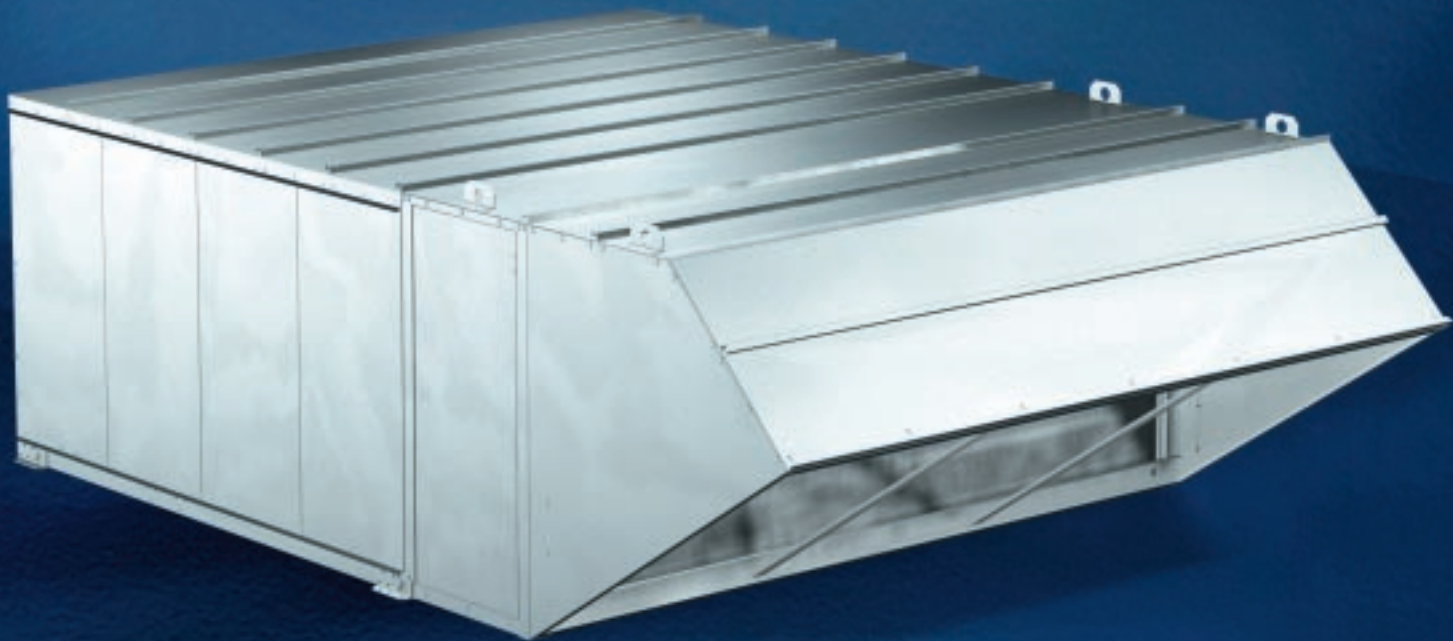


Direct Fired Gas
MODEL TSU MAKE-UP AIR UNIT



Other Heating Options

- Hot Water
- Steam
- Electric

Cooling Options

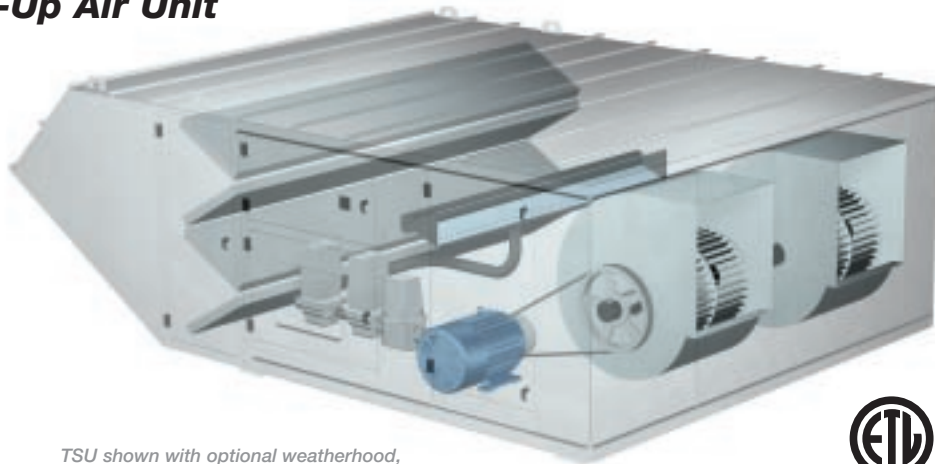
- Direct Evaporative
- Chilled Water
- Direct Expansion (DX)

Model TSU

Direct Fired Gas Make-Up Air Unit

The Greenheck model TSU is a 100% efficient direct fired gas heating and ventilating unit. Airflow options include 100% make-up air for constant volume or variable volume applications. For space heating, 80/20 Recirculation is available.

The TSU is specifically designed for providing heating and make-up air for manufacturing facilities and warehouses. Air flow volumes up to 64,000 cfm and heating capacities up to 6,050,000 BTU/Hr are offered.



TSU shown with optional weatherhood, filter section and horizontal fan discharge.



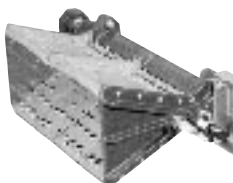
Direct Fired Gas Heat

Durable Construction

Designed for maximum weather resistance, TSU housings are constructed of heavy gauge G90 galvanized steel. Lifting lugs are standard.

Direct Fired Gas System

- Maxon cast iron burners with stainless steel mixing plates
- Maxitrol burner modulation control
- Flame safeguard with digital fault indicator capability
- 25:1 turn down ratio



Control Center

The control center includes the following standard components:

- Magnetic motor starter with solid state overload protection
- Control transformer with fusing
- Integral door interlocking disconnect switch
- Separately fused motor
- Distribution terminal strip



Premium grade control components are selected for reliable operation. All electrical components are UL Listed, recognized or classified and factory prewired for single point power connection.

Vibration Isolators

The entire fan and motor assembly is mounted on vibration isolators to minimize noise transmission into the building.



Reliable Fan Performance

Air performance ratings from Greenheck's AMCA registered test chamber ensure accurate data.

Double width, double inlet forward curved wheels for high efficiency and low sound levels are constructed of heavy gauge steel. Wheels are statically and dynamically balanced to ensure vibration free operation.



Access Doors and Panels

Large access doors and panels are provided for easy inspection and maintenance of motors, drives, fan wheels, filters, and heater controls.

Factory Wired and Tested

All units are tested prior to shipment. Units are checked for vibration and proper operation.



Variable Volume

The variable volume option is recommended when a building's exhaust volumes may vary. This option enables the make-up air volume to track with the exhaust volume, providing only the amount of make-up air that is required.

The variable volume TSU saves energy in two ways. First, the fan power is reduced whenever make-up air requirements are less than the maximum. Second, whenever lower air volumes are sufficient, the TSU requires less gas to heat the outdoor air.

Airflow Control Strategies

Greenheck offers three methods of controlling the make-up air volume. All three vary the fan speed for maximum energy savings.

- **Variable Frequency Drive** controlled by **building pressure**.
- **Variable Frequency Drive** controlled **manually** with a remote potentiometer.
- **2 speed motor** controlled **manually** with a remote switch.

80/20 Recirculation

The 80/20 Recirculation option is recommended when the ventilation equipment provides the primary source of heating for the space.

This option recirculates up to 80% of the supply air and efficiently heats it to maintain the desired space temperature. A minimum of 20% outdoor air is mixed with the recirculated air to provide a continuous source of fresh air.

Only outdoor air is used for combustion. This eliminates the possibility of contaminants in the recirculated air from crossing the burner.

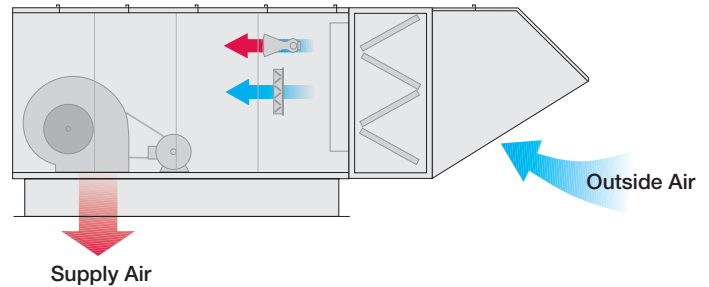
Airflow Control Strategies

Greenheck offers four methods of controlling the recirculated air to outdoor air ratio. The ratio is determined by the outdoor air and recirculated air damper positions. The methods for adjusting damper positions are outlined below:

- **Modulating actuator** controlled by **building pressure**.
- **Modulating actuator** controlled **manually** with a remote potentiometer.
- **Two position actuator** controlled **manually** with a remote switch.
- **Manually operated damper quadrants** set to a **fixed position**.

Temperature Control

A Room Temperature Control package is included with the Variable Volume systems. The space temperature is controlled by a room mounted thermostat. A factory supplied remote control panel is required.



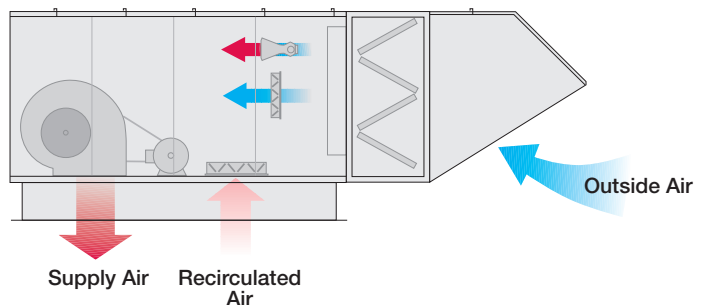
Burner By-Pass Damper

Both the Variable Volume and 80/20 Recirculation option include a patent pending burner by-pass damper, which maintains the pressure drop across the burner as air volumes change. This assures that complete and proper combustion occurs. The by-pass damper is self-adjusting, designed for minimal maintenance, and requires no controls.

In all cases, the fan provides a constant volume of supply air.

Temperature Control

A Room Temperature Control package is included with the 80/20 Recirculation system. The space temperature is controlled by a room mounted thermostat. A factory supplied remote control panel is required.



Other Heating Options

Hot Water and Steam

These options provide economical heat where boilers are available. Hot water and steam coils are available with face and by-pass dampers.



Electric Heat

Electric heaters are UL Listed and feature open coil heating elements with all heat output released into the airstream. Electric heater control cabinets are installed completely within the supply unit for housing sizes 10, 20 and 30. Electric heating units meet all requirements of the National Electric Code.



Additional Accessories

V-Bank Filters

Washable 2 inch aluminum mesh filters or 2 inch disposable (30% efficient) filters are available.

Air Filter Gauge

Indicates when filters become dirty. An indicator light may be wall/beam mounted or provided with a remote control panel.

Motorized Dampers

Intake or discharge dampers are available to prevent backdrafts when the fan is not in operation. Intake dampers are factory mounted and wired.

Spring Vibration Isolation

Spring vibration isolators are available in lieu of neoprene isolators for fan sizes 115 and larger.

Freeze Protection

An on/off type discharge duct stat (with a timer) prevents the discharge of cold air into the building when the burner is not providing adequate tempering.

Inlet Air Sensor

An on/off type duct stat automatically de-energizes the gas system and interrupts the flow of gas to the burner when the inlet air temperature is above the desired setting.

115 Volt Service Receptacle

A 115 volt outlet is mounted in the heater control compartment for the convenience of field service personnel. A separate 115 volt power source is required.

Cooling Options

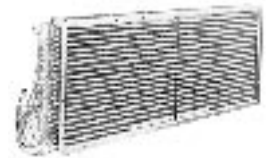
Evaporative Cooling

Available in cooling only or in combination with any heating option. Coolers are capable of producing a humidifying effectiveness of at least 90 percent at 500 ft./min. Standard evaporative media is Munters CELdek. GLASdek is also available.



Chilled Water and Direct Expansion (DX)

Cooling coils are available for cooling only units or in combination with heating options. Consult the factory for DX cooling and direct fired gas combination.



Roof Curbs

Factory provided roof curbs are available to ensure compatibility between make-up air unit and roof curb. Standard construction is G90 galvanized steel. Curbs for housing sizes 40 and 50 ship knocked down.

Fiberglass Insulation

Fiberglass insulation is used to line the housing to prevent the formation of condensation and to form an acoustical barrier.

Weather Hood

Standard construction is G90 galvanized steel. Weather hoods for housing sizes 10 through 40 ship assembled as standard.

Backward Inclined Fans

Backward inclined fans are available for high static pressure applications on housing sizes 20 and larger.

Propane Gas

A propane heater may be provided in lieu of natural gas.

Gas Pressure Regulator

Required if building gas line pressure exceeds TSU maximum inlet gas pressure.

Special Coatings

Greenheck's Permatector coating is available for a durable, long lasting finish. Decorative paints are also available in a variety of colors to match existing building fixtures. Consult your Greenheck representative for paint selections.

Remote Control Panels

A wide variety of remote control panels are available. Specify the desired combination of switches, thermostats, temperature selectors and indicator lights (see examples at right). A terminal strip within the remote control panel makes connection to the TSU control center simple.



Basic remote control panel with thermostat for room temperature control option.



Remote panel with circuit analyzer and thermostat for room override option.

Temperature Controls

Discharge Temperature Control

Control of discharge air temperature is accomplished with a factory installed sensor located at the fan discharge. A Maxitrol 14 system controls the gas valve to provide the desired discharge temperature.

Room Override

This option, available with the Maxitrol 14 system, enables a room thermostat to increase the TSU supply temperature above its discharge temperature set point. Discharge sensor is factory installed. Room sensor may be wall/beam mounted or included on a remote control panel.



Room Temperature Control

Specify this option when the TSU has the primary responsibility for controlling the room temperature. A room mounted thermostat (shown below) senses the room temperature and provides feedback to the Maxitrol 44 control system. The gas valves are then modulated to satisfy the selected room temperature.

The thermostat is manually adjustable to the desired room temperature. The room thermostat may be wall/beam mounted or included on a remote control panel.



AIR PERFORMANCE

Housing Size 10

MODEL	CFM		TOTAL STATIC PRESSURE in inches of WG						Maximum MBH
			0.50	0.75	1.00	1.25	1.50	1.75	
TSU-108	800	RPM	993	1109	1216	1311	1399		85
		BHP	0.21	0.26	0.31	0.35	0.40		
	1,000	RPM	1112	1228	1325	1415	1500	1579	105
		BHP	0.34	0.41	0.47	0.53	0.59	0.65	
	1,200	RPM	1238	1347	1445	1530			130
		BHP	0.51	0.59	0.68	0.75			
TSU-109	1,500	RPM	880	1014	1140	1255	1361	1460	160
		BHP	0.36	0.45	0.54	0.63	0.73	0.84	
	1,950	RPM	990	1102	1210	1312	1411	1504	210
		BHP	0.61	0.73	0.86	0.97	1.1	1.2	
	2,400	RPM	1123	1216	1306	1397	1484		260
		BHP	0.99	1.1	1.3	1.4	1.6		
TSU-110	2,000	RPM	805	912	1013	1110	1199		265
		BHP	0.48	0.59	0.71	0.84	0.96		
	2,500	RPM	906	995	1082	1166	1247	1325	270
		BPH	0.79	0.93	1.1	1.2	1.4	1.5	
	3,000	RPM	1014	1097	1172	1244	1315	1386	275
		BPH	1.2	1.4	1.6	1.7	1.9	2.1	

Housing Size 20

MODEL	CFM		TOTAL STATIC PRESSURE in inches of WG						Maximum MBH
			0.75	1.00	1.25	1.50	1.75	2.00	
TSU-112	2,600	RPM	761	853	934	1009			310
		BHP	0.7	0.9	1.0	1.2			
	3,500	RPM	839	920	993	1065	1133	1195	420
		BHP	1.3	1.5	1.7	1.9	2.1	2.3	
	4,400	RPM	939	1006	1073	1137	1197		530
		BHP	2.1	2.4	2.6	2.9	3.1		
TSU-115	4,000	RPM	681	756	822	892			480
		BHP	1.3	1.5	1.8	2.1			
	5,250	RPM	757	823	884	943	998	1049	630
		BHP	2.2	2.5	2.8	3.2	3.5	3.8	
	6,500	RPM	850	906	960	1013	1062		780
		BHP	3.5	3.9	4.3	4.7	5.1		

Housing Size 30

MODEL	CFM		TOTAL STATIC PRESSURE in inches of WG						Maximum MBH
			0.75	1.00	1.25	1.50	1.75	2.00	
TSU-118	6,500	RPM	609	668	724	777			850
		BHP	2.1	2.5	2.8	3.2			
	8,000	RPM	668	721	772	819	864	910	1,045
		BHP	3.3	3.7	4.2	4.6	5.0	5.5	
	9,500	RPM	736	783	827	872	914		1,240
		BHP	4.9	5.4	5.9	6.4	6.9		
TSU-120	9,000	RPM	559	608	657	703	747	792	1,170
		BHP	3.2	3.7	4.2	4.6	5.2	5.7	
	10,500	RPM	606	648	691	734	775	813	1,375
		BHP	4.5	5.0	5.6	6.1	6.7	7.3	
	12,000	RPM	655	695	732	770	807	844	1,375
		BHP	6.2	6.8	7.4	8.0	8.6	9.2	

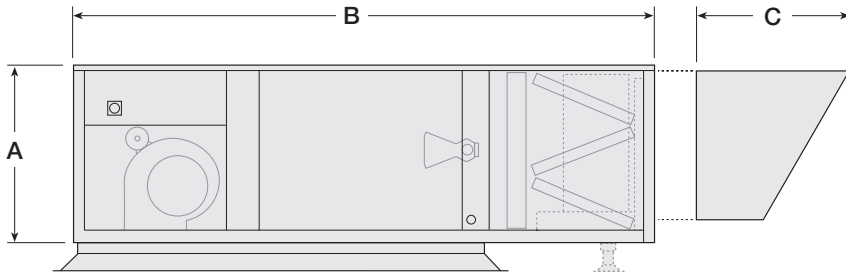
Housing Size 40

MODEL	CFM		TOTAL STATIC PRESSURE in inches of WG						Maximum MBH
			0.75	1.00	1.25	1.50	1.75	2.00	
TSU-218	14,000	RPM	612	672	726	779			1,830
		BHP	5.0	5.7	6.5	7.4			
	18,000	RPM	691	738	788	836	881	923	2,350
		BHP	8.7	9.6	10.6	11.6	12.6	13.6	
	22,000	RPM	787	825	865	902	944	985	2,875
		BHP	14.3	15.4	16.5	17.5	18.8	20.0	
TSU-220	20,000	RPM	575	621	667	711	752	791	2,610
		BHP	8.3	9.3	10.3	11.4	12.5	13.7	
	24,000	RPM	636	677	716	755	792	830	3,135
		BHP	12.6	13.9	15.1	16.3	17.5	18.9	
	28,000	RPM	703	739	774	809	841	875	3,300
		BHP	18.4	19.9	21.3	22.8	24.2	25.6	

Housing Size 50

MODEL	CFM		TOTAL STATIC PRESSURE in inches of WG						Maximum MBH
			0.75	1.00	1.25	1.50	1.75	2.00	
TSU-225	32,000	RPM	446	482	515	548			3,830
		BHP	12.1	13.8	15.4	16.9			
	38,000	RPM	491	523	553	582	610	638	4,550
		BHP	18.0	19.8	21.9	23.9	25.7	27.5	
	45,000	RPM	547	575	603	629	655	679	5,390
		BHP	27.4	29.5	31.6	33.9	36.3	38.7	
TSU-230	44,000	RPM	401	429	456	483	509	535	5,270
		BHP	16.8	18.9	21.2	23.7	26.3	29.0	
	52,000	RPM	446	470	494	516	539	562	6,050
		BHP	24.9	27.3	29.8	32.2	35.0	38.0	
	60,000	RPM	494	514	535	556	576	596	6,050
		BHP	36.2	38.3	40.9	43.9	46.7	49.5	

Housing Sizes 10 - 30

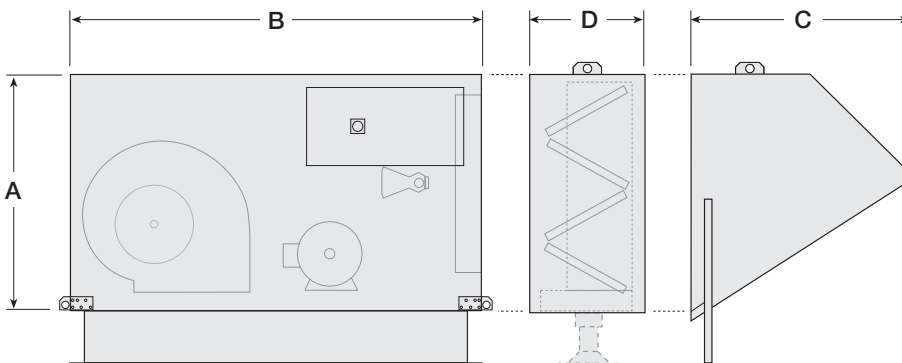


DIMENSIONS

HOUSING SIZE	Width	A	B	C
10	30	32	105	28
20	40	38	116	24
30	52	48	128	30

All dimensions are shown in inches.

Housing Sizes 40 & 50



DIMENSIONS

HOUSING SIZE	Width	A	B	C	D
40	110	51	88	46	25
50	156	64	100	71	31

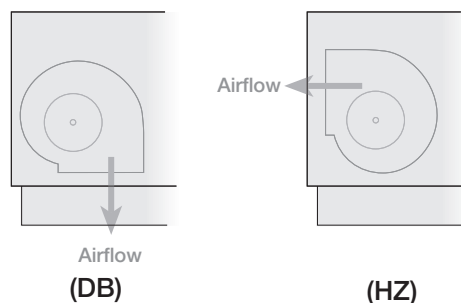
All dimensions are shown in inches.

PRESSURE DROP DATA

Housing	CFM	2 in. 30% Filter	Inlet Damper	Gas Burner
10	1000	0.10	0.02	0.625
	3000	0.16	0.06	
20	2500	0.11	0.02	0.625
	6500	0.17	0.09	
30	6000	0.12	0.03	0.625
	12000	0.20	0.10	
40	14000	0.14	0.05	0.625
	28000	0.28	0.16	
50	30000	0.14	0.04	0.625
	60000	0.28	0.15	

Discharge Arrangements

For installation flexibility, fan discharges are available in either Downblast (DB), Horizontal (HZ) or Upblast (UB) configuration.



General: Make-up air unit shall be as manufactured by Greenheck or approved equal provided all specifications are met. Greenheck Model TSU is used as the basis of design. Performance shall be as scheduled on plans.

Gas Train and Controls: Direct fired gas system shall have a draw through design, field adjustable burner baffles and Maxon type NP burner for optimal burning efficiency. Flame safeguard shall be Honeywell 7800 series with digital coded fault indicator capability. Fault indicator shall provide service history by storing codes for the last five faults. Safety shutoff valves shall be industrial duty and use 120 VAC control signals. Temperature control shall incorporate a Maxitrol 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 or hinged doors.

Insulation: Unit casing to be lined with 1 inch fiberglass insulation. Insulation in accordance with NFPA 90A and tested to meet UL 181 erosion requirements and secured to unit with water proof adhesive and permanent mechanical fasteners.

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 statically and dynamically balanced. Ground and polished steel fan shafts shall be mounted in permanently lubricated ball bearings (up to size 118) or ball bearing pillow blocks (size 120 and larger). 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 TE 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, 10 horse power and less shall be supplied with an adjustable drive pulley.

Electrical: All internal electrical components shall be prewired for single point power connection. 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 120 VAC circuit, integral door interlocking disconnect switch with separate motor fusing and terminal strip. Contactors, Class 20 adjustable overload protection and single phase protection shall be standard.

Filter Section: Filters shall be mounted in a V-bank arrangement such that velocities across the filters do not exceed 550 feet per minute. Filters shall be easily accessible through a removable access panel.

Weather Hood: Weather hood shall be constructed of G90 galvanized steel with birdscreen mounted at the intake.

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.

Due to continuing research, Greenheck reserves the right to change specifications without notice.



Number one in air movement and control.



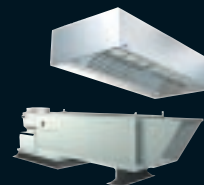
Centrifugal and Vane Axial Fans



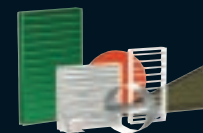
Fans and Ventilators



Energy Recovery Ventilators & Make-Up Air Units



Kitchen Ventilation Systems



Dampers and Louvers

Visit the Greenheck website for the most current information available
www.greenheck.com

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