Industrial Space Heating

Direct Gas-Fired Heating

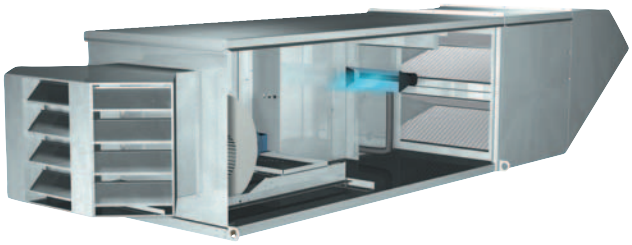
- Greenheat® 100% Outdoor Air
- 80/20 Recirculation
- Greenheat® 50/50 Recirculation

GREENHECK
Building Value in Air.

March
2008

Industrial Space Heating

Greenheck's space heating systems are designed to heat large spaces as comfortably and economically as possible. Greenheck's space heating models include the same commitment to quality you would expect from a worldwide leader in air movement and control products.



Direct Gas-Fired Heating

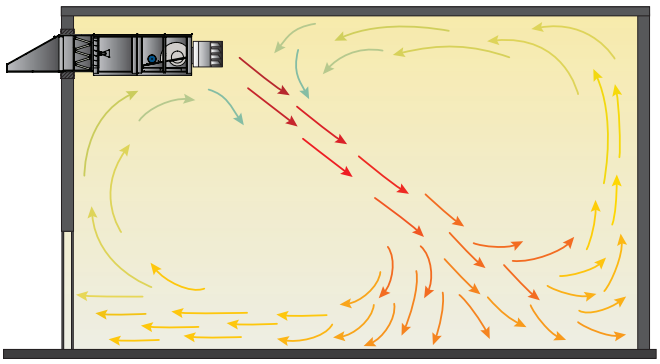
High-efficiency direct gas-fired burners promote excellent space comfort and low operating cost. The Greenheck space heating line includes the Greenheat® 100% outdoor air, Greenheat® 50/50 recirculation, and the 80/20 recirculation systems. These systems provide a variety of choices to meet the needs of your space heating application.

Basic Applications

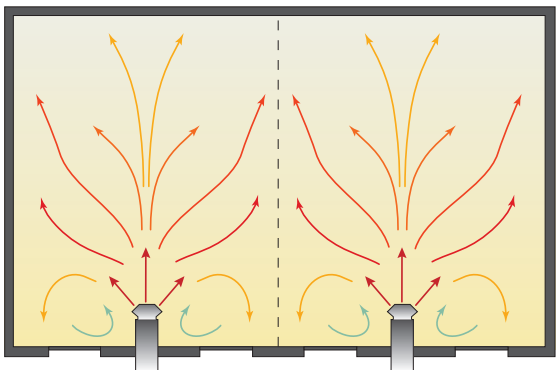
- Warehouses
- Manufacturing facilities
- Distribution centers
- Other large spaces in need of heat

Space Heating Basics

High-velocity, high-temperature air is discharged at a downward angle to provide effective mixing and even heat distribution throughout the space. Each unit operates in response to local conditions to provide heating when and where heat is needed.



High-velocity discharge air directed properly by the diffuser limits stratification (elevation temperature difference)



Typical air distribution pattern is shown as high-velocity discharge air mixes with space air for even heating

Greenheck space heating systems introduce outdoor air to the space, improving indoor air quality (IAQ) and positively pressurizing the building. Positive pressurization offsets the effects of cold air infiltration that would otherwise occur near doors and other openings. The air changes per hour (ACH) introduced by the space heating systems should exceed the natural cold air infiltration rate.

Space Heating Comparison

Properties	Air Turnover	Unit Heaters	Infrared Tube Systems	Greenheck Space Heating		
				100%	50/50	80/20
Heating Efficiency	Low (80%)	Low (80%)	Low (80%)	High (92%)	High (92%)	High (92%)
Offsets Cold Air Infiltration	No*	No	No	Yes	Yes	Yes
IAQ Benefits	No*	No	No	Yes	Yes	Yes
Stratification Effects	Limited	Yes	Yes	Limited	Limited	Limited

*Without outdoor air modification

Space Heating Rules of Thumb

Space Heating Capacities[A]	Air Changes Per Hour[B]	Effects of Insulation[C]
Buildings < 100,000 ft²	ACH 100% Outdoor Air	Well-insulated buildings
One heater per 30,000 to 50,000 ft²	~ 0.10 to 0.50 ACH	Require 15 to 20 Btu per hour/ft²
Buildings > 100,000 ft²	ACH - 50/50 Recirculation	Minimally insulated buildings
One heater per 50,000 to 100,000 ft²	~ 0.10 to 0.50 ACH	Require 20 to 30 Btu per hour/ft²

A It is recommended that at least two units be used for space heating applications. Multiple units add redundancy and also promote a more even heating distribution across the space.

B Natural winter infiltration rate is 0.10 to 0.20 ACH for tight buildings.

C Colder climates will tend to be at the higher end of these ranges.

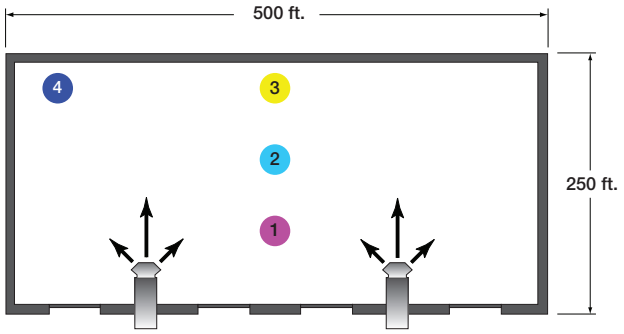
Proven Performance

Greenheck's space heating systems have heated millions of square feet of warehouses, distributions centers, and manufacturing facilities.

Results:

- Even heating throughout the space
- Excellent de-stratification
- Consistent space temperatures
- Proven Performance

Typical Space Heating Application



Typical Week of Winter Operation

In *Figures 1 and 2*, temperature data is displayed for a typical week of winter operation, with readings recorded every 30 minutes. The color code and numbers correspond to the temperature sensor location.

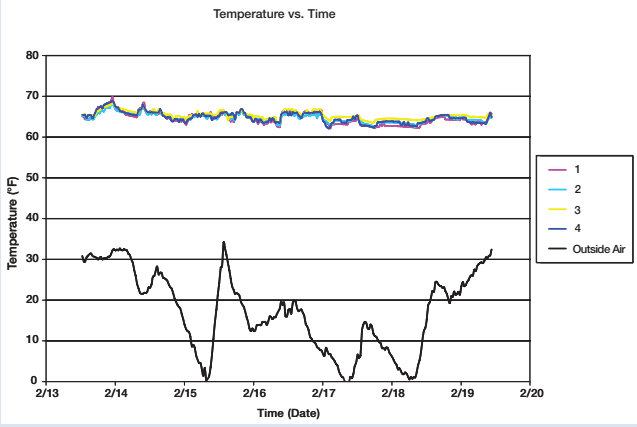


Figure 1

At 5 ft. off the floor, temperatures at any two points are ± 2°F *(-1.1°C)*

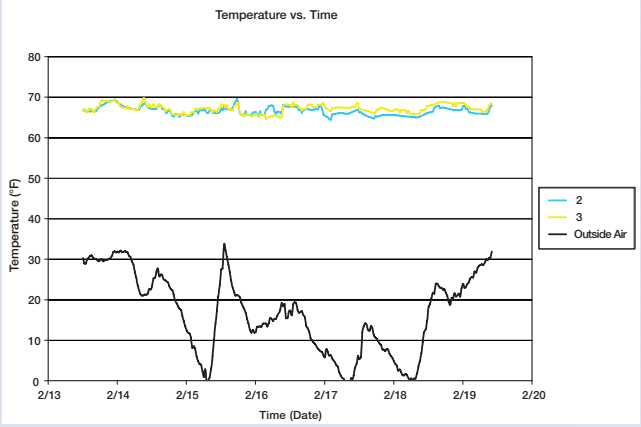


Figure 2

Temperature gradients from 5 ft. to 25 ft. off the floor are ± 2°F *(-1.1°C)*

As weather changes, and doors open and close, the space temperature at 5 ft. off the floor remains within ± 3°F *(-1.7°C)* of the 65°F *(18°C)* set point

Greenheat® 100% Outdoor Air System

The Greenheat 100% outdoor air systems provide maximum heating with maximum airflow. Air is supplied to the space at a high velocity and high discharge temperature (120-140°F). This unit cycles both the blower and direct-fired burner on a call for heat from a remote space thermostat. Utilizing 100% of the outdoor air positively pressurizes the space to offset the effects of cold air infiltration. This system is great for poorly insulated spaces with high infiltration rates such as warehouses and distribution centers.

Greenheat® 50/50 Recirculation System

The Greenheat 50/50 recirculation systems are fixed to provide a 50/50 mixture of fresh outside air and return air. The intelligent unit design allows only fresh outside air to pass across the burner and ensures that mixing occurs downstream of the heater section. Air is supplied to the space at a high velocity and high discharge temperature (140°F). The blower and burner on a 50/50 unit cycles on a call for heat from a remote space thermostat. The 50/50 system combines the benefits of 80/20 and 100% outdoor air systems, and is great for medium-to-well insulated spaces such as warehouses, distribution centers, and large manufacturing facilities.

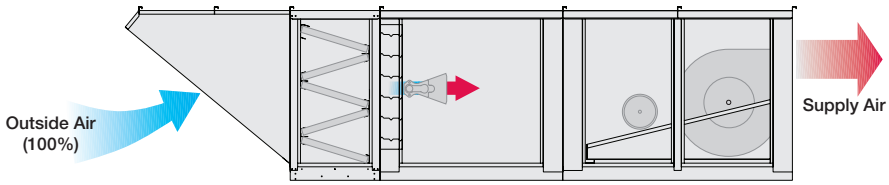
Louvered Intake

80/20 Recirculation System

The 80/20 recirculation system is a hybrid make-up air system. Supply air is a variable mixture of return air and fresh outdoor air. The intelligent unit design allows only fresh outside air to pass across the burner and ensures that mixing occurs downstream of the heater section. Outdoor air volumes vary from 20% to 100% of total airflow, often configured to respond to building pressure fluctuations. The 80/20 units are excellent for facilities with mechanical exhaust systems, especially when the exhaust volume is variable. The fan runs continuously to respond to varying exhaust volumes, and the heat runs continuously in winter operation to satisfy a remote space sensor. Discharge temperatures typically range from 80-110°F.

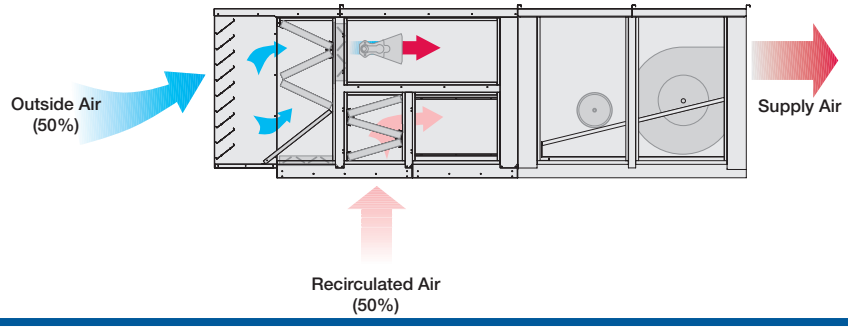
Additional Benefits:

- Low installation cost on buildings greater than 25,000 ft²
- Low operating costs
- Low moisture content from combustion improves indoor comfort
- Fresh outdoor air improves IAQ
- Provides summer ventilation



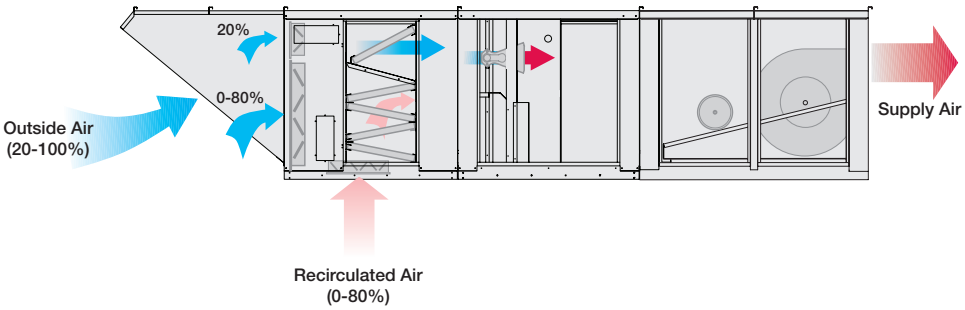
Additional Benefits:

- Maximizes discharge air temperature with lower outdoor air volume to provide the highest BTU/cfm ratio in the industry and superior energy savings
- Low installation cost on buildings greater than 25,000 ft²
- Low moisture content from combustion improves indoor comfort
- Fresh outdoor air and filtered return air improves IAQ
- Provides summer ventilation



Additional Benefits:

- Pressurizes building to offset infiltration
- Responds well to mechanical exhaust systems with varying airflows
- Fresh outdoor air and filtered return air improves IAQ
- Provides summer ventilation



Features and Accessories

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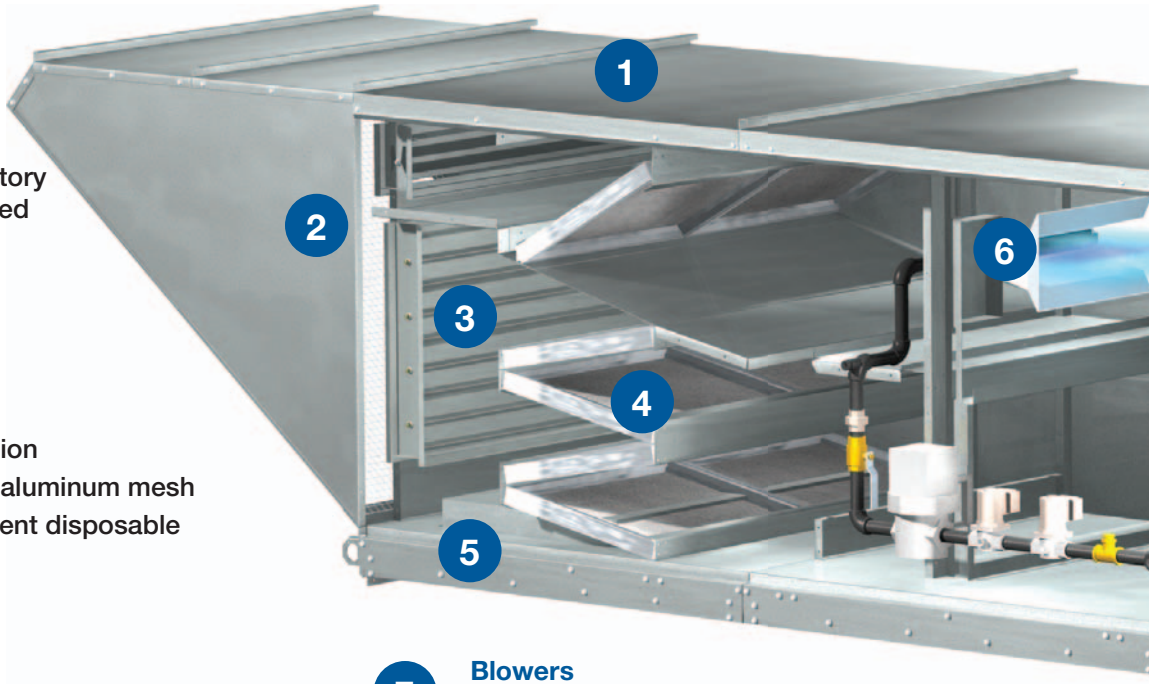
2 Weatherhood

- Standard weatherhood with birdscreen for outdoor installations (100% Outdoor Air and 80/20)
- Filtered thru-wall weatherhood with 2-inch aluminum mesh filters for indoor installations (100% Outdoor Air)
- Louvered weatherhood including a drainable blade louver at intake with 2-inch aluminum mesh filters (50/50)

1 Construction

- Designed for maximum weather resistance
- Constructed of heavy-gauge G90 galvanized steel
- Lifting lugs are standard
- Single or double wall construction with 1-inch fiberglass insulation
- Large hinged doors and access panels



3 Dampers

- Low leakage, factory mounted and wired dampers with limit switches

4 Filters

- V-bank filter section
- 2-inch washable aluminum mesh
- 2-inch 30% efficient disposable

5 Recirculation (50/50 and 80/20)

- Building pressure control via remote photohelic gauge (80/20)
- Fixed recirculation (50/50)
- Filtered return air

7 Blowers

- Accurate, third-party accredited air performance ratings
- Double-width, double-inlet forward-curved wheels
- Balanced wheels to ensure a vibration-free operation
- Neoprene or spring vibration isolators

6 Direct Gas-Fired System

- High-quality cast aluminum burners with stainless steel mixing plates
- ETL Listed to ANSI Z83.4-2004 for 100% outdoor air and ANSI Z83.18-2000 for recirculation
- Full electronic modulation burner control
- Flame safeguard with digital fault indicator capability
- 25:1 turn down ratio

8 Diffuser

- 3-way design for both horizontal and downblast discharge
- 45° diffuser elbow (not shown) included with the downblast discharge

Space Heating Controls

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Greenheat® Remote Control Panel

- Lockable access
- Indicating lights
- Keyed switch for summer and winter modes
- Thermostat (not shown) is located inside the panel

Greenheat® Temperature Control

100% and 50/50

- The Greenheat® space heating control system cycles the blower and burner on a call for heat from a factory provided space thermostat.

80/20 Remote Control Panel

- Includes toggle switches for fan and heating modes
- Room thermostats and photohelic pressure gauge

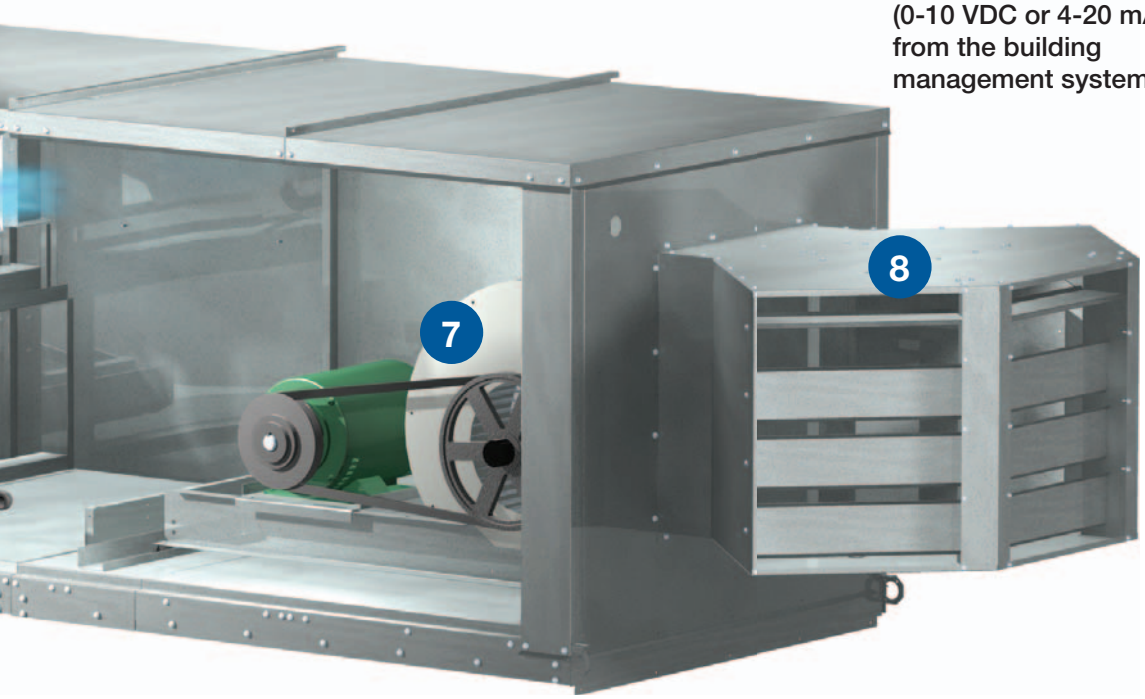
80/20 Recirculation Temperature Control

Room Control (80/20 Standard)

- A manually adjusted room thermostat provides feedback to the unit controls. This feedback varies the discharge temperature to maintain the desired room set point.

DDC Interface Control

- Allows for an external signal (0-10 VDC or 4-20 mA) from the building management system.



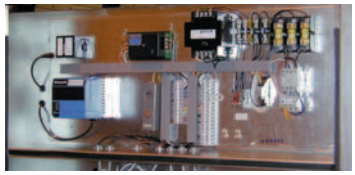
Accessories

- Remote panels
- Roof curb with duct adapter
- Dirty filter switch
- Freeze protection
- Auxiliary contacts
- Service receptacle
- Inlet air sensor
- Painted exterior

9

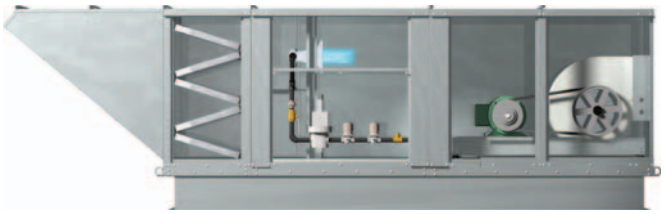
Control Center

- 24 volt control voltage
- Magnetic motor starter with solid state overload protection
- Control transformer
- Disconnect switch
- Distribution terminal strip
- UL Listed, Recognized, or Classified electrical components
- Factory prewired for single point power connection

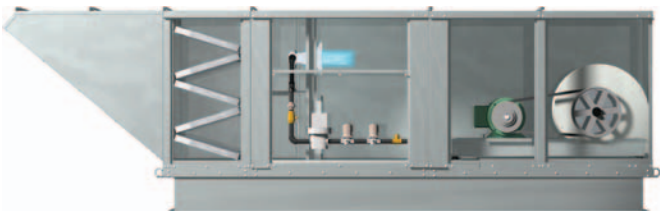


Roof Mounted Installation

Greenheck space heating units feature horizontal (indoor) and downblast (outdoor) discharges as standard, and factory roof curbs are available.



Horizontal Discharge - Arrangement HZ



Downblast Discharge - Arrangement DB

Indoor Installation

Greenheat® units have a pre-engineered thru-wall installation option, which is ideal when a roof penetration is not desirable. The following factory options facilitate easy installation and ensure problem-free installation:

Weatherhood:

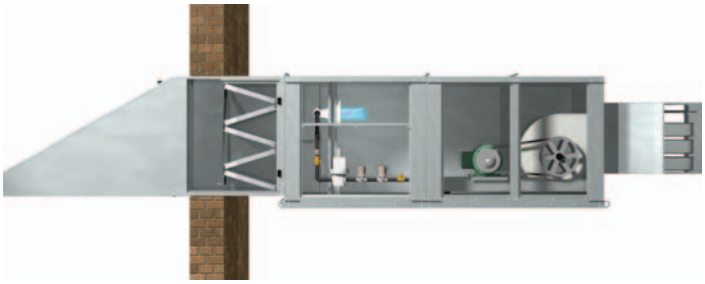
A full, downturn design on 100% units, with a generous intake area to minimize intake velocity and moisture entrainment. The 50/50 Greenheat® units feature a louvered intake that mounts flush to the exterior wall.

Thru-Wall Sleeve:

The thru-wall sleeve provides an attachment interface between the weatherhood and burner section. The sleeve accommodates walls up to 15 inches (*38 cm*) in depth. Not required for 50/50 units.

Filter Section:

The V-bank aluminum mesh filter section strips fine mist in addition to providing filtration for outside air. A drain captures any moisture that enters the filter section and directs it to the outside of the building.



100% Outdoor Air Greenheat®

50/50 Greenheat®

System Comparison

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		Greenheat®		
		100% Outdoor Air	50/50 Recirculation	80/20 Recirculation
Application				
Excellent For:		Warehouses and Distribution Centers	Warehouses, Distribution Centers, and Manufacturing Facilities	Uniform Wall-to-Wall Heating
		Low-to-Medium Insulated Spaces	Medium-to-Well Insulated Spaces	Well-Insulated Spaces
		Buildings With High Cold Air Infiltration	Buildings With Low-to-Medium Cold Air Infiltration	Buildings With Variable Exhaust Air Volumes
Zone Heating Capabilities		Good	Good	Minimal
Number of Units Required		Minimal	Minimal	Minimal
Mounting Location		Indoor or Outdoor	Indoor or Outdoor	Outdoor
Operation				
Outdoor Air Range		100% Fixed	50% Fixed	20-100%
Return Air Range		—	50% Fixed	0-80%
Unit Operation		Cycles On & Off	Cycles On & Off	Runs Continuously
Energy Savings		Better	Best	Good
Recirculation Control		—	—	Building Pressure
Discharge Temperature		140°F *(60°C)* Maximum	140°F *(60°C)* Maximum	80-110°F *(27-43°C)*
Maximum Temperature Rise		140°F *(60°C)*	123°F *(51°C)* Equivalent[1]	49°F *(9.4°C)* Equivalent[2]
Temperature Control		Space Cycle Standard	Space Cycle Standard	Room Control
Features and Options				
Weatherhood	Indoor	Thru-Wall Standard	Louvered Standard	Optional (No Thru-Wall)
	Outdoor	Birdscreen Standard		
Filter Section	Indoor	—	Aluminum Mesh Standard	Aluminum Mesh or Disposable Standard
	Outdoor	Aluminum Mesh Standard	Disposable Standard	
Motorized Damper	Inlet	Standard	Standard	Standard
	Return Air	—	—	Standard
Freeze Protection		Standard	Standard	Optional
3-Way Discharge Diffuser		Standard	Standard	Optional
Remote Panel		Space Heating[3]	Space Heating[3]	Industrial
Double Wall Construction		Optional	Standard	Optional
Fiberglass Insulation		Standard	Standard	Standard
Accessories				
Special Coatings		Available	Available	Available
Roof Curbs		Available	Available	Available
Duct Adapter		Available	Available	Available
Inlet Air Sensor		—	—	Available
Spring Vibration Isolation		Available	Available	Available
Dirty Filter Switch		Available	Available	Available
Service Receptacle		Available	Available	Available
Auxiliary Contacts		Available	Available	Available

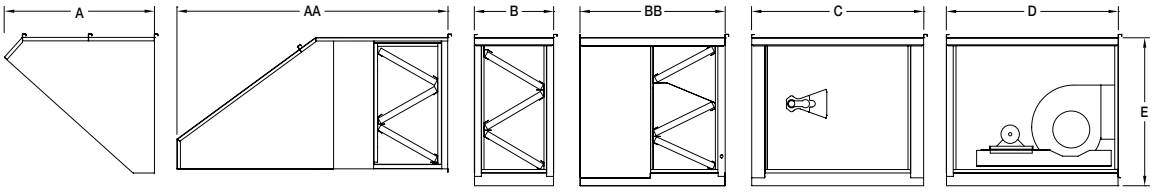
[1] Equivalent temperature rise, plus the average of the entering outdoor and recirculation dry bulb temperatures, equals the actual discharge temperature. Maximum of 140°F (*60°C*).

[2] ANSI standard Z83.18-2000 restricts the amount of recirculation based on temperature rise. A CO_2 sensor must be supplied by the factory if the temperature rise exceeds the maximum rating.

[3] Operation modes controlled by lockable switch. In Summer mode, heat is turned off and blower runs continuously for ventilation. In Winter mode, the blower and heat are enabled on a call for heat from a space thermostat. The burner will operate at the maximum unit rated discharge temperature to satisfy space temperature requirements.

Greenheat® 100% Outdoor Air and 80/20 Recirculation System

Weatherhood w/ Birdscreen | Thru-Wall Weatherhood[1] | V-Bank Filters[2] | V-Bank Filters w/ Recirculation[3] | Burner | Blower



[1] Includes V-Bank Filters and Wall Sleeve
[2] Not Required with Thru-Wall Weatherhood
[3] Includes Outdoor Air and Return Air Dampers (80/20 Units Only)

100% Greenheat® Outdoor Air and 80/20 Unit Dimensions

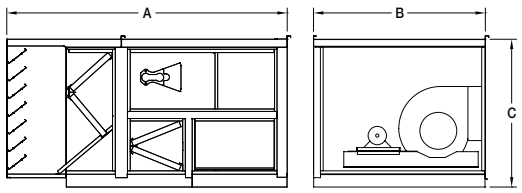
Housing	A	AA	B	BB	C	D	E	Width	Weight 100% (lbs)*	Weight 80/20 (lbs)*
H22	45.6	83.0	24.0	44.0	52.3	52.3	45.0	44.3	1175	1475
H32	47.3	104.8	25.8	50.2	52.5	66.0	48.8	53.3	1650	2100
H35	47.1	120.8	27.7	51.3	55.0	62.0	54.5	78.5	2550	3130
H38	60.9	—	—	50.0	58.1	71.5	63.9	95.5	—	4200
H42	70.00	—	—	55.0	58.1	75.5	67.9	100.3	—	4800

All dimensions in inches.

* Weights are approximate and do not include accessories external to the unit (diffusers, curbs, etc.)

Greenheat® 50/50 Recirculation System

Burner Module[1] | Blower



[1] Includes V-Bank Filters, Wall Sleeve, Outdoor Air Damper, and Louvered Intake w/ Thru-Wall Sleeve

50/50 Greenheat® Unit Dimensions

Housing	A	B	C	Width	Weight (lbs)*
H22	85.25	52.25	45.0	44.3	1300
H32	87.50	66.00	48.8	53.3	1870
H35	96.50	62.00	54.5	78.5	2840

All dimensions in inches.

* Weights are approximate and do not include accessories external to the unit (diffusers, curbs, etc.)

Greenheat®

	Housing	Blower	MBH	CFM	Total Static Pressure (Ps)	RPM	Motor HP
50/50 Recirculation	H22	115	800	6,272[1]	1.121	950	5
	H32	120	1,600	12,544[1]	1.411	500	10
			2,000	15,681[1]	1.712	935	15
	H35	125	2,400	18,817[1]	1.233	639	15
			2,800	21,953[1]	1.362	708	20
100%	H22	115	800	5,511	1.055	878	3
	H32	118	1,200	8,266	1.005	752	5
		120	1,600	11,021	1.106	700	7.5
			2,000	13,776	1.236	804	10
	H35	125	2,400	16,532	1.126	584	10
			2,800	19,287	1.217	641	15

80/20 Recirculation

	Blower	CFM	RPM / BHP	Total Static Pressure (in.wg)					
				0.75	1.00	1.25	1.50	1.75	2.00
Housing 22	112	2,600	RPM	761	853	934	1009	—	—
			BHP	0.7	0.9	1.0	1.2	—	—
		4,400	RPM	939	1006	1073	1137	1197	1254
			BHP	2.1	2.4	2.6	2.9	3.1	3.3
	115	4,000	RPM	681	756	822	892	—	—
			BHP	1.3	1.5	1.8	2.1	—	—
		6,500	RPM	850	906	960	1013	1062	1110
			BHP	3.5	3.9	4.3	4.7	5.1	5.5
Housing 32	118	6,500	RPM	609	668	724	777	—	—
			BHP	2.1	2.5	2.8	3.2	—	—
		9,500	RPM	736	783	827	872	914	954
			BHP	4.9	5.4	5.9	6.4	6.9	7.4
	120	10,000	RPM	590	634	678	723	765	803
			BHP	4.0	4.5	5.0	5.6	6.1	6.6
		15,000	RPM	763	795	829	861	892	921
			BHP	10.9	11.6	12.3	13.1	13.8	14.5
Housing 35	122	15,000	RPM	605	637	667	698	727	755
			BHP	8.3	8.9	9.6	10.4	11.1	11.9
		19,000	RPM	720	746	771	796	821	845
			BHP	15.2	16.1	17.0	17.8	18.6	19.4
	125	19,000	RPM	563	594	625	655	683	711
			BHP	9.8	10.7	11.7	12.8	13.8	14.8
		23,000	RPM	643	671	967	723	748	—
			BHP	15.9	16.9	18.0	19.2	20.4	—
Housing 38	127	24,000	RPM	451	478	504	530	554	578
			BHP	11.6	13.0	14.3	15.8	17.2	18.6
		30,000	RPM	525	548	571	593	613	—
			BHP	19.6	21.4	23.2	24.9	26.6	—
	130	26,000	RPM	—	412	440	467	494	520
			BHP	—	12.5	13.9	15.2	16.8	18.3
		34,000	RPM	454	477	499	519	542	—
			BHP	21.5	23.1	24.8	26.4	28.3	—
Housing 42	133	32,000	RPM	371	397	422	446	467	488
			BHP	15.7	17.5	19.2	21.0	22.6	24.3
		40,000	RPM	426	448	470	491	512	531
			BHP	27.1	29.1	31.5	33.7	35.8	37.9
	136	42,000	RPM	405	426	445	464	482	499
			BHP	27.7	29.8	32.0	34.1	36.3	38.5
		48,000	RPM	447	465	483	500	—	—
			BHP	39.0	41.5	44.0	46.4	—	—

[1] Airflow represents total volume delivered to space. Outdoor air volume is one-half of the total volume.
All data shown at standard elevation.

Specifications and Warranty

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General: Space heat unit shall be manufactured by Greenheck or approved equal providing all specifications are met. Greenheck Greenheat® or 80/20 equipment is used as the basis of design. Performance to be as scheduled on plans. Space heat shall be ETL Listed to ANSI Z83.4-2004, CSA 3.7-M99 (for 100% outdoor air) or ANSI Z83.18-2000 (for recirculation).

Gas Train and Controls: Direct gas-fired system shall have a draw through design and field adjustable burner baffles. Gas trains up to 400,000 Btu/hr shall include a direct spark ignition system. Gas trains greater than 400,000 Btu/hr shall include a pilot ignition system and shall have digital coded fault indicator capability. Fault indicator shall provide service history by storing codes for the last five faults. Dual safety shutoff valves shall be industrial duty and use 120 VAC control signals. Temperature control shall incorporate a full electronic modulation control system.

Unit Casing and Frames: Unit shall be of internal frame type construction of galvanized steel. All frames and panels shall be G90 galvanized steel. Where top panels are joined there shall be a standing seam to insure positive weather protection. All metal-to-metal surfaces exposed to the weather shall be sealed, requiring no caulking at job site. All components shall be easily accessible through removable doors.

Insulation: Unit casing to be lined with 1-inch fiberglass insulation where specified. Insulation shall be in accordance with NFPA 90A and tested to meet UL 181 erosion requirements. Double wall shall be provided where specified.

Fan Section: Centrifugal fans shall be double-width, double inlet. Fan and motor shall be mounted on a common base and shall be internally isolated. All blower wheels shall be balanced. Ground and polished steel fan shafts shall be mounted in permanently lubricated ball bearings or ball bearing pillow blocks. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged speeds.

Motors and Drives: Motors shall be energy efficient, complying with EPACT standards, for single speed ODP and TEFC enclosures. Motors shall be permanently lubricated, heavy-duty type, matched to the fan load and furnished at the specified voltage, phase and enclosure. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be cast and have machined surfaces, 15 horsepower and less shall be supplied with an adjustable drive pulley.

Electrical: All internal electrical components shall be prewired for single point power connection with exception of the larger evaporative cooling sections. All electrical components shall be UL Listed, Recognized or Classified where applicable and wired in compliance with the National Electrical Code. Control center shall include motor starter, control circuit fusing, control transformer for 24 VAC circuit, integral disconnect switch and terminal strip. Contactors, Class 20 adjustable overload protection and single-phase protection shall be standard.

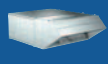
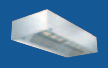
Filter Section: Filter section shall be designed such that velocities across the filters do not exceed 550 feet per minute. Filters shall be 2-inch washable aluminum mesh or 2-inch disposable.

Weatherhood: Weatherhood shall be constructed of G90 galvanized steel with birdscreen (Greenheat® 100% and 80/20) mounted at the intake. Louvered intake shall be provided for Greenheat® 50/50 units.

Recirculation: Recirculation airflow shall be fixed (Greenheat® 50/50) or adjustable (80/20). Input signal for return damper shall be from building pressure sensors or external signals. Recirculated air shall not be permitted to pass across the burner. Return air shall be filtered.





Our Warranty

Greenheck warrants this equipment to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at our option when returned to our factory, transportation prepaid. Motors are warranted by the motor manufacturer for a period of one year. Should motors furnished by Greenheck prove defective during this period, they should be returned to the nearest authorized motor service station. Greenheck will not be responsible for any removal or installation costs.

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

U.S. Green Building Council Member
Prepared to Support Green Building Efforts

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