048)	74 x 60 (1880 x 1524)
Quick Build program available		✓	✓	✓	✓			

Section 5
Backdraft Dampers EM, ES, & GM Series

GREENHECK
Building Value in Air.

EM and ES series are extruded aluminum backdraft dampers that open by air pressure differential and close by gravity.

ES Series

ES dampers are an extruded standard series damper rated for velocities up to 2000 ft/min. (10.2 m/s) and pressure up to 2.5 in. wg (0.6 kPa).

Options available are:

- Flanges 1½ in. (38mm)
- Birdscreen or Insect screen

EM Series

EM dampers are an extruded medium series damper rated for velocities of 2500 to 3500 ft/min. (12.7 to 17.8 m/s) and pressure of 4 to 10 in. wg (1 kPa to 2.5 kPa).

Options available are:

- Flanges 1½ in. (38mm)
- Adjustable pressure controller (APC) used for field-setting of relief pressure
- Paint finishes

GM Series

GM dampers have a galvanized steel frame with extruded aluminum blades.

Flanged EM Series with APC (Adjustable Pressure Controller)

Commercial Backdraft (EM, ES, and GM Series) Quick Selection Guide

Model	Material		Counter-balance Weights	Mounting Position	Airflow Direction	Flange	Maximum Velocity ft/min. (m/s)	Maximum Back Pressure in. wg (kPa)	Start-Open Pressure* in. wg (kPa)
	Frame	Blade							
EM-10	Aluminum	Aluminum	Std	H	Vertical Up	No	3500 (17.8)	10 (2.5)	0.05 (0.01)
EM-11			Std	H	Vertical Up	Discharge	3500 (17.8)	10 (2.5)	0.05 (0.01)
EM-12			Std	H	Vertical Up	Intake	3500 (17.8)	10 (2.5)	0.05 (0.01)
EM-30			Opt	V	H	No	3500 (17.8)	10 (2.5)	0.03 (0.01)[1] 0.01 (0.002)[2]
EM-31			Opt	V	H	Discharge	3500 (17.8)	10 (2.5)	0.03 (0.01)[1] 0.01 (0.002)[2]
EM-32			Opt	V	H	Intake	3500 (17.8)	10 (2.5)	0.03 (0.01)[1] 0.01 (0.002)[2]
EM-40			Std	H	Vertical Down	No	3500 (17.8)	10 (2.5)	0.07 (0.017)
EM-41			Std	H	Vertical Down	Discharge	3500 (17.8)	10 (2.5)	0.07 (0.017)
EM-42			Std	H	Vertical Down	Intake	3500 (17.8)	10 (2.5)	0.07 (0.017)
ES-10			Std	H	Vertical Up	No	2000 (10.2)	2.5 (0.6)	0.035 (0.008)
ES-11			Std	H	Vertical Up	Discharge	2000 (10.2)	2.5 (0.6)	0.035 (0.008)
ES-12			Std	H	Vertical Up	Intake	2000 (10.2)	2.5 (0.6)	0.035 (0.008)
ES-30			Opt	V	H	No	2000 (10.2)	2.5 (0.6)	0.05 (0.012)[1] 0.015 (0.004)[2]
ES-31			Opt	V	H	Discharge	2000 (10.2)	2.5 (0.6)	0.05 (0.012)[1] 0.015 (0.004)[2]
ES-32			Opt	V	H	Intake	2000 (10.2)	2.5 (0.6)	0.05 (0.012)[1] 0.015 (0.004)[2]
ES-40			Std	H	Vertical Down	No	2000 (10.2)	2.5 (0.6)	0.075 (0.019)
ES-41			Std	H	Vertical Down	Discharge	2000 (10.2)	2.5 (0.6)	0.075 (0.019)
ES-42			Std	H	Vertical Down	Intake	2000 (10.2)	2.5 (0.6)	0.075 (0.019)
GM-30	Galvanized Steel	Aluminum	Std	V	H	No	2500 (13)	4 (1)	0.03 (0.01)[1] 0.01 (0.002)[2]
GM-31			Std	V	H	Discharge	2500 (13)	4 (1)	0.03 (0.01)[1] 0.01 (0.002)[2]
GM-32			Std	V	H	Intake	2500 (13)	4 (1)	0.03 (0.01)[1] 0.01 (0.002)[2]

H = Horizontal; V = Vertical; N/A = Not Available; Opt = Optional; Std = Standard; [1] = w/o weights; [2] = w/ weights
* Note that start-open is the pressure at which damper blades just begin to rotate, blades are not fully open at this point.
Damper size and bearing selection may cause start-open pressure to vary from this value.

Section 6
Codes

GREENHECK
Building Value in Air.

The purpose of this document is to inform air handler manufacturers and contractors how utilizing Greenheck dampers will help meet the requirements of California Title 24, and ASHRAE 90.1 as they pertain to economizers and dampers used in the air handlers. ASHRAE 90.1 is a standard of which the International Energy Conservation Code (IECC) required in most States, references for certain requirements, and California Title 24 is the energy code that the State of California utilizes and is also being actively reviewed for adoption by other Sates. The specific sections of the Code and Standard that apply are listed below along with which Greenheck damper products meet the specific requirements.

California Title 24 December 2018

Section 120.1(f).2&3
Design and Control Requirements for Quantities of Outdoor Air

This section requires that the outdoor airflow if measured, be maintained within 10 percent of required outdoor air rate. The Greenheck AMD, & AMD-TD, models meet the requirements and come as a packaged unit that has been tested on our AMCA accredited chamber and verified to maintain accuracies within +/-5%. You do not need to source a damper and flow pickup stations from separate manufacturers, figure out how to install them and then hope the system is accurate to meet requirements, Greenheck has an accurate turn-key assembly available for you to utilize.

If airflow is controlled but not measured, the Greenheck VCD damper models VCD-23, 33, 42, and 43, meet the requirements and can be ordered in a configuration to make mounting the damper quick and easy.

Section 120.2(f)
Dampers for Air Supply and Exhaust Equipment

This section requires the fans to have Volume Control Dampers (VCD) which close automatically upon fan shutdown. The same as above applies for this requirement where the Greenheck VCD and AMD models of dampers can be utilized for these applications.

Section 140.4(e) Economizers.

1A. This section requires that the outside air damper for any system with a total design cooling capacity over 54,000 BTU/hr be large enough to allow the entire amount of air to pass through the outside air damper when the damper is in the full open position. The historically typical configuration utilizing the airflow through two smaller dampers for return air and outside air added together to reach the design air quantity is not allowed.

2D(ii). This section indicates that the damper must pass a 60,000 cycle test and still work as intended.

2D(iii). This section requires that dampers be certified and have a maximum leakage rate of 10 cfm/ft² at 1inch of water gauge when tested in accordance with AMCA 500D. The code makes no mention of specific requirements for credentials of the person or organization certifying the leakage of the dampers.

Greenheck VCD-23, 33, 42, and 43, ICD-44, and 45, AMD, and AMD-TD models meet the requirements of A, B, and C in this section. By selecting the appropriate model, Greenheck dampers are AMCA certified Class 1A and Class 1 leakage rated. Greenheck dampers have been tested to 100,000 cycles and easily pass the 60,000 cycle test requirement.

Greenheck also has the capability of making the entire economizer to your specification, which could be fastened into your air handler as a complete assembly. Greenheck can also provide a 5 year warranty option to meet the economizer warranty requirement.

Section 150.0.(m)
Air-Distribution and Ventilation System Ducts, Plenums, and Fans.

7. Backdraft Dampers

This section requires that a backdraft or automated volume control damper is required to isolate outside air from the remainder of the system and prevent unintended air leakage when the system is not in use. Greenheck has dampers that meet and exceed the requirements.

8. Gravity Ventilation Dampers

This section requires all gravity ventilating systems serving conditioned spaces include either automatic dampers or accessible manual dampers to isolate the system from the outside air unless serving a combustion inlet, outlet, or elevator shaft vent.

ASHRAE Standard 90.1 – 2016

Energy Standards for Buildings with the Exception of Low-Rise Residential

6.4.3.3.4 Zone Isolation

This section requires that control dampers with the capability to close automatically be used to isolate each area that supplies conditioned air, outdoor air, and exhaust air. The Greenheck VCD-23, 33, 42, and 43, damper models will meet this requirement.

6.4.3.4.1 Stair and Shaft Vents

This section requires that stairwell and shaft vents be equipped with motorized dampers that are capable of being open/closed automatically. Greenheck VCD-23, 33, 42, and 43 damper models would meet this requirement. In the event that a Smoke damper is specified Greenheck Smoke dampers also meet these requirements.

6.4.3.4.2 Shutoff Damper Controls

This section requires that motorized dampers be installed in all outdoor air intake and exhaust systems on buildings 3 stories and taller unless located in climate zones 0, 1, 2 or 3, where backdraft dampers are then acceptable. Greenheck VCD-23, 33, 42, and 43 damper models would meet this requirement for automatic shutoff, or Greenheck EM models meet the backdraft damper requirements.

6.4.3.4.3 Damper Leakage

This section requires that dampers have a maximum leakage rate as indicated in table 6.4.3.4.3 that is dependent on several factors which include specific climate zones, whether a damper is motorized or non-motorized (Backdraft) and whether the building is 3 stories or taller. Greenheck VCD-23, 33, 42, and 43 dampers which carry Class 1A and Class 1 leakage ratings meet the motorized damper requirements and Greenheck Backdraft dampers that are smaller than 24" square also meet this requirement for Non-motorized dampers.

6.5.1.1.1 Design Capacity

This section requires that the outside air damper be large enough to allow the entire amount of air that the system is designed for, to pass through when the damper is in the full open position. The historically typical configuration that utilizes two smaller dampers for return air and outside air added together is not allowed to reach the design air quantity. This is so that when cooling is required, 100% of the air can be cooled free. Greenheck VCD-23, 33, 42, and 43 damper models meet this requirement.

6.5.1.1.4 Dampers

This section requires that return, exhaust/relief, and outdoor air dampers shall meet the requirements of Section 6.4.3.4.3 Ventilation System Controls. Greenheck VCD-23, 33, 42, and 43 damper models meet this requirement.

6.5.3.1.1 Fan System Power and Efficiency

This section applies to the amount of power that a fan uses and where credits are given for return and/or exhaust airflow control devices ie. Directly measuring airflow, and although a smaller impact the pressure loss of a damper which negatively affects the brake horsepower of a fan system. The result of a damper with lower pressure drop being an advantage for the design professional to utilize equipment that uses less power. Utilization of Greenheck AMD, and AMD-TD air measuring damper models would eliminate over-tempering air.

6.5.6.1 Exhaust Air Energy Recovery

This section requires that air be allowed to either bypass the energy recovery system or that it be capable of being turned off to permit the economizer to function properly as required by section 6.5.1.1. Air handlers will need low pressure drop options for the air to bypass an energy wheel for example. Greenheck VCD-23, 33, 42, and 43 model dampers would be the best option to meet this requirement providing the low pressure drop option and positive shutoff with low leakage when in the closed position.

IECC - 2015

C403.2.4.3 Shutoff dampers.

This section states that gravity (non-motorized) dampers shall have an air leakage rating not greater than 20 cfm/ft^2 where not less than 24 inches in either dimension and 40 cfm/ft^2 where less than 24 inches in either direction. The rate of air leakage shall be determined at 1 inch water gauge when tested in accordance with AMCA 500D for such purpose. The dampers shall be labeled by an approved agency. Greenheck BD, EM-30, ES-10, and ES-30 series backdraft dampers meet these requirements.

Additional Information For California Title 24 December 2018

Section 120.1(f)
Design and Control Requirements for Quantities of Outdoor Air.

1. All mechanical ventilation and space-conditioning systems shall be designed with and have installed ductwork, dampers, and controls to allow outside air rates to be operated at the larger of (1) the minimum levels specified in Section 120.1(c)3 or (2) the rate required for make-up of exhaust systems that are required for an exempt or covered process, for control of odors, or for the removal of contaminants within the space.
2. All variable air volume mechanical ventilation and space-conditioning systems shall include dynamic controls that maintain measured outside air ventilation rates within 10 percent of the required outside air ventilation rate at both full and reduced supply airflow conditions. Fixed minimum damper position is not considered to be dynamic and is not an allowed control strategy.
3. Measured outdoor air rates of constant volume mechanical ventilation and space-conditioning systems shall be within 10 percent of the required outside air rate.

Section 120.2 (f)
Dampers for Air Supply and Exhaust Equipment.

Outdoor air supply and exhaust equipment shall be installed with dampers that automatically close upon fan shutdown.

EXCEPTION 1 to Section 120.2(f): Where it can be demonstrated to the satisfaction of the enforcing agency that the equipment serves an area that must operate continuously.

EXCEPTION 2 to Section 120.2(f): Gravity and other nonelectrical equipment that has readily accessible manual damper controls.

Section 6
Codes

GREENHECK
Building Value in Air.

EXCEPTION 3 to Section 120.2(f): At combustion air intakes and shaft vents.

EXCEPTION 4 to Section 120.2(f): Where prohibited by other provisions of law.

Section 140.4(e)
(e) Economizers.

1. Each cooling fan system that has a design total mechanical cooling capacity over 54,000 Btu/hr shall include either:
   A. An air economizer capable of modulating outside-air and return-air dampers to supply 100 percent of the design supply air quantity as outside-air; or
   B. A water economizer capable of providing 100 percent of the expected system cooling load as calculated in accordance with a method approved by the Commission, at outside air temperatures of 50°F dry-bulb and 45°F wet-bulb and below.

EXCEPTION 1 to Section 140.4(e)1: Where special outside air filtration and treatment, for the reduction and treatment of unusual outdoor contaminants, makes compliance infeasible.

EXCEPTION 2 to Section 140.4(e)1: Where the use of outdoor air for cooling will affect other systems, such as humidification, dehumidification, or supermarket refrigeration systems, so as to increase overall building TDV energy use.

EXCEPTION 3 to Section 140.4(e)1: Systems serving high-rise residential living quarters and hotel/motel guest rooms.

EXCEPTION 4 to Section 140.4(e)1: Where cooling systems have the cooling efficiency that meets or exceeds the cooling efficiency improvement requirements in TABLE 140.4-D.

EXCEPTION 5 to Section 140.4(e)1: Fan systems primarily serving computer room(s). See Section 140.9(a) for computer room economizer requirements.

EXCEPTION 6 to section 140.4(e)1: Systems design to operate at 100 percent outside air at all times.

Table 140.4-D Economizer Trade-Off Table For Cooling Systems

Climate Zone	Efficiency Improvement[a]
1	70%
2	65%
3	65%
4	65%
5	70%
6	30%
7	30%
8	30%
9	30%
10	30%
11	30%
12	30%
13	30%
14	30%
15	30%
16	70%

[a] If a unit is rated with an IPLV, IEER or SEER, then to eliminate the required air or water economizer, the applicable minimum cooling efficiency of the HVAC unit must be increased by the percentage shown. If the HVAC unit is only rated with a full load metric, such as EER or COP cooling, then that metric must be increased by the percentage shown.

2. If an economizer is required by Section 140.4(e)1, and an air economizer is used to meet the requirement, then it shall be:
   A. Designed and equipped with controls so that economizer operation does not increase the building heating energy use during normal operation; and

EXCEPTION to Section 140.4(e)2A: Systems that provide 75 percent of the annual energy used for mechanical heating from site-recovered energy or a site-solar energy source.

   B. Capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load.
   C. Designed and equipped with a device type and high limit shut off complying with TABLE 140.4-E.

Table 140.4-E Air Economizer High Limit Shut Off Control Requirements			
Device Type[a]	Climate Zones	Required High Limit (Economizer Off When):	
		Equation[b]	Description
Fixed Dry Bulb	1,3,5,11-16	T_{OA}> 75°F	Outdoor air temperature exceeds 75°F
	2,4,10	T_{OA}> 73°F	Outdoor air temperature exceeds 73°F
	6,8,9	T_{OA}> 71°F	Outdoor air temperature exceeds 71°F
	7	T_{OA}> 69°F	Outdoor air temperature exceeds 69°F
Differential Dry Bulb	1,3,5,11-16	T_{OA}>T_{RA} °F	Outdoor air temperature exceeds return air temperature
	2,4,10	T_{OA}>T_{RA}-2°F	Outdoor air temperature exceeds return air temperature minus 2°F
	6,8,9	T_{OA}>T_{RA}-4°F	Outdoor air temperature exceeds return air temperature minus 4°F
	7	T_{OA}>T_{RA}-6°F	Outdoor air temperature exceeds return air temperature minus 6°F
Fixed Enthalpy[c] + Fixed Drybulb	All	h_{OA}>28 Btu/lb[c] or T_{OA}>75°F	Outdoor air enthalpy exceeds 28 Btu/lb of dry air[c] or Outdoor air temperature exceeds 75°F

D. The air economizer and all air dampers shall have the following features:

i. **Warranty**. 5-year Manufacturer warranty of economizer assembly.

ii. **Damper reliability testing.** Suppliers of economizers shall certify that the economizer assembly, including but not limited to outdoor air damper, return air damper, drive linkage, and actuator, have been tested and are able to open and close against the rated airflow and pressure of the system after 60,000 damper opening and closing cycles.

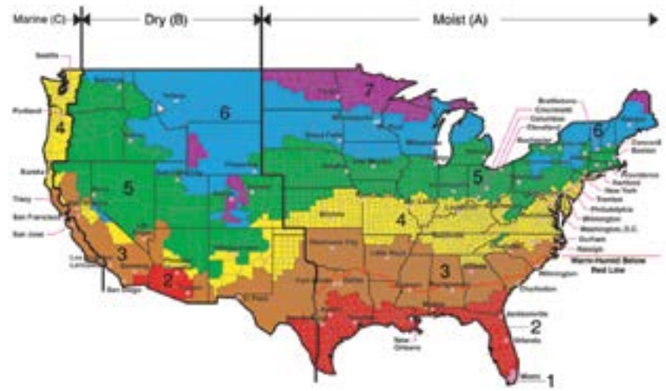
iii. **Damper leakage.** Economizer and return dampers shall be certified in accordance with AMCA Standard 500-D to have a maximum leakage rate of 10 cfm/sf at 1.0 in. w.g.

Section 150.0.(m).7
Air-Distribution and Ventilation System Ducts, Plenums, and Fans.

7. **Backdraft Dampers.** All fan systems, regardless of volumetric capacity, that exchange air between the building conditioned space and the outside of the building shall be provided with backdraft or automatic dampers to prevent unintended air leakage through the fan system when the fan system is not operating.
8. **Gravity Ventilation Dampers.** All gravity ventilating systems that serve conditioned space shall be provided with either automatic or readily accessible, manually operated dampers in all openings to the outside except combustion inlet and outlet air openings and elevator shaft vents.

Additional Information For ASHRAE Standard 90.1 - 2016

Climate Zone Map



6.4.3.3.4 Zone Isolation

- "……Each isolation area shall be equipped with isolation devices capable of and configured to automatically shut off the supply of conditioned air and outdoor air to and exhaust air from the area……."

6.4.3.4.1 Stair and Shaft Vents

- "……vents shall be equipped with motorized dampers that are capable of and configured to automatically close……."

6.4.3.4.2 Shutoff Damper Controls

- "All outdoor air intake and exhaust systems shall be equipped with motorized dampers……."
- Exceptions
  - "1. – Backdraft gravity dampers are acceptable…….in buildings less than three stories in height and for ventilation air intakes and exhaust and relief dampers in buildings of any height located in climate zones 0, 1, 2, and 3. Backdraft dampers for ventilation air intakes must be protected from direct exposure to wind"
  - "2. – Backdraft gravity dampers are acceptable ……..300 cfm or less"
  - "3. – Dampers are not required in ventilation or exhaust systems serving unconditioned spaces"
  - "4. – Dampers are not required in exhaust systems serving Type 1 kitchen exhaust hoods

6.4.3.4.3 Damper leakage

- "……maximum leakage rate…… as indicated in Table 6.4.3.4.3……."

Table 6.4.3.4.3 Maximum Damper Leakage, CFM Per FT² at 1.0 in. of water				
Climate Zone	Ventilation Air Intake		Exhaust/Relief	
	Non-motorized[1]	Motorized	Non-motorized[1]	Motorized
1,2 any height	20	4	20	4
3 any height	20	10	20	10
4,5b,5c				
less than 3 stories	not allowed	10	20	10
3 or more stories	not allowed	10	not allowed	10
5a, 6, 7, 8				
less than 3 stories	not allowed	4	20	4
3 or more stories	not allowed	4	not allowed	4
[1]Dampers smaller than 24 in. in either dimension may have leakage of 40 cfm/ft².				

6.4.4.2.1 Duct Sealing

- "……Openings for rotating shafts shall be sealed with bushings or other devices that seal off air leakage. Pressure sensitive tape shall not be used as the primary sealant……."

6.5.1.1.1 Design Capacity

- "Air economizer systems shall be capable of and configured to modulate outdoor air and return air dampers to provide up to 100% of the design supply air quantity as outdoor air for cooling"

6.5.1.1.4 Dampers

• "Return, exhaust/relief, and outdoor air dampers shall meet the requirements of Section 6.4.3.4.3"

6.5.3.1.1 Fan System Power and Efficiency

Table 6.5.3.1.1A Fan Power Limitation[a]			
	Limit	Constant Volume	Variable Volume
Option 1: Fan System Motor Nameplate hp	Allowable Nameplate Motor hp	hp ≤ CFM_s x 0.0011	hp ≤ CFM_s x 0.0015
Option 2: Fan System bhp	Allowable Fan System bhp	bhp ≤ CFM_s x 0.0094 + A	bhp ≤ CFM_s x 0.0013 + A

[a] where

CFM_s = maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute

hp = maximum combined motor nameplate horsepower

bhp = maximum combined fan brake horsepower

A = sum of (PD x CFM_D/4131)

where

PD = each applicable pressure drop adjustment from Table 6.5.3.1-2 in in. of water

L/S = the design airflow through each applicable device from Table 6.5.3.1-2 in cubic feet per minute

Table 6.5.3.1-2 Fan Power Limitation Pressure Drop Adjustment	
Device	**Adjustment**
Credits	
Return or exhaust systems required by code or accreditation standards to be fully ducted, or systems required to maintain air pressure differentials between adjacent rooms.	0.5 in. of water (2.15 in. of water for laboratory and vivarium systems)
Return and/or exhaust airflow *control devices*	0.5 in. of water
Exhaust filters, scrubbers, or other exhaust treatment	The pressure drop of device calculated at fan system design condition
Particulate Filtration Credit: MERV 9 through 12	0.5 in. of water
Particulate Filtration Credit: MERV 13 through 15	0.9 in. of water
Particulate Filtration Credit: MERV 16 and greater and electronically enhanced filters	Pressure drop calculated at 2x clean filter pressure drop at fan system design condition
Carbon and other gas-phase air cleaners	Clean filter pressure drop at fan system design condition
Biosafety cabinet	Pressure drop of device at fan system design condition
Energy recovery device, other than coil runaround loop	For each airstream [(2.2 x Enthalpy Recovery Ratio) - 0.5] in. of water
Coil runaround loop	0.6 in. of water for each airstream
Evaporative humidifier/cooler in series with another cooling coil	Pressure drop of device at fan system design condition
Sound attenuation section (fans serving spaces with design background noise goals below NC35)	0.15 in. of water
Exhaust system serving fume hoods	0.35 in. of water
Laboratory and vivarium exhaust systems in high-rise buildings	0.25 in. of water/100 ft of vertical duct exceeding 75 ft

6.5.6.1 Exhaust Air Energy Recovery

• "……Provision shall be made to bypass or control the energy recovery system to permit air economizer operation as required by 6.5.1.1"

SUMMARY

The specific section requirements of ASHRAE standard 90.1 2016, and California Title 24 2108 code requirements listed in this document that pertain to the application of dampers in and around air handlers and economizers can be met by utilizing Greenheck dampers and air measuring products with better pressure drop performance and leakage ratings than can be realized using other manufacturers products for similar applications

Greenheck	Ruskin	Tamco	United Enertech
Backdraft			
EM-10	BD6; CBD4	7000CW	CB-601
EM-11	BD6; CBD4	7000CW	CB-601
EM-12	BD6; CBD4	7000CW	CB-601
EM-30	CBD4	7000CW	CB-601
EM-31	CBD4	7000CW	CB-601
EM-32	CBD4	7000CW	CB-601
EM-40	CBD4	7000CW	CB-601
EM-41	CBD4	7000CW	CB-601
EM-42	CBD4	7000CW	CB-601
ES-10	BD2/A2; CBD2	7000	CB-600
ES-11	BD2/A2; CBD2	7000	CB-600
ES-12	BD2/A2; CBD2	7000	CB-600
ES-30	BD2/A2; CBD2	7000	CB-600
ES-31	BD2/A2; CBD2	7000	CB-600
ES-32	BD2/A2; CBD2	7000	CB-600
ES-40	CBD2	7000	CB-600
ES-41	CBD2	7000	CB-600
ES-42	CBD2	7000	CB-600
GM-30	-	-	-
GM-31	-	-	-
GM-32	-	-	-
Commercial Control			
VCD-20	CD35; CD355	-	CD-110; CD-111
VCD-20V	-	-	-
VCD-23	CD36; CD356	-	CD-110; CD-111
VCD-23V	-	-	-
SEVCD-23	-	-	-
VCD-33	CD60	-	CD-160; CD-161; CD-170; CD-171
VCD-33V	CD60V	-	-
SEVCD-33	-	-	-
VCD-34	IL35; TED40	-	-
VCD-40	CD40; CD403	-	CD-145; CD-146
VCD-42	-	-	-
VCD-42V	-	-	-
VCD-43	CD50; CD504; CD50L	1000; 1500	CD-150; CD-151
VCD-43V	CD50V	-	-
VCDR-50	CDR25	-	RI
VCDR-53	CDR25; CDRS15; CDRS25	-	RI
VCDRM-50	-	-	R-PB/OB
VCDRM-53	-	-	R-PB/OB

Section 7
Competitor Cross Reference

Greenheck	Ruskin	Tamco	United Enertech
Face & Bypass			
FBH-23	CD36	-	CD-110; CD-111
FBV-23	CD36	-	CD-110; CD-111
FBH-33	CD60	-	CD-170; CD-171
FBV-33	CD60	-	CD-170; CD-171
FBH-43	CD40; CD50; CD50L; CD504	1000; 1500	CD-150; CD-151
FBV-43	CD40; CD50; CD50L; CD504	-	CD-150; CD-151
Air Measuring			
AMS	AMS	-	X-10
AMD-23	-	-	-
AMD-33	-	-	-
AMD-42	AMS050	-	X-11; X-12
AMD-42V	-	-	-
AMD-23-TD	-	-	-
AMD-33-TD	-	-	-
AMD-42-TD	AIRFLOW-IQ	AIR-IQ	-
AMD-42V-TD	-	-	-
Thermally Broken, Insulated			
ICD-45	TED50; TED50XT	9000BF	TB-155; TB156
ICD-44	TED50	9000	-

Enjoy Greenheck's extraordinary service, before, during and after the sale.

Greenheck offers added value to our wide selection of top performing, energy-efficient products by providing several unique Greenheck service programs.

- Our **Quick Delivery** Program ensures shipment of our in-stock products within 24 hours of placing your order. Our **Quick Build** made-to-order products can be produced in 1-3-5-10-15 or 25-day production cycles, depending upon their complexity.
- Greenheck's free **Computer Aided Product Selection** program (CAPS), rated by many as the best in the industry, helps you conveniently and efficiently select the right products for the challenge at hand.
- Greenheck has been **Green** for a long time! Our energy-saving products and ongoing corporate commitment to sustainability can help you qualify for LEED credits.
- Our **3D service** allows you to download at no charge lightweight, easy-to-use AutoDesk™ Revit™ 3D drawings for many of our ventilation products.

Find out more about these special Greenheck services at **greenheck.com**

Our Commitment

As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.

Specific Greenheck product warranties are located on greenheck.com within the product area tabs and in the Library under Warranties.

Prepared to Support Green Building Efforts

GREENHECK
Building Value in Air.

P.O. Box 410 • Schofield, WI 54476-0410 • Phone (715) 359-6171 • greenheck.com

R2 4-2019