

International HVAC Control & Balancing Dampers

Models VCD, ICD, FBH, FBV, MBD and RBD

• Selection • Construction • Performance



 **GREENHECK**
Building Value in Air.



October
2018



Greenheck's employees are deeply committed to being easy to do business with anywhere in the world. As an industry-leading manufacturer, our focus is to build value in air... by offering the widest range of reliable air movement and control products and to exceed your expectations for on-time delivery, easy installation, performance and operating efficiency.

Our commitment to our customers is what drives our long-standing sustainability practices. We continuously strive to reduce energy usage and other production costs to ensure competitive prices for you and ongoing business success. We support the health, safety and training of our employees to achieve the high quality product performance you expect from Greenheck — and deserve. And we take on the industry's most complex challenges by introducing innovative new product solutions to meet your future needs.

Our Mission: To be the market leader in the development, manufacture and worldwide sale of quality air moving and control equipment with total commitment to the customer.



Our Vision: Greenheck will be a company that exceeds customer expectations and that others strive to emulate. We will be the worldwide leader in providing timely, flexible and cost-effective solutions focused on the movement, cleaning, tempering, and control of air.

Building value in air — from the beginning.

Today, we're the world's largest manufacturer of commercial, institutional and industrial air movement and control equipment.

Greenheck's worldwide leadership in providing cost-effective, value-added solutions for air movement and control challenges evolved from rather humble beginnings. Bernie and Bob Greenheck weren't sure what lay ahead when they opened their small sheet metal shop in Schofield, Wisconsin USA in 1947. But they were determined that no product would ever leave their shop, unless it met the most stringent quality standards—their own. At first, the company manufactured a variety of sheet metal products. In 1956, Greenheck engineers developed a highly efficient power roof ventilator. This product and the innovative ventilation solutions that followed ultimately enabled us to expand our distribution throughout the world. Today, quality Greenheck products are efficiently moving air in commercial buildings, institutions and factories throughout North America, Latin America, the Middle East, and Asia.



The first factory.
1947

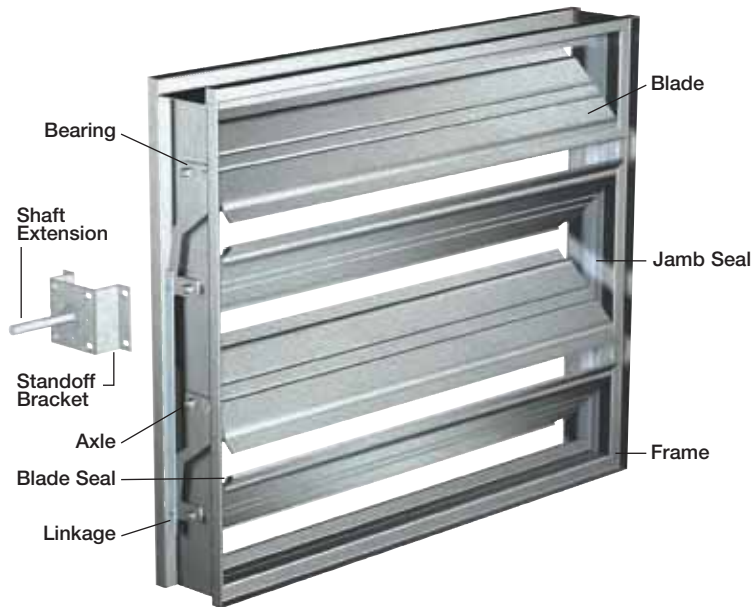


Bernie and Bob Greenheck
1956

Customer driven employees.

Greenheck employees continue to share an extraordinary commitment to meeting and exceeding customers' expectations. We know our future success depends on the value we bring to the market: reliable, top-quality products and exceptional service.





Commercial Control Dampers are used in buildings to regulate the flow of air in an HVAC system. They can be used in intake, exhaust, or mixed air applications.

There are two categories of control dampers:

- Balancing
- Volume Control

Frame - Tog-L-Loc® Advantage

Greenheck control dampers utilize a 5 in. x 1 in. (127mm x 25mm) hat channel frame. Each frame is built with four separate pieces of material and joined by our Tog-L-Loc® process.



Tog-L-Loc®
Reinforced Corner

Rigid frame - The joint has an equivalent thickness of 10 ga. (3.5mm) steel.

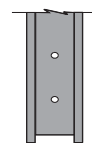
Increased corrosion resistance - The Tog-L-Loc process does not use heat, so Greenheck damper frames have greater corrosion resistance by retaining the galvanized coating.

Square frame for easier install - Using four separate frame components (top, bottom, and two sides), Greenheck's Tog-L-Loc process results in four sturdy, 90° joints. This ensures that each Greenheck damper is square and provides optimum performance in the field.

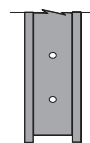
Frame Options

There are five frame options available:

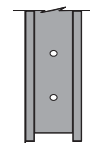
- **Channel (standard)** - allows damper to be insert mounted into an opening or duct
- **Single flange or single reverse flange** - can be insert mounted or directly mounted to the wall or mating surfaces such as a plenum wall
- **Double flange** - when you are not sure which side you need a flange
- **Quick connect (VCD-43, -43V; ICD series)** - designed to match up to a TDC, TDF, or Ductmate connection



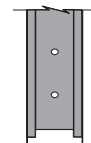
Channel
Frame



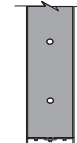
Single
Flange
(actuator side)



Single
Reverse
Flange
(opposite actuator)



Double
Flange



Quick
Connect

Maximize Performance - Low Profile Frame

On dampers that are 17 in. (432mm) high or less, Greenheck uses a low profile top and bottom frame section to maximize free area which allows for lower pressure drop and increases damper performance.



Blades



3V Blade

- Fabricated from a single thickness galvanized steel or stainless steel
- Three V-type grooves running the full length of the blade to increase strength
- Low to medium velocity and pressure applications



Aluminum Airfoil Blade

- Constructed of heavy gauge extruded aluminum
- This blade design results in lower resistance to airflow and increased strength
- High velocity and pressure applications



Steel Airfoil Blade

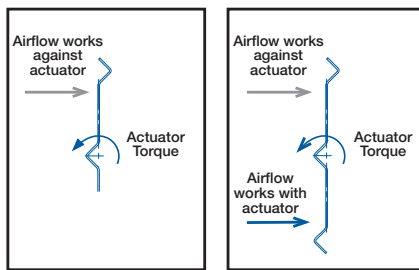
- Constructed of double-skin galvanized steel or stainless steel
- This blade design results in lower resistance to airflow and increased strength
- High velocity and pressure applications



ICD Blade

- Extruded aluminum airfoil blades with thermal breaks and insulated with polyurethane foam
- Used in harsh environments/high temperature differentials

Variable Symmetric Blade Design (VSB) - a Greenheck Exclusive!



Unbalanced Blade
Requires Higher Torque

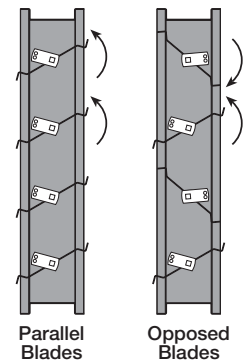
Balanced Blade
Requires Less Torque

- Blades are symmetric about their axis
- Combination of 4, 5, 6, and 7 in. (102, 127, 152, and 178mm) blade widths are used in a single damper
- Reduces the need for closure strips which optimize pressure drop performances
- Damper can be mounted in either direction of flow
- Through extensive testing of our dampers, we have determined using various blade sizes reduces required actuator torque which reduces the size and quantity of actuators used on dampers. This reduces first costs for the building owner and on-going electrical power consumption.

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 operates in two positions, open or closed.
- **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.



Parallel
Blades

Opposed
Blades

Seals

Seals are used for low leakage applications.

- **Blade seals:** Thermoplastic Elastomer (TPE) is standard. For extreme temperatures, select silicone seals.
- **Sweep seals:** Sweep seals are used on bottom of damper blades to eliminate the use of closure strips (size dependent).
- **Jamb seals:** Jamb seals are constructed of 304SS jamb seal to help reduce leakage along the blade edges. The ICD series have silicone jamb seals available for cold temperature applications.



Jamb
Seal

Linkage

Greenheck control dampers have blade linkages concealed in the frame to prevent additional pressure drop and unwanted noise. The linkage is engineered to accurately control each and every blade without need for adjustment.



Bearings

Synthetic - Standard on VCD series

304SS - Optional, used for extreme temperatures or environment

316SS - Used on SEVCD series

ICD series - Dual bearing with inner sleeve and flanged outer bearing features no metal-to-metal or metal-to-plastic contact



Synthetic



304SS

Energy Codes

Three common energy code standards that pertain to dampers are:

- ASHRAE Standard 90.1 - Energy Standard for Buildings except Low-Rise Residential Buildings
- California Title 24
- IECC - International Energy Conservation Code

The primary requirements for dampers based on each standard:

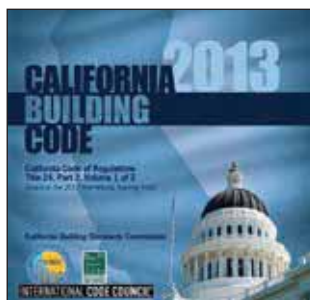
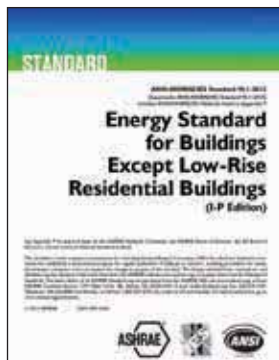
ASHRAE Standard 90.1 (2013 edition) states that maximum damper leakage at 1 in. wg for a:

- non-motorized damper is 20 cfm/ft² or
- motorized damper is 4 cfm/ft² (see Table 6.4.3.4.3 from ASHRAE Standard 90.1)

California Title 24 (2013 edition, section 140.4.4) states that the dampers shall be certified in accordance with AMCA Publication 511 to have a maximum leakage of 10 cfm/ft² at 1 in. wg. The dampers 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.

IECC (2015, section C402.5.5) states that the outdoor air supply and exhaust opening be supplied with Class 1A motorized dampers with a maximum leakage rate of 4 cfm/ft² at 1 in. wg when tested in accordance with AMCA 500D.

Greenheck's volume control dampers meets the requirements of ASHRAE, California Title 24 and IECC.



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.

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

Torque

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

Torque

Data is based on a torque of 9.0 in-lb/ft² (1.02 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:

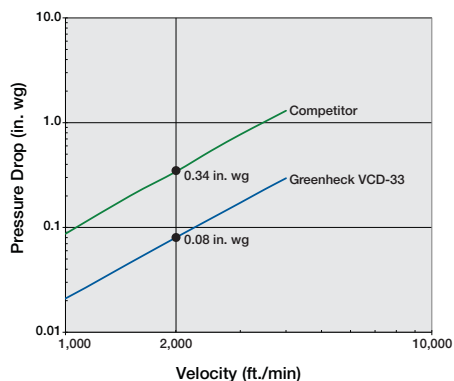
- Leakage Class 1A - 3 cfm/ft² @ 1 in. wg (Class 1A is only defined at 1 in. wg).
- Leakage Class 1 - 4 cfm/ft² @ 1 in. wg
 - 8 cfm/ft² @ 4 in. wg
 - 11 cfm/ft² @ 8 in. wg
 - 12.6 cfm/ft² @ 10 in. wg

Maximum Leakage cfm/sq. ft. (cmh/sq.m)		
Model	Pressure	
	@ 1 in. wg (0.25 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

Pressure Drop Comparison

Greenheck compared the AMCA licensed pressure drop data of a VCD-33 12 in. wide x 12 in. high (305mm x 305mm) versus a competitor's equivalent 12 in. wide x 12 in. high (305mm x 305mm) damper. Both dampers were tested in a fully ducted system. The chart below shows the results at a velocity of 2,000 ft./min. The results were dramatic!

AMCA Licensed Pressure Drop Data



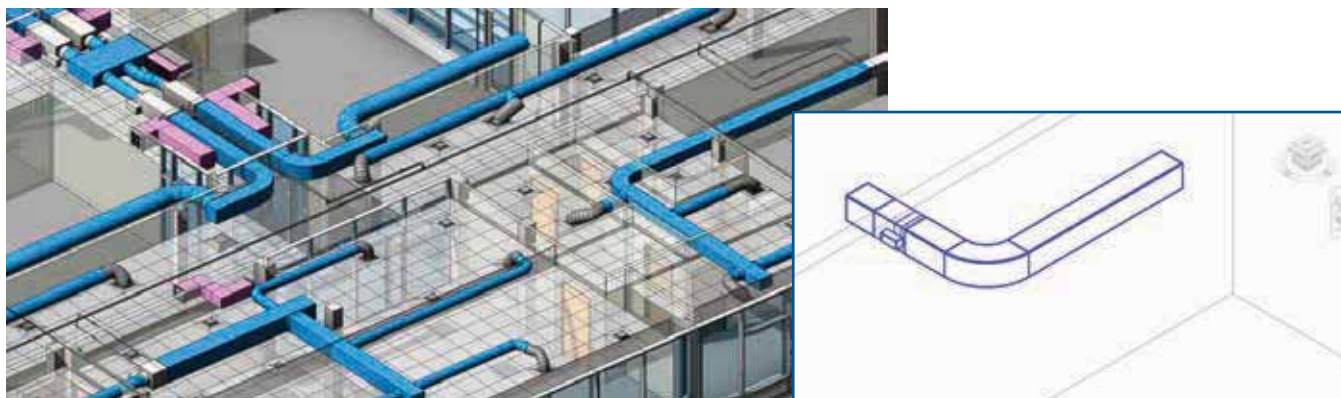
AMCA Figure 5.3
12 in. x 12 in.
Fabricated Airfoil Damper

To illustrate the cost saving benefits of a damper with lower pressure loss, we put our VCD-33 control damper to the test. Greenheck's VCD-33 requires 30% less energy consumption to achieve the same CFM as our competitor. Based on an energy rate of \$.10 kWh, continuous operation (24 hours per day, 365 days per year) for one damper, a realized savings of \$173.76 can be obtained.



Revit®

The latest edition of ASHRAE 90.1 mandates specific fan power limits based on cfm. By using Greenheck's Revit models with the most accurate and lowest certified pressure loss performance in the industry, engineers can analyze their designs to minimize system effects. Contact your local Greenheck representative to calculate the actual pressure loss based on your cfm or velocity.



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/ft³ (1.2 kg/m³).

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.

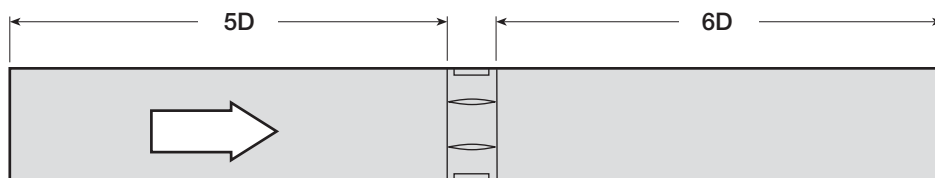


Figure 5.3

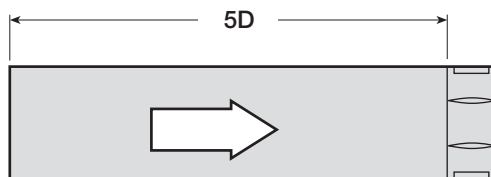


Figure 5.2

D = Duct length
W = Damper width
H = Damper height

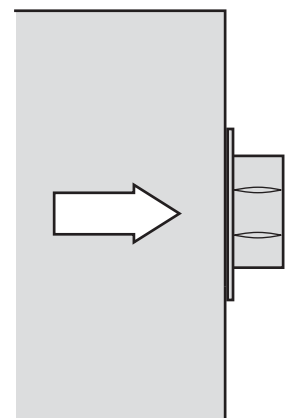


Figure 5.5

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



Greenheck Fan Corporation certifies that the model VCD-20 and VCD-40 shown herein are licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Programs. The AMCA Certified Ratings Seal applies to Air Performance ratings only.



Greenheck Fan Corporation certifies that the model ICD-44 and ICD-45 shown herein are licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Programs. The AMCA Certified Ratings Seal applies to Air Leakage, Air Performance and Energy Efficiency ratings.



Greenheck Fan Corporation certifies that the model VCD-23, 33, 34, 43, SEVCD-23 and 33 shown herein are licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Programs. The AMCA Certified Ratings Seal applies to Air Leakage and Air Performance ratings.



Greenheck India Pvt. Ltd. certifies that the model VCD-20 shown herein are licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Programs. The AMCA Certified Ratings Seal applies to Air Performance ratings only.



Greenheck India Pvt. Ltd. certifies that the model VCD-23 and VCD-33 shown herein are licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Programs. The AMCA Certified Ratings Seal applies to Air Performance ratings only.

ICD-44 and ICD-45

- Extruded aluminum airfoil blades with thermal breaks and insulated with polyurethane foam
- Extruded Frame (ICD-44) with thermal breaks (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	.04	.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

VCDR-50 and 53

- Insert type round single blade
- Blade seals VCDR-53



Dimension inches	12			24		
AMCA figure	5.2	5.3	5.5	5.2	5.3	5.5
Velocity (ft/min.)	Pressure Drop in. wg					
500	.01	.01	.02	.01	.01	.02
1000	.06	.02	.10	.04	.01	.09
1500	.13	.05	.22	.08	.03	.20
2000	.23	.08	.38	.15	.06	.36
2500	.37	.13	.60	.23	.09	.56
3000	.53	.19	.86	.33	.13	.81

VCDRM-50 and 53

- Insert type round multi-blade
- Blade seals VCDRM-53



Dimension inches	12			24			36		
AMCA figure	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	.03	.05	.03	.02	.04	.05	.05	.06
1000	.15	.11	.19	.13	.10	.15	.19	.20	.25
1500	.33	.25	.42	.29	.21	.33	.42	.44	.57
2000	.59	.45	.75	.51	.38	.59	.75	.79	1.01
2500	.93	.70	1.18	.79	.60	.92	1.18	1.23	1.58

VCD-20, 23

- Galvanized 3V blade
- Blade and jamb seals VCD-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	.03	.01	.01	.03	.01	.01	.03
1000	.05	.03	.13	.03	.02	.12	.02	.02	.12	.04	.03	.12	.03	.03	.12
1500	.11	.08	.30	.06	.04	.26	.05	.03	.28	.08	.07	.27	.07	.06	.28
2000	.19	.13	.53	.10	.07	.47	.09	.06	.50	.15	.12	.47	.12	.10	.49
2500	.29	.20	.82	.16	.11	.75	.14	.09	.78	.22	.18	.75	.18	.16	.77
3000	.41	.29	1.19	.23	.16	1.04	.19	.13	1.12	.32	.26	1.07	.26	.22	1.12
3500	.55	.40	1.62	.30	.21	1.41	.27	.19	1.53	.43	.36	1.45	.36	.30	1.53
4000	.72	.51	2.10	.40	.28	1.90	.35	.25	2.00	.56	.46	1.91	.47	.39	2.01



VCD-20V and 23V

- Vertical 3V blade
- Blade and jamb seals VCD-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	.03	.01	.01	.03	.01	.01	.03
1000	.05	.03	.13	.03	.02	.12	.02	.02	.12	.03	.03	.12	.04	.03	.12
1500	.11	.08	.30	.06	.04	.26	.05	.03	.28	.07	.06	.28	.08	.07	.27
2000	.19	.13	.53	.10	.07	.47	.09	.06	.50	.12	.10	.49	.15	.12	.47
2500	.29	.20	.82	.16	.11	.75	.14	.09	.78	.18	.16	.77	.22	.18	.75
3000	.41	.29	1.19	.23	.16	1.04	.19	.13	1.12	.26	.22	1.12	.32	.26	1.07
3500	.55	.40	1.62	.30	.21	1.41	.27	.19	1.53	.36	.30	1.53	.43	.36	1.45
4000	.72	.51	2.10	.40	.28	1.90	.35	.25	2.00	.47	.39	2.01	.56	.46	1.91



VCD-33 and 34

- Galvanized airfoil blade
- Insulated airfoil VCD-34
- 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	.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



VCD-33V

- Vertical galvanized airfoil blade
- 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	.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-40

- Extruded aluminum airfoil blade
- Blades contained within the 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	.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	1.70	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	.30	1.60	.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-42

- 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	.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-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



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	.06	.03	.11	.03	.02	.11
1500	.13	.07	.31	.10	.04	.27	.06	.02	.22	.13	.06	.25	.06	.04	.26
2000	.23	.14	.55	.18	.08	.48	.12	.04	.39	.23	.11	.46	.10	.08	.46
2500	.35	.21	.86	.28	.13	.75	.18	.06	.61	.36	.17	.72	.16	.12	.72
3000	.50	.29	1.23	.40	.19	1.07	.26	.09	.87	.51	.25	1.05	.23	.18	1.02
3500	.68	.39	1.67	.54	.26	1.47	.35	.13	1.19	.71	.34	1.43	.30	.24	1.40
4000	.88	.51	2.19	.70	.34	1.91	.46	.17	1.56	.93	.45	1.87	.39	.31	1.83



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	.06	.03	.11
1500	.13	.07	.31	.10	.04	.27	.06	.02	.22	.06	.04	.26	.13	.06	.25
2000	.23	.14	.55	.18	.08	.48	.12	.04	.39	.10	.08	.46	.23	.11	.46
2500	.35	.21	.86	.28	.13	.75	.18	.06	.61	.16	.12	.72	.36	.17	.72
3000	.50	.29	1.23	.40	.19	1.07	.26	.09	.87	.23	.18	1.02	.51	.25	1.02
3500	.68	.39	1.67	.54	.26	1.47	.35	.13	1.19	.30	.24	1.40	.71	.34	1.40
4000	.88	.51	2.19	.70	.34	1.91	.46	.17	1.56	.39	.31	1.83	.93	.45	1.83



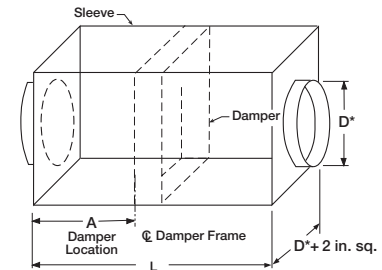
Open Close Indicator - OCI

The OCI provides 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.



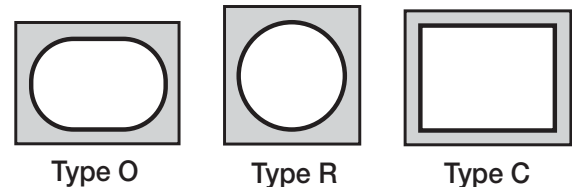
Factory Sleeve Option

Greenheck control dampers are available with factory furnished sleeves in lengths up to 48 in. (1219mm). When dampers are installed in factory sleeves, the "A" dimension specifies the location of damper within the sleeve.



Transitions

Greenheck control dampers can be supplied with the appropriate transition option in applications where dampers require installation in round or oval openings. The sleeve is transitioned at each end to the appropriate round, oval, or rectangular size.



Transition options available

Security Bars

When security becomes an issue, Greenheck offers optional factory-installed security bars. Security bars are factory welded into a 10 ga. (3.5mm) sleeve.



Paint Finishes

A wide variety of paint finishes are available including:

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

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



QR Codes

Greenheck has added QR (Quick Response) codes to the labels on commercial control and air measuring dampers.

When you scan the QR code with your smartphone, it will link to www.greenheck.com based on the model.



Actuators can be installed at the factory or shipped loose with the necessary linkage and brackets required for mounting. When you order factory installed, each unit is tested for operation before shipping.

Manual Hand Quadrant

- ✓ **Location**
 - Internal or External

Electric Actuator Checklist

- ✓ **Power Supply**
 - 24 VDC, 24 VAC, 120 VAC, and 240 VAC
 - Frequency
- ✓ **Operation**
 - Spring Return (spring will drive damper to original starting point)
 - Power Open or Power Closed
- ✓ **Operating Mode**
 - Two-position (damper position is open or closed)
 - Modulating (damper position determined by modulating control signal)
 - Floating (damper can be stopped anywhere between open and closed)
- ✓ **Fail Direction (for spring return only)**
 - Open or Closed
- ✓ **Location**
 - Internal or External
- ✓ **Control Signal (for modulating only)**
 - 0-10 VDC, 2-10 VDC or 4-20 mAdc
- ✓ **NEMA Enclosure**
 - 1, 3, 4, 4X, or 7 (specify one per application)
- ✓ **Accessories**
 - Auxiliary Switches
 - Transformers

Greenheck's most commonly used electric actuator manufacturers are Honeywell, Belimo, and Siemens.

Contact your Greenheck representative for other options.

Pneumatic Actuator Checklist

- ✓ **Power Supply**
 - 20 psi
- ✓ **Operation**
 - Spring Return (spring will drive damper to original starting point)
- ✓ **Operating Mode**
 - Two-position (damper position is open or closed)
 - Modulating (damper position determined by modulating pressure signal)
- ✓ **Fail Direction (for spring return only)**
 - Open or Closed
- ✓ **Location**
 - Internal or External
- ✓ **Control Signal (for modulating only)**
 - 3-15 psi
- ✓ **Accessories**
 - Solenoid Valves or Positioner

Greenheck's most commonly used pneumatic actuator manufacturer is Siemens.

Contact your Greenheck representative for other options.



Manual
Quadrant



Electric
External Mount



Electric
Internal Mount



Pneumatic

Volume Control Dampers

Quick Selection Chart

X = Standard O = Optional		VCD-20	VCD-20V	VCD-23	VCD-23V	VCD-33	VCD-33V	VCD-34	VCD-34V	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	Airfoil - Insulated Vertical Blade								X	
	Galvanized	X	X	X	X	X	X	X	X	
	304 Stainless Steel	O	O	O	O	O	O	O	O	
Blade Material	Aluminum									X
	Galvanized	X	X	X	X	X	X	X	X	
	304 Stainless Steel	O	O	O	O	O	O	O	O	
	316 Stainless Steel									
Frame Gauge	Aluminum									X
	16	X	X	X	X	X	X	X	X	
	12	O	O	O	O	O	O	O	O	
Blade Seals	TPE			X	X	X	X	X	X	X
	Silicone			O	O	O	O	O	O	O
Jamb Seals	304 Stainless Steel			X	X	X	X	X	X	X
Bearings	Synthetic	X	X	X	X	X	X	X	X	X
	304 Stainless Steel	O	O	O	O	O	O	O	O	O
Axles	Steel	X	X	X	X	X	X	X	X	X
	304 Stainless Steel	O	O	O	O	O	O	O	O	O
Linkage Material	Steel	X	X	X	X	X	X	X	X	X
	304 Stainless Steel	O	O	O	O	O	O	O	O	O
Accessories	Sleeves	O	O	O	O	O	O	O	O	
	Transitions	O	O	O	O	O	O	O	O	
	Actuators*	O	O	O	O	O	O	O	O	O
	Flanges**	O	O	O	O	O	O	O	O	O
	Retaining Angles	O	O	O	O	O	O	O	O	O
	Security Bars	O	O	O	O	O		O	O	
Sizing inches (mm)	Minimum Size	6x6 (152x152)	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)	60x74 (1524x1880)
	Maximum Multi-Section Size	Unlimited	120x72 (3048x1829)	Unlimited	120x72 (3048x1829)	Unlimited	120x72 (3048x1829)	Unlimited	60x74 (1524x1880)	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)	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)	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.

Volume Control Dampers

Quick Selection Chart

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						
Frame Material	Galvanized	X	X					X	X	X	X
	304 Stainless Steel							O	O	O	O
	316 Stainless Steel					X	X				
	Aluminum			X	X						
Blade Material	Galvanized							X	X	X	X
	304 Stainless Steel							O	O	O	O
	316 Stainless Steel					X	X				
	Aluminum	X	X	X	X						
Frame Gauge	20							X	X		
	16	X	X			X	X	O	O		
	14							O	O	X	X
	12	O	O								
	10									O	O
	Aluminum			.125 (3.2)	.125 (3.2)						
Blade Seals	EPDM								X		Vinyl
	TPE	X	X	X	X	X	X				
	Silicone	O	O	O	O	O	O		O		
Jamb Seals	304 Stainless Steel	X	X	X	X						X
	316 Stainless Steel					X	X				
Bearings	Synthetic	X	X	X	X						
	Bronze							X	X	X	X
	304 Stainless Steel	O	O	O	O			O	O	O	O
	316 Stainless Steel					X	X				
Axles	Steel	X	X	X	X			X	X	X	X
	304 Stainless Steel	O	O	O	O			O	O	O	O
	316 Stainless Steel					X	X				
Linkage Material	Steel	X	X	X	X					X	X
	304 Stainless Steel	O	O	O	O					O	O
	316 Stainless Steel					X	X				
Accessories	Sleeves	O	O	O	O	O	O				
	Transitions	O	O			O	O				
	Actuators*	O	O	O	O	O	O	O	O	O	O
	Flanges**	O	O	O	O	O	O				
	Retaining Angles	O	O			O	O				
	Security Bars	O									
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.

ICD - Insulated Control Damper

Greenheck's ICD dampers were developed for applications where it is necessary to minimize the thermal transfer and reduce condensation. 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



Cross section of thermally broken frame and blade

			ICD-44	ICD-45
Thermal Efficiency Ratio			593%	941%
Maximum Velocity fpm (m/s)			4000 (20.3)	4000 (20.3)
Maximum Pressure in. wg (kPa)			8 (2)	8 (2)
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 Gauge			.125 in. (3.2mm)	.125 in. (3.2mm)
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	304SS		X	–
	Silicone		0	X
Axle Bearings	Dual Bearing with Acetal Inner Sleeve		X	X
Axle Material	Plated Steel		X	X
	304SS		0	0
Linkage	Plated Steel		X	X
	304SS		0	0
Paint Finishes*	Anodize		0	0
	Baked Enamel		0	0
	Epoxy		0	0
	Hi-Pro Polyester		0	0
	Industrial Epoxy		0	0
	Kynar/Hylar (70%)		0	0
Sizing inches (mm)	Minimum Size	Channel, Single or Reverse Flange	12 x 7 (305 x 178)	12 x 7 (305 x 178)
		Quick Connect	12 x 6 (305 x 152)	12 x 6 (305 x 152)
	Maximum Single Section Size		48 x 74 (1219 x 1880)	48 x 74 (1219 x 1880)
	Maximum Multi-Section Size	Channel, Single or Reverse Flange	144 x 148 (3658 x 3759)	144 x 120 (3658 x 3048)
		Quick Connect	96 x 148 (2438 x 3759)	96 x 120 (2438 x 3048)

* Additional lead time is required. Consult factory.

X = Standard 0 = Optional - = NA

AMCA Certified Energy Efficiency Performance

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

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

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
GREEN

Supporting Green Building
Initiatives Worldwide

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.

X = Standard O = Optional		FBH-23	FBH-33	FBH-43	FBV-23	FBV-33	FBV-43
F & B Style	Horizontal	X	X	X			
	Vertical				X	X	X
Blade Profile	3V	X			X		
	Airfoil		X	X		X	X
Material	Galvanized	X	X		X	X	
	Aluminum			X			X
Blade Seals	TPE	X	X	X	X	X	X
	Silicone	O	O	O	O	O	O
Bearings	Synthetic	X	X	X	X	X	X
	304 Stainless Steel	O	O	O	O	O	O
Axles	Steel	X	X	X	X	X	X
	304 Stainless Steel	O	O	O	O	O	O
Linkage Material	Steel	X	X	X	X	X	X
	304 Stainless Steel	O	O	O	O	O	O
Sizing inches (mm)	Minimum Size	8x6 (203x152)	8x6 (203x152)	8x6 (203x152)	8x6 (203x152)	8x6 (203x152)	8x6 (203x152)
	Maximum Single Section Size	48x74 (1219x1880)	60x74 (1524x1880)	60x74 (1524x1880)	48x74 (1219x1880)	60x74 (1524x1880)	60x74 (1524x1880)
	Maximum Multi-Section Size (Face Only)	96 x 74 (2438 x 1880)	96 x 74 (2438 x 1880)	96 x 74 (2438 x 1880)	96 x 74 (2438 x 1880)	96 x 74 (2438 x 1880)	96 x 74 (2438 x 1880)
Ratings	Max. Velocity ft/min. (m/s)	3000 (15.2)	4000 (20.3)	6000 (30.5)	3000 (15.2)	4000 (20.3)	6000 (30.5)
	Max. Pressure in. wg (kPa)	5 (1.2)	10 (2.5)	6 (1.5)	5 (1.2)	10 (2.5)	6 (1.5)



FBV



FBH

Manual Balancing Dampers

Manual balancing dampers are control dampers that regulate the flow of air but are not intended to be used in applications as a positive shut-off or for automatic control. These dampers are shipped with manual hand quadrants that can be locked in place.

There are four balancing damper models available:

- **MBD-10** (single blade)
- **MBD-10M** (single blade)
- **MBD-15** (multi-blade)
- **MBDR-50** (round blade)

Remote Balancing Dampers

Remote balancing dampers offer the same function as a manual balancing damper plus the added benefit of controlling the damper remotely at a diffuser or wall plate. These remote balancing dampers are ideal for applications where it is difficult to gain access to manually adjust the dampers to balance airflow. The “EZ Balance” remote control operates the damper motor by connecting to the wall, ceiling, or diffuser mounted RJ11 connector.

There are two remote balancing damper models available:

- **RBD-10** (single blade)
- **RBDR-50** (round blade)



MBD-10

- Single blade

*Shown with optional
standoff bracket



MBD-15

- Multi-blade
- Meets SMACNA recommended construction requirements



MBDR-50

- Round blade



RBD-10

- Single blade

*Actuator shipped as a
kit for field installation



RBDR-50

- Round blade
- Factory-mounted actuator

Manual and Remote Balancing Dampers

A wide variety of accessories are available for the RBD and RBDR series. They include:

- Diffuser connector
- Wall plates with ports
- Round wall/ceiling plate with single port
- Single gang outlet box
- EZ Balance handheld remote kit
- Plenum and non-plenum rated cables
- Cable connectors



EZ Balance
handheld remote kit

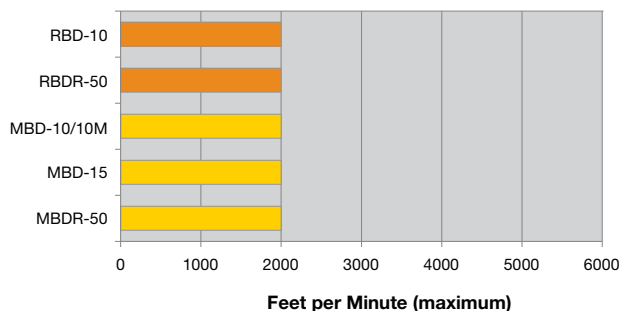
Quick Selection Chart

		MBD-10	MBD-10M	MBD-15	MBDR-50	RBD-10	RBDR-50
Blade Profile	Single Blade	X	X			X	
	3V			X			
	Round				X		X
Material	Galvanized	X	X	X	X	X	X
Frame Gauge	22 (0.8)	X	X			X	
	20 (1)				X		X
	16 (1.5)			X			
Bearings	Synthetic		X	X	X		X
	Bronze			0			
Axles	Steel			X	X		X
Linkage Material	Steel			X			
Actuator	Manual Quadrant	X	X	X	X		
	1-1/2 in. Standoff Bracket	0	0	X	0		
	2 in. Standoff Bracket	0	0	0	0		
	Remote Powered 9 Volt Actuator					X	X
Sizing Inches (mm)	Minimum	6 x 4 (152 x 102)	8 x 4 (203 x 102)	6 x 6 (152 x 152)	4 (102)	6 x 4 (152 x 102)	4 (102)
	Maximum Single Section	36 x 12 (914 x 305)	36 x 12 (914 x 305)	48 x 60 (1219 x 1524)	24 (610)	36 x 12 (914 x 305)	24 (610)
	Maximum Multi-Section	-	-	96 x 96 (2438 x 2438)	-	-	-

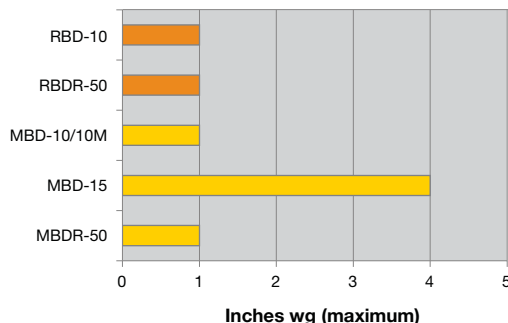
X = Standard

0 = Optional

Velocity



Pressure



Models by Manufacturing Location

Volume Control Dampers		
	Manufacturing Location	
	Greenheck Fan Corporation	Greenheck India Pvt., Ltd.
VCD-23V, 43V	✓	
VCD-40	✓	
VCD-33, 42, 42V	✓	
VCDR-53	✓	
VCDRM-53	✓	
VCDRM-50	✓	
ICD-44	✓	
ICD-45	✓	
VCDR-50	✓	
VCDR-53	✓	
VCD-20, 23	✓	✓
SEVCD-23	✓	
VCD-20V, 23V	✓	
SEVCD-33	✓	
VCD-33V	✓	
VCD-33	✓	✓
VCD-34, 34V	✓	
VCD-40	✓	
VCD-42	✓	
VCD-42V	✓	
VCD-43	✓	
VCD-43V	✓	
OFD-150	✓	
FD-300	✓	
FD-310	✓	
FD-350	✓	
SSFD-350	✓	

Manual Balancing Dampers		
	Manufacturing Location	
	Greenheck Fan Corporation	Greenheck India Pvt., Ltd.
MBD-10	✓	
MBD-10M	✓	
MBD-15	✓	✓
MBDR-50	✓	

NOTE: Accessories and options vary by manufacturing location. Refer to CAPS to determine what is available.

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we engineer value.**

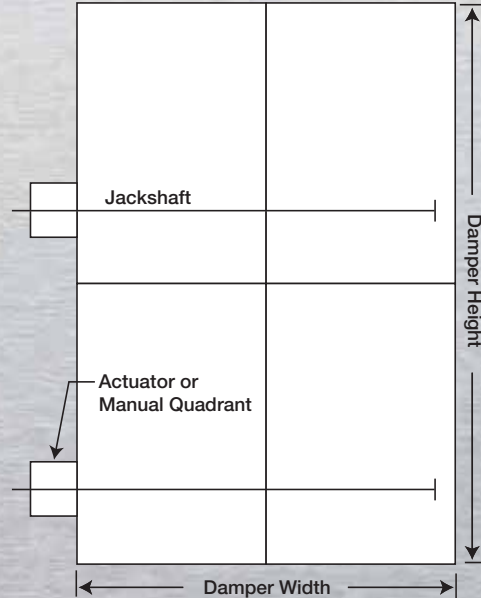


Drive Arrangement Definition

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



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Prepared to Support
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