DESIGN ANALYSIS

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PART 1 - Basis of Design

Description of Work
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USDA / ARS
Solvent Storage Building & Steam Tunnel Repairs
Wyndmoor, PA

Description of Work

The Solvent Storage Building and the Steam Tunnel, which connects the Service Building to the Main Building, have experienced water intrusion which has deteriorated both structures.

The Scope of Work (SOW) for this project includes the following:

1. Solvent Storage Building - Perform repairs to the entire building envelope.
2. Steam Tunnel – Perform repairs to the cracks that have formed in the roof of the underground tunnel.

1 Architectural Design

1.1 Demolition

The architectural work includes the following:

1.1.1 Remove the stone coping and copper flashing at the parapet wall.
1.1.2 Remove the exterior wythe of brick masonry that has disconnected from the structural masonry.
1.1.3 Remove the two, round metal through-wall scupper pipes
1.1.4 Remove the copper wall flashing on the inside of the parapet wall.
1.1.5 Remove the two gravity vent metal curbs on the roof.
1.1.6 Remove the existing pair of doors, door frame and steel lintel angle in the East wall.
1.1.7 Remove the +/- 2” asphalt curb installed below the pair of doors, where a threshold belongs.
1.1.8 Remove the loose concrete that has cracked and spalled at the exposed concrete foundation.
1.1.9 Remove all existing waterproofing to exterior face of the concrete foundation.
1.1.10 Clean out existing subsurface storm drainage system.

1.2 New Work

The architectural work includes the following:

1.2.1 Provide new stone coping and copper flashing, self-adhering flashing membrane and weeps (per the REI report) at the parapet wall.
1.2.2 Provide new wall ties and reinstall the existing brick, that separated from the wall.
1.2.3 Provide two new copper conductor heads and downspouts at existing round scupper pipes. Outlet into existing storm drainage system.
1.2.4 Clean all existing storm drain lines to be used in this project and ensure they are functioning properly, prior to reuse.
1.2.5 Repoint all brick mortar joints in exterior wythe of brick.
1.2.6 Apply a clear penetrating siloxane sealant to the brick wall surfaces to reduce the absorption of the brick.
1.2.7 Repair spalls, delamination's and cracks in the exposed concrete foundation. Clean and coat all exposed steel reinforcing.
1.2.8 Clean the exposed concrete foundation and provide a protective coating. Areas of exposed rust stains should be properly prepared prior to protective coating application.
1.2.9 Provide a backer rod and sealant between vertical steps in foundation at the interface of the concrete and the brick. Rake the mortar back from the face of the concrete and install a backer rod and silicone sealant.
1.2.10 Repair all through-wall penetrations in masonry walls (outside and inside) with new sealant and backer rod.
1.2.11 Remove abandoned anchors in wall and repair holes with mortar or sealant.
1.2.12 Temporarily remove wall mounted conduit and equipment to allow wall to be repointed. Reinstall conduit and equipment and seal wall penetrations.
1.2.13 Provide new copper flashing and counterflashing to inside face of parapet walls.
1.2.14 Provide two (2) new explosion-proof, powered ventilators and new 8" high copper clad roof curbs, where existing vents were removed.
1.2.15 Install a new steel lintel angle and a new stainless steel drip edge above the new pair of doors and frame.
1.2.16 Install a new +/- 2" concrete curb and threshold below the new pair of doors.
1.2.17 Install a new pair of 2' - 8" insulated metal doors and hollow metal frame. Provide +/- 4 sqft. of louvers with mechanically actuated dampers in each door leaf interlocked with the exhaust system. Paint all exposed surfaces.
1.2.18 Install a new floor drain cover over the existing floor drain and permanently seal floor drain.
1.2.19 Existing copper clad skylight is in proper working order. Protect throughout entire construction.
1.2.20 Appropriately close off the steam tunnel opening in the interior corner of the Solvent Storage Building.

1.3 Applicable Codes and Standards

- IBC 2024 International Building Code, 2024 Edition
- SMACNA Architectural Sheet Metal Manual, 2012 Seventh Edition

2 Mechanical Design

2.1 Existing Conditions

The hazmat storage building is currently protected by an existing CO_2 fire suppression system designed to provide total flooding protection of the space. The fire suppression system includes pneumatically actuated dampers installed at door louvers and at duct connections serving the existing natural ventilation system. These dampers are actuated by the CO_2 system to close upon system activation in order to isolate the space and retain the extinguishing agent.

Ventilation for the space is presently provided by natural means, consisting of two wind-driven roof ventilators (whirly birds) and louvered exterior doors. While this configuration provides passive airflow under favorable wind conditions, it does not ensure consistent or reliable ventilation rates. The existing system does not provide positive exhaust control or predictable air movement, particularly during low wind or stagnant conditions.

2.2 Demolition

As part of this project, the existing pneumatically actuated dampers serving the door louvers and the ductwork connected to the natural ventilation system will be removed. The existing ductwork associated with the wind-driven ventilators will also be demolished. There are two roof ventilators total; however, the ductwork and damper associated with one ventilator have already been removed under a previous effort. The remaining ventilator, ductwork, and damper will be removed under this project.

Prior to demolition activities, the existing CO_2 actuation piping serving the dampers will be disconnected and capped by a qualified, factory-authorized fire suppression contractor to ensure the system is depressurized and safely isolated. Demolition will not proceed until the CO_2 system has been verified to be in a safe, non-discharge condition.

2.3 New Work

The proposed work includes the installation of two roof-mounted powered exhaust fans at the locations of the existing wind-driven ventilators. New exhaust ductwork will be routed through the roof, with exhaust grilles installed near the floor level to effectively remove heavier-than-air solvent vapors and minimize vapor accumulation in occupied and storage areas. Each exhaust fan is sized at 220 CFM, providing a combined exhaust capacity of 440 CFM, which satisfies the minimum ventilation requirement of 1 cfm per square foot for the 432-square-foot building.

New exhaust ductwork will be equipped with fire/smoke isolation dampers that are interlocked with the existing CO_2 fire suppression system to ensure automatic closure upon system pre-discharge activation. New dampers installed at the door louvers will also be electrically actuated and interlocked with the fire suppression system to maintain enclosure integrity during a CO_2 event. In addition, the exhaust

fans will be interlocked to shut down upon activation of the CO_2 pre-discharge alarm to prevent agent loss and ensure proper system operation. All interfaces with the fire suppression system will be performed by a factory-authorized contractor in accordance with the system manufacturer's requirements.

2.4 Applicable Codes and Standards

- IBC 2024 – International Building Code, 2024 Edition
- NFPA 30 – Flammable and Combustible Liquids Code, 2024 Edition
- NFPA 12 – Carbon Dioxide Extinguishing Systems, 2022 Edition
- NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems, 2021 Edition
- UL 555 – Standard for Fire Dampers
- UL 555S – Standard for Smoke Dampers
- USDA ARS 242.1

3 Civil Design

3.1 Existing Conditions

The existing steam tunnel consists of precast concrete boxes to create an underground tunnel. The tunnel spans beneath the parking area from the research building to the mechanical building. The tunnel varies from approximately 1 foot below finished grade to approximately 3 feet below finished grade. Utilities routed through the tunnel include steam, chilled water, hot water, vacuum lines, and electrical lines. Drain lines are routed along the exterior, bottom edge of each side of the tunnel.

The existing ceiling of the existing tunnel has multiple cracks that are allowing water to penetrate into the steam tunnel. Additionally, there is a steel plate in the ceiling of the tunnel where the major leak is occurring.

The finished grade above the tunnel consists of an asphalt parking lot. During the construction portions of this parking lot, the Contractor will need to block off the parking lot to prevent USDA personnel from entering the construction site.

3.2 Demolition

The civil work consists of the following:

3.2.1 Remove the asphalt paving, gravel and earthen fill to expose the top of the subsurface steam tunnel, in four locations as shown on the drawings.

3.2.2 Remove a portion of the existing steam tunnel roof and steel plate, in one location as shown on the drawings.

3.3 New Work

The civil work consists of the following:

2.3.1 Rout out the existing crack in the concrete ceiling to the full depth of the crack.
2.3.2 Provide waterproof fill to the concrete.
2.3.3 Install a new galvanized steel plate to match the existing plate. Paint exposed metal.
2.3.4 Repair exposed top side of existing concrete tunnel and waterproof.
2.3.5 Provide new earthen fill in 6” lifts and tamp to compact each lift. Provide crushed aggregate subbase and cold applied asphalt patch.

3.4 Applicable Codes and Standards

- ASCE 7-22 American Society of Civil Engineers, “Minimum Design Loads for Buildings and Other Structures” 2022 Edition
- IBC 2024 International Building Code, 2024 Edition
- UFC 3-201-01 Unified Facilities Criteria, Civil Engineering, December 2022.

END OF REPORT

PART 2 – Product Data

Architectural Product Data
Mechanical Product Data

Architectural Product Data

Hollow Metal Door System

ALLEGION™

STEELCRAFT®

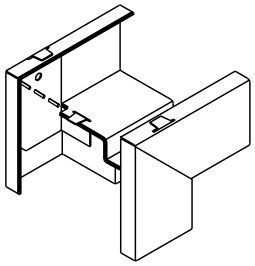
Hollow metal doors and frames

Standard door construction features and benefits

- **Beveled hinge and lock edges** Tighter tolerances and opening fit with a 3/32" gap, ensuring easier operation and eliminating binding and sticking; max allowable meeting edge gap is 3/16" (per NFPA 80 allowable gap 1/8" + 1/16" tolerance)
- **Full height, epoxy-filled mechanical interlock edges** Structural support and stability the full height of the door
- **Universal hinge preparations** Patented design creating fast and easy field conversion from the standard weight .134" to heavy weight .180" hinges
- **True 7-gauge hinge reinforcements** Strong internal support for hinges to keep the door from sagging during everyday use and abuse
- **Recessed Dezigner™ glass trim** Interior welds and fasteners, inset into a recessed perimeter channel for a clean, neat, and flush finish
- **Screwed-in top caps** Flush cap installed into top and bottom channels for additional protection from the elements, dirt and debris
- **Heavy 14-gauge top and bottom channels** Performance and stability for the top and bottom door edges
- **Seamless edge** Option creating a finished, one-piece look with clean lines
- **Mortise lock body stabilizers** Easier installation by centering the lock body in the door
- **61L cylindrical lock preparation** Universal features accommodate any cylindrical lock in the market with a 3 7/16" or larger rose
- **Structural honeycomb core design** Greater structural integrity than steel stiffened doors while reducing overall weight, successfully tested to 10,000,000 cycles including 23 twist tests using 300 pounds of applied force. Optional cores for better insulating value include polystyrene, polyurethane, steel stiffened with fiberglass batting, and temperature rise mineral fiber board.
- **Factory applied baked-on rust inhibiting primer** Provides the best possible protection against corrosion, abrasion and weather, and is an excellent base for our finish paint in standard or custom colors. In accordance with ANSI A250.10-1998 (R2004).

Frames

Steelcraft manufactures a wide variety of frames in jamb depths for virtually any wall condition or entryway requirement.

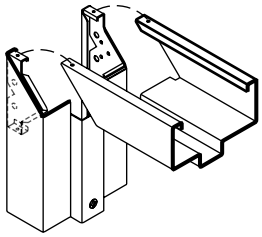


Flush frames

Flush (F, FE and FN Series) frames are designed to be installed as part of the wall framing sequence for exterior and interior walls of wood stud, steel stud and masonry construction. Frames are manufactured from 16-, 14- and 12-gauge (F only) commercial-quality carbon steel in cold-rolled, A60 galvannealed and G90 galvanized steel. Flush frame corners in 16 and 14 gauge may lock together by bending over four integral tabs, and may also be welded and ground smooth.

Multiple use frames

Multiple use (MU Series) frames have a jamb profile similar to drywall frames but are designed to be installed as part of the wall framing sequence. MU Series frames are available in 16- or 14-gauge cold-rolled, A60 galvannealed or G90 galvanized steel.



Drywall frames

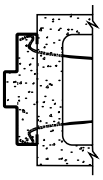
Drywall (DW, K, C and CK Series) frames are designed to be installed in rough openings after the wall is constructed. They can be installed in minutes and can be relocated without damage to the frame. Drywall frame corners lock together once the frame is assembled. The tab design prohibits the head from raising, and keeps the head and jamb members in the same plane. C and CK frames do not have backbends and are designed to have architectural trim casing applied.

Specifications

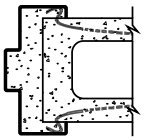
Door thickness	1 3/4"	(45mm)				
Standard heights	6'8"	(2032mm)	7'0"	(2134mm)	7'2"	(2184mm)
	8'0"	(2438mm)	9'0"	(2743mm)	10'0"	(3048mm)
Standard widths	Increments of 2" (50mm) from 1'6" (457mm) to 8'0" (2438mm)					

Custom sizes per request.

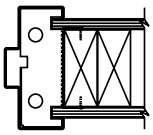
Typical wall conditions – F and FN Series



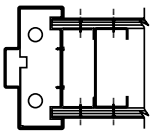
Butted masonry



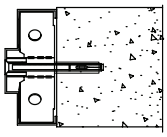
Wrap-around masonry



Wood stud



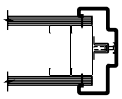
Closed steel stud wall



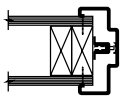
Existing wall

Typical wall conditions – DW and K Series

Drywall frames are designed for drywall construction using wood studs or steel studs. DW and K Series frames are available in 16- or 14-gauge cold-rolled, A60 galvannealed or G90 galvanized steel.



Steel stud



Wood stud

Frames

Anchors – F and FN Series

Adjustable wire anchor
for masonry

Wood stud
anchor

Closed steel
stud anchor

Adjustable base
anchor - F, FN and C

Anchors – DW and K Series

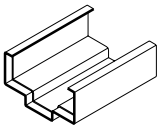
Lock in base
anchor – DW Series

Quick and easy base
anchor - K and CK Series

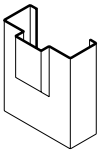
Compression anchor
- DW, K and CK Series

Optional
security anchor

Design options

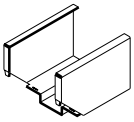


14-gauge closer
reinforcing sleeve

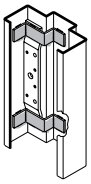


(F, FN,
DW, and
MU Series
only)

Hospital stop



4" face head



10-gauge high
frequency
reinforcement
(F, MU, DW and
FE Series only)

High frequency
hinge reinforcement

Frame profiles

F Series

MU Series

FE Series

DE Series

DW Series

C/CK Series

Relative cost

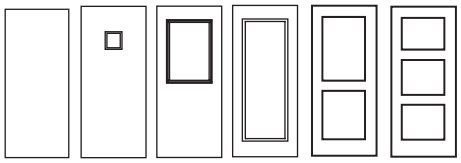
F16, 1 3/4" (45mm), 3'0" (914mm) x 7'0" (2134mm), 5 3/4" (147mm) prime painted, CRS knock down frame used as base of 100.

F16-4	CRS	16-gauge, 1 3/4" KD 100
F16-4	CRS 7'2"	16-gauge, 1 3/4" KD 102
F16-4	Galvannealed	16-gauge, 1 3/4" KD 114
F16-4	Label	16-gauge, 1 3/4" KD 116
FN16-4	CRS	16-gauge, 1 3/4" KD 100

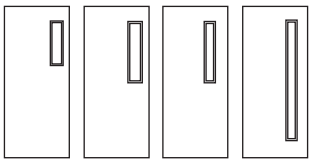
F14-4	CRS	14-gauge, 1 3/4" KD 123
F12-4	CRS	12-gauge, 1 3/4" KD 161
DW16-4	Drywall	16-gauge, 1 3/4" KD 102
MU16-4	Multi-use	16-gauge, 1 3/4" KD 102

Typical elevations

Flush panel and glass doors



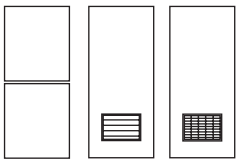
F V G FG FG2 FG3



N4 N5 N3 LNL

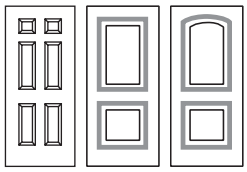
Dutch doors

Doors with louvers or grilles



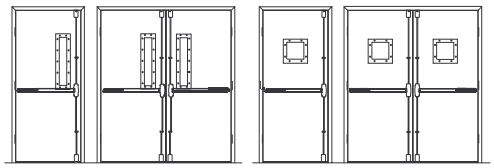
Dutch Louver Grille

Embossed panel doors

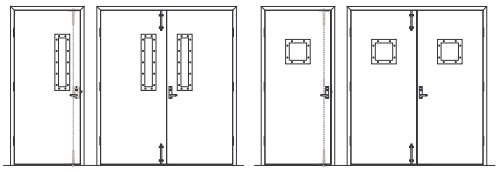


E6 HD2 HD2A

ADA Compliant PN(F) Narrow and PN(F) Vision Lights – WS98/9927, WS98/9957



PN(F) Narrow and PV(F) Vision Lights – LM 9300



Flush doors

Flush doors are defined as having no seams on the face, with seams permitted on the edges. Doors are available in commercial-quality carbon steel or A-60 galvannealed steel, G-90 galvanized steel and stainless steel (Type 304 and 316).

L Series

The L Series door has a honeycomb core, beveled hinge, and lock edge with a visible seam on both edges. Optional cores are polystyrene or polyurethane. L Series doors are available in 14-, 16-, 18- and 20-gauge steel.

B Series

The B Series door has a steel-stiffened core with visible seams on the hinge and lock edges. 20-gauge vertical steel stiffeners are welded to the inside of one face sheet and bonded to the opposite face. Void areas between the stiffeners are filled with fiber bat insulation. B Series doors are available in 14-, 16- and 18-gauge steel.

T Series

The T Series doors are designed to meet the requirements for temperature rise fire-rated applications. These doors include the same construction features of the L Series doors, yet include a mineral board core for a 250º or 450º temperature rise rating. T Series doors are available in 14-, 16-, 18- and 20-gauge steel.

CE Series

CE Series are decorative doors featuring deeply embossed panels on both sides, creating the appearance of hand-carved doors. The door includes all construction features of the L Series door and is available with a variety of glass sizes. These doors are available in 16-, 18- and 20-gauge steel.

H Series

H Series hurricane-rated doors offer the utmost in life safety solutions. Each door, frame and hardware configuration offered has been tested and certified as an assembly to meet stringent Florida Building Code, Miami Dade and Texas Department of Insurance standards. With this approach of assembly approval, Allegion offers the assurance of a turnkey solution that is certified as a whole, while also expediting project approval.

Paladin™ Series

The Paladin opening system is designed and tested to ICC 500 standards and FEMA 361/320 guidelines, and those established by the Red Cross to protect the general public from the extreme environmental effects of tornadoes. The severe storm opening system is designed for commercial and residential tornado storm shelters. Paladin options include patented factory installed ADA glass lights from Technical Glass Products (TGP).

Design options

GRAINTECH™

GRAINTECH™ doors are L,T, H or CE Series doors, produced using steel sheets that have been embossed to create a wood grain appearance. GRAINTECH™ doors are fabricated from stainable steel and available with an optional factory finish in six standard color stains, including a factory-applied clear coat with ultraviolet (UV) inhibitors. GRAINTECH™ gives you the look of wood with the durability and fire-rating of a steel door.

Specifications

Door thickness	1 3/4" (45mm)	
Standard heights L and B Series	6'8" (2032mm) 7'2" (2184mm) 9'0" (2743mm)	7'0" (2134mm) 8'0" (2438mm) 10'0" (3048mm)
Standard heights CE Series	6'8" (2032mm) 8'0" (2438mm)	7'0" (2134mm)
Standard widths L and B Series	Increments of 2" (50mm) from 1'6" (457mm) to 4'0" (1219mm) Custom dimensions available on request	
Standard widths CE Series	Increments of 2" (50mm) from 2'6" (762mm) to 3'8" (1118mm)	

Custom sizes per request.

Membrane Flashing

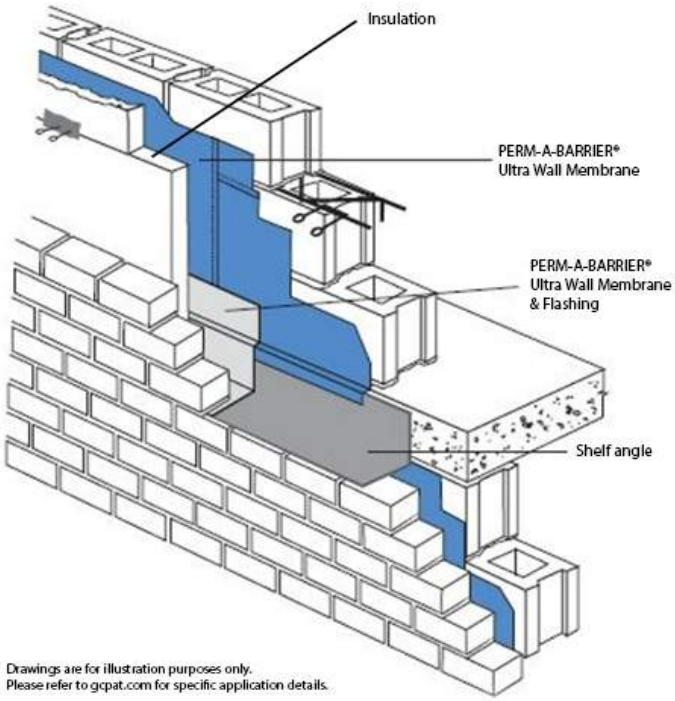
PERM-A-BARRIER® Ultra™ Wall Membrane and Flashing

100% Butyl Rubber, Aluminum Faced Self-Adhered Air & Vapor Barrier Membrane

Product Description

PERM-A-BARRIER® Ultra is a 30mil thick cold applied self-adhered membrane with cross laminated high density polyethylene film laminated to an aluminum foil and coated on high temperature 100% Butyl adhesive.

PERM-A-BARRIER® Ultra Wall Membranes and Flashings are ideal for protecting the building superstructure from the damaging effects of the elements. PERM-A-BARRIER Ultra Wall Membranes and Flashings minimizes air and water vapor flow through the building exterior and prevent premature deterioration of the building envelope in extreme climate, Enhance thermal performance of the structure and save energy costs.



Product Advantages

- Aggressive, conformable 100% Butyl rubber adhesive - allows self-sealing around mechanical fasteners, Compatible with adjacent PERM-A-BARRIER products and variety of roofing products such as TPO & EPDM*.
- Aluminum facer - provides extended UV exposure, compatible with variety of construction sealant, improved adhesion to film, dimensional stability, high tear, puncture and impact resistance
- Stable at high Inservice temperature up to 300°F, recommended for high altitude, high temperature & under metal cladding applications and parapet details.

- PERM-A-BARRIER Ultra Flashings are heavy duty commercial window and door flashing compatible with other PERM-A-BARRIER sheet and liquid applied air barriers.
- Fire resistant - meets NFPA 285 as part of various wall assemblies with exterior insulations minimizes the air
- Waterproof and impermeable to moisture - Impermeable to the passage of liquid water and vapor
- Airtight - protects against air passage and associated energy losses. Meets ASTM E2357 standard as required by IECC 2012
- Wide temperature application window
- PERM-A-BARRIER Ultra Wall Membrane and Flashing is suitable for application above surface and ambient temperatures at 25°F (-4°C)
- AAMA 711 compliant flashings

System components

- PERM-A-BARRIER® Adhesive Primer - Primer used to facilitate tenacious adhesion of PERM-A-BARRIER Ultra to the various substrate
- PERM-A-BARRIER® WB Primer - high tack, water-based primer for use with PERM-A-BARRIER Ultra on various substrate
- PERM-A-BARRIER® Universal Flashing & Sealant - one part moisture curing, STPE sealant for sealing penetrations, terminations, brick ties, final terminations, sheathing joint & flashing application.
- PERM-A-BARRIER® Wall Flashing - fully adhered through wall flashing system
- PERM-A-BARRIER® Ultra Flashing - fully adhered flashing for protecting and sealing critical detail areas. Available in 6", 9" and 12" width.

Safety & Handling

PERM-A-BARRIER® products must be handled properly. Vapors from the mastic and solvent-based primer are harmful and flammable. For these products, the best available information on safe handling, storage, personal protection, health and environmental considerations has been gathered. Refer to product label and SDS (Safety Data Sheet) before use. All users should acquaint themselves with this information prior to working with the material. Carefully read detailed precaution statements on the product labels and SDS before use. SDSs can be obtained from our web site or by contacting us toll free at 866-333-3726.

Storage Information

- Pallets of PERM-A-BARRIER® Ultra must not be double stacked on the job site.
- All materials must be protected from rain and physical damage.
- Store off ground under tarps with adequate ventilation or otherwise protected from rain and ground moisture. Store membrane where temperatures will not exceed 90°F (32°C) for extended periods.
- Store in dry conditions at 40°F (4.5°C)-90°F(32°C)
- Review technical letter #30 Shelf Life/Storage and Handling of GCP Waterproofing and Air Barrier Products
- Observe two (2) year shelf life and use on a first in- first out basis

Surface Preparation

Surface must be smooth, clean, dry and free of voids, spalled areas, loose aggregate, loose nails, sharp protrusions or other matter that will hinder the adhesion or regularity of the membrane installation. Clean loose dust or dirt from the surface to which the wall membrane is to be applied by wiping with a clean, dry cloth or brush. It is best practice to first apply primer onto any gypsum sheathing cut edges that will receive PERM-A-BARRIER Ultra and Ultra Flashing to help reduce dust that may impact adhesion. In cold temperature installations do not apply over ice or frost.

Temperature

PERM-A-BARRIER® Ultra can be applied in dry weather when air and surface temperatures are above 25°F (-4°C).

Application

Priming of the substrate: Primer should be used prior to application of membrane. PERM-A-BARRIER® Adhesive Primer Or PERM-A-BARRIER® WB Primer can be used. Refer to Technical Letter 2, Substrate Preparation for Application of PERM-A-BARRIER® Products to Glass Mat Faced Gypsum Sheathing for priming requirements on specific glass-mat faced sheathing products.

Membrane Application

- Pre-cut PERM-A-BARRIER Ultra to easily handled lengths. Peel release liner from roll to expose adhesive and carefully position the membrane against substrate. The entirety of the membrane must be pressed firmly into place with sufficient pressure using a rubber or vinyl hand roller during application to ensure continuous and intimate contact with the substrate and to prevent water from migrating under the membrane. Overlap adjacent pieces 2 in. (51 mm) and roll overlap with a steel hand roller.
- When applying PERM-A-BARRIER Ultra to PERM-A-BARRIER® Wall Membranes and PERM-A-BARRIER® Wall Flashing – Apply a bead of Universal Flashing & Sealant along top edges of cuts on all non-water shedding laps, penetrations, all laps and seams on horizontal surfaces (e.g. sill plates), critical areas and as shown in GCP detail drawings, and tool into place.
- All non-water shedding edges must be sealed with Universal Flashing & Sealant.
- When applying PERM-A-BARRIER Ultra to other PERM-A-BARRIER product – Apply a bead of PAB Universal Flashing & Sealant along top edges, cuts, penetrations, all laps and seams on horizontal surfaces (e.g. sill plates), critical areas and as shown in GCP detail drawings, and trowel into place.
- PERM-A-BARRIER Ultra can be wet set (1 hr after application) into PERM-A-BARRIER VPL 50RS UV Stable. Alternatively, PERM-A-BARRIER Ultra can be applied over cured PERM-A-BARRIER VPL 50RS UV Stable (24 hrs after application).
- No reglet is necessary when installing PERM-A-BARRIER Ultra to vertical surfaces.
- (*) if tying into PVC & EPDM roofing, consult GCP Technical services for approved tie-in detailing.

Membrane Repairs

- Repairs must be made using PERM-A-BARRIER® Ultra sized to extend 6 in. (150mm) in all directions from the perimeter of the affected area.
- The repair piece must be pressed into place with a hand roller as soon as possible to ensure continuous and intimate contact with the substrate.
- When sealing the patch if placed in a diamond pattern both water sheading edges will need sealant. If the patches are placed straight, then the top edge and minimum of 3" down each side will need sealant termination.

Membrane Protection

PERM-A-BARRIER® Ultra must be protected from damage by other trades or construction materials.

Limitations of use

- Approved uses only include those uses specifically detailed in this Product Data Sheet and other current Product Data Sheets that can be found at gcpat.com PERM-A-BARRIER Ultra is not intended for any other use. Contact GCP Technical Services where any other use is anticipated or intended.
- PERM-A-BARRIER Ultra & Ultra Flashings must not be applied in areas where it will be exposed to direct sunlight permanently and must be covered within 1 year of installation. Refer to Technical Letter 19, Exposure Guidelines for PERM-A-BARRIER Self-Adhered Membranes.
- Maximum In Service Temperature (as installed) is 300°F (149°C)
- Not recommended direct over granular surfaces.

Supply

PRODUCT	UNIT OF SALE	APPROXIMATE COVERAGE	WEIGHT	PALLETIZATION
PERM-A-BARRIER® Ultra	1 roll	210 ft2 (19.5 m2) 36 in. X 70 ft (0.91 x 21.3m) roll	54 lbs/roll	25 cartons (25 rolls)
PERM-A-BARRIER® Ultra Flashing				
6 in. (150 mm) 9 in. (225 mm) 12 in. (300 mm) 36 in. (914 mm)	6 rolls 4 rolls 3 roll 1 roll	70 linear ft per roll 70 linear ft per roll 70 linear ft per roll 70 linear ft per roll	9.1 lbs/roll 13.5 lbs/roll 18.0 lbs/roll 54 lbs/roll	25 cartons (150 rolls) 25 cartons (100 rolls) 25 cartons (75 rolls) 25 cartons (25 rolls)
PERM-A-BARRIER® Universal Flashing & Sealant- 29 oz. Cartridge	1 cartridge	approx. 30 linear ft x 1/4 in. bead	29 oz. cartridge	10 cartridges/ carton 42 cartons/ pallet

Typical Properties

PROPERTY	PERM-A-BARRIER® Ultra	TEST METHOD
Thickness	0.03 in. (0.8 mm)	ASTM D3767 method A
Minimum tensile strength, film	5000 psi (34.5 MPa)	ASTM D882
Minimum elongation, to failure	200%	ASTM D882
Pliability, at 180° bend over 1 in. (25 mm) mandrel	Pass at -20°F (-29°C)	ASTM D1970
Nail Sealability	Pass	ASTM D1970
Minimum puncture resistance, membrane	70 lbs (311 N)	ASTM E154
Lap peel adhesion	3.5 lbs/in.	ASTM D903 Mod
Maximum permeance to water vapor transmission	<0.01 perms / 0.02 perms	ASTM E96 Method A/ Method B
Water resistance of in-place membrane	Pass	ASTM E331
Air permeance of in-place membrane [1]	< 0.02 L/s/m^2 (0.004cfm/ft^2)	ASTM E2178
Assembly air permeance at 1.57 psf (75 Pa) pressure difference [1]	< 0.02 L/s/m^2 (0.004cfm/ft^2)	ASTM E2357
Wall assembly fire test	Pass as part of various wall assemblies	NFPA 285
Peel Adhesion to Gypsum board	>5 pli	ASTM D903
Peel adhesion to concrete	>5 pli	ASTM D903

Footnote:

1. Air permeance measured at a pressure differential of 1.57 psf (75 Pa).
2. Specific wall assemblies are available at gcpat.com.

We hope the information here will be helpful. It is based on data and knowledge considered to be true and accurate, and is offered for consideration, investigation and verification by the user, but we do not warrant the results to be obtained. Please read all statements, recommendations, and suggestions in conjunction with our conditions of sale, which apply to all goods supplied by us. No statement, recommendation, or suggestion is intended for any use that would infringe any patent, copyright, or other third party right.

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GCP Applied Technologies Inc., 2325 Lakeview Parkway, Suite 400, Alpharetta, GA 30009, USA

GCP Canada, Inc., 294 Clements Road, West, Ajax, Ontario, Canada L1S 3C6

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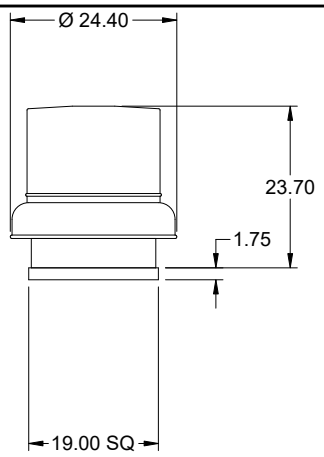
Last Updated: 2025-05-13
gcpat.com/solutions/products/perm-a-barrier-air-barrier-system/perm-a-barrier-ultra-wall-membrane-and

Mechanical Product Data

Model: GB-097-6

Belt Drive Centrifugal Roof Exhaust Fan

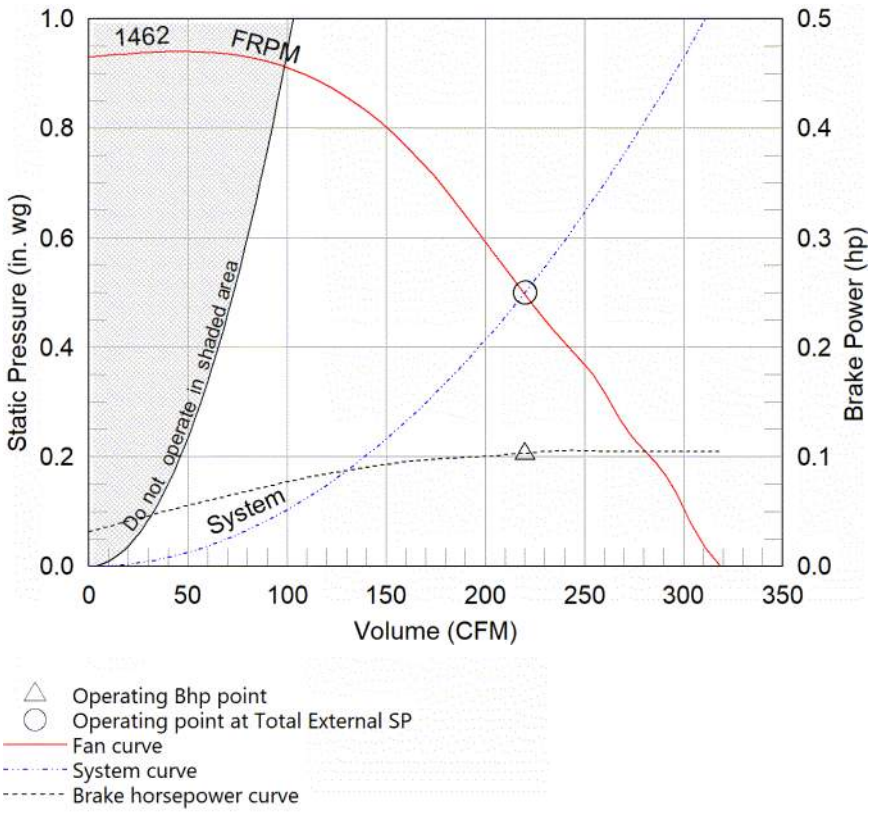


OVERALL HEIGHT MAY BE GREATER DEPENDING ON MOTOR, ADAPTER, AND/OR HINGE BASE.

Dimensional	
Quantity	1
Weight w/o Acc's (lb)	52
Weight w/ Acc's (lb)	57
Max T Motor Frame Size	56
Standard Curb Cap Size (in.)	19 x 19
Roof Opening (in.)	15.5 x 15.5

Performance	
Requested Volume (CFM)	220
Actual Volume (CFM)	220
Total External SP (in. wg)	0.5
Fan RPM	1462
Operating Power (hp)	0.1
Elevation (ft)	135
Airstream Temp.(F)	70
Air Density (lb/ft3)	0.075
Drive Loss (%)	23.1
Tip Speed (ft/min)	4,283
Static Eff. (%)	22

Misc Fan Data	
Fan Energy Index (FEI)	-
Outlet Velocity (ft/min)	229



Motor	
Motor Included	Yes
Size (hp)	1/6
Voltage/Cycle/Phase	115/60/1
Enclosure	ODP
Motor RPM	1725
Efficiency Rating	Standard
Windings	1
NEC FLA* (Amps)	4.4
Min. Circuit Ampacity (MCA)	5.5
Max. Overcurrent Protection (MOP)	15
Short Circuit Current Rtg (SCCR)	5 kA

Notes:

All dimensions shown are in units of in.
*NEC FLA, MCA and MOP are for reference only – based on tables 430.248 or 430.25 of National Electric Code 2020. Actual motor FLA may vary, for sizing thermal overload, consult factory. MCA and MOP values shown only account for the motor, not accessories (damper actuator, field supplied VFD, etc).
LwA - A weighted sound power level, based on ANSI S1.4
dBA - A weighted sound pressure level, based on 11.5 dB attenuation per Octave band at 5 ft - dBA levels are not licensed by AMCA International
Sones - calculated using ANSI/AMCA 301 at 5 ft

Sound Power by Octave Band

Sound Data	62.5	125	250	500	1000	2000	4000	8000	LwA	dBA	Sones
Inlet	74	72	72	62	58	51	47	43	66	55	7.6

Model: GB-097-6

Belt Drive Centrifugal Roof Exhaust Fan

Standard Construction Features:

- Aluminum housing - Backward inclined aluminum wheel - Curb cap with prepunched mounting holes - Motor and drives isolated on shock mounts - Birdscreen - Ball bearing motors - Adjustable motor pulley - Adjustable motor plate - Fan shaft mounted in ball bearing pillow blocks - Bearings meet or exceed temperature rating of fan - Static resistant belts - Corrosion resistant fasteners - Sizes 141 and larger have internal lifting lugs.

Spark B construction was selected.
Greenheck has included options and accessories for this product that meet the intent of AMCA 99 - spark resistant construction guidelines. Greenheck recommends, but does not require, an EXP motor for this product line. If an EXP motor is not selected, the engineer of record must determine if this is acceptable for the application. The resulting fan construction in no way implies a guarantee of safety for any level of spark resistance. Spark resistant construction does not prevent ignition of explosive gasses or vapors due to catastrophic failure or from any airstream material that may exist within in a system.

Selected Options & Accessories:

Curb Cap Size - 19 Square
Spark B Construction
UL/cUL 705 Listed - "Power Ventilators"
Switch, NEMA-3R, Toggle,
Junction Box Mounted & Wired
Birdscreen: Galvanized, nom. 84% Free Area
Aluminum Wheel Material
Conduit Chase Qty 1
Unit Warranty: 1 Yr (Standard)

AMCA

AMCA Licensed for Sound and Air Performance. Power rating (BHP/kW) includes transmission losses.

Greenheck Fan Corporation certifies that the model shown herein is licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program. Performance certified is for installation type A: Free inlet, Free outlet. Power rating (BHP/kW) includes transmission losses. Performance ratings do not include the effects of appurtenances (accessories). The sound ratings shown are loudness values in fan sones at 5 ft. (1.5 m) in a hemispherical free field calculated per ANSI/AMCA Standard 301. Values shown are for installation type A: free inlet hemispherical sone levels. dBA levels are not licensed by AMCA International. The AMCA Certified Ratings Seal applies to sone ratings only.

Model OFSD-211

Out of Wall Combination Fire Smoke Damper
UL555S Leakage Class I
UL555 1½ Hour Fire Resistance Rating

Application

Model OFSD-211 is approved for use in walls, partitions, and floors with fire resistance ratings less than 3 hours. OFSD-211 is an 'out of the wall' combination fire smoke damper with 3V style blades. Removal of wall grille allows access to actuator and other components. This model's operational ratings of 2000 fpm (10.2 m/s) and pressures to 6 in. wg (1.5 kPa). Model OFSD-211 shall be installed vertically (with blades running horizontal) or horizontally and is rated for airflow and leakage in either direction.

UL555 Fire Resistance Ratings

Fire Rating
1½ hours in walls
Dynamic Closure
Actual limits are size dependent
Maximum Velocity
2000 fpm (10.2 m/s)
Maximum Pressure
6 in. wg. (1.5 kPa) - differential pressure

UL555S Leakage Ratings

Leakage Class
I
Operational Rating
Actual limits are size dependent
Maximum Velocity
2000 fpm (10.2 m/s)
Maximum Pressure
6 in. wg (1.5 kPa)
Maximum Temperature
350°F (177°C) - depending upon the actuator

W & H dimensions furnished approximately ¼ in. (6mm) undersize. Add blanket thickness (⅛ in. 3mm) and sleeve thickness for overall sleeved damper dimension.

Oversize wall opening as follows: Nominal damper size plus ⅜ in.(9.5mm).

See complete marking on product.

UL 555 and UL 555S Classification R13317

CAN/ULC S112.1

Size Limitations

WxH	Minimum Size	Maximum Size Single Section
Inches	8 x 8	36 x 36
mm	203 x 203	914 x 914

Model OFSD-211 meets the requirements for fire dampers, smoke dampers and combination fire smoke dampers established by:

National Fire Protection Association
NFPA Standards 80, 90A, 92, 101 & 105

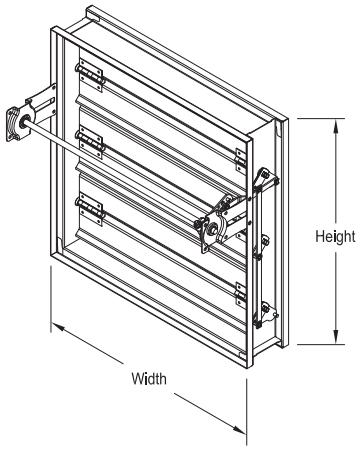
IBC International Building Codes

CSFM California State Fire Marshal
Fire Damper Listing (#3225-0981:103)
Leakage (Smoke) Damper Listing (#3230-0981:104)

Construction

	Standard	Optional
Frame Material	Galvanized Steel	-
Frame Thickness	16 ga. (1.5mm)	-
Frame Type	5 in. x 1in. (127mm x 25mm) hat channel	-
Blade Action	Parallel	-
Blade Material	Galvanized Steel	-
Blade Orientation	Horizontal	-
Blade Thickness	16 ga. (1.5mm)	-
Blade Type	3V	-
Linkage	Plated steel out of air-stream, concealed in jamb	-
Axle Bearings	316SS	-
Axle Material	Plated Steel	-
Blade Seals	Silicone	-
Jamb Seals	Stainless Steel	-
Closure Device	RRL	RRL/OCI, TOR, Fusible Link
Closure Temperature	165°F (74°C)	212°F (100°C), 250°F (121°C), 286°F (141°C)*, 350°F (177°C)
Mounting	Vertical	Horizontal

*only available with fusible link



Note:

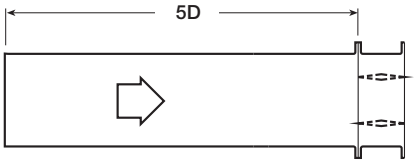
The frames are constructed with reinforced corners. Low profile head and sill are used on sizes less than 17 in. (432 mm) high for lower pressure drop and improved damper performance.

Options

- BACnet test module - 120V
- BACnet test module - 24V
- Clean wrap
- Greenheck test switches (GTS)
- Grille tabs
- Momentary test switch
- Retaining angles
- Sealed transitions and sleeves
- Smoke detector - no flow
- Smoke detector - low flow
- Transitions: R, C, O

Pressure Drop

AMCA Figure 5.2



12 in. x 12 in. (305mm x 305mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.04
1000	0.14
1500	0.31
2000	0.55
2500	0.86
3000	1.24
3500	1.69
4000	2.20

24 in. x 24 in. (610mm x 610mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.02
1000	0.07
1500	0.16
2000	0.29
2500	0.45
3000	0.65
3500	0.89
4000	1.16

36 in. x 36 in. (914mm x 914mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.01
1000	0.04
1500	0.09
2000	0.16
2500	0.25
3000	0.36
3500	0.49
4000	0.64

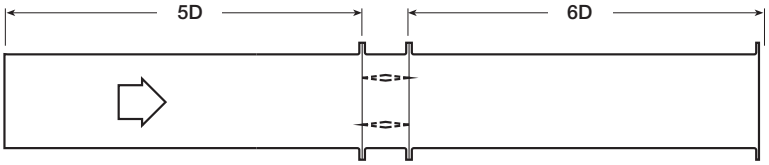
12 in. x 48 in. (305mm x 1219mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.01
1000	0.06
1500	0.13
2000	0.23
2500	0.36
3000	0.52
3500	0.70
4000	0.92

48 in. x 12 in. (1219mm x 305mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.03
1000	0.10
1500	0.23
2000	0.41
2500	0.63
3000	0.91
3500	1.24
4000	1.62

AMCA Figure 5.3



12 in. x 12 in. (305mm x 305mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.02
1000	0.09
1500	0.20
2000	0.36
2500	0.56
3000	0.81
3500	1.10
4000	1.44

24 in. x 24 in. (610mm x 610mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.01
1000	0.04
1500	0.09
2000	0.16
2500	0.25
3000	0.35
3500	0.48
4000	0.63

36 in. x 36 in. (914mm x 914mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.01
1000	0.03
1500	0.06
2000	0.11
2500	0.17
3000	0.24
3500	0.33
4000	0.42

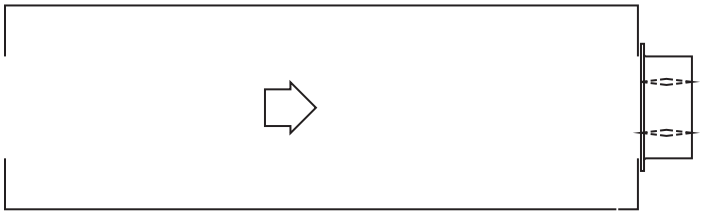
12 in. x 48 in. (305mm x 1219mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.01
1000	0.04
1500	0.10
2000	0.17
2500	0.27
3000	0.39
3500	0.53
4000	0.70

48 in. x 12 in. (1219mm x 305mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.02
1000	0.07
1500	0.16
2000	0.29
2500	0.45
3000	0.64
3500	0.88
4000	1.14

AMCA Figure 5.5



12 in. x 12 in. (305mm x 305mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.06
1000	0.22
1500	0.50
2000	0.89
2500	1.39
3000	2.00
3500	2.72
4000	3.55

24 in. x 24 in. (610mm x 610mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.03
1000	0.14
1500	0.31
2000	0.54
2500	0.85
3000	1.22
3500	1.66
4000	2.17

36 in. x 36 in. (914mm x 914mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.03
1000	0.12
1500	0.26
2000	0.46
2500	0.73
3000	1.05
3500	1.42
4000	1.86

12 in. x 48 in. (305mm x 1219mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.03
1000	0.13
1500	0.30
2000	0.53
2500	0.83
3000	1.19
3500	1.62
4000	2.11

48 in. x 12 in. (1219mm x 305mm)

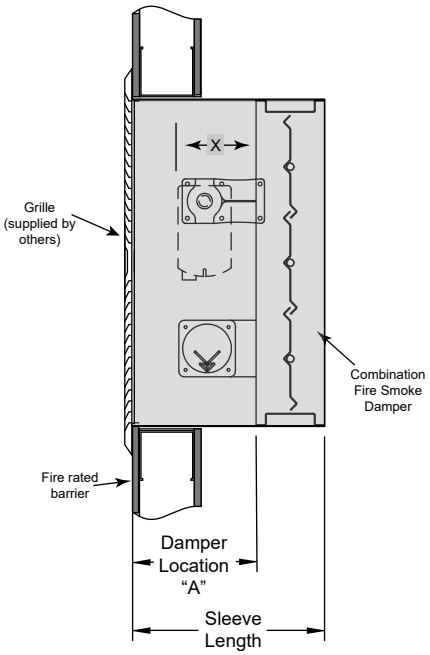
Velocity (fpm)	Pressure Drop (in. wg)
500	0.04
1000	0.17
1500	0.38
2000	0.67
2500	1.04
3000	1.50
3500	2.05
4000	2.67

Greenheck Fan Corporation certifies that the model OFSD-211 shown herein is 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.

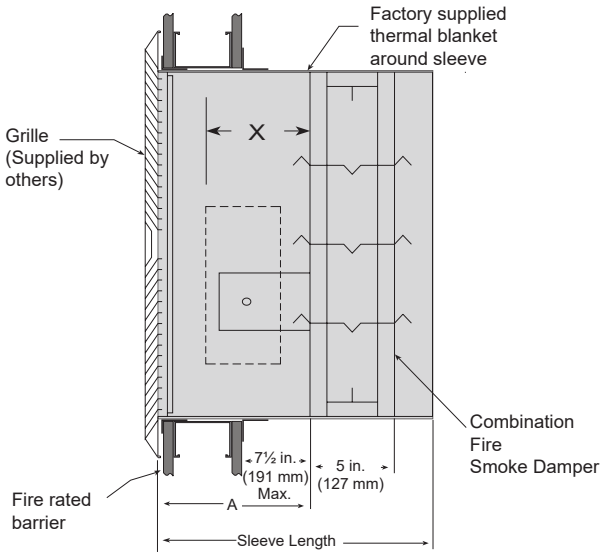
Application Data

Actuator Space Envelopes

The drawing below and corresponding table show the minimum dimensions required for internal actuator mounting on OFSD-211. The standard mounting locations provide enough space for the mounting of actuators and controls plus allowing space for a grille.



OFSD's that don't require a breakaway connection



OFSD's that require a breakaway connection

Actuator Type/Model	'X' Dimension
FSLF24-S, 120, 230-S Belimo	7½ in (191mm)
FSNF24, 120, 230-S Belimo	7⅜ in. (187mm)
FSTF24, 120, 230-S Belimo	7⅛ in (181mm)
MSXX09 Series Honeywell	7½ in (191mm)
MSXX04 Series Honeywell	7½ in (191mm)
MSXX20 Series Honeywell	7½ in (191mm)

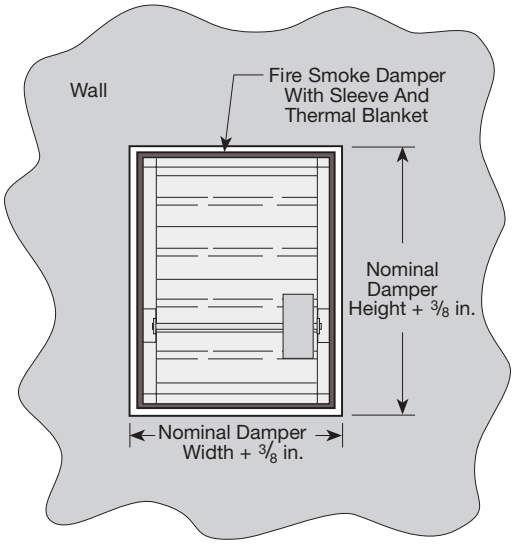
Wall Opening Sizing

To accommodate for sleeve and thermal blanket thickness, the wall opening must be oversized by ⅜ in. (9.5mm) as shown. For example, if the nominal damper size required is 18 in. x 14 in. (457mm x 356mm), the wall opening size needs to be 18⅜ in. x 14⅜ in. (467mm x 365mm). The damper itself is undersized ¼ in. (6mm) on each dimension for an actual damper size of 17¾ in. x 13¾ in. (451mm x 349mm). This is also the inside dimensions of the sleeve (for grille considerations).

Sleeve Information

Sleeve length is dependent on actuator, grille depth, OBD depth, and damper height and whether or not a breakaway connection is required on the side opposite the actuator.

'Sleeve Gauge' = 16 ga. or 20 ga. (1.5mm or 1mm)



Document Links

INSTALLATION

CATALOG

SELECTION GUIDE

SPECIFICATIONS

WARRANTY

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OFSD-211, R18, April 2025
Greenheck Fan Corporation reserves the right to make product changes without notice.

350R, 350F AND 350R-SS
PERFORMANCE BASED ON NOMINAL SIZES SHOWN IN BOLD

NC-20

Nominal Duct Size (in.)	Nominal Duct Area (ft²)	Core Area (ft²)	Core Velocity / Velocity Pressure / Neg. Static Pressure	100 / 0.001 / 0.002	200 / 0.002 / 0.008	300 / 0.006 / 0.018	400 / 0.010 / 0.032	500 / 0.016 / 0.051	600 / 0.022 / 0.073	700 / 0.031 / 0.099	800 / 0.040 / 0.130	900 / 0.050 / 0.164
6x6	**0.25**	**0.19**	Airflow, cfm	19	38	57	76	95	114	133	152	171
			NC	-	-	-	-	-	13	19	25	29
8x6	**0.33**	**0.26**	Airflow, cfm	26	52	78	104	130	156	182	208	234
			NC	-	-	-	-	-	15	20	26	30
10x6	**0.42**	**0.34**	Airflow, cfm	34	68	102	136	170	204	238	272	306
			NC	-	-	-	-	-	16	21	28	32
8x8	**0.44**	**0.37**	Airflow, cfm	37	74	111	148	185	222	259	296	333
			NC	-	-	-	-	-	16	22	28	32
12x6	**0.5**	**0.41**	Airflow, cfm	41	82	123	164	205	246	287	328	369
			NC	-	-	-	-	-	17	22	30	34
14x6	**0.58**	**0.48**	Airflow, cfm	48	96	144	192	240	288	336	384	432
			NC	-	-	-	-	-	18	24	30	34
16x6 **12x8**	**0.67**	**0.57**	Airflow, cfm	57	114	171	228	285	342	399	456	513
			NC	-	-	-	-	10	19	25	30	35
10x10	**0.69**	**0.59**	Airflow, cfm	59	118	177	236	295	354	413	472	531
			NC	-	-	-	-	10	19	25	31	35
18x6	**0.75**	**0.63**	Airflow, cfm	63	126	189	252	315	378	441	504	567
			NC	-	-	-	-	10	19	25	32	35
20x6 **12x10**	**0.83**	**0.72**	Airflow, cfm	72	144	216	288	360	432	504	576	648
			NC	-	-	-	-	11	19	25	30	35
22x6	**0.92**	**0.77**	Airflow, cfm	77	154	231	308	385	462	539	616	693
			NC	-	-	-	-	11	19	25	30	35
24x6 **12x12**	**1**	**0.88**	Airflow, cfm	88	176	264	352	440	528	616	704	792
			NC	-	-	-	-	11	19	25	30	35
30x6 **18x10**	**1.25**	**1.11**	Airflow, cfm	111	222	333	444	555	666	777	888	999
			NC	-	-	-	-	12	20	26	32	35
14x14	**1.36**	**1.22**	Airflow, cfm	122	244	366	488	610	732	854	976	1098
			NC	-	-	-	-	12	20	27	32	35
36x6 **18x12**	**1.5**	**1.35**	Airflow, cfm	135	270	405	540	675	810	945	1080	1215
			NC	-	-	-	-	13	20	27	32	35
22x10	**1.53**	**1.37**	Airflow, cfm	137	274	411	548	685	822	959	1096	1233
			NC	-	-	-	-	13	20	27	32	36
30x8 **24x10**	**1.67**	**1.49**	Airflow, cfm	149	298	447	596	745	894	1043	1192	1341
			NC	-	-	-	-	14	21	27	33	37
42x6 **18x14**	**1.75**	**1.59**	Airflow, cfm	159	318	477	636	795	954	1113	1272	1431
			NC	-	-	-	-	14	21	27	33	37
16x16	**1.78**	**1.62**	Airflow, cfm	162	324	486	648	810	972	1134	1296	1458
			NC	-	-	-	-	14	21	27	33	37
24x12 18x16	**2**	**1.82**	Airflow, cfm	182	364	546	728	910	1092	1274	1456	1638
			NC	-	-	-	-	14	21	28	33	38
18x18	**2.25**	**2.07**	Airflow, cfm	207	414	621	828	1035	1242	1449	1656	1863
			NC	-	-	-	-	14	21	28	33	38
24x14	**2.33**	**2.14**	Airflow, cfm	214	428	642	856	1070	1284	1498	1712	1926
			NC	-	-	-	-	14	22	28	33	38
30x12	**2.5**	**2.29**	Airflow, cfm	229	458	687	916	1145	1374	1603	1832	2061
			NC	-	-	-	-	15	22	28	33	38
24x16	**2.67**	**2.46**	Airflow, cfm	246	492	738	984	1230	1476	1722	1968	2214
			NC	-	-	-	-	15	22	29	34	39
20x20	**2.78**	**2.57**	Airflow, cfm	257	514	771	1028	1285	1542	1799	2056	2313
			NC	-	-	-	-	16	23	29	34	39
36x12	**3**	**2.75**	Airflow, cfm	275	550	825	1100	1375	1650	1925	2200	2475
			NC	-	-	-	-	16	23	29	34	39
30x16 **24x20**	**3.33**	**3.11**	Airflow, cfm	311	622	933	1244	1555	1866	2177	2488	2799
			NC	-	-	-	-	17	24	30	35	40
22x22	**3.36**	**3.14**	Airflow, cfm	314	628	942	1256	1570	1884	2198	2512	2826
			NC	-	-	-	-	17	24	30	35	40
42x12 36x14	**3.5**	**3.22**	Airflow, cfm	322	644	966	1288	1610	1932	2254	2576	2898
			NC	-	-	-	-	17	24	30	36	40
24x22	**3.67**	**3.43**	Airflow, cfm	343	686	1029	1372	1715	2058	2401	2744	3087
			NC	-	-	-	-	17	24	30	36	40
30x18	**3.75**	**3.5**	Airflow, cfm	350	700	1050	1400	1750	2100	2450	2800	3150
			NC	-	-	-	-	17	24	30	36	40

NC-30

NC-40

- Static pressures are negative, in inches of water, measured per ANSI/ASHRAE Standard 70-2006
- NC based on room absorption of 10 dB, re 10^{-12} watts, measured per ANSI/ASHRAE Standard 70-2006

350R, 350F AND 350R-SS
PERFORMANCE BASED ON NOMINAL SIZES SHOWN IN BOLD

Nominal Duct Size (in.)	Nominal Duct Area (ft²)	Core Area (ft²)	Core Velocity Velocity Pressure Neg. Static Pressure	100 0.001 0.002	200 0.002 0.008	300 0.006 0.018	400 0.010 0.032	500 0.016 0.051	600 0.022 0.073	700 0.031 0.099	800 0.040 0.130	900 0.050 0.164
								NC-20	NC-30		NC-40	
48x12 **24x24**	**4**	**3.75**	Airflow, cfm NC	375 -	750 -	1125 -	1500 -	1875 18	2250 25	2625 37	3000 38	3375 41
36x18	**4.5**	**4.22**	Airflow, cfm NC	422 -	844 -	1266 -	1688 -	2110 18	2532 25	2954 31	3376 38	3798 41
36x20 30x24	**5**	**4.71**	Airflow, cfm NC	471 -	942 -	1413 -	1884 -	2355 18	2826 25	3297 31	3768 38	4239 41
42x18	**5.25**	**4.94**	Airflow, cfm NC	494 -	988 -	1482 -	1976 -	2470 18	2964 25	3458 31	3952 38	4446 41
28x28	**5.44**	**5.16**	Airflow, cfm NC	516 -	1032 -	1548 -	2064 -	2580 18	3096 25	3612 32	4128 38	4644 41
42x20 30x28	**5.83**	**5.51**	Airflow, cfm NC	551 -	1102 -	1653 -	2204 10	2755 18	3306 26	3857 32	4408 38	4959 41
48x18 36x24	**6**	**5.66**	Airflow, cfm NC	566 -	1132 -	1698 -	2264 10	2830 18	3396 26	3962 32	4528 38	5094 41
30x30	**6.25**	**5.94**	Airflow, cfm NC	594 -	1188 -	1782 -	2376 10	2970 18	3564 26	4158 32	4752 38	5346 41
42x24 36x28	**7**	**6.66**	Airflow, cfm NC	666 -	1332 -	1998 -	2664 10	3330 19	3996 26	4662 32	5328 38	5994 41
46x22	**7.03**	**6.68**	Airflow, cfm NC	668 -	1336 -	2004 -	2672 10	3340 19	4008 27	4676 32	5344 38	6012 42
32x32	**7.11**	**6.78**	Airflow, cfm NC	678 -	1356 -	2034 -	2712 10	3390 19	4068 27	4746 32	5424 38	6102 42
36x30	**7.5**	**7.16**	Airflow, cfm NC	716 -	1432 -	2148 -	2864 10	3580 19	4296 27	5012 32	5728 38	6444 42
48x24 36x32	**8**	**7.63**	Airflow, cfm NC	763 -	1526 -	2289 -	3052 10	3815 19	4578 27	5341 32	6104 38	6867 42
34x34	**8.03**	**7.68**	Airflow, cfm NC	768 -	1536 -	2304 -	3072 10	3840 19	4608 27	5376 32	6144 38	6912 42
36x34	**8.5**	**8.14**	Airflow, cfm NC	814 -	1628 -	2442 -	3256 11	4070 19	4884 27	5698 32	6512 38	7326 42
42x30	**8.75**	**8.38**	Airflow, cfm NC	838 -	1676 -	2514 -	3352 11	4190 20	5028 27	5866 32	6704 38	7542 42
36x36	**9**	**8.63**	Airflow, cfm NC	863 -	1726 -	2589 -	3452 11	4315 20	5178 27	6041 33	6904 38	7767 43
42x34 **48x30**	**10**	**9.6**	Airflow, cfm NC	960 -	1920 -	2880 -	3840 11	4800 20	5760 27	6720 33	7680 38	8640 43
38x38	**10.03**	**9.64**	Airflow, cfm NC	964 -	1928 -	2892 -	3856 11	4820 20	5784 27	6748 33	7712 38	8676 43
42x36	**10.5**	**10.1**	Airflow, cfm NC	1010 -	2020 -	3030 -	4040 11	5050 20	6060 27	7070 33	8080 38	9090 43
46x34	**10.86**	**10.45**	Airflow, cfm NC	1045 -	2090 -	3135 -	4180 11	5225 20	6270 27	7315 33	8360 38	9405 43
42x38	**11.08**	**10.67**	Airflow, cfm NC	1067 -	2134 -	3201 -	4268 11	5335 20	6402 27	7469 33	8536 38	9603 43
40x40	**11.11**	**10.7**	Airflow, cfm NC	1070 -	2140 -	3210 -	4280 11	5350 20	6420 27	7490 33	8560 38	9630 43
48x36	**12**	**11.57**	Airflow, cfm NC	1157 -	2314 -	3471 -	4628 11	5785 20	6942 27	8099 33	9256 39	10413 44
42x42	**12.25**	**11.82**	Airflow, cfm NC	1182 -	2364 -	3546 -	4728 11	5910 20	7092 27	8274 33	9456 39	10638 44
44x44	**13.44**	**12.99**	Airflow, cfm NC	1299 -	2598 -	3897 -	5196 12	6495 21	7794 28	9093 34	10392 39	11691 44
48x42	**14**	**13.54**	Airflow, cfm NC	1354 -	2708 -	4062 -	5416 12	6770 21	8124 28	9478 34	10832 40	12186 45
46x46	**14.69**	**14.22**	Airflow, cfm NC	1422 -	2844 -	4266 -	5688 12	7110 21	8532 28	9954 35	11376 40	12798 45
48x46	**15.33**	**14.85**	Airflow, cfm NC	1485 -	2970 -	4455 -	5940 12	7425 22	8910 28	10395 35	11880 40	13365 45
48x48	**16**	**15.5**	Airflow, cfm NC	1550 -	3100 -	4650 -	6200 13	7750 22	9300 29	10850 35	12400 40	13950 45

- Static pressures are negative, in inches of water, measured per ANSI/ASHRAE Standard 70-2006
- NC based on room absorption of 10 dB, re 10^{-12} watts, measured per ANSI/ASHRAE Standard 70-2006

350ZR AND 350ZF
PERFORMANCE BASED ON NOMINAL SIZES SHOWN IN BOLD

Nominal Duct Size (in.)	Nominal Duct Area (ft²)	Core Area (ft²)	Core Velocity Velocity Pressure Neg. Static Pressure	300 0.006 0.012	400 0.010 0.022	500 0.016 0.034	600 0.022 0.049	700 0.031 0.067	900 0.050 0.111	1100 0.075 0.165	1300 0.105 0.231	1500 0.140 0.307
							NC-10	NC-20		NC-30		NC-40
6x6	**0.25**	**0.19**	Airflow, cfm	57	76	95	114	133	171	209	247	285
			NC	-	-	-	-	13	20	26	31	35
8x6	**0.33**	**0.26**	Airflow, cfm	78	104	130	156	182	234	286	338	390
			NC	-	-	-	-	14	22	27	32	36
10x6	**0.42**	**0.34**	Airflow, cfm	102	136	170	204	238	306	374	442	510
			NC	-	-	-	11	16	23	28	33	37
8x8	**0.44**	**0.37**	Airflow, cfm	111	148	185	222	259	333	407	481	555
			NC	-	-	-	12	16	23	29	34	38
12x6	**0.5**	**0.41**	Airflow, cfm	123	164	205	246	287	369	451	533	615
			NC	-	-	-	12	16	24	29	34	38
14x6	**0.58**	**0.48**	Airflow, cfm	144	192	240	288	336	432	528	624	720
			NC	-	-	-	13	17	24	30	35	39
16x6 **12x8**	**0.67**	**0.57**	Airflow, cfm	171	228	285	342	399	513	627	741	855
			NC	-	-	-	13	18	25	31	36	40
10x10	**0.69**	**0.59**	Airflow, cfm	177	236	295	354	413	531	649	767	885
			NC	-	-	-	14	18	25	31	36	40
18x6	**0.75**	**0.63**	Airflow, cfm	189	252	315	378	441	567	693	819	945
			NC	-	-	-	14	18	25	31	36	40
20x6 **12x10**	**0.83**	**0.72**	Airflow, cfm	216	288	360	432	504	648	792	936	1080
			NC	-	-	-	14	19	26	32	37	41
22x6	**0.92**	**0.77**	Airflow, cfm	231	308	385	462	539	693	847	1001	1155
			NC	-	-	-	15	19	26	32	37	41
24x6 **12x12**	**1**	**0.88**	Airflow, cfm	264	352	440	528	616	792	968	1144	1320
			NC	-	-	-	15	20	27	33	37	42
30x6 **18x10**	**1.25**	**1.11**	Airflow, cfm	333	444	555	666	777	999	1221	1443	1665
			NC	-	-	11	16	21	28	34	38	43
14x14	**1.36**	**1.22**	Airflow, cfm	366	488	610	732	854	1098	1342	1586	1830
			NC	-	-	11	17	21	28	34	39	43
36x6 **18x12**	**1.5**	**1.35**	Airflow, cfm	405	540	675	810	945	1215	1485	1755	2025
			NC	-	-	12	17	22	29	35	39	43
22x10	**1.53**	**1.37**	Airflow, cfm	411	548	685	822	959	1233	1507	1781	2055
			NC	-	-	12	17	22	29	35	39	43
30x8 **24x10**	**1.67**	**1.49**	Airflow, cfm	447	596	745	894	1043	1341	1639	1937	2235
			NC	-	-	12	18	22	29	35	40	44
42x6 **18x14**	**1.75**	**1.59**	Airflow, cfm	477	636	795	954	1113	1431	1749	2067	2385
			NC	-	-	13	18	22	29	35	40	44
16x16	**1.78**	**1.62**	Airflow, cfm	486	648	810	972	1134	1458	1782	2106	2430
			NC	-	-	13	18	22	30	35	40	44
24x12 18x16	**2**	**1.82**	Airflow, cfm	546	728	910	1092	1274	1638	2002	2366	2730
			NC	-	-	13	18	23	30	36	41	45
18x18	**2.25**	**2.07**	Airflow, cfm	621	828	1035	1242	1449	1863	2277	2691	3105
			NC	-	-	14	19	23	31	36	41	45
24x14	**2.33**	**2.14**	Airflow, cfm	642	856	1070	1284	1498	1926	2354	2782	3210
			NC	-	-	14	19	24	31	37	41	45
30x12	**2.5**	**2.29**	Airflow, cfm	687	916	1145	1374	1603	2061	2519	2977	3435
			NC	-	-	14	19	24	31	37	42	46
24x16	**2.67**	**2.46**	Airflow, cfm	738	984	1230	1476	1722	2214	2706	3198	3690
			NC	-	-	15	20	24	31	37	42	46
20x20	**2.78**	**2.57**	Airflow, cfm	771	1028	1285	1542	1799	2313	2827	3341	3855
			NC	-	-	15	20	24	32	37	42	46
36x12	**3**	**2.75**	Airflow, cfm	825	1100	1375	1650	1925	2475	3025	3575	4125
			NC	-	-	15	20	25	32	38	42	47
30x16 **24x20**	**3.33**	**3.11**	Airflow, cfm	933	1244	1555	1866	2177	2799	3421	4043	4665
			NC	-	-	16	21	25	32	38	43	47
22x22	**3.36**	**3.14**	Airflow, cfm	942	1256	1570	1884	2198	2826	3454	4082	4710
			NC	-	-	16	21	25	32	38	43	47
42x12 36x14	**3.5**	**3.22**	Airflow, cfm	966	1288	1610	1932	2254	2898	3542	4186	4830
			NC	-	-	16	21	25	33	38	43	47
24x22	**3.67**	**3.43**	Airflow, cfm	1029	1372	1715	2058	2401	3087	3773	4459	5145
			NC	-	-	16	21	26	33	39	43	47
30x18	**3.75**	**3.5**	Airflow, cfm	1050	1400	1750	2100	2450	3150	3850	4550	5250
			NC	-	-	16	21	26	33	39	43	48

- Static pressures are negative, in inches of water, measured per ANSI/ASHRAE Standard 70-2006
- NC based on room absorption of 10 dB, re 10^{-12} watts, measured per ANSI/ASHRAE Standard 70-2006

350ZR AND 350ZF
PERFORMANCE BASED ON NOMINAL SIZES SHOWN IN BOLD

Nominal Duct Size (in.)	Nominal Duct Area (ft²)	Core Area (ft²)	Core Velocity Velocity Pressure Neg. Static Pressure	300 0.006 0.012	400 0.010 0.022	500 0.016 0.034	600 0.022 0.049	700 0.031 0.067	900 0.050 0.111	1100 0.075 0.165	1300 0.105 0.231	1500 0.140 0.307
					NC-10		NC-20	NC-30		NC-40		
48x12 **24x24**	**4**	**3.75**	Airflow, cfm NC	1125 -	1500 -	1875 16	2250 22	2625 26	3375 33	4125 39	4875 44	5625 48
36x18	**4.5**	**4.22**	Airflow, cfm NC	1266 -	1688 -	2110 17	2532 22	2954 27	3798 34	4642 39	5486 44	6330 48
36x20 30x24	**5**	**4.71**	Airflow, cfm NC	1413 -	1884 11	2355 17	2826 23	3297 27	4239 34	5181 40	6123 45	7065 49
42x18	**5.25**	**4.94**	Airflow, cfm NC	1482 -	1976 11	2470 18	2964 23	3458 27	4446 34	5434 40	6422 45	7410 49
28x28	**5.44**	**5.16**	Airflow, cfm NC	1548 -	2064 11	2580 18	3096 23	3612 27	4644 35	5676 40	6708 45	7740 49
42x20 30x28	**5.83**	**5.51**	Airflow, cfm NC	1653 -	2204 12	2755 18	3306 23	3857 28	4959 35	6061 41	7163 45	8265 50
48x18 36x24	**6**	**5.66**	Airflow, cfm NC	1698 -	2264 12	2830 18	3396 23	3962 28	5094 35	6226 41	7358 46	8490 50
30x30	**6.25**	**5.94**	Airflow, cfm NC	1782 -	2376 12	2970 18	3564 24	4158 28	5346 35	6534 41	7722 46	8910 50
42x24 36x28	**7**	**6.66**	Airflow, cfm NC	1998 -	2664 12	3330 19	3996 24	4662 28	5994 36	7326 41	8658 46	9990 50
46x22	**7.03**	**6.68**	Airflow, cfm NC	2004 -	2672 12	3340 19	4008 24	4676 29	6012 36	7348 41	8684 46	10020 50
32x32	**7.11**	**6.78**	Airflow, cfm NC	2034 -	2712 13	3390 19	4068 24	4746 29	6102 36	7458 42	8814 46	10170 50
36x30	**7.5**	**7.16**	Airflow, cfm NC	2148 -	2864 13	3580 19	4296 24	5012 29	6444 36	7876 42	9308 47	10740 51
48x24 36x32	**8**	**7.63**	Airflow, cfm NC	2289 -	3052 13	3815 19	4578 25	5341 29	6867 36	8393 42	9919 47	11445 51
34x34	**8.03**	**7.68**	Airflow, cfm NC	2304 -	3072 13	3840 19	4608 25	5376 29	6912 36	8448 42	9984 47	11520 51
36x34	**8.5**	**8.14**	Airflow, cfm NC	2442 -	3256 13	4070 20	4884 25	5698 29	7326 37	8954 42	10582 47	12210 51
42x30	**8.75**	**8.38**	Airflow, cfm NC	2514 -	3352 13	4190 20	5028 25	5866 29	7542 37	9218 42	10894 47	12570 51
36x36	**9**	**8.63**	Airflow, cfm NC	2589 -	3452 14	4315 20	5178 25	6041 30	7767 37	9493 43	11219 47	12945 51
42x34 **48x30**	**10**	**9.6**	Airflow, cfm NC	2880 -	3840 14	4800 20	5760 26	6720 30	8640 37	10560 43	12480 48	14400 52
38x38	**10.03**	**9.64**	Airflow, cfm NC	2892 -	3856 14	4820 20	5784 26	6748 30	8676 37	10604 43	12532 48	14460 52
42x36	**10.5**	**10.1**	Airflow, cfm NC	3030 -	4040 14	5050 21	6060 26	7070 30	9090 38	11110 43	13130 48	15150 52
46x34	**10.86**	**10.45**	Airflow, cfm NC	3135 -	4180 14	5225 21	6270 26	7315 30	9405 38	11495 43	13585 48	15675 52
42x38	**11.08**	**10.67**	Airflow, cfm NC	3201 -	4268 14	5335 21	6402 26	7469 31	9603 38	11737 44	13871 48	16005 52
40x40	**11.11**	**10.7**	Airflow, cfm NC	3210 -	4280 15	5350 21	6420 26	7490 31	9630 38	11770 44	13910 48	16050 52
48x36	**12**	**11.57**	Airflow, cfm NC	3471 -	4628 15	5785 21	6942 26	8099 31	10413 38	12727 44	15041 49	17355 53
42x42	**12.25**	**11.82**	Airflow, cfm NC	3546 -	4728 15	5910 21	7092 27	8274 31	10638 38	13002 44	15366 49	17730 53
44x44	**13.44**	**12.99**	Airflow, cfm NC	3897 -	5196 15	6495 22	7794 27	9093 31	11691 39	14289 44	16887 49	19485 53
48x42	**14**	**13.54**	Airflow, cfm NC	4062 -	5416 16	6770 22	8124 27	9478 32	12186 39	14894 45	17602 49	20310 53
46x46	**14.69**	**14.22**	Airflow, cfm NC	4266 -	5688 16	7110 22	8532 27	9954 32	12798 39	15642 45	18486 50	21330 54
48x46	**15.33**	**14.85**	Airflow, cfm NC	4455 -	5940 16	7425 22	8910 28	10395 32	13365 39	16335 45	19305 50	22275 54
48x48	**16**	**15.5**	Airflow, cfm NC	4650 -	6200 16	7750 23	9300 28	10850 32	13950 39	17050 45	20150 50	23250 54
										NC-50		

- Static pressures are negative, in inches of water, measured per ANSI/ASHRAE Standard 70-2006
- NC based on room absorption of 10 dB, re 10^{-12} watts, measured per ANSI/ASHRAE Standard 70-2006

355R AND 355F

PERFORMANCE BASED ON NOMINAL SIZES SHOWN IN BOLD

NC-20 NC-30

Nominal Duct Size (in.)	Nominal Duct Area (ft²)	Core Area (ft²)	Core Velocity Velocity Pressure Neg. Static Pressure	100 0.001 0.003	200 0.002 0.011	300 0.006 0.026	400 0.010 0.045	500 0.016 0.071	600 0.022 0.102	700 0.031 0.139	800 0.040 0.182	900 0.050 0.230
6x6	**0.25**	**0.19**	Airflow, cfm	19	38	57	76	95	114	133	152	171
			NC	-	-	-	-	10	18	25	29	33
8x6	**0.33**	**0.26**	Airflow, cfm	26	52	78	104	130	156	182	208	234
			NC	-	-	-	-	11	19	25	30	35
10x6	**0.42**	**0.34**	Airflow, cfm	34	68	102	136	170	204	238	272	306
			NC	-	-	-	-	12	20	26	31	36
8x8	**0.44**	**0.37**	Airflow, cfm	37	74	111	148	185	222	259	296	333
			NC	-	-	-	-	12	20	26	31	36
12x6	**0.5**	**0.41**	Airflow, cfm	41	82	123	164	205	246	287	328	369
			NC	-	-	-	-	12	20	26	32	36
14x6	**0.58**	**0.48**	Airflow, cfm	48	96	144	192	240	288	336	384	432
			NC	-	-	-	-	12	20	26	32	37
16x6			Airflow, cfm	57	114	171	228	285	342	399	456	513
12x8	**0.67**	**0.57**	NC	-	-	-	-	13	21	27	32	38
			Airflow, cfm	59	118	177	236	295	354	413	472	531
10x10	**0.69**	**0.59**	NC	-	-	-	-	13	21	27	32	38
			Airflow, cfm	63	126	189	252	315	378	441	504	567
18x6	**0.75**	**0.63**	NC	-	-	-	-	14	22	28	33	38
20x6			Airflow, cfm	72	144	216	288	360	432	504	576	648
12x10	**0.83**	**0.72**	NC	-	-	-	-	14	22	28	33	38
			Airflow, cfm	77	154	231	308	385	462	539	616	693
22x6	**0.92**	**0.77**	NC	-	-	-	-	14	22	28	34	38
24x6			Airflow, cfm	88	176	264	352	440	528	616	704	792
12x12	**1**	**0.88**	NC	-	-	-	-	15	22	28	34	39
30x6			Airflow, cfm	111	222	333	444	555	666	777	888	999
18x10	**1.25**	**1.11**	NC	-	-	-	-	15	22	28	34	39
			Airflow, cfm	122	244	366	488	610	732	854	976	1098
14x14	**1.36**	**1.22**	NC	-	-	-	-	16	23	29	34	39
36x6			Airflow, cfm	135	270	405	540	675	810	945	1080	1215
18x12	**1.5**	**1.35**	NC	-	-	-	-	16	24	29	34	39
			Airflow, cfm	137	274	411	548	685	822	959	1096	1233
22x10	**1.53**	**1.37**	NC	-	-	-	-	16	24	30	35	39
30x8			Airflow, cfm	149	298	447	596	745	894	1043	1192	1341
24x10	**1.67**	**1.49**	NC	-	-	-	-	16	24	30	35	39
42x6			Airflow, cfm	159	318	477	636	795	954	1113	1272	1431
18x14	**1.75**	**1.59**	NC	-	-	-	-	17	24	30	35	39
16x16	**1.78**	**1.62**	Airflow, cfm	162	324	486	648	810	972	1134	1296	1458
			NC	-	-	-	-	17	24	30	35	39
24x12	**2**	**1.82**	Airflow, cfm	182	364	546	728	910	1092	1274	1456	1638
18x16			NC	-	-	-	-	17	24	30	35	39
18x18	**2.25**	**2.07**	Airflow, cfm	207	414	621	828	1035	1242	1449	1656	1863
			NC	-	-	-	-	18	25	31	35	40
24x14	**2.33**	**2.14**	Airflow, cfm	214	428	642	856	1070	1284	1498	1712	1926
			NC	-	-	-	-	18	25	31	35	40
30x12	**2.5**	**2.29**	Airflow, cfm	229	458	687	916	1145	1374	1603	1832	2061
			NC	-	-	-	-	18	25	31	35	40
24x16	**2.67**	**2.46**	Airflow, cfm	246	492	738	984	1230	1476	1722	1968	2214
			NC	-	-	-	10	18	25	32	36	39
20x20	**2.78**	**2.57**	Airflow, cfm	257	514	771	1028	1285	1542	1799	2056	2313
			NC	-	-	-	10	18	25	32	36	40
36x12	**3**	**2.75**	Airflow, cfm	275	550	825	1100	1375	1650	1925	2200	2475
			NC	-	-	-	10	19	26	32	37	42
30x16	**3.33**	**3.11**	Airflow, cfm	311	622	933	1244	1555	1866	2177	2488	2799
24x20			NC	-	-	-	10	19	26	32	37	42
			Airflow, cfm	314	628	942	1256	1570	1884	2198	2512	2826
22x22	**3.36**	**3.14**	NC	-	-	-	10	19	26	33	38	42
42x12			Airflow, cfm	322	644	966	1288	1610	1932	2254	2576	2898
36x14	**3.5**	**3.22**	NC	-	-	-	10	19	26	33	38	43
			Airflow, cfm	343	686	1029	1372	1715	2058	2401	2744	3087
24x22	**3.67**	**3.43**	NC	-	-	-	10	19	26	33	38	43
			Airflow, cfm	350	700	1050	1400	1750	2100	2450	2800	3150
30x18	**3.75**	**3.5**	NC	-	-	-	10	19	26	33	38	43

NC-40

- Static pressures are negative, in inches of water, measured per ANSI/ASHRAE Standard 70-2006
- NC based on room absorption of 10 dB, re 10^{-12} watts, measured per ANSI/ASHRAE Standard 70-2006

355R AND 355F
PERFORMANCE BASED ON NOMINAL SIZES SHOWN IN BOLD

Nominal Duct Size (in.)	Nominal Duct Area (ft²)	Core Area (ft²)	Core Velocity Velocity Pressure Neg. Static Pressure	100 0.001 0.003	200 0.002 0.011	300 0.006 0.026	400 0.010 0.045	500 0.016 0.071	600 0.022 0.102	700 0.031 0.139	800 0.040 0.182	900 0.050 0.230
								NC-20	NC-30		NC-40	
48x12 **24x24**	**4**	**3.75**	Airflow, cfm NC	375 -	750 -	1125 -	1500 10	1875 19	2250 26	2625 33	3000 39	3375 43
36x18	**4.5**	**4.22**	Airflow, cfm NC	422 -	844 -	1266 -	1688 10	2110 19	2532 26	2954 33	3376 39	3798 43
36x20 30x24	**5**	**4.71**	Airflow, cfm NC	471 -	942 -	1413 -	1884 11	2355 19	2826 27	3297 33	3768 38	4239 43
42x18	**5.25**	**4.94**	Airflow, cfm NC	494 -	988 -	1482 -	1976 12	2470 20	2964 28	3458 34	3952 39	4446 44
28x28	**5.44**	**5.16**	Airflow, cfm NC	516 -	1032 -	1548 -	2064 12	2580 21	3096 28	3612 34	4128 40	4644 44
42x20 30x28	**5.83**	**5.51**	Airflow, cfm NC	551 -	1102 -	1653 -	2204 12	2755 21	3306 28	3857 34	4408 40	4959 44
48x18 36x24	**6**	**5.66**	Airflow, cfm NC	566 -	1132 -	1698 -	2264 12	2830 21	3396 28	3962 35	4528 40	5094 44
30x30	**6.25**	**5.94**	Airflow, cfm NC	594 -	1188 -	1782 -	2376 12	2970 21	3564 28	4158 35	4752 40	5346 44
42x24 36x28	**7**	**6.66**	Airflow, cfm NC	666 -	1332 -	1998 -	2664 13	3330 22	3996 29	4662 35	5328 40	5994 45
46x22	**7.03**	**6.68**	Airflow, cfm NC	668 -	1336 -	2004 -	2672 13	3340 22	4008 29	4676 35	5344 40	6012 45
32x32	**7.11**	**6.78**	Airflow, cfm NC	678 -	1356 -	2034 -	2712 13	3390 22	4068 29	4746 35	5424 40	6102 45
36x30	**7.5**	**7.16**	Airflow, cfm NC	716 -	1432 -	2148 -	2864 14	3580 23	4296 30	5012 36	5728 41	6444 46
48x24 36x32	**8**	**7.63**	Airflow, cfm NC	763 -	1526 -	2289 -	3052 14	3815 23	4578 30	5341 36	6104 41	6867 46
34x34	**8.03**	**7.68**	Airflow, cfm NC	768 -	1536 -	2304 -	3072 14	3840 23	4608 30	5376 36	6144 41	6912 46
36x34	**8.5**	**8.14**	Airflow, cfm NC	814 -	1628 -	2442 -	3256 14	4070 23	4884 30	5698 36	6512 41	7326 46
42x30	**8.75**	**8.38**	Airflow, cfm NC	838 -	1676 -	2514 -	3352 14	4190 23	5028 30	5866 36	6704 41	7542 46
36x36	**9**	**8.63**	Airflow, cfm NC	863 -	1726 -	2589 -	3452 14	4315 23	5178 30	6041 36	6904 41	7767 46
42x34 **48x30**	**10**	**9.6**	Airflow, cfm NC	960 -	1920 -	2880 -	3840 14	4800 23	5760 30	6720 36	7680 41	8640 46
38x38	**10.03**	**9.64**	Airflow, cfm NC	964 -	1928 -	2892 -	3856 14	4820 23	5784 30	6748 36	7712 41	8676 46
42x36	**10.5**	**10.1**	Airflow, cfm NC	1010 -	2020 -	3030 -	4040 15	5050 23	6060 31	7070 37	8080 42	9090 47
46x34	**10.86**	**10.45**	Airflow, cfm NC	1045 -	2090 -	3135 -	4180 15	5225 23	6270 31	7315 37	8360 42	9405 47
42x38	**11.08**	**10.67**	Airflow, cfm NC	1067 -	2134 -	3201 -	4268 15	5335 23	6402 31	7469 37	8536 42	9603 47
40x40	**11.11**	**10.7**	Airflow, cfm NC	1070 -	2140 -	3210 -	4280 15	5350 23	6420 31	7490 37	8560 42	9630 47
48x36	**12**	**11.57**	Airflow, cfm NC	1157 -	2314 -	3471 -	4628 15	5785 23	6942 31	8099 37	9256 42	10413 47
42x42	**12.25**	**11.82**	Airflow, cfm NC	1182 -	2364 -	3546 -	4728 15	5910 24	7092 31	8274 37	9456 42	10638 47
44x44	**13.44**	**12.99**	Airflow, cfm NC	1299 -	2598 -	3897 -	5196 15	6495 24	7794 32	9093 38	10392 43	11691 48
48x42	**14**	**13.54**	Airflow, cfm NC	1354 -	2708 -	4062 -	5416 16	6770 24	8124 32	9478 38	10832 43	12186 48
46x46	**14.69**	**14.22**	Airflow, cfm NC	1422 -	2844 -	4266 -	5688 16	7110 25	8532 32	9954 39	11376 44	12798 48
48x46	**15.33**	**14.85**	Airflow, cfm NC	1485 -	2970 -	4455 -	5940 16	7425 25	8910 32	10395 39	11880 44	13365 48
48x48	**16**	**15.5**	Airflow, cfm NC	1550 -	3100 -	4650 -	6200 16	7750 25	9300 32	10850 39	12400 44	13950 48

- Static pressures are negative, in inches of water, measured per ANSI/ASHRAE Standard 70-2006
- NC based on room absorption of 10 dB, re 10^{-12} watts, measured per ANSI/ASHRAE Standard 70-2006

355ZR AND 355ZF
PERFORMANCE BASED ON NOMINAL SIZES SHOWN IN BOLD

Nominal Duct Size (in.)	Nominal Duct Area (ft²)	Core Area (ft²)	Core Velocity Velocity Pressure Neg. Static Pressure	300 0.006 0.013	400 0.010 0.022	500 0.016 0.035	600 0.022 0.050	700 0.031 0.068	800 0.040 0.089	900 0.050 0.113	1000 0.062 0.140	1100 0.075 0.169
						NC-10		NC-20				NC-30
6x6	**0.25**	**0.19**	Airflow, cfm NC	57 -	76 -	95 -	114 12	133 16	152 20	171 23	190 25	209 28
8x6	**0.33**	**0.26**	Airflow, cfm NC	78 -	104 -	130 -	156 13	182 17	208 21	234 24	260 27	286 29
10x6	**0.42**	**0.34**	Airflow, cfm NC	102 -	136 -	170 -	204 15	238 19	272 22	306 24	340 28	374 31
8x8	**0.44**	**0.37**	Airflow, cfm NC	111 -	148 -	185 -	222 15	259 19	296 23	333 26	370 28	407 31
12x6	**0.5**	**0.41**	Airflow, cfm NC	123 -	164 -	205 11	246 15	287 19	328 23	369 26	410 29	451 31
14x6	**0.58**	**0.48**	Airflow, cfm NC	144 -	192 -	240 11	288 16	336 20	384 24	432 27	480 30	528 32
16x6 **12x8**	**0.67**	**0.57**	Airflow, cfm NC	171 -	228 -	285 12	342 17	399 21	456 24	513 27	570 30	627 33
10x10	**0.69**	**0.59**	Airflow, cfm NC	177 -	236 -	295 12	354 17	413 21	472 25	531 28	590 30	649 33
18x6	**0.75**	**0.63**	Airflow, cfm NC	189 -	252 -	315 12	378 17	441 21	504 25	567 28	630 31	693 33
20x6 **12x10**	**0.83**	**0.72**	Airflow, cfm NC	216 -	288 -	360 13	432 18	504 22	576 25	648 29	720 31	792 34
22x6	**0.92**	**0.77**	Airflow, cfm NC	231 -	308 -	385 13	462 18	539 22	616 26	693 29	770 32	847 34
24x6 **12x12**	**1**	**0.88**	Airflow, cfm NC	264 -	352 -	440 14	528 19	616 23	704 26	792 29	880 32	968 35
30x6 **18x10**	**1.25**	**1.11**	Airflow, cfm NC	333 -	444 -	555 15	666 20	777 24	888 27	999 30	1110 33	1221 36
14x14	**1.36**	**1.22**	Airflow, cfm NC	366 -	488 -	610 15	732 20	854 24	976 28	1098 31	1220 34	1342 36
36x6 **18x12**	**1.5**	**1.35**	Airflow, cfm NC	405 -	540 -	675 16	810 21	945 25	1080 28	1215 31	1350 34	1485 37
22x10	**1.53**	**1.37**	Airflow, cfm NC	411 -	548 -	685 16	822 21	959 25	1096 28	1233 31	1370 34	1507 37
30x8 **24x10**	**1.67**	**1.49**	Airflow, cfm NC	447 -	596 -	745 16	894 21	1043 25	1192 29	1341 32	1490 34	1639 37
42x6 **18x14**	**1.75**	**1.59**	Airflow, cfm NC	477 -	636 11	795 17	954 21	1113 25	1272 29	1431 32	1590 35	1749 37
16x16	**1.78**	**1.62**	Airflow, cfm NC	486 -	648 11	810 17	972 21	1134 25	1296 29	1458 32	1620 35	1782 37
24x12 18x16	**2**	**1.82**	Airflow, cfm NC	546 -	728 11	910 17	1092 22	1274 26	1456 29	1638 33	1820 35	2002 38
18x18	**2.25**	**2.07**	Airflow, cfm NC	621 -	828 12	1035 18	1242 22	1449 26	1656 30	1863 33	2070 36	2277 38
24x14	**2.33**	**2.14**	Airflow, cfm NC	642 -	856 12	1070 18	1284 23	1498 27	1712 30	1926 33	2140 36	2354 39
30x12	**2.5**	**2.29**	Airflow, cfm NC	687 -	916 12	1145 18	1374 23	1603 27	1832 30	2061 34	2290 36	2519 39
24x16	**2.67**	**2.46**	Airflow, cfm NC	738 -	984 13	1230 18	1476 23	1722 27	1968 31	2214 34	2460 37	2706 39
20x20	**2.78**	**2.57**	Airflow, cfm NC	771 -	1028 13	1285 19	1542 23	1799 27	2056 31	2313 34	2570 37	2827 39
36x12	**3**	**2.75**	Airflow, cfm NC	825 -	1100 13	1375 19	1650 24	1925 28	2200 31	2475 34	2750 37	3025 40
30x16 **24x20**	**3.33**	**3.11**	Airflow, cfm NC	933 -	1244 14	1555 19	1866 24	2177 28	2488 32	2799 35	3110 38	3421 40
22x22	**3.36**	3.14	Airflow, cfm NC	942 -	1256 14	1570 19	1884 24	2198 28	2512 32	2826 35	3140 38	3454 40
42x12 36x14	**3.5**	3.22	Airflow, cfm NC	966 -	1288 14	1610 20	1932 24	2254 28	2576 32	2898 35	3220 38	3542 40
24x22	**3.67**	**3.43**	Airflow, cfm NC	1029 -	1372 14	1715 20	2058 25	2401 29	2744 32	3087 35	3430 38	3773 41
30x18	**3.75**	**3.5**	Airflow, cfm NC	1050 -	1400 14	1750 20	2100 25	2450 29	2800 32	3150 35	3500 38	3850 41
												NC-40

- Static pressures are negative, in inches of water, measured per ANSI/ASHRAE Standard 70-2006.
- NC based on room absorption of 10 dB, re 10^{-12} watts, measured per ANSI/ASHRAE Standard 70-2006.

355ZR AND 355ZF
PERFORMANCE BASED ON NOMINAL SIZES SHOWN IN BOLD

Nominal Duct Size (in.)	Nominal Duct Area (ft²)	Core Area (ft²)	Core Velocity / Velocity Pressure / Neg. Static Pressure	NC-10 300 0.006 0.013	NC-20 400 0.010 0.022	500 0.016 0.035	NC-30 600 0.022 0.050	700 0.031 0.068	800 0.040 0.089	NC-40 900 0.050 0.113	1000 0.062 0.140	1100 0.075 0.169
42x18	**5.25**	**4.94**	Airflow, cfm	1482	1976	2470	2964	3458	3952	4446	4940	5434
			NC	-	16	21	26	30	34	37	40	42
28x28	**5.44**	**5.16**	Airflow, cfm	1548	2064	2580	3096	3612	4128	4644	5160	5676
			NC	-	16	22	26	30	34	37	40	42
42x20 30x28	**5.83**	**5.51**	Airflow, cfm	1653	2204	2755	3306	3857	4408	4959	5510	6061
			NC	-	16	22	27	31	34	37	40	43
48x18 36x24	**6**	**5.66**	Airflow, cfm	1698	2264	2830	3396	3962	4528	5094	5660	6226
			NC	-	16	22	27	31	34	37	40	43
30x30	**6.25**	**5.94**	Airflow, cfm	1782	2376	2970	3564	4158	4752	5346	5940	6534
			NC	-	16	22	27	31	35	38	40	43
42x24 36x28	**7**	**6.66**	Airflow, cfm	1998	2664	3330	3996	4662	5328	5994	6660	7326
			NC	-	17	23	28	32	35	38	41	43
46x22	**7.03**	**6.68**	Airflow, cfm	2004	2672	3340	4008	4676	5344	6012	6680	7348
			NC	-	17	23	28	32	35	38	41	43
32x32	**7.11**	6.78	Airflow, cfm	2034	2712	3390	4068	4746	5424	6102	6780	7458
			NC	-	17	23	28	32	35	38	41	44
36x30	**7.5**	7.16	Airflow, cfm	2148	2864	3580	4296	5012	5728	6444	7160	7876
			NC	-	17	23	28	32	35	38	41	44
48x24 36x32	**8**	7.63	Airflow, cfm	2289	3052	3815	4578	5341	6104	6867	7630	8393
			NC	-	17	23	28	32	36	39	42	44
34x34	**8.03**	7.68	Airflow, cfm	2304	3072	3840	4608	5376	6144	6912	7680	8448
			NC	-	18	23	28	32	36	39	42	44
36x34	**8.5**	**8.14**	Airflow, cfm	2442	3256	4070	4884	5698	6512	7326	8140	8954
			NC	-	18	24	28	32	36	39	42	44
42x30	**8.75**	**8.38**	Airflow, cfm	2514	3352	4190	5028	5866	6704	7542	8380	9218
			NC	-	18	24	29	33	36	39	42	44
36x36	**9**	**8.63**	Airflow, cfm	2589	3452	4315	5178	6041	6904	7767	8630	9493
			NC	-	18	24	29	33	36	39	42	45
42x34 **48x30**	**10**	**9.6**	Airflow, cfm	2880	3840	4800	5760	6720	7680	8640	9600	10560
			NC	11	18	24	29	33	37	40	43	45
38x38	**10.03**	**9.64**	Airflow, cfm	2892	3856	4820	5784	6748	7712	8676	9640	10604
			NC	11	18	24	29	33	37	40	43	45
42x36	**10.5**	**10.1**	Airflow, cfm	3030	4040	5050	6060	7070	8080	9090	10100	11110
			NC	11	19	25	29	33	37	40	43	45
46x34	**10.86**	**10.45**	Airflow, cfm	3135	4180	5225	6270	7315	8360	9405	10450	11495
			NC	11	19	25	29	34	37	40	43	45
42x38	**11.08**	**10.67**	Airflow, cfm	3201	4268	5335	6402	7469	8536	9603	10670	11737
			NC	11	19	25	30	34	37	40	43	45
40x40	**11.11**	**10.7**	Airflow, cfm	3210	4280	5350	6420	7490	8560	9630	10700	11770
			NC	11	19	25	30	34	37	40	43	45
48x36	**12**	**11.57**	Airflow, cfm	3471	4628	5785	6942	8099	9256	10413	11570	12727
			NC	12	19	25	30	34	37	41	43	46
42x42	**12.25**	**11.82**	Airflow, cfm	3546	4728	5910	7092	8274	9456	10638	11820	13002
			NC	12	19	25	30	34	38	41	43	46
44x44	**13.44**	**12.99**	Airflow, cfm	3897	5196	6495	7794	9093	10392	11691	12990	14289
			NC	12	20	26	30	34	38	41	44	46
48x42	**14**	**13.54**	Airflow, cfm	4062	5416	6770	8124	9478	10832	12186	13540	14894
			NC	12	20	26	31	35	38	41	44	47
46x46	**14.69**	**14.22**	Airflow, cfm	4266	5688	7110	8532	9954	11376	12798	14220	15642
			NC	13	20	26	31	35	38	41	44	47
48x46	**15.33**	**14.85**	Airflow, cfm	4455	5940	7425	8910	10395	11880	13365	14850	16335
			NC	13	20	26	31	35	39	42	44	47
48x48	**16**	**15.5**	Airflow, cfm	4650	6200	7750	9300	10850	12400	13950	15500	17050
			NC	13	21	26	31	35	39	42	45	47

- Static pressures are negative, in inches of water, measured per ANSI/ASHRAE Standard 70-2006
- NC based on room absorption of 10 dB, re 10^{-12} watts, measured per ANSI/ASHRAE Standard 70-2006