MODINE
APPLIED THERMAL INNOVATION™

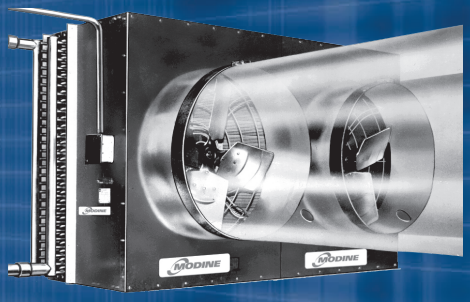
1-150.11
October, 2008

Steam/Hot Water Unit Heaters

MODEL HSB/HC

MODEL V/VN

MODEL PT/PTN



MODEL GLW

INDOOR AIR SOLUTIONS

MODINE INDOOR AIR SOLUTIONS

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C SA US

TECHNICAL STANDARDS & SAFETY AUTHORITY TSSA

Canadian Registered heat exchangers CRN OH 9234.5

As Modine Manufacturing Company has a continuous product improvement program, it reserves the right to change design and specifications without notice.

Application, Design, Construction Overview - All Units

Wide Product Selection

- Ratings as low as 11,300 Btu/hr for hot water to as high as 952,000 Btu/hr for steam, based on standard conditions.
- Horizontal, Vertical, and Power-Throw™ (high velocity horizontal air delivery) models offer maximum application flexibility.
- Ratings are shown as Btu/hr (based on 2 PSI steam, 60°F entering air conditions), eliminating the need to convert from EDR. This simplifies the matching of unit ratings to building heat loss.

Application Flexibility

- Horizontal and Power-Throw™ units are furnished with louvers for directional control of heated air. Vertical units are available with various louver, truncone, and cone-jet deflector options to accommodate many different air distribution patterns. See page 22 for more information.
- Units are available as low outlet temperature (LOT) models. LOT models have coils with fewer fins per inch to reduce the output rating. This is a benefit for applications where the steam pressure exceeds 30 PSI and mounting height is critical; the lower output results in outlet air temperatures that approximate that of standard coils at standard steam pressure. LOT models are also well suited for dirty environments where the increased fin spacing decreases the build-up of foreign particles. Finally, LOT models offer lower airside resistance resulting in greater allowable mounting heights and greater heat throw.
- Vertical and Power-Throw™ units are available with 90/10 cupro-nickel coils for high pressure/temperature applications, up to 250 PSI or 400°F.
- Side piping connections on the HC horizontal air delivery model allow for low clearance installations.
- Explosion proof motors are available for use in hazardous areas. See page 8 for additional details.
- Design assures the correct relationship between air temperature, velocity, and air volume for greater heat throw; air is delivered to the floor at maximum mounting height, increasing comfort and reducing fuel costs.

Ease of Installation/Maintenance = Reliability

- Units are compact and lightweight, requiring fewer contractor hours to install.
- All units include an electrical junction box, either integral to the motor or mounted on the unit casing, to allow for easy electrical connections.
- All motors are totally enclosed. All single phase and explosion proof motors include internal overload protection to protect the motor from insulation damaging heat, resulting in longer motor life.
- Different suspension options are available for most units including threaded rod or pipe hanger adapters.
- All units are component tested for proper motor function and the coils are leak tested under pressure to ensure proper function when the unit arrives at the jobsite.
- Fins on all units are vertical to limit build-up of foreign particles, prolonging periods between cleanings. Fins on vertical and Power-Throw™ units are exposed for easy cleaning.

Blends with the Environment

- Quiet operation is assured through the use of carefully selected motors, fans, and scientifically designed venturi fan shrouds.
- HSB and HC models have squared off corners for a clean, defined appearance. Vertical and Power-Throw™ units have a pleasing circular symmetry.
- Casings are treated for corrosion resistance and finished with a neutral gray-green baked-on, electrostatically applied polyester powder coat paint finish.

Unit Features - Horizontal Delivery Unit Heaters

Horizontal delivery unit heaters are the most popular of all types. These units are ideal for heating buildings with large open areas and low ceilings. They are used to counter heat loss along outside building walls, especially where windows are present.

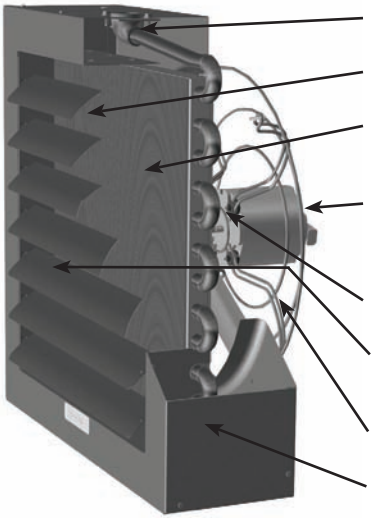
HSB MODEL
TOP/BOTTOM CONNECTIONS

HC MODEL
SIDE CONNECTIONS

In addition to the features noted on page 2, features that enhance the popularity of the horizontal delivery unit heater are:

- HSB units have top and bottom supply and return connections. This permits the unit to be rotated 360° without piping changes.
- HC units have side supply and return connections. This permits the unit to be installed in low clearance areas.
- Units have a 2-piece casing for easy coil access.
- All models have tapped holes for suspension by threaded rod or optional pipe hanger adapter kit, except HSB-18 and HSB-24 which mount directly to and are supported by the supply and return piping.
- Serpentine copper tube coil design has high resistance to thermal shock, even under high steam pressures.
- Absence of coil headers eliminates potential leaks and increases coil face area without increasing overall size of unit.
- Coil designed for greater water carrying capacity with lower friction loss.

Figure 4.1 - Unit Features



Connections – Female type permits direct connection of unit heater to the piping and eliminates the need for additional fittings.

Vertical Fins – Less opportunity for dust and dirt to collect. Reduces cleaning. Fins die-formed for added strength and heat transfer.

Coil – All air passes through coil. Heating is uniform. Design assures maximum control over air delivery and temperature of air leaving the heater. Aluminum fins die-formed for added strength – increased heat transfer. Fins mechanically bonded to serpentine copper tube.

Motor – All motors are totally enclosed. Single phase and explosion-proof types include built in thermal overload protection. Selected and tested for operation on specific unit heater models. All motor wiring is terminated in an electrical junction box either supplied on the unit heater casing, or as an integral part of the motor.

Fan – Lightweight. Blades accurately balanced and pitched to move air quietly and positively – with minimum power requirement.

Deflector Blades – Adjustable horizontal air-deflector blades are standard. Vertical blades are also standard on models HC/HSB-258, HC/HSB-290 and HC/HSB-340 and are optional on other models. Both horizontal and vertical blades are illustrated.

Safety Fan Guard – Standard equipment. Bolted to rear casing, steel rod fan guard completely surrounds the fan offering constant protection.

Casings – Baked-on gray-green polyester powdercoat paint is applied over rust-and corrosion-resistance-treated steel for long life.

Unit Features - Vertical Delivery Unit Heaters

Vertical delivery unit heaters are ideal for heating buildings with high ceilings or areas that require the heater to be mounted above obstructions such as craneways. Selection from a variety of heat throw patterns is made easy by choosing from four types of air deflectors. Heat throw patterns range from a high-velocity narrow jet to a gentle-velocity broad based cone of heated air.

In addition to the features noted on page 2, features that enhance the popularity of the vertical delivery unit heater are:

- Extended motor life with the use of the standard motor cooling cone. The cooling cone protects the motor from intense radiant and convection heat from the coil when the fan is not running. The cone also meters a controlled volume of ambient air over the motor to reduce motor temperature, when the motor is running.
- All models through V/VN-279 have tapped holes for threaded rod or optional pipe hanger adapter kit.
- All models V/VN-333 and larger have angle-iron mounting bracket with 5/8" diameter hanger holes.
- All vertical units are supplied with an outlet fan guard covering the opening in the bottom of the unit.

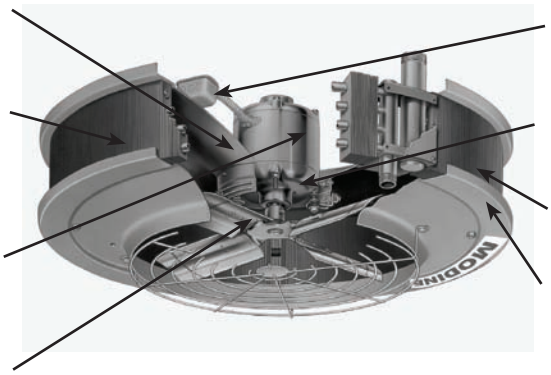
Figure 5.1 - Unit Features

Motor-Cooling Cone – Shields motor from coil heat - prolongs life of insulation, windings, and lubricant. Prolongs motor life (V/VN models only).

Coil – Aluminum fins firmly bonded to tubes for maximum heat transfer. Steam and water-carrying passages between extra-heavy steel pipe connections are copper for model V/PT and cupro-nickel for model VN/PTN.

Motor – All motors are totally enclosed. Single phase and explosion-proof types include built in thermal overload protection. Selected and tested for operation on specific unit heater models.

Fan – Accurately balanced to operate quietly and at lowest possible power cost.



Junction Box – All motor wiring is terminated in an electrical junction box either supplied on the unit heater casing or as an integral part of the motor.

Motor Easily Removable – Modine design permits motor to be removed through opening below the unit especially important where heaters are installed close to ceiling (V/VN models only).

Vertical Fins – Less opportunity for dust and dirt to collect. Exposed for easy cleaning with air hose and brush.

Casings – Baked-on, gray-green polyester powder coat paint applied over rust- and corrosion-resistance treated steel lasts longer.

Unit Features - Power-Throw™ Horizontal Delivery Unit Heaters

Power-Throw™ horizontal delivery unit heaters are ideal for heating large buildings where a number of smaller units can be replaced by a few larger Power-Throw™ units. This results in a more economical installation. Their high velocity air delivery results in the greatest heat throw available.

Power-Throw™ units are also ideally suited for blanketing doors that frequently open.

Because of high velocity air delivery, care must be taken to avoid directing the air stream at building occupants.

In addition to the features noted on page 2, features that enhance the popularity of the Power-Throw™ horizontal delivery unit heater are:

- All models through PT/PTN-279 have hanger brackets with 5/8" diameter hanger holes for 3-point suspension.
- All models larger than PT/PTN-279 have hanger brackets with 5/8" diameter hanger holes for 2-point suspension and angle supports for 4-point suspension.
- Air distribution is controlled by a standard adjustable position horizontal louver assembly.
- The air stream can be concentrated into a high velocity jet or broadened to cover a greater area.
- Fan blades are properly balanced and pitched to move large volumes of high velocity air at relatively low sound levels.
- Refer to Figure 5.1 for features similar to the V/VN vertical models.

Unit Features - Low Water Temperature Greenhouse Heating Units

The Modine model GLW units are specifically designed to heat greenhouses with low-temperature water. They can be successfully used in applications where waste or reject heat from steam-electric power plants, refineries, pumping stations, distilleries, and other industrial or processing plants can be utilized for heating. With the ever-increasing cost of fossil fuel, utilizing reject heat as a heat source for greenhouses is a sensible solution with the model GLW.

Standard features include:

- Hot water coil with 1/2" O.D. copper tubes, aluminum fins, and 1-1/2" MPT copper connections.
- Maximum operating pressure is 300 PSI, maximum operating water temperature is 180°F
- Frame, enclosure panels, and 24" polytube transitions are galvanized steel for corrosion resistance in humid environments.
- 1/2 HP, totally enclosed motors (1 for GLW330S, 2 for GLW660S), available for single phase or three phase voltages.
- High airflow, 3850CFM for GLW330S and 7700CFM for GLW660S, based on 150 feet of polytube duct.

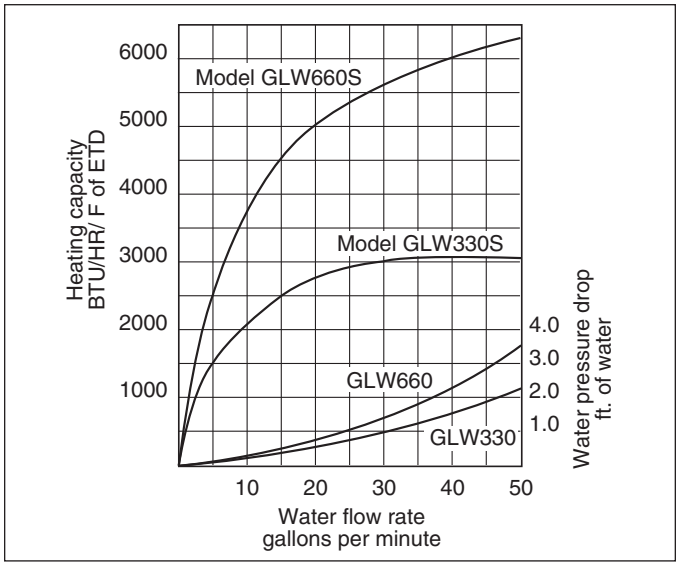
Unit Sizing

Unit performance is based on the flow rate and the temperature of the water relative to the ambient air temperature. Refer to Figure 6.1 and the following example for determining performance.

Example:
Determine heating capacity in BTU/hr for model GLW660S at 20GPM, 100°F entering water, and 70°F entering air.

1. Figure 6.1 shows output in terms of BTU/hr per °F of ETD (Entering Temperature Difference). ETD is the difference between the entering water temperature and the entering air temperature. For this example, ETD = 100°F – 70°F = 30°F.
2. From Figure 6.1, at 20GPM, the BTU/hr per °F of ETD for the GLW660S is 5000.
3. The heating capacity = 5000 x 30 = 150,000 BTU/hr.
4. The water temperature drop = (heating capacity)/(500 x GPM) = 150,000/(500 x 20) = 15°F.
5. The water pressure drop from the curve is 0.7 Ft. of water.

Figure 6.1 - Model GLW Performance Curves



Dimensions and Specifications - Model GLW660S, GLW330S (All dimensions in inches)

Figure 6.2 - Top View

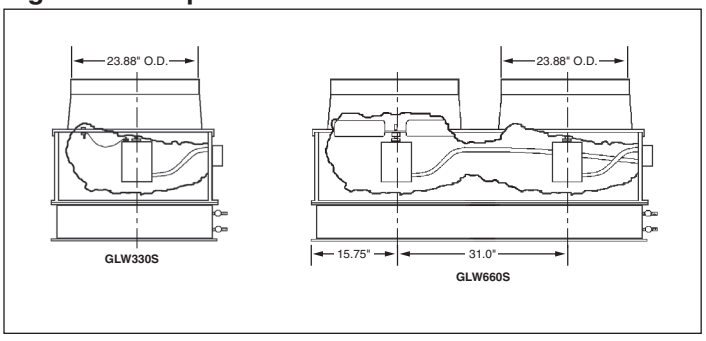
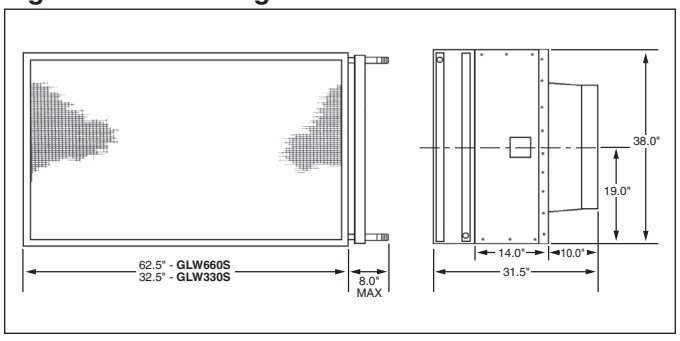


Figure 6.3 - Discharge and Side Views



Weight: GLW330S=200 lbs., GLW660S=380 lbs.

Note: Information on this page applies only to Model GLW units. Information contained in Catalog that is not on this page does not apply to Model GLW units.

Options and Accessories

Table 7.1
Factory Mounted Options

Factory Mounted Option	Description
Fingerproof Fan Guard	Standard fan guard may be factory replaced with fingerproof fan guard. For HSB/HC units only. Not available for units with explosion proof motors.

Table 7.2
Field Installed Accessories for Horizontal Models

Field Installed Accessories	Description
Vertical Deflector Blades	Blades used to deflect airflow in directions left or right of unit heater. Used in addition to standard horizontal deflector blades. Vertical deflector blades are standard on HSB/HC models 258 through 340. Not available for Power-Throw™ models.
Solid State Speed Control	Allows for remote control of airflow volume by controlling fan speed. Available only on HSB/HC models 18 through 108 with Power Code 01.

Table 7.3
Field Installed Accessories for Vertical Models

Field Installed Accessories	Description
Cone-Jet	The cone-jet allows the discharge air stream to be adjusted from a concentrated high velocity jet to a broadened air stream to cover a larger area. See page 22 for additional information.
Truncone	The truncone causes a broad discharge air stream covering a larger area than possible with the cone-jet. See page 22 for additional information.
One Way Louver	The one-way louver allows the discharge air stream to be adjusted in one direction. See page 22 for additional information.
Two Way Louver	The two-way louver allows the discharge air stream to be adjusted in two directions. See page 22 for additional information.

Table 7.4
Field Installed General Accessories

Field Installed Accessories	Description
Thermostat	Honeywell T4051A1003, 50-80°F range, 16A @ 115V, 8A @ 230V
Thermostat	Honeywell T451A3005, 44-86°F range, 9.8A @ 115V, 4.9A @ 230V
Thermostat	Johnson Controls T22BBC-1, 40-90°F range, Auto/Off/Fan switch, 10A @ 115V, 4.9A @ 230V
Explosion Proof Thermostat	Honeywell T6051B1006, 46-84° range, 10.2A @ 115V, 6.5A @ 230V
Aquastat	Aquastat, 10 amps @ 115V; 6 amps @ 230V; 100°-240°F range, SPDT, 10°F Diff. Fixed, Johnson A19DAC-1
Thermostat Guard	Clear plastic locking guard with tumbler lock and two keys. Available only on thermostat Item Codes 23124, 23125 and 90348.
Pipe Hanger Adapter Kit	Allows unit heater to be suspended by threaded pipe instead of threaded rod. Two kits are required for V and VN models. Kits are not available for HSB-18 and HSB-24 models or Power-Throw™ models.
Manual Starter	Toggle switch starter with thermal overload protection for remote on/off control of unit fan operation. Available for power codes 01 and 02 only.
Step-Down Transformer	For supply voltages of 208V/60Hz/1ph and all non-explosion proof 3 phase voltages of 208, 230, 460 and 575, certain Model Numbers require that a 115V/60Hz/1 phase Power Code 01 unit heater be used with a shipped loose accessory transformer. See page 23 for additional information.

Power Code Descriptions, Sound Classifications, Control Sequence

Table 8.1
Power Code Descriptions

Power Code	Supply Voltage	Motor Enclosure	Motor Type	Thermal Overload Protection	Motor Starter
01	115/60/1	Totally Enclosed	①	Yes	N/A
02	230/60/1	Totally Enclosed	①	Yes	N/A
04	200-208/60/3	Totally Enclosed	Polyphase Induction	No	Field Supplied/Installed
05	230/460/60/3	Totally Enclosed	Polyphase Induction	No	Field Supplied/Installed
06	115/60/1	Explosion Proof ②	Split Phase	Yes	N/A
09	230/460/60/3	Explosion Proof ②	Polyphase Induction	Yes	Field Supplied/Installed
10	575/60/3	Totally Enclosed	Polyphase Induction	No	Field Supplied/Installed

① Motors are shaded pole for models HSB/HC18-33 and V/VN42-95. Models HSB/HC47-340 and V/VN139-333 are permanent split capacitor.

② Explosion proof motors are suitable for Class I, Group D, Class II, Groups F and G, and Class III, Division 1 and 2 environments. Canadian Standard Association (CSA) requirements state that the explosion proof units may not be used with a fluid temperature in excess of 329°F or pressures greater than 87 psig and still maintain their explosion proof rating for National Electric Code ignition temperature rating T3B for grain dust.
Class I, Group D motors are for operations in areas containing gasoline, petroleum, naphtha, benzene, butane, propane, alcohol, acetone, lacquer solvent or natural gas.
Class II, Group F motors are for operations in areas containing carbon black, coal or coke dust.
Class II, Group G motors are for operations in areas containing flour, starch or grain dust.
Class III motors are for operations in areas containing easily ignitable fibers and flyings.

Sound Classifications

While sound is created anytime fans and motors are used to move air, Modine unit heaters were designed to minimize their sound level through the careful selection of motors, fan blades and the design of the air intake opening. Table 8.2 shows typical types of buildings or rooms with a corresponding Sound Class rating. For a unit heater with a given Sound Class rating, when placed in the type of building or room shown in Table 8.2, the sound of the unit heater will be relatively comparable to the ambient sound level of all sounds within that type of building or room. The Sound Class rating for each unit heater is shown in Tables 12.1-13.2 and 18.1-19.2.

Table 8.2
Sound Class Ratings

Type of Building or Room	Sound Class Rating
Apartments, Classrooms, Court Rooms, Executive Offices, Hospitals, Libraries, Museums	I
General Offices, Hotel Dining Rooms, Recreation Rooms, Show Rooms, Small Stores	II
Bank Lobbies, Grocery Stores, Gymnasiums, Post Offices, Restaurants, Service Stations	III
Factories, Foundries, Machine Shops, Packing Plants, Shipping Platforms	II-VII
Forge Shops, Steel Fabricating Shops, Boiler Works	VII

Control Sequence

The following control sequence descriptions are typical for steam/hot water unit heaters.

Intermittent Fan Operation - Hot Coil
When a room thermostat calls for heat, the motor is energized. Hot water or steam is continuously supplied to the unit heater, even when the motor is not running. When the thermostat is satisfied, the motor is de-energized.

Continuous Fan Operation - Intermittent Hot/Cold Coil
When a room thermostat calls for heat, a valve is opened, allowing steam or hot water to enter the unit heater. When the thermostat is satisfied, the valve is closed. The fan runs continuously.

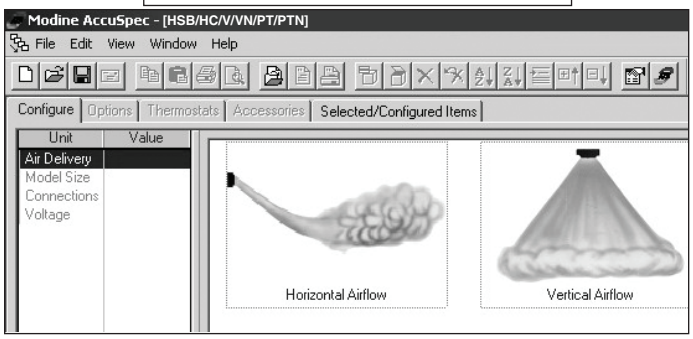
Intermittent Fan Operation - Intermittent Hot/Cold Coil
When a room thermostat calls for heat, the motor is energized. At the same time, a valve is opened allowing steam or hot water to enter the unit heater. An aquastat may be attached to the supply or return piping to prevent fan operation until the coil is adequately heated to avoid cold air delivery. When the thermostat is satisfied, the valve closes and the motor is de-energized.

MODINE INDOOR AIR SOLUTIONS

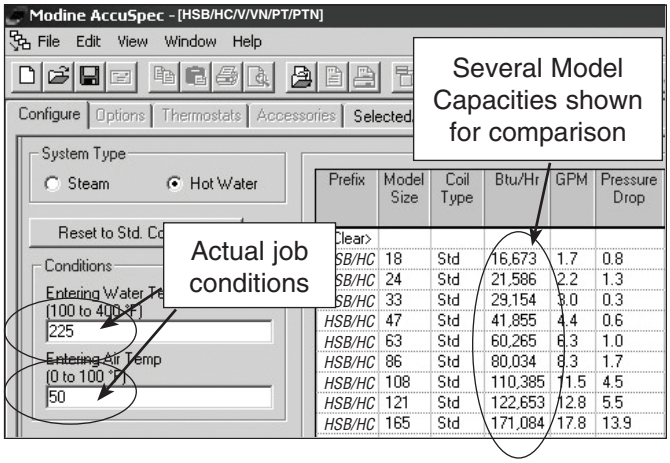
Modine Breeze™ AccuSpec Sizing and Selection Program

The Modine Breeze AccuSpec is the fastest way to generate performance data based on actual job conditions. The Breeze AccuSpec program is a Windows based sizing and selection program. The program provides a series on step-by-step questions that allow for the easy configuration of Modine products. After a model has been configured, the program can generate Submittal Schedules, Submittal Data including performance and dimensional drawings, and Specifications.

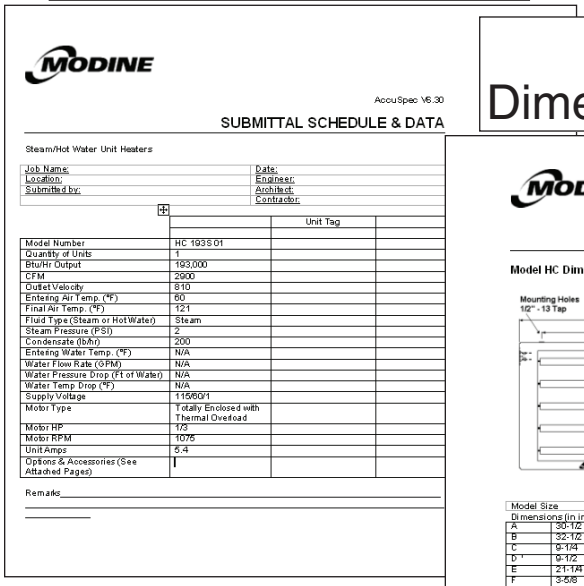
Pictures for Visual Selection



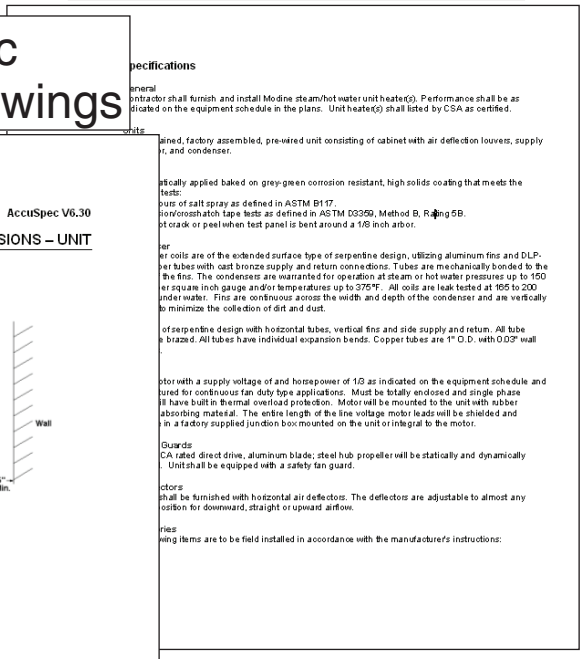
Capacities at Job Conditions



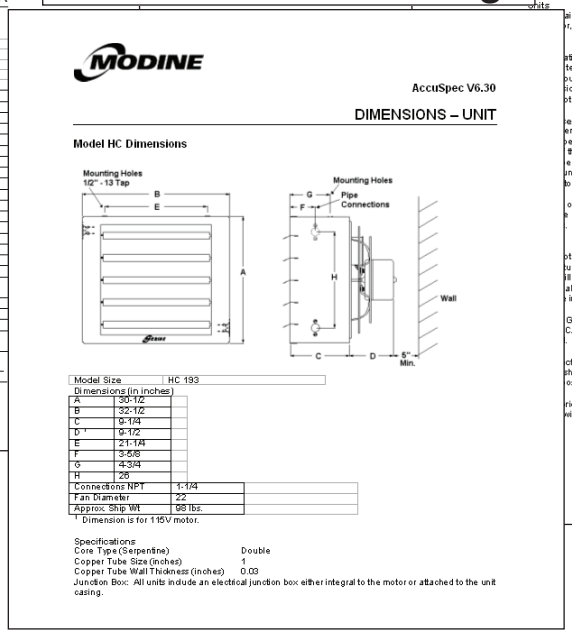
Submittal Schedules



Job Specific Specifications



Unit Specific Dimensional Drawings



For a copy of the Breeze AccuSpec program, contact your local Modine sales representative.

Steam Conversion Tables

Table 10.1 and the formulas below are used to determine the heating capacity (Btu/hr) of a unit heater at a steam pressure and/or entering air temperature other than standard conditions of 2 lb. steam, 60°F entering air temperature.

Table 10.1
Steam Heating Capacity Conversion Factors

Unit Heater Type	Steam Pressure (PSIG)	Entering Air Temperature (°F)											
		-10	0	10	20	30	40	50	60	70	80	90	100
Horizontal Delivery	0	1.54	1.45	1.37	1.27	1.19	1.11	1.03	0.96	0.88	0.81	0.74	0.67
	2	1.59	1.50	1.41	1.32	1.24	1.16	1.08	1.00	0.93	0.85	0.78	0.71
	5	1.64	1.55	1.46	1.37	1.29	1.21	1.13	1.05	0.97	0.90	0.83	0.76
	10	1.73	1.64	1.55	1.46	1.38	1.29	1.21	1.13	1.06	0.98	0.91	0.84
	15	1.80	1.71	1.61	1.53	1.44	1.34	1.28	1.19	1.12	1.04	0.97	0.90
	20	1.86	1.77	1.68	1.58	1.50	1.42	1.33	1.25	1.17	1.10	1.02	0.95
	30	1.97	1.87	1.78	1.68	1.60	1.51	1.43	1.35	1.27	1.19	1.12	1.04
	40	2.06	1.96	1.86	1.77	1.68	1.60	1.51	1.43	1.35	1.27	1.19	1.12
	50	2.13	2.04	1.94	1.85	1.76	1.67	1.58	1.50	1.42	1.34	1.26	1.19
	60	2.20	2.09	2.00	1.90	1.81	1.73	1.64	1.56	1.47	1.39	1.31	1.24
	70	2.26	2.16	2.06	1.96	1.87	1.78	1.70	1.61	1.53	1.45	1.37	1.29
	75	2.28	2.18	2 09	1.99	1.90	1.81	1.72	1.64	1.55	1.47	1.40	1.32
	80	2.31	2.21	2.11	2.02	1.93	1.84	1.75	1.66	1.58	1.50	1.42	1.34
	90	2.36	2.26	2.16	2.06	1.97	1.88	1.79	1.71	1.62	1.54	1.46	1.38
	100	2.41	2.31	2.20	2.11	2.02	1.93	1.84	1.75	1.66	1.58	1.50	1.42
	125	2.51	2.41	2.31	2.21	2.11	2.02	1.93	1.84	1.76	1.68	1.59	1.51
	150	2.60	2.50	2.40	2.30	2.20	2.11	2.02	1.93	1.84	1.76	1.67	1.59
Vertical Delivery and Power-Throw	0	1.49	1.41	1.33	1.25	1.18	1.11	1.03	0.96	0.90	0.83	0.76	0.69
	2	1.52	1.45	1.37	1.29	1.22	1.15	1.07	1.00	0.93	0.86	0.80	0.73
	5	1.58	1.50	1.42	1.34	1.27	1.20	1.12	1.05	0.98	0.91	0.85	0.78
	10	1.64	1.57	1.49	1.41	1.34	1.27	1.19	1.12	1.05	0.98	0.91	0.85
	15	1.70	1.62	1.55	1.47	1.40	1.32	1.25	1.18	1.11	1.04	0.97	0.90
	20	1.75	1.67	1.60	1.52	1.45	1.37	1.30	1.23	1.16	1.09	1.02	0.96
	30	1.83	1.75	1.68	1.61	1.53	1.46	1.39	1.32	1.25	1.18	1.11	1.04
	40	1.90	1.82	1.75	1.68	1.61	1.53	1.46	1.39	1.32	1.25	1.18	1.11
	50	1.96	1.87	1.81	1.74	1.67	1.59	1.52	1.45	1.38	1.31	1.24	1.17
	60	2.02	1.94	1.87	1.79	1.72	1.64	1.57	1.50	1.43	1.36	1.29	1.22
	70	2.07	1.99	1.92	1.84	1.76	1.69	1.62	1.55	1.47	1.40	1.33	1.27
	75	2.10	2.02	1.94	1.86	1.79	1.71	1.64	1.57	1.49	1.42	1.36	1.29
	80	2.11	2.04	1.96	1.88	1.80	1.73	1.66	1.59	1.51	1.44	1.38	1.31
	90	2.15	2.08	2.00	1.92	1.84	1.77	1.69	1.62	1.55	1.48	1.41	1.34
	100	2.19	2.11	2.03	1.95	1.88	1.80	1.73	1.66	1.59	1.52	1.45	1.38
	125	2.27	2.19	2.11	1.99	1.91	1.88	1.81	1.74	1.67	1.60	1.53	1.46
	150	2.34	2.26	2.18	2.10	2.03	1.95	1.88	1.81	1.74	1.67	1.60	1.53
	175	2.40	2.32	2.24	2.16	2.09	2.01	1.94	1.87	1.80	1.73	1.66	1.59
	200	2.45	2.37	2.29	2.22	2.14	2.07	1.99	1.92	1.85	1.78	1.71	1.64
	225	2.50	2.42	2.34	2.26	2.19	2.12	2.04	1.97	1.90	1.83	1.76	1.69
	250	2.54	2.46	2.38	2.31	2.23	2.16	2.09	2.01	1.94	1.87	1.80	1.73

Applicable formulas (examples on page 15):

To find actual unit heater capacity when operated at non-standard (actual) conditions:

Btu_A = Btu_S x Heating Capacity Factor

To select a heater capacity based on standard conditions to meet a heating capacity at non-standard (actual) conditions:

Btu_S = Btu_A ÷ Heating Capacity Factor

Where:
Btu_S = Capacity at standard conditions (2 lb. steam, 60°F entering air temperature) from Tables 13.1 through 14.2
Btu_A = Capacity at non-standard (actual) conditions

Steam Conversion Tables

Table 11.1 and the formulas below are used to determine the air temperature rise of a unit heater at a steam pressure and/or entering air temperature other than standard conditions of 2 lb. steam, 60°F entering air temperature.

Table 11.1
Air Temperature Rise Conversion Factors

Unit Heater Type	Steam Pressure (PSIG)	Entering Air Temperature (°F)											
		-10	0	10	20	30	40	50	60	70	80	90	100
Horizontal Delivery	**0**	1.33	1.28	1.24	1.17	1.12	1.07	1.01	0.96	0.90	0.84	0.78	0.72
	2	1.38	1.33	1.27	1.22	1.17	1.11	1.06	1.00	0.94	0.88	0.83	0.76
	5	1.43	1.38	1.33	1.27	1.21	1.16	1.11	1.05	1.00	0.93	0.88	0.82
	10	1.50	1.45	1.40	1.35	1.29	1.24	1.19	1.13	1.07	1.02	0.95	0.90
	15	1.56	1.51	1.46	1.42	1.36	1.31	1.24	1.19	1.14	1.08	1.02	0.97
	20	1.61	1.56	1.52	1.46	1.41	1.36	1.30	1.25	1.19	1.14	1.08	1.02
	30	1.70	1.65	1.61	1.55	1.51	1.46	1.40	1.35	1.29	1.24	1.18	1.12
	40	1.78	1.73	1.68	1.62	1.58	1.54	1.48	1.43	1.38	1.32	1.26	1.21
	50	1.84	1.79	1.74	1.69	1.65	1.60	1.55	1.50	1.45	1.39	1.33	1.28
	60	1.91	1.86	1.81	1.75	1.71	1.66	1.61	1.56	1.50	1.45	1.40	1.33
	70	1.95	1.91	1.86	1.81	1.76	1.71	1.66	1.61	1.56	1.51	1.45	1.39
	75	1.97	1.93	1.89	1.84	1.79	1.74	1.69	1.64	1.58	1.53	1.47	1.42
	80	2.00	1.95	1.91	1.86	1.82	1.76	1.72	1.66	1.61	1.56	1.49	1.44
	90	2.04	2.00	1.95	1.90	1.86	1.81	1.75	1.70	1.65	1.60	1.54	1.49
	100	2.08	2.04	1.99	1.95	1.89	1.85	1.79	1.75	1.69	1.64	1.59	1.53
	125	2.17	2.13	2.09	2.04	1.99	1.94	1.89	1.84	1.79	1.74	1.68	1.63
	150	2.25	2.21	2.17	2.12	2.07	2.03	1.98	1.93	1.87	1.83	1.77	1.71
Vertical Delivery and Power-Throw	**0**	1.36	1.31	1.25	1.19	1.13	1.08	1.02	0.96	0.90	0.84	0.78	0.72
	2	1.41	1.35	1.29	1.24	1.18	1.12	1.06	1.00	0.94	0.88	0.82	0.76
	5	1.46	1.40	1.35	1.29	1.23	1.17	1.12	1.06	1.00	0.94	0.88	0.82
	10	1.54	1.48	1.43	1.37	1.31	1.25	1.20	1.14	1.08	1.02	0.96	0.89
	15	1.61	1.55	1.49	1.44	1.38	1.32	1.26	1.20	1.14	1.09	1.02	0.97
	20	1.67	1.61	1.55	1.50	1.44	1.38	1.32	1.26	1.20	1.15	1.08	1.02
	30	1.77	1.71	1.65	1.60	1.54	1.48	1.42	1.36	1.30	1.25	1.18	1.12
	40	1.85	1.79	1.74	1.68	1.62	1.56	1.51	1.45	1.39	1.33	1.27	1.21
	50	1.92	1.86	1.81	1.75	1.69	1.64	1.58	1.52	1.46	1.40	1.34	1.28
	60	1.99	1.93	1.88	1.82	1.76	1.70	1.65	1.58	1.53	1.47	1.41	1.35
	70	2.05	1.99	1.94	1.88	1.82	1.76	1.70	1.65	1.59	1.53	1.47	1.41
	75	2.08	2.02	1.96	1.91	1.85	1.79	1.73	1.67	1.62	1.56	1.50	1.43
	80	2.10	2.04	1.99	1.93	1.87	1.81	1.75	1.70	1.64	1.58	1.52	1.46
	90	2.15	2.09	2.04	2.00	1.92	1.86	1.80	1.74	1.69	1.63	1.57	1.51
	100	2.19	2.14	2.08	2.02	1.97	1.91	1.85	1.79	1.73	1.67	1.61	1.55
	125	2.29	2.24	2.18	2.12	2.07	2.01	1.95	1.89	1.83	1.77	1.71	1.65
	150	2.39	2.33	2.27	2.22	2.16	2.10	2.04	1.99	1.93	1.87	1.81	1.75
	175	2.46	2.41	2.35	2.29	2.24	2.18	2.12	2.06	2.00	1.94	1.88	1.82
	200	2.54	2.48	2.42	2.37	2.31	2.25	2.19	2.13	2.07	2.02	1.96	1.89
	225	2.60	2.54	2.49	2.43	2.37	2.32	2.26	2.20	2.14	2.08	2.02	1.96
	250	2.66	2.60	2.55	2.49	2.43	2.38	2.32	2.26	2.20	2.14	2.08	2.02

Applicable formulas (examples on page 15):

To find actual air temperature rise of unit heater when operated at non-standard (actual) conditions:

$ATR_A = (FAT_S - EAT_S) \times$ Air Temperature Rise Factor

To find actual final air temperature of unit heater when operated at non-standard (actual) conditions:

$FAT_A = EAT_A + ATR_A$

Where:

EAT_S = Standard conditions entering air temperature (60°F)
EAT_A = Non-standard (actual) entering air temperature
FAT_S = Final air temperature at standard conditions from Tables 13.1 through 14.2
FAT_A = Final air temperature at non-standard (actual) conditions
ATR_A = Air temperature rise at non-standard (actual) conditions

Steam Conversion Tables

Table 12.1 is used to determine how steam pressures other than 2 lb. affect mounting height.

Table 12.1
Steam Unit Heater Mounting Height Correction Factors ①②

	Steam Pressure, PSIG																		
	2	5	10	15	20	30	40	50	60	70	80	90	100	125	150	175	200	225	250
Correction Factor	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.82	0.80	0.79	0.77	0.76	0.76	0.74	0.72	0.71	0.70	0.69	0.68

① Factors are for use with entering air temperatures that range from 50° to 70°F.
② While all units are capable of operation on steam pressures greater than 30 lb., low outlet temperature models are ideally suited for steam pressures above 30 lb. when mounting height is critical.

Applicable formula (examples on page 15):

Max. Mounting Height$_A$ = Max. Mounting Height$_S$ x Correction Factor

Where:
Max. Mounting Height$_A$ = Maximum mounting height at actual conditions
Max. Mounting Height$_S$ = Maximum mounting height at standard conditions

Table 12.2 is used to determine the rate of condensate production at steam pressures other than 2 lb.

Table 12.2
Properties of Steam

Gauge Pressure (PSIG)	Temp (°F)	Latent Heat (Btu/lb.)	Gauge Pressure (PSIG)	Temp (°F)	Latent Heat (Btu/lb.)	Gauge Pressure (PSIG)	Temp (°F)	Latent Heat (Btu/lb.)	Gauge Pressure (PSIG)	Temp (°F)	Latent Heat (Btu/lb.)
0	212.0	970.3	**34**	279.4	924.7	**70**	316.0	897.3	**109**	343.6	875.4
2	218.5	966.2	**36**	281.9	922.9	**72**	317.7	896.0	**112**	345.4	873.9
4	224.4	962.4	**38**	284.3	921.1	**74**	319.3	894.8	**115**	347.2	872.5
5	227.2	960.6	**40**	286.7	919.3	**76**	320.9	893.5	**118**	348.9	871.0
6	229.8	958.8	**42**	289.0	917.6	**78**	322.4	892.3	**121**	350.7	869.6
8	234.8	955.6	**44**	291.3	915.9	**80**	323.9	891.1	**124**	352.4	868.2
10	239.4	952.5	**46**	293.5	914.3	**82**	325.4	889.9	**125**	352.9	867.8
12	243.7	949.6	**48**	295.6	912.7	**84**	326.9	888.8	**127**	354.0	866.9
14	247.8	946.8	**50**	297.7	911.2	**86**	328.4	887.6	**130**	355.7	865.5
16	251.6	944.2	**52**	299.7	909.7	**88**	329.8	886.5	**133**	357.3	864.1
18	255.3	941.7	**54**	301.7	908.2	**90**	331.2	885.4	**136**	358.9	862.9
20	258.8	939.3	**56**	303.6	906.7	**92**	332.5	884.3	**139**	360.4	861.5
22	262.1	936.9	**58**	305.5	905.3	**94**	333.9	883.2	**142**	362.0	860.3
24	265.3	934.7	**60**	307.3	903.9	**96**	335.2	882.1	**145**	363.5	859.0
26	268.3	932.5	**62**	309.1	902.5	**98**	336.6	881.1	**150**	365.9	856.9
28	271.3	930.5	**64**	310.9	901.2	**100**	337.9	880.0	**175**	377.4	846.8
30	274.1	928.5	**66**	312.6	899.9	**103**	339.8	878.5	**200**	387.9	837.2
32	276.8	926.6	**68**	314.4	898.6	**106**	341.7	876.9	**225**	397.3	828.5
-	-	-	-	-	-	-	-	-	**250**	406.1	820.0

Applicable formula (examples on page 15):

Condensate rate = Btu$_A$ ÷ Latent Heat of Steam

Where:
Btu$_A$ = Capacity at actual operating conditions

MODINE INDOOR AIR SOLUTIONS

Steam Performance Data - Standard Models

Table 13.1
Performance Data for Standard Units at Standard Conditions of 2 lb. Steam and 60°F Entering Air
High Motor Speed

Type	Model No.	Btu/hr	Sq. Ft. EDR	Air Data								Motor Data	
				Sound Class ④	Maximum Mounting Height (ft.) ①		Heat Throw or Spread @ Max. Height ①		Cfm ②	Outlet Velocity (Fpm)	Final Air Temp. (°F)	Condensate lb/hr	Hp	Approx. RPM
Horizontal Delivery	**HSB/HC-18**	18,000	75	II	8		17		340	625	107	19	1/60	1550
	HSB/HC-24	24,000	100	II	9		18		370	695	119	25	1/25	1550
	HSB/HC-33	33,000	138	II	10		21		630	690	108	34	1/25	1550
	HSB/HC-47	47,000	196	III	12		28		730	810	119	49	1/12	1550
	HSB/HC-63	63,000	263	III	14		29		1120	690	111	65	1/12	1550
	HSB/HC-86	86,000	358	III	15		31		1340	835	118	89	1/8	1625
	HSB/HC-108	108,000	450	III	17		31		2010	790	109	112	1/8	1625
	HSB/HC-121	121,000	504	III	16		25		1775	715	122	125	1/5	1075
	HSB/HC-165	165,000	688	IV	19		40		3240	880	106	171	1/3	1075
	HSB/HC-193	193,000	804	IV	18		38		2900	810	121	200	1/3	1075
	HSB/HC-258	258,000	1075	V	19		44		4560	750	111	267	1/2	1075
	HSB/HC-290	290,000	1208	V	20		46		4590	765	117	300	1/2	1075
	HSB/HC-340	340,000	1417	V	20		46		5130	735	120	352	1/2	1075
Power-Throw™ ③	**PT/PTN-279**	279,000	1163	V	16		100		5460	2165	111	289	1/2	1075
	PT/PTN-333	333,000	1388	VI	17		110		5980	2165	116	345	3/4	1140
	PT/PTN-385	385,000	1604	VI	17		115		7680	1860	110	398	1	1140
	PT/PTN-500	500,000	2083	VI	18		130		10,390	2520	108	517	1-1/2	1140
	PT/PTN-610	610,000	2542	VI	20		140		11,750	2315	112	631	1-1/2	1140
	PT-952	952,000	3967	VI	21		145		12,170	2321	139	985	2	1140
Vertical Delivery ③	**V/VN-42**	42,000	175	II	11	**15**	17	**11**	950	825	103	43	1/30	1050
	V/VN-59	59,000	246	II	14	**19**	21	**14**	1155	1005	111	61	1/30	1050
	V/VN-78	78,000	325	II	15	**20**	23	**15**	1590	1065	109	81	1/15	1050
	V/VN-95	95,000	396	II	15	**20**	23	**15**	1665	1120	118	98	1/15	1050
	V/VN-139	139,000	579	III	18	**24**	27	**18**	2660	1285	112	144	1/5	1075
	V/VN-161	161,000	671	IV	20	**27**	30	**20**	2945	1420	115	167	1/3	1075
	V/VN-193	193,000	804	IV	22	**30**	33	**22**	3500	1690	116	200	1/3	1075
	V/VN-212	212,000	883	IV	22	**30**	33	**22**	3610	1740	120	219	1/3	1075
	V/VN-247	247,000	1029	V	26	**34**	39	**26**	4820	1910	111	256	1/2	1075
	V/VN-279	279,000	1163	V	30	**37**	45	**30**	5460	2165	111	289	1/2	1075
	V/VN-333	333,000	1388	V	30	**37**	45	**30**	5980	2165	116	345	3/4	1140
	V/VN-385	385,000	1604	VI	30	**36**	45	**30**	7680	1860	110	398	1	1140
	V/VN-500	500,000	2083	VI	37	**44**	56	**37**	10,390	2520	108	517	1-1/2	1140
	V/VN-610	610,000	2542	VI	36	**43**	54	**36**	11,750	2315	112	631	1-1/2	1140
	V-952	952,000	3967	VI	37	**45**	56	**56**	12,170	2321	139	985	2	1140

Table 13.2
Performance Data for Standard Units at Standard Conditions of 2 lb. Steam and 60°F Entering Air
Reduced Motor Speed ⑤

Type	Model No.	Btu/hr	Sq. Ft. EDR	Air Data						Motor Data	
				Sound Class ④	Maximum Mounting Height (ft.) ①	Heat Throw @ Max. Height ①	Cfm ②	Outlet Velocity (Fpm)	Final Air Temp. (°F)	Condensate lb/hr	Hp	Approx. RPM
Horizontal Delivery	**HSB/HC-18**	14,000	58	I	8	10	220	415	118	14	1/60	1000
	HSB/HC-24	18,000	75	I	9	11	230	440	131	19	1/25	1000
	HSB/HC-33	25,000	104	I	10	13	395	440	118	26	1/25	1000
	HSB/HC-47	38,000	158	II	12	17	450	515	137	39	1/12	1000
	HSB/HC-63	47,000	196	II	14	17	685	430	122	49	1/12	1000
	HSB/HC-86	64,000	267	II	15	19	825	525	131	66	1/8	1000
	HSB/HC-108	81,000	338	II	17	19	1255	500	119	84	1/8	1000

① Horizontal units with horizontal louvers open 30° from vertical plane. Vertical types equipped with cone jet deflector, blades fully opened are shown in bold. Please see page 22 for additional outlet accessory performance data.
② Cfm for horizontal types is entering Cfm. Cfm for vertical and Power-Throw™ types is leaving Cfm.
③ V and PT models have copper tubes, VN and PTN models have 90/10 cupro-nickel tubes.
④ See page 8 for Sound Class definitions.
⑤ Requires Solid State Motor Speed Controller.

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Steam Performance Data - Low Outlet Temperature Models

Table 14.1
Performance Data for Low Outlet Temperature Units at Standard Conditions of 2 lb. Steam and 60°F Entering Air High Motor Speed

Type	Model No.	Btu/hr	Sq. Ft. EDR	Air Data								Motor Data	
				Sound Class ④	Maximum Mounting Height (ft.) ①		Heat Throw or Spread @ Max. Height ①		Cfm ②	Outlet Velocity (Fpm)	Final Air Temp. (°F)	Condensate lb/hr	Hp	Approx. RPM
Horizontal Delivery ③	**HSB/HC-18L**	15,900	66	II	9		20		364	655	100	16	1/60	1550
	HSB/HC-24L	19,300	80	II	11		21		435	795	100	20	1/25	1550
	HSB/HC-33L	29,500	123	II	12		24		695	745	99	31	1/25	1550
	HSB/HC-47L	32,000	133	III	14		32		855	910	94	33	1/12	1550
	HSB/HC-63L	52,500	219	III	16		33		1170	710	101	54	1/12	1550
	HSB/HC-86L	61,500	256	III	17		36		1510	910	97	64	1/8	1625
	HSB/HC-108L	86,500	360	III	19		36		2150	825	97	90	1/8	1625
	HSB/HC-121L	88,000	367	III	18		29		2070	800	98	91	1/5	1075
	HSB/HC-165L	143,000	596	IV	21		45		3480	930	97	148	1/3	1075
	HSB/HC-258L	190,000	792	V	22		51		4655	750	98	197	1/2	1075
	HSB/HC-290L	207,000	863	V	23		53		5040	805	94	214	1/2	1075
	HSB/HC-340L	255,000	1063	V	23		53		5575	775	102	264	1/2	1075
Power-Throw™ ③	**PT/PTN-610L**	470,000	1958	VI	22		154		12,400	2445	97	486	1-1/2	1140
Vertical Delivery ③	**V/VN-42L**	33,000	138	II	13	**17**	20	**13**	960	835	94	34	1/30	1050
	V/VN-59L	44,000	183	II	16	**22**	24	**16**	1190	1035	96	45	1/30	1050
	V/VN-78L	62,000	258	II	19	**26**	29	**19**	1740	1070	95	65	1/15	1050
	V/VN-95L	71,000	296	II	19	**26**	29	**19**	1760	1180	99	73	1/15	1050
	V/VN-139L	103,000	429	III	23	**31**	35	**23**	2860	1380	95	106	1/6	1075
	V/VN-161L	127,000	529	IV	26	**35**	39	**26**	3400	1640	96	132	1/3	1075
	V/VN-193L	149,000	621	IV	27	**36**	41	**27**	3710	1790	99	154	1/3	1075
	V/VN-212L	163,000	679	IV	27	**36**	41	**27**	3830	1845	102	169	1/3	1075
	V/VN-247L	190,000	792	V	32	**42**	48	**32**	5110	2030	96	197	1/2	1075
	V/VN-279L	215,000	896	V	36	**45**	54	**36**	5790	2300	96	222	1/2	1075
	V/VN-333L	256,000	1067	V	36	**45**	54	**36**	6340	2300	100	265	3/4	1140
	V/VN-385L	296,000	1233	VI	36	**43**	54	**36**	8140	1970	95	307	1	1140
	V/VN-500L	385,000	1604	VI	45	**54**	68	**45**	11,000	2670	94	400	1-1/2	1140
	V/VN-610L	470,000	1958	VI	44	**52**	66	**44**	12,400	2445	97	485	1-1/2	1140
	V-952L	733,000	3054	VI	45	**61**	68	**68**	12,940	2450	115	759	2	1140

Table 14.2
Performance Data for Low Outlet Temperature Units at Standard Conditions of 2 lb. Steam and 60°F Entering Air Reduced Motor Speed ⑤

Type	Model No.	Btu/hr	Sq. Ft. EDR	Air Data						Motor Data	
				Sound Class ④	Maximum Mounting Height (ft.) ①	Heat Throw @ Max. Height ①	Cfm ②	Outlet Velocity (Fpm)	Final Air Temp. (°F)	Condensate lb/hr	Hp	Approx. RPM
Horizontal Delivery	**HSB/HC-18L**	12,000	50	I	9	12	230	425	108	12	1/60	1000
	HSB/HC-24L	14,400	60	I	11	13	265	490	109	15	1/25	1000
	HSB/HC-33L	22,000	92	I	12	14	430	470	107	23	1/25	1000
	HSB/HC-47L	24,300	101	II	14	19	540	580	101	25	1/12	1000
	HSB/HC-63L	39,500	165	II	16	20	725	445	109	41	1/12	1000
	HSB/HC-86L	46,000	192	II	17	22	925	565	105	48	1/8	1000
	HSB/HC-108L	65,000	271	II	19	22	1330	520	104	67	1/8	1000

① Horizontal units with horizontal louvers open 30° from vertical plane. Vertical types equipped with cone jet deflector, blades fully opened are shown in bold. Please see page 22 for additional outlet accessory performance data.
② Cfm for horizontal types is entering Cfm. Cfm for vertical and Power-Throw™ types is leaving Cfm.
③ V and PT models have copper tubes, VN and PTN models have 90/10 cupro-nickel tubes.
④ See page 8 for Sound Class definitions.
⑤ Requires Solid State Motor Speed Controller.

Steam Conversion Tables - Example Calculations

Conversion factor example #1:

For an HSB340S operating at 30 lb. steam and 50°F entering air temperature, determine the following:
- Capacity (Btu/hr)
- Final air temperature (°F)
- Condensate (lb./hr)
- Maximum mounting height

Solution:

The factors/data necessary to solve this problem are as follows:
- Steam heating capacity conversion factor for 30 lb. steam and 50°F entering air is 1.43, from Table 10.1.
- Air temperature rise conversion factor is 1.40, from Table 11.1.
- The latent heat of steam at 30 lb. is 928.5 Btu/lb., from Table 12.2.
- The mounting height correction factor is 0.86, from Table 12.1.
- The standard rated capacity of an HSB340 is 340,000 Btu/hr, from Table 13.1.
- The final air temperature of an HSB340 at standard conditions is 120°F, from Table 13.1.
- The maximum mounting height at standard conditions is 20 feet, from Table 13.1.

$Btu_A = Btu_S$ x Heating Capacity Factor = 340,000 x 1.43 = 486,200 Btu/hr

$ATR_A = (FAT_S - EAT_S)$ x Air Temp Rise Factor = (120°F - 60°F) x 1.40 = 84°F
$FAT_A = EAT_A + ATR_A$ = 50°F + 84°F = 134°F

Condensate rate = Btu_A ÷ Latent Heat of Steam = 486,200 ÷ 928.5 = 523.6 lb./hr

Max. Mounting $Height_A$ = Max. Mounting $Height_S$ x Correction Factor = 20 feet x 0.86 = 17.2 feet

Conversion factor example #2:

Which vertical unit heater model is required to deliver 155,500 Btu/hr at 20 lb. steam and 60°F entering air temperature. What will be the actual capacity and rate of condensate production for the selected unit?

Solution:

The factors/data necessary to solve this problem are as follows:
- Steam heating capacity conversion factor for 20 lb. steam and 60°F entering air is 1.23, from Table 10.1.
- The latent heat of steam at 20 lb. is 939.3 Btu/lb. from Table 12.2.

$Btu_S = Btu_A$ ÷ Heating Capacity Factor = 155,500 ÷ 1.23 = 126,423 Btu/hr (at standard conditions)
From Table 13.1, a V-139 model meets the requirement with a rated capacity of 139,000 Btu/hr at standard conditions.

The capacity of the V-139 at actual conditions will be $Btu_A = Btu_S$ x Heating Capacity Factor =
139,000 x 1.23 = 170,970 Btu/hr.

Condensate rate = Btu_A ÷ Latent Heat of Steam = 170,970 ÷ 939.3 = 182.0 lb./hr.

Alternate Solution:

Low Outlet Temperature models are normally recommended for steam pressures above 30 lb. However, the use of these models with steam pressure less than 30 lb. is acceptable.

Based on the example above, a V-161L model, from Table 14.1, meets the requirement with a rated capacity of 127,000 Btu/hr at standard conditions.

The capacity of the V-161L at actual conditions will be $Btu_A = Btu_S$ x Heating Capacity Factor =
127,000 x 1.23 = 156,210 Btu/hr.

Condensate rate = Btu_A ÷ Latent Heat of Steam = 156,210 ÷ 939.3 = 166.3 lb./hr.

Hot Water Conversion Tables

Table 16.1 and the formulas below are used to determine the heating capacity (Btu/hr) of a unit heater at a water temperature and/or entering air temperature other than standard conditions of 200° entering water temperature, 60° entering air temperature.

Table 16.1
Hot Water Heating Capacity Conversion Factors

Entering Water	Entering Air Temperature (°F)										
Temp. (°F)	0	10	20	30	40	50	60	70	80	90	100
60	0.462	0.380	0.300	0.222	0.146	0.072	0	0	0	0	0
70	0.539	0.456	0.375	0.296	0.219	0.145	0.071	0	0	0	0
80	0.615	0.531	0.450	0.370	0.293	0.217	0.143	0.071	0	0	0
90	0.692	0.607	0.524	0.444	0.366	0.289	0.214	0.141	0.070	0	0
100	0.769	0.683	0.599	0.518	0.439	0.361	0.286	0.212	0.140	0.069	0
110	0.846	0.759	0.674	0.592	0.512	0.434	0.357	0.283	0.210	0.138	0.068
120	0.923	0.835	0.749	0.666	0.585	0.506	0.429	0.353	0.279	0.207	0.137
130	1.000	0.911	0.824	0.740	0.658	0.578	0.500	0.424	0.349	0.276	0.205
140	1.077	0.987	0.899	0.814	0.731	0.651	0.571	0.494	0.419	0.345	0.273
150	1.154	1.063	0.974	0.888	0.805	0.723	0.643	0.565	0.489	0.414	0.342
160	1.231	1.139	1.049	0.962	0.878	0.795	0.714	0.636	0.559	0.483	0.410
170	1.308	1.215	1.124	1.036	0.950	0.867	0.786	0.706	0.629	0.552	0.478
180	1.385	1.291	1.199	1.110	1.024	0.940	0.857	0.777	0.699	0.621	0.547
190	1.462	1.367	1.274	1.184	1.097	1.012	0.929	0.848	0.768	0.690	0.615
200	1.539	1.443	1.349	1.258	1.170	1.084	1.000	0.918	0.838	0.759	0.684
210	1.615	1.519	1.424	1.332	1.243	1.157	1.071	0.989	0.908	0.828	0.752
220	1.692	1.594	1.499	1.406	1.312	1.229	1.143	1.060	0.978	0.897	0.820
230	1.769	1.670	1.573	1.480	1.390	1.301	1.214	1.130	1.048	0.966	0.889
240	1.846	1.746	1.649	1.554	1.463	1.373	1.286	1.201	1.118	1.035	0.957
250	1.923	1.822	1.723	1.628	1.536	1.446	1.357	1.272	1.188	1.104	1.025
260	2.000	1.898	1.798	1.702	1.609	1.518	1.429	1.342	1.257	1.173	1.094
270	2.077	1.974	1.873	1.776	1.682	1.590	1.500	1.413	1.327	1.242	1.162
280	2.154	2.050	1.948	1.850	1.755	1.663	1.571	1.483	1.397	1.311	1.230
290	2.231	2.126	2.023	1.924	1.829	1.734	1.643	1.554	1.467	1.380	1.300
300	2.308	2.202	2.098	1.998	1.902	1.807	1.714	1.625	1.537	1.449	1.367
310	2.385	2.278	2.173	2.072	1.974	1.879	1.786	1.695	1.607	1.518	1.436
320	2.462	2.354	2.248	2.146	2.048	1.952	1.857	1.766	1.677	1.587	1.504
330	2.539	2.430	2.323	2.220	2.121	2.024	1.929	1.837	1.746	1.656	1.572
340	2.615	2.506	2.398	2.294	2194	2.096	2.000	1.907	1.816	1.725	1.641
350	2.962	2.581	2.473	2.368	2.267	2.168	2.071	1.978	1.886	1.794	1.709
360	2.769	2.657	2.548	2.442	2.340	2.241	2.143	2.049	1.956	1.863	1.778
370	2.846	2.733	2.622	2.516	2.413	2.313	2.214	2.119	2.026	1.932	1.846
380	2.923	2.809	2.697	2.590	2.486	2.385	2.286	2.190	2.096	2.001	1.914
390	3.000	2.885	2.772	2.664	2.560	2.458	2.357	2.261	2.165	2.070	1.983
400	3.077	2.961	2.847	2.738	2.633	2.530	2.429	2.331	2.235	2.139	2.051

Applicable formulas (examples on page 21):
To find actual unit heater capacity when operated at non-standard (actual) conditions:

$Btu_A = Btu_S$ x Heating Capacity Factor

To select a heater capacity based on standard conditions to meet a heating capacity at non-standard (actual) conditions:

$Btu_S = Btu_A \div$ Heating Capacity Factor

Where:

Btu_S = Capacity at standard conditions (200°F entering water temperature, 60°F entering air temperature) from Tables 19.1 through 20.2

Btu_A = Capacity at non-standard (actual) conditions

Hot Water Conversion Tables

Table 17.1 - Minimum Water Flow and Water Volume (gallons) ①

Type	Model	Min. GPM	Max. GPM	Coil Volume (gals)	Type	Model	Min. GPM	Max. GPM	Coil Volume (gals)	Type	Model	Min. GPM	Max. GPM	Coil Volume (gals)
HORIZONTAL DELIVERY **HSB/HC**	18	0.25	5	0.13	POWER-THROW™ **PT/PTN**	279	4.5	60	0.97	VERTICAL DELIVERY **V/VN**	42	0.5	10	0.15
	24	0.25	5	0.13		333	4.5	100	1.24		59	0.75	15	0.23
	33	0.40	10	0.41		385	4.5	100	1.24		78	1	20	0.31
	47	0.40	10	0.41		500	6	100	1.66		95	1.25	25	0.38
	63	0.50	20	0.66		610	6	100	1.98		139	1	30	0.43
	86	0.50	20	0.66		952	14	200	6.50		139	1.25	40	0.54
	108	0.50	30	0.98							193	1.5	50	0.65
	121	0.50	30	0.98							212	2	60	0.86
	165	2.00	30	1.35							279	2.25	75	0.97
	193	2.00	50	1.45							333	2.25	75	1.24
	258	2.50	70	2.20							385	2.25	75	1.24
	290	2.50	70	2.20							500	3	100	1.66
	340	2.50	70	2.50							610	6	100	1.98
											952	14	200	6.50

① Water flow and water volume is the same for standard coils and low-outlet temperature coils

Table 17.2 - Ethylene Glycol Correction Factors ②

Table 17.2 is used to determine how glycol solutions affect heater capacity. These factors should be applied to the heater capacity at actual entering water and air temperature conditions.

Solution Temperature (°F)	Ethylene Glycol Solution %						
	20%	30%	40%	50%	60%	70%	80%
60	0.99	0.96	0.93	0.89	0.85	0.81	0.76
100	0.99	0.96	0.93	0.89	0.85	0.81	0.76
150	0.99	0.96	0.94	0.90	0.87	0.83	0.78
200	0.99	0.96	0.94	0.92	0.88	0.85	0.81
250	0.98	0.96	0.94	0.92	0.89	0.86	0.82
300	0.98	0.95	0.95	0.92	0.90	0.87	0.83
350	0.98	0.95	0.95	0.93	0.91	0.88	0.84
400	0.97	0.95	0.95	0.93	0.92	0.89	0.85

② For Propylene Glycol solution correction factor, multiply Ethylene Glycol correction factor by 0.95.

Applicable formulas (examples on page 21):

To find actual unit heater capacity when operated with glycol solution:

Btu_{AG} = Btu_S (or Btu_A) x Glycol Correction Factor

To select a heater capacity based on standard conditions to meet a heating capacity with a glycol solution:

Btu_S (or Btu_A) = Btu_{AG} ÷ Glycol Correction Factor

Where:

Btu_S = Capacity at standard conditions (200°F entering water temperature, 60°F entering air temperature) from Tables 19.1 through 20.2
Btu_A = Capacity at non-standard (actual) conditions
Btu_{AG} = Capacity with glycol solution

Table 17.3 - Hot Water Unit Heater Mounting Height Correction Factors ③

Table 17.3 is used to determine how hot water temperatures other than 200°F affect mounting height.

Entering Water Temperature, °F	Correction Factor	Entering Water Temperature, °F	Correction Factor	Entering Water Temperature, °F	Correction Factor
140	1.33	**230**	0.91	**320**	0.74
150	1.25	**240**	0.89	**330**	0.72
160	1.19	**250**	0.86	**340**	0.71
170	1.13	**260**	0.84	**350**	0.70
180	1.08	**270**	0.82	**360**	0.69
190	1.04	**280**	0.80	**370**	0.67
200	1.00	**290**	0.78	**380**	0.66
210	0.97	**300**	0.77	**390**	0.65
220	0.94	**310**	0.75	**400**	0.64

③ Factors are for use with entering air temperatures that range from 50° to 70°F

Applicable formula (examples on page 21):

Max. Mounting $Height_A$ = Max. Mounting $Height_S$ x Correction Factor

Where:

Max. Mounting $Height_A$ = Maximum mounting height at actual conditions
Max. Mounting $Height_S$ = Maximum mounting height at standard conditions

Hot Water Conversion Tables - Miscellaneous Formulas

Table 18.1 is used to determine how water temperature drop affects heater capacity in Btu, water flow rate in GPM and pressure drop in feet of water. These factors should be applied to the values at actual entering water and air temperature conditions.

Table 18.1
Correction Factors for Varying Water Temperature Drop ①

	Water Temperature Drop, °F											
	5	10	15	20	25	30	35	40	45	50	55	60
Btu Correction Factor	1.23	1.13	1.06	1.00	0.95	0.90	0.86	0.82	0.78	0.72	0.69	0.67
GPM Correction Factor	4.64	2.21	1.40	1.00	0.76	0.61	0.50	0.42	0.36	0.30	0.26	0.23
WPD Correction Factor	17.24	4.32	1.85	1.00	0.61	0.41	0.30	0.22	0.18	0.14	0.12	0.11

① Water temperature drop correction factors valid only for standard 200°F entering water and 60°F air temperature conditions.

Applicable formulas (examples on page 21):

To find actual unit heater capacity or flow rate or water pressure drop when operated at non-standard (actual) conditions:

$Btu_A = Btu_S$ x Btu Correction Factor

$GPM_A = GPM_S$ x GPM Correction Factor

$WPD_A = WPD_S$ x WPD Correction Factor

To select a heater capacity based on standard conditions to meet a heating capacity at non-standard (actual) conditions:

$Btu_S = Btu_A \div$ Btu Correction Factor

Where:
- Btu_S = Capacity at standard conditions (200°F entering water temperature, 60°F entering air temperature) from Tables 19.1 through 20.2
- Btu_A = Capacity at non-standard (actual) conditions
- GPM_S = Flow rate at standard conditions (200°F entering water temperature, 60°F entering air temperature) from Tables 19.1 through 20.2
- GPM_A = Flow rate at non-standard (actual) conditions
- WPD_S = Water pressure drop at standard conditions (200°F entering water temperature, 60°F entering air temperature) from Tables 19.1 through 20.2
- WPD_A = Water pressure drop at non-standard (actual) conditions

Other miscellaneous useful formulas:

$FAT_A = EAT_A + [(460 + EAT_A) \times (Btu_A) \div (573 \times Cfm_S)]$ **for HSB and HC units only**

$FAT_A = EAT_A + [(460 + EAT_A) \div ((573 \times Cfm_S \div Btu_A) - 1)]$ **for V/VN and PT/PTN units only**

$WTD_A = Btu_A \div (480 \times GPM_A)$

Where:
- EAT_A = Entering air temperature at actual conditions
- FAT_A = Final air temperature at actual conditions
- Btu_A = Capacity at actual conditions
- Cfm_S = Unit airflow as found in Tables 19.1 through 20.2
- GPM_A = Water flow rate at actual conditions in GPM
- WTD_A = Water temperature drop at actual conditions

MODINE INDOOR AIR SOLUTIONS

Hot Water Performance Data - Standard Models

Table 19.1
Performance Data for Standard Units at Standard Conditions of 200°F Entering Water and 60°F Entering Air
High Motor Speed

			Water Data			Air Data						Motor Data	
Type	Model No.	Btu/hr.	GPM	Pressure Drop (Ft. of Water)	Min/Max GPM	Sound Class ④	Maximum Mounting Height (ft.) ①	Heat Throw or Spread @ Max. Height ①	Cfm ②	Outlet Velocity (Fpm)	Final Air Temp. (°F)	Hp	Approx. RPM
Horizontal Delivery	HSB/HC-18	12,600	1.3	0.5	0.25 / 5.0	II	9	18	340	615	93	1/60	1550
	HSB/HC-24	16,200	1.7	0.8	0.25 / 5.0	II	10	19	370	675	100	1/25	1550
	HSB/HC-33	21,700	2.3	0.2	0.4 / 10.0	II	11	22	630	675	91	1/25	1550
	HSB/HC-47	30,900	3.2	0.4	0.4 / 10.0	III	13	30	730	785	98	1/12	1550
	HSB/HC-63	45,600	4.7	0.6	0.5 / 20.0	III	15	31	1120	680	97	1/12	1550
	HSB/HC-86	60,200	6.3	1.0	0.5 / 20.0	III	16	33	1340	820	101	1/8	1625
	HSB/HC-108	83,700	8.7	2.8	0.5 / 30.0	III	18	33	2010	775	98	1/8	1625
	HSB/HC-121	93,000	9.7	3.3	0.7 / 30.0	III	17	27	1775	700	107	1/5	1075
	HSB/HC-165	130,900	13.6	8.6	2.0 / 30.0	IV	20	43	3240	870	96	1/3	1075
	HSB/HC-193	143,000	14.9	1.4	2.0 / 50.0	IV	19	40	2900	790	105	1/3	1075
	HSB/HC-258	201,900	21.0	5.7	2.5 / 70.0	V	20	47	4560	740	100	1/2	1075
	HSB/HC-290	228,600	23.8	7.1	2.5 / 70.0	V	21	49	4590	750	105	1/2	1075
	HSB/HC-340	271,100	28.2	11.3	2.5 / 70.0	V	21	49	5130	720	108	1/2	1075
Power-Throw™ ③	PT/PTN-279	192,300	20.0	0.2	4.5 / 60.0	V	17	106	5460	2165	94	1/2	1075
	PT/PTN-333	238,500	24.8	0.4	4.5 / 100.0	VI	18	117	5980	2165	99	3/4	1140
	PT/PTN-385	276,100	28.8	0.6	4.5 / 100.0	VI	18	122	7680	1860	95	1	1140
	PT/PTN-500	358,000	37.3	0.5	6.0 / 100.0	VI	19	138	10,390	2520	93	1-1/2	1140
	PT/PTN-610	450,400	46.9	1.0	6.0 / 100.0	VI	21	149	11,750	2315	97	1-1/2	1140
	PT-952	721,600	75.2	1.1	14.0 / 200.0	VI	22	154	12,166	2321	120	2	1140
Vertical Delivery ③	V/VN-42	30,100	3.1	0.6	0.5 / 10.0	II	12 **16**	18 **12**	950	825	90	1/30	1050
	V/VN-59	42,600	4.4	0.5	0.75 / 15.0	II	15 **20**	22 **15**	1155	1005	96	1/30	1050
	V/VN-78	57,000	5.9	0.5	1.0 / 20.0	II	16 **22**	24 **16**	1590	1065	95	1/15	1050
	V/VN-95	69,300	7.2	0.5	1.25 / 25.0	II	16 **22**	24 **16**	1665	1120	101	1/15	1050
	V/VN-139	106,600	11.1	2.6	1.0 / 30.0	III	19 **26**	29 **19**	2660	1285	99	1/5	1075
	V/VN-161	123,200	12.8	2.2	1.25 / 40.0	IV	21 **29**	32 **22**	2945	1420	101	1/3	1075
	V/VN-193	147,200	15.3	2.2	1.5 / 50.0	IV	23 **32**	35 **24**	3500	1690	101	1/3	1075
	V/VN-212	161,700	16.8	1.5	2.0 / 60.0	IV	23 **32**	35 **24**	3610	1740	104	1/3	1075
	V/VN-247	188,700	19.7	2.1	2.0 / 60.0	V	28 **37**	41 **28**	4820	1910	98	1/2	1075
	V/VN-279	212,600	22.2	2.1	2.25 / 75.0	V	32 **40**	48 **32**	5460	2165	98	1/2	1075
	V/VN-333	260,100	27.1	3.8	2.25 / 75.0	V	32 **40**	48 **32**	5980	2165	102	3/4	1140
	V/VN-385	302,100	31.5	5.0	2.25 / 75.0	VI	32 **39**	48 **32**	7680	1860	98	1	1140
	V/VN-500	391,700	40.8	4.8	3.0 / 100.0	VI	39 **47**	60 **40**	10,390	2520	96	1-1/2	1140
	V/VN-610	450,400	46.9	1.0	6.0 / 100.0	VI	38 **46**	57 **39**	11,750	2315	97	1-1/2	1140
	V-952	721,600	75.2	1.1	14.0 / 200.0	VI	39 **63**	60 **70**	12,166	2321	120	2	1140

Table 19.2
Performance Data for Standard Units at Standard Conditions of 200°F Entering Water and 60°F Entering Air
Reduced Motor Speeds ⑤

			Water Data		Air Data						Motor Data	
Type	Model No.	Btu/hr.	GPM	Pressure Drop (Ft. of Water)	Sound Class ④	Maximum Mounting Height (ft.) ①	Heat Throw @ Max. Height ①	Cfm ②	Outlet Velocity (Fpm)	Final Air Temp. (°F)	Hp	Approx. RPM
Horizontal Delivery	HSB/HC-18	9900	1.3	0.5	I	9	11	220	400	101	1/60	1000
	HSB/HC-24	12,400	1.7	0.8	I	10	12	230	425	109	1/25	1000
	HSB/HC-33	16,700	2.3	0.2	I	11	14	395	430	98	1/25	1000
	HSB/HC-47	23,600	3.2	0.4	II	13	18	450	490	107	1/12	1000
	HSB/HC-63	34,600	4.7	0.6	II	15	18	685	420	106	1/12	1000
	HSB/HC-86	45,900	6.3	1.0	II	16	20	825	515	110	1/8	1000
	HSB/HC-108	64,300	8.7	2.8	II	18	20	1255	490	106	1/8	1000

① Horizontal units with horizontal louvers open 30° from vertical plane. Vertical types equipped with cone jet deflector, blades fully opened are shown in bold. Non-bolded mounting height/spread data is for units without deflectors. Please see page 22 for additional outlet accessory performance data.
② Cfm for horizontal types is entering Cfm. Cfm for vertical and Power-Throw™ types is leaving Cfm.
③ V and PT models have copper tubes, VN and PTN models have 90/10 cupro-nickel tubes.
④ See page 8 for Sound Class definitions.
⑤ Requires Solid State Motor Speed Controller.

MODINE INDOOR AIR SOLUTIONS

Hot Water Performance Data - Low Outlet Temperature Models

Table 20.1

Performance Data for Low Outlet Temperature Units at Standard Conditions of 200°F Entering Water and 60°F Entering Air – High Motor Speed

			Water Data			Air Data							Motor Data	
Type	Model No.	Btu/hr.	GPM	Pressure Drop (Ft. of Water)	Min/Max GPM	Sound Class ④	Maximum Mounting Height (ft.) ①		Heat Throw or Spread @ Max. Height ①		Cfm ②	Outlet Velocity (Fpm)	Final Air Temp. (°F)	Hp	Approx. RPM
Horizontal Delivery	HSB/HC-18L	11,300	1.2	0.4	0.25 / 5.0	II	10		21		364	650	88	1/60	1550
	HSB/HC-24L	13,700	1.4	0.6	0.25 / 5.0	II	12		22		435	775	88	1/25	1550
	HSB/HC-33L	19,300	2.0	0.2	0.4 / 10.0	II	13		26		695	730	85	1/25	1550
	HSB/HC-47L	21,100	2.2	0.2	0.4 / 10.0	III	15		34		855	890	82	1/12	1550
	HSB/HC-63L	37,900	4.0	0.4	0.5 / 20.0	III	17		35		1170	695	89	1/12	1550
	HSB/HC-86L	44,600	4.6	0.6	0.5 / 20.0	III	18		38		1510	890	87	1/8	1625
	HSB/HC-108L	66,100	6.9	1.8	0.8 / 30.0	III	20		38		2150	815	88	1/8	1625
	HSB/HC-121L	66,700	6.9	1.9	0.8 / 30.0	III	19		31		2070	785	89	1/5	1075
	HSB/HC-165L	113,200	11.8	6.6	2.0 / 30.0	IV	22		48		3480	920	89	1/3	1075
	HSB/HC-258L	147,400	15.4	3.2	2.5 / 70.0	V	23		54		4655	735	89	1/2	1075
	HSB/HC-290L	161,100	16.8	3.7	2.5 / 70.0	V	24		56		5040	800	89	1/2	1075
	HSB/HC-340L	200,900	20.9	6.6	2.5 / 70.0	V	24		56		5575	760	93	1/2	1075
Power-Throw™ ③	PT/PTN-610L	344,900	35.9	0.6	6.0 / 100.0	VI	23		164		12,400	2445	86	1-1/2	1140
Vertical Delivery ③	V/VN-42L	23,000	2.4	0.4	0.5 / 10.0	II	14	**18**	21	**14**	960	835	83	1/30	1050
	V/VN-59L	32,600	3.4	0.3	0.75 / 15.0	II	17	**23**	26	**17**	1190	1035	86	1/30	1050
	V/VN-78L	43,600	4.5	0.3	1.0 / 20.0	II	20	**28**	31	**21**	1740	1170	84	1/15	1050
	V/VN-95L	53,100	5.5	0.3	1.25 / 25.0	II	20	**28**	31	**21**	1760	1180	89	1/15	1050
	V/VN-139L	81,200	8.5	1.6	1.0 / 30.0	III	24	**33**	37	**25**	2860	1380	87	1/5	1075
	V/VN-161L	93,900	9.8	1.3	1.25 / 40.0	IV	28	**37**	41	**28**	3400	1640	86	1/3	1075
	V/VN-193L	112,500	11.7	1.3	1.5 / 50.0	IV	29	**38**	44	**29**	3710	1790	89	1/3	1075
	V/VN-212L	123,400	12.9	0.9	2.0 / 60.0	IV	29	**38**	44	**29**	3,830	1845	91	1/3	1075
	V/VN-247L	143,600	15.0	1.2	2.0 / 60.0	V	34	**45**	51	**35**	5110	2030	87	1/2	1075
	V/VN-279L	162,200	16.9	1.2	2.25 / 75.0	V	38	**48**	57	**39**	5790	2300	87	1/2	1075
	V/VN-333L	198,300	20.7	2.3	2.25 / 75.0	V	38	**48**	57	**39**	6340	2300	90	3/4	1140
	V/VN-385L	229,100	23.9	3.0	2.25 / 75.0	VI	38	**46**	57	**49**	8140	1970	87	1	1140
	V/VN-500L	295,000	30.7	2.8	3.0 / 100.0	VI	48	**57**	72	**49**	11,000	2670	85	1-1/2	1140
	V/VN-610L	344,900	35.9	0.6	6.0 / 100.0	VI	47	**55**	70	**48**	12,400	2445	86	1-1/2	1140
	V-952L	546,700	56.9	0.7	14.0 / 100.0	VI	48	**61**	72	**68**	12,800	2440	102	2	1140

Table 20.2

Performance Data for Low Outlet Temperature Units at Standard Conditions of 200°F Entering Water and 60°F Entering Air – Reduced Motor Speeds ⑤

			Water Data		Air Data						Motor Data	
Type	Model No.	Btu/hr.	GPM	Pressure Drop (Ft. of Water)	Sound Class ④	Maximum Mounting Height (ft.) ①	Heat Throw @ Max. Height ①	Cfm ②	Outlet Velocity (Fpm)	Final Air Temp. (°F)	Hp	Approx. RPM
Horizontal Delivery	HSB/HC-18L	8700	1.2	0.4	I	10	13	230	410	94	1/60	1000
	HSB/HC-24L	10,400	1.4	0.6	I	12	14	265	475	95	1/25	1000
	HSB/HC-33L	14,700	2.0	0.2	I	13	15	430	455	91	1/25	1000
	HSB/HC-47L	16,300	2.2	0.2	II	15	20	540	570	87	1/12	1000
	HSB/HC-63L	29,000	4.0	0.4	II	17	21	725	435	96	1/12	1000
	HSB/HC-86L	33,900	4.6	0.6	II	18	23	925	550	93	1/8	1000
	HSB/HC-108L	50,500	6.9	1.8	II	20	23	1330	510	94	1/8	1000

① Horizontal units with horizontal louvers open 30° from vertical plane. Vertical types equipped with cone jet deflector, blades fully opened are shown in bold. Non-bolded mounting height/spread data is for units without deflectors. Please see page 22 for additional outlet accessory performance data.
② Cfm for horizontal types is entering Cfm. Cfm for vertical and Power-Throw™ types is leaving Cfm.
③ V and PT models have copper tubes, VN and PTN models have 90/10 cupro-nickel tubes.
④ See page 8 for Sound Class definitions.
⑤ Requires Solid State Motor Speed Controller.

Hot Water Conversion Tables - Example Calculations

Conversion factor example #1:

What is the capacity (Btu/hr), water flow rate (GPM), water temperature drop (°F) and final air temperature (°F) for an HSB 86 at 240°F entering water temperature (EWT) and 70°F entering air temperature (EAT)? What is the maximum mounting height?

Solution:

The factors/data necessary to solve this problem are as follows:
- Hot water heating capacity conversion factor for 240°F EWT and 70°F entering air is 1.201, from Table 16.1.
- The standard rated capacity of an HSB 86 is 60,200 Btu/hr, from Table 19.1.
- The standard rated capacity of an HSB 86 is based on water flow rate of 6.3 GPM, from Table 19.1.
- The standard high motor speed airflow of an HSB 86 is 1340 CFM, from Table 19.1.
- The maximum mounting height, at standard conditions for an HSB 86 is 16 feet, from Table 19.1.
- The mounting height correction factor for 240°F EWT is 0.89 from Table 17.2.

$Btu_A = Btu_S$ x Heating Capacity Factor = 60,200 x 1.201 = 72,300 Btu/hr

For water flow rate, since only the entering water and air temperature conditions have changed, the water flow rate will remain 6.3 GPM.

$WTD_A = Btu_A \div (480 \times G_A)$ = 72,300 Btu/hr ÷ (480 x 6.3 GPM) = 23.9°F

$FAT_A = EAT_A + [(460 + EAT_A) \times (Btu_A) \div (576 \times Cfm_S)]$ = 70°F + [(460 + 70°F) x (72,300) ÷ (576 x 1340)] = 120°F

Max. Mounting $Height_A$ = Max. Mounting $Height_S$ x Correction Factor = 16 ft. x 0.89 = 14.2 feet

Conversion factor example #2:

Select a vertical unit heater model that can deliver at least 150,000 Btu/hr with 160°F EWT and 60°F EAT. What will be the required water flow rate, water temperature drop, final air temperature and maximum mounting height?

Solution:

The factors/data necessary to solve this problem are as follows:
- Hot water heating capacity conversion factor for 160°F EWT and 60°F entering air is 0.714, from Table 16.1.
- The mounting height correction factor for 160°F EWT is 1.19, from Table 17.2.

$Btu_S = Btu_A \div$ Heating Capacity Factor = 150,000 ÷ 0.714 = 210,084 Btu/hr (at standard conditions)
From Table 19.1, a V-279 model will meet the requirement with a rated capacity of 212,600 Btu/hr at standard conditions.

The capacity of the V-279 at actual conditions will be $Btu_A = Btu_S$ x Heating Capacity Factor = 212,600 x 0.714 = 151,796 Btu/hr.

Since the capacity was calculated based off standard conditions with factors for changes in entering water and air temperature conditions, the water flow rate will remain 22.2 GPM.

$WTD_A = Btu_A \div (480 \times GPM_A)$ = 151,796 Btu/hr ÷ (480 x 22.2 GPM) = 14.2°F

$FAT_A = EAT_A + [(460 + EAT_A) \div ((576 \times Cfm_S \div Btu_A) - 1)]$ = 60°F + [(460 + 60°F) ÷ ((576 x 5,460 ÷ 151,796) - 1)] = 86.4°F

Max. Mounting $Height_A$ = Max. Mounting $Height_S$ x Correction Factor = 40 ft. (with cone-jet deflector) x 1.19 = 47.6 feet

Maximum Mounting Heights for Vertical Outlet Accessories, Dimensions

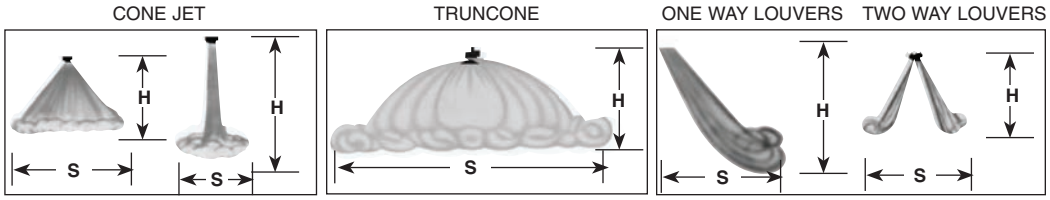


Table 22.1
Mounting Height/Spread for Vertical Unit Air Outlet Accessories ①②③④

	Cone-Jet				Truncone				One Way Louvers				Two Way Louvers			
	Standard		L.O.T.		Standard		L.O.T.		Standard		L.O.T.		Standard		L.O.T.	
Model	H	S	H	S	H	S	H	S	H	S	H	S	H	S	H	S
V/VN-42	15	11	17	13	8	19	9	23	13	11	15	13	8	22	9	26
V/VN-59	19	14	22	16	9	25	11	28	16	14	18	16	10	28	11	32
V/VN-78	20	15	26	19	11	26	14	33	17	15	22	19	11	30	13	38
V/VN-95	20	15	26	19	11	26	14	33	17	15	22	19	11	30	13	38
V/VN-139	24	18	31	23	13	32	17	40	21	18	26	23	13	36	16	46
V/VN-161	27	20	35	26	14	35	18	46	23	20	30	26	14	40	18	52
V/VN-193	30	22	36	27	16	39	19	47	25	22	31	27	15	44	19	54
V/VN-212	30	22	36	27	16	39	19	47	15	44	19	54	25	22	31	27
V/VN-247	34	26	42	32	17	46	21	56	18	52	22	64	30	26	37	32
V/VN-279	37	30	45	36	18	53	22	63	21	60	25	72	35	30	41	36
V/VN-333	37	30	45	36	17	53	20	63	21	60	25	72	35	30	41	3
V/VN-385	36	30	43	36	17	53	20	63	21	60	25	72	35	30	41	36
V/VN-500	44	37	54	45	19	65	24	79	26	74	31	90	42	37	51	45
V/VN-610	43	36	52	44	19	63	24	77	25	72	30	88	41	41	50	44
V-952	-	-	-	-	-	-	-	-	26	66	31	82	45	56	54	65

① Data shown for standard 2 lb. steam, 60°F entering air temperature conditions. For louvers or cone-jet, data shown for deflectors in fully-opened position. For mounting height/spread at steam pressures other than 2 lb., multiply the value by the correction factor in Table 11.1.
② For mounting height and spread for hot water, multiple the values above by 1.06 to approximate the mounting height and spread at 200°F entering water temperature. For entering water temperature other than 200°F, multiply the values above by 1.06 and than multiply the correction factor in Table 16.2
③ All dimensions in feet.
④ V models have copper tubes and VN models have 90/10 cupro-nickel tubes.

Figure 22.2 - Vertical Air Outlet Accessories

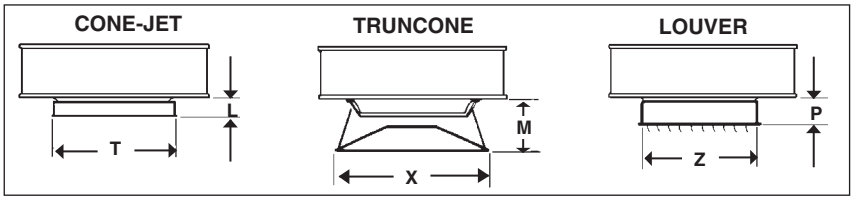


Table 22.2 - Vertical Air Outlet Accessories Dimensions ⑤

Model	Cone-Jet		Truncone		Louvers	
Number	L	T	M	X	P	Z
V-42, V-59	6-1/2	18-7/8	12	22	6-1/2	16-7/8
V-78, V-95	6-1/2	18-7/8	12	22	6-1/2	16-7/8
V-139, V-212	7-1/2	24-3/4	13	27	7-1/2	19-3/4
V-247, V-279	8	26-7/8	16	34	8	22-3/4
V-333	8-1/2	28	16	34	8-1/2	22-3/4
V-385, V-500	10	22-3/4	21	41	10	27-3/4
V-610	10-1/2	36-3/4	21	41	10-1/2	30-3/4
V-952	-	-	-	-	19-1/2	32

⑤ All dimensions in inches.

MODINE INDOOR AIR SOLUTIONS

Motor Data, Step-Down Transformer Accessory Data

Table 23.1 - Motor Data ①

Model Number	Motor HP ②	Motor Type, Voltage and Power Code							
		Totally Enclosed w/Thermal Overload ③						Explosion Proof w/ Thermal Overload	
		115/60/1	208/60/1	230/60/1	208/60/3	230/460/3	575/60/3	115/60/1	230/460/60/3
		01	N/A	02	04	05	10	06	09
		Amps	Amps	Amps	Amps	Amps	Amps	Amps	Amps
HSB/HC-18	1/60	0.8	④	0.44	④	④	④	3.1	-
HSB/HC-24	1/25	1.6	④	0.44	④	④	④	3.1	-
HSB/HC-33	1/25	1.6	④	1	④	④	④	3.1	-
HSB/HC-47	1/12	2.2	④	1	④	1.4/0.4 ⑤	④	3.1	-
HSB/HC-63	1/12	2.2	④	1	④	1.4/0.4 ⑤	④	3.1	-
HSB/HC-86	1/8	2.3	④	1	④	1.4/0.4 ⑤	④	3.1	-
HSB/HC-108	1/8	2.3	④	1	④	1.4/0.4 ⑤	④	3.1	-
HSB/HC-121	1/5	2.8	④	1.5	1.9 ⑤	2.1/1.05 ⑤	④	4.1	1.5/0.75
HSB/HC-165	1/3	5.4	④	2.23	1.9 ⑤	2.1/1.05 ⑤	④	6.1	1.5/0.75
HSB/HC-193	1/3	5.4	④	2.23	1.9 ⑤	2.1/1.05 ⑤	④	6.1	1.5/0.75
HSB/HC-258	1/2	7.5	④	3.5	2.6 ⑤	3.0/1.5 ⑤	④	5.8	2.0/1.0
HSB/HC-290	1/2	7.5	④	3.5	2.6 ⑤	3.0/1.5 ⑤	④	5.8	2.0/1.0
HSB/HC-340	1/2	7.5	④	3.5	2.6 ⑤	3.0/1.5 ⑤	④	5.8	2.0/1.0
V/VN-42	1/30	1.9	④	1.28	1.9 ⑤	2.1/1.05 ⑤	④	4.1	-
V/VN-59	1/30	1.9	④	1.28	1.9 ⑤	2.1/1.05 ⑤	④	4.1	-
V/VN-78	1/15	2.4	④	1.28	1.9 ⑤	2.1/1.05 ⑤	④	4.1	-
V/VN-95	1/15	2.4	④	1.28	1.9 ⑤	2.1/1.05 ⑤	④	4.1	-
V/VN-139	1/5	2.8	④	1.5	1.9 ⑤	2.1/1.05 ⑤	④	4.1	1.5/.75
V/VN-161	1/3	5.4	④	2.23	1.9 ⑤	2.1/1.05 ⑤	④	6.1	1.5/.75
V/VN-193	1/3	5.4	④	2.23	1.9 ⑤	2.1/1.05 ⑤	④	6.1	1.5/.75
V/VN-212	1/3	5.4	④	2.23	1.9 ⑤	2.1/1.05 ⑤	④	6.1	1.5/.75
V/VN-247	1/2	7.5	④	3.5	2.6 ⑤	3.0/1.5 ⑤	④	5.8	2.0/1.0
V/VN, PT/PTN-279	1/2	7.5	④	3.5	2.6 ⑤	3.0/1.5 ⑤	④	5.8	2.0/1.0
V/VN, PT/PTN-333	3/4	8.8	④	4.4	3.7 ⑤	3.5/1.8 ⑤	④	-	-
V/VN, PT/PTN-385	1	-	-	-	4	4.0/2.0	1.5	-	3.5/1.75
V/VN, PT/PTN-500	1-1/2	-	-	-	5.8	5.2/2.6	2	-	5.8/2.9
V/VN, PT/PTN-610	1-1/2	-	-	-	5.8	5.2/2.6	2	-	5.8/2.9
V, PT-952	2	-	-	-	-	6.8/3.4	-	-	6.2/3.1

① Ratings shown are for Standard and Low Outlet Temperature Models.

② AllHSB/HC units, V/VN-42 thru V/VN,PT/PTN-333 motor HP listed for power code 01. V/VN,PT/PTN333 thru V/VN,PT/PTN610 motor HP listed for power code 04 and V/PT-952 motor HP listed for power code 05.

③ For model sizes V/VN/PT/PTN385 and above, motors for Power Codes 04, 05, and 10 do not have thermal overload protection.

④ Forsupply voltages of 208V/60Hz/1ph and all non-explosion proof 3 phase voltages of 208, 230, 460 and 575, Model Numbers indicated with Note ④, require that a 115V/60Hz/1 phase Power Code 01 unit heater be used with a shipped loose accessory transformer. See Table 23.2 for Transformer Sizes.

⑤ For non-explosion proof 3 phase supply voltages of 208, 230, and 460, Model Numbers indicated with Note ⑤, can be ordered with a Power Code (208V/3ph=04, 230/460V/3ph=05) that provides a motor matched to the supply voltage with amp draw as shown. Alternately, a 115V/60Hz/1 phase Power Code 01 unit heater could be used with a shipped loose accessory transformer. See Table 23.2 for Transformer Sizes.

Figure 23.1
Field Installed Transformer Accessory

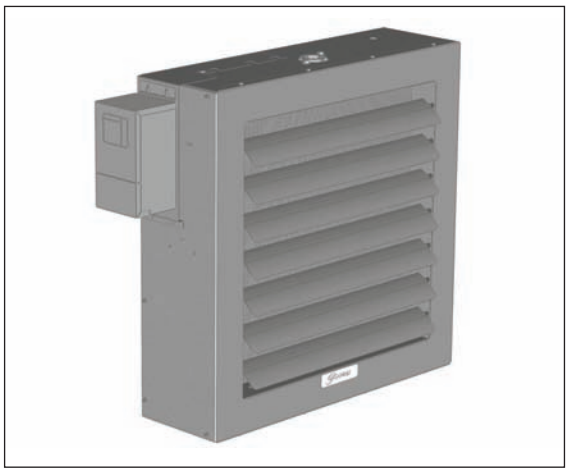


Table 23.2 - Step-Down Transformer Accessory Selection

	208V/60Hz/1 or 3 phase	230/460V/ 60Hz/3 phase	575V/60Hz/ 3 phase
Model Number	kVA	kVA	kVA
HSB/HC 18-63	0.50	0.25	0.25
HSB/HC 86-121		0.50	0.50
HSB/HC165-193	1.00	0.75	0.75
HSB/HC258-340		1.00	1.00
V/VN 42-59	0.50	0.25	0.25
V/VN 78-139		0.50	0.50
V/VN161-212	1.00	0.75	0.75
V/VN247-333		1.00	1.00
PT/PTN279-333	1.00	1.00	1.00

kVA Size	Ship Wt. (Lb.)
0.25	7
0.50	13
0.75	15
1.00	19

Dimensions - Horizontal Air Delivery Models

Figure 24.1 - Model Dimensions HSB18-193

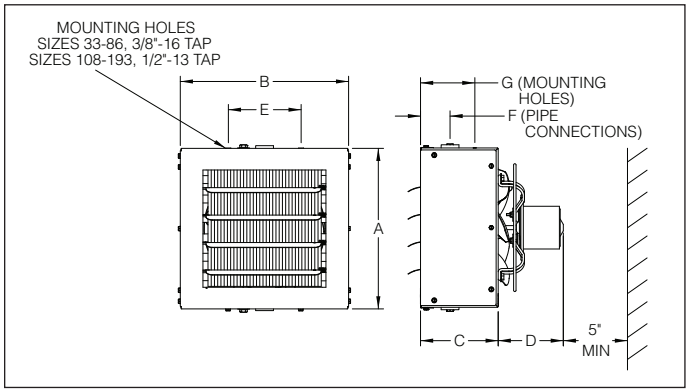


Figure 24.2 - Model Dimensions HSB258-340

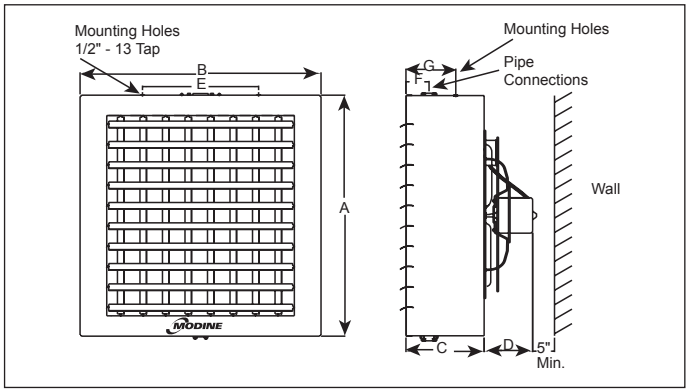


Figure 24.3 - Model Dimensions HC18-165

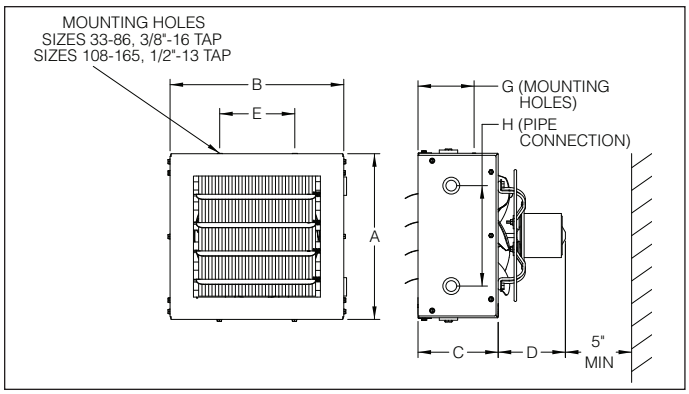
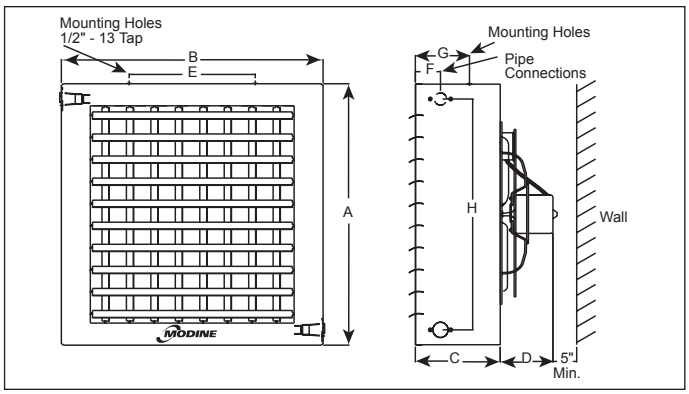


Figure 24.4 - Model Dimensions HC193-340 ①



① Verticaldeflector blades shown are standard on models HC 258-340 and optional on model HC 193.

Table 24.1 - Model HS and HC Dimensions ②③

Model Number	A	B	C	D 115 Std. Motor	D 115V Exp. Motor	E	F	G	H	Female Connections NPT	Fan Diameter	Approx. Shipping Wt. lb.
HSB-18	12-3/8	13	6	5	12-1/4	-	3	-	-	3/4	9	16
HSB-24	12-3/8	13	6	5	12-1/4	-	3	-	-	3/4	9	20
HSB-33	16-3/8	17-1/2	8-3/4	6	11-3/4	11	3-5/8	6	-	1-1/4	12	34
HSB-47	16-3/8	17-1/2	8-3/4	6	11-3/4	11	3-5/8	6	-	1-1/4	12	36
HSB-63	20-7/16	21-1/2	8-3/4	7-3/4	12	15	3-5/8	6	-	1-1/4	14	48
HSB-86	20-7/16	21-1/2	8-3/4	7-3/4	12	15	3-5/8	6	-	1-1/4	14	52
HSB-108	24-7/16	25-1/2	9-1/2	6-3/4	13-1/4	18	3-3/4	6-3/8	-	1-1/4	18	74
HSB-121	24-7/16	25-1/2	9-1/2	6-3/4	13-1/4	18	3-3/4	6-3/8	-	1-1/4	18	76
HSB-165	30-1/2	30-1/2	9-1/4	8-1/2	14	21-1/4	3-3/4	6-3/8	-	1-1/4	22	92
HSB-193	30-1/2	30-1/2	9-1/4	8-1/2	14	21-1/4	3-3/4	6-3/8	-	1-1/4	22	98
HSB-258	38-1/2	38-1/2	12-1/2	10	15	18-1/2	3-5/8	7-7/8	-	1-1/4	22	162
HSB-290	38-1/2	38-1/2	12-1/2	10	15	18-1/2	3-5/8	7-7/8	-	1-1/4	24	168
HSB-340	38-1/2	44-1/2	12-1/2	10	15	18-1/2	3-5/8	7-7/8	-	1-1/4	24	176
HC-18	11-1/2	13	6	5	12-1/4	5-5/8	2-1/4	4-1/8	7-1/2	1/2	9	16
HC-24	11-1/2	13	6	5	12-1/4	5-5/8	2-1/4	4-1/8	7-1/2	1/2	9	20
HC-33	15	17-1/2	8-3/4	6	11-3/4	11	3-5/8	6	10	3/4	12	34
HC-47	15	17-1/2	8-3/4	6	11-3/4	11	3-5/8	6	10	3/4	12	35
HC-63	18-1/2	21-1/2	8-3/4	7-3/4	12	15	3-5/8	6	14	3/4	12	48
HC-86	18-1/2	21-1/2	8-3/4	7-3/4	12	15	3-5/8	6	14	3/4	14	52
HC-108	22-1/2	25-1/2	9-1/2	6-3/4	13-1/4	18	3-5/8	6-3/8	18	3/4	18	74
HC-121	22-1/2	25-1/2	9-1/2	6-3/4	13-1/4	18	3-5/8	6-3/8	18	3/4	18	76
HC-165	26-1/2	29-1/2	9-1/4	8-1/2	14	21-1/4	3-5/8	6-3/8	22	3/4	22	92
HC-193	30-1/2	32-1/2	9-1/4	8-1/2	14	21-1/4	3-5/8	4-3/4	26	1-1/4	22	98
HC-258	38-1/2	38-1/2	12-1/2	10	15	18-1/2	3-5/8	8	34	1-1/4	22	163
HC-290	38-1/2	38-1/2	12-1/2	10	15	18-1/2	3-5/8	8	34	1-1/4	24	168
HC-340	38-1/2	44-1/2	12-1/2	10	15	18-1/2	3-5/8	8	34	1-1/4	24	176

② All dimensions in inches.
③ Dimensions shown are for Standard and Low Outlet Temperature Models.

Dimensions - Vertical Air Delivery Models

Figure 25.1 - Model V/VN and PT/PTN Dimensions

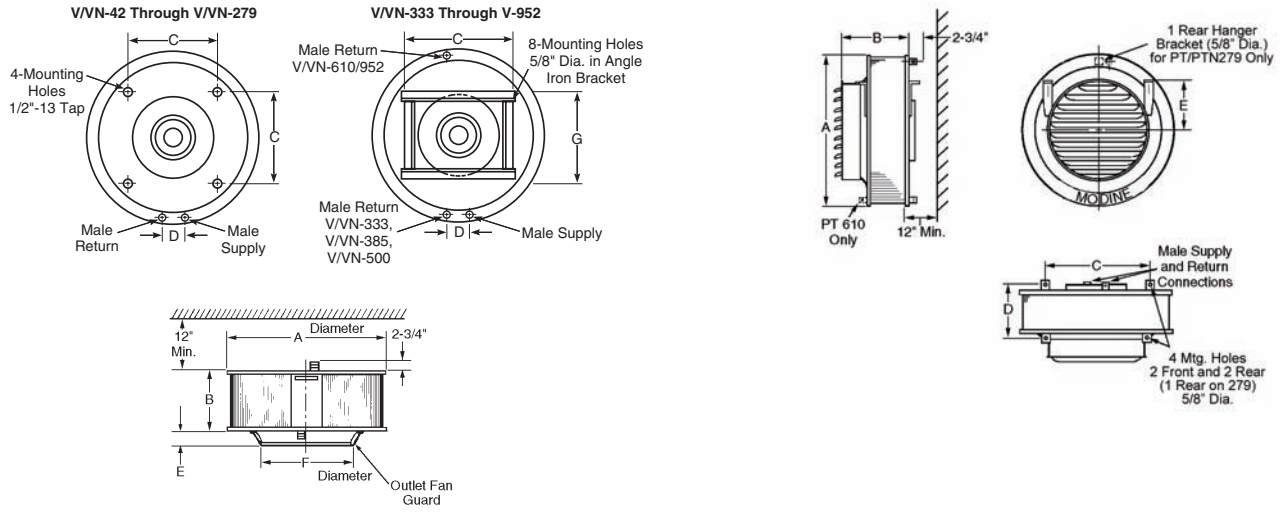


Table 25.1 - Model V/VN and PT/PTN Dimensions ①②③

Model Number	A	B	C	D	E	F	G	Fan Diameter	Male Connections NPT		Approx. Shipping Wt. (lb.)
									Top	Bottom	
V/VN-42	24-3/4	3-5/8	11-3/8	2-1/8	4-3/8	14-1/2	-	14	1-1/4	1-1/4	36
V/VN-59	24-3/4	5-1/8	11-3/8	2-1/8	4-3/8	14-1/2	-	14	1-1/4	1-1/4	42
V/VN-78	24-3/4	6-5/8	11-3/8	2-1/8	2-5/8	16-1/2	-	16	1-1/4	1-1/4	46
V/VN-95	24-3/4	8-1/8	11-3/8	2-1/8	2-5/8	16-1/2	-	16	1-1/4	1-1/4	48
V/VN-139	34-3/4	6-7/8	18-3/8	2-1/8	3	19-1/2	-	19	1-1/2	1	70
V/VN-161	34-3/4	8-3/8	18-3/8	2-1/8	3	19-1/2	-	19	1-1/2	1	80
V/VN-193	34-3/4	9-7/8	18-3/8	2-1/8	3	19-1/2	-	19	1-1/2	1	86
V/VN-212	34-3/4	12-7/8	18-3/8	2-1/2	3	19-1/2	-	19	2	1-1/4	94
V/VN-247	34-3/4	12-7/8	18-3/8	2-1/2	3	21-1/2	-	21	2	1-1/4	108
V/VN-279	34-3/4	14-3/8	18-3/8	2-1/2	3	21-1/2	-	21	2	1-1/4	112
V/VN-333	43-1/4	14-5/8	31-1/2	2-7/8	3-1/8	22-1/2	18-1/5	22	2-1/2	1-1/2	166
V/VN-385	43-1/4	14-1/2	31-1/2	2-7/8	3-1/2	27-1/2	18-1/5	27	2-1/2	1-1/2	168
V/VN-500	43-1/4	19	31-1/2	2-7/8	3-1/2	27-1/2	18-1/5	27	2-1/2	1-1/2	360
V/VN-610	51-1/2	19-1/8	31-3/8	-	3-3/4	30-1/2	31-3/8	30	2-1/2	1-1/2	450
V-952	53-3/4	21-1/8	30	-	3-1/2	31	30	30	3	3	487
PT/PTN-279	34-3/4	22-5/8	25-1/4	16-3/4	16-3/4	-	-	21	2	1-1/4	122
PT/PTN-333	43-1/4	23-7/8	30	15-3/4	14-3/8	-	-	22	2-1/2	1-1/2	176
PT/PTN-385	43-1/4	25-3/4	30	15-3/4	14-3/8	-	-	27	2-1/2	1-1/2	184
PT/PTN-500	43-1/4	29	30	20-1/4	14-3/8	-	-	27	2-1/2	1-1/2	376
PT/PTN-610	51-1/2	29-5/8	30	20-3/8	21	-	-	30	2-1/2	1-1/2	472
PT-952	53-3/4	26-3/8	30	23-1/8	26-7/8	-	-	30	3	3	487

① All dimensions in inches.
② Dimensions shown are for Standard and Low Outlet Temperature Models.
③ See page 23 for optional air outlet accessory dimensions.

Model Identification

Figure 26.1
Model Number Designation

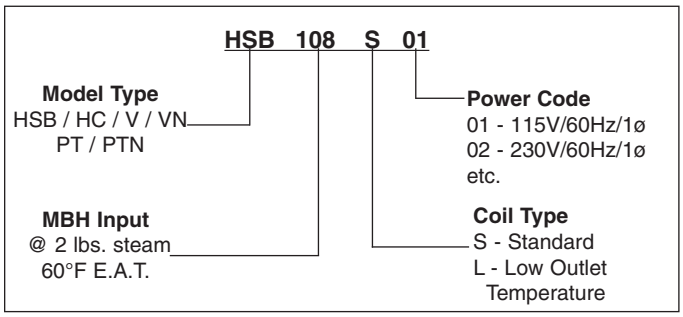


Figure 26.2
Serial Number Designation

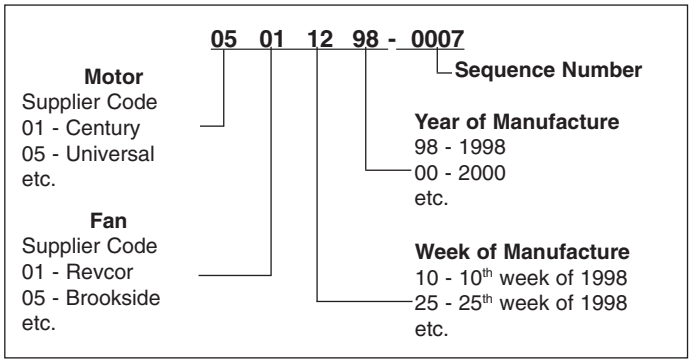
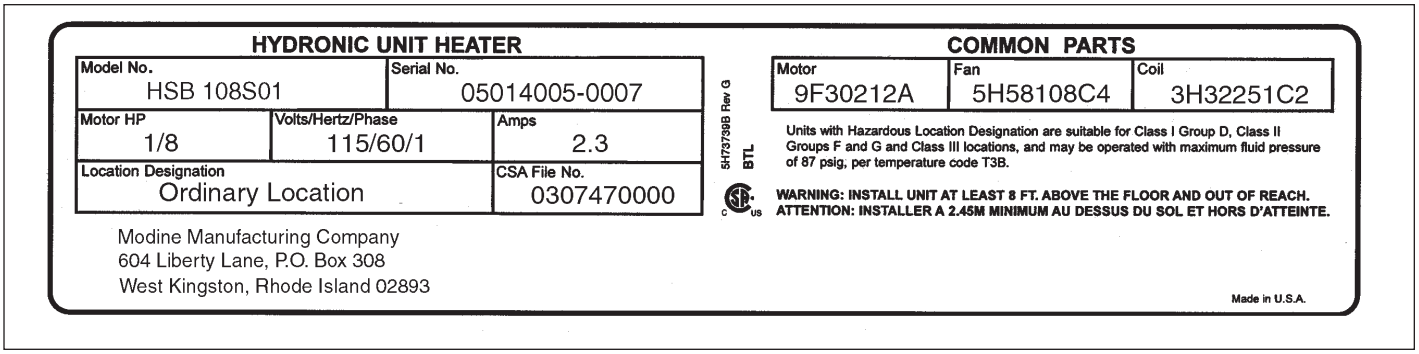


Figure 26.3
Model Identification Plate



Specification for Horizontal, Vertical and Power-Throw™ Models

General

Contractor shall furnish and install steam/hot water unit heater model _____. Performance shall be as indicated on the equipment schedule in the plans. Units shall be listed by CSA as certified to CAN/CSA-C22.2 No. 236-05 “Heating and Cooling Equipment” and UL Std. No. 1995 “Heating and Cooling Equipment.” Additionally for Canada, the units shall have CRN registered heat exchangers.

Casing

HSB and HC Models - Casings on model sizes 18 through 86 are 20 gauge steel (18 gauge on all other models) and consist of front and back halves. Both halves are joined together at the top and bottom utilizing the condenser mounting screws. Casing top is provided with threaded hanger connections for unit suspension (except for HSB18 and HSB24 which are directly mounted to the supply and return piping). Fan venturi is formed in casing back half.

Vertical and Power-Throw™ Models - Casings consist of two circular 18 gauge steel covers. With the coil in between, the covers are securely bolted together to form a single unit. The bottom cover has a die-formed fan venturi. The top cover incorporates a motor cooling cone, which shields the motor from coil heat therefore prolonging motor life. An opening is also provided for circulation of motor cooling air.

All Models - Casing shall be treated to prevent corrosion and painted with a corrosion resistant, baked, polyester powdercoat gray-green finish.

Condenser

Condenser coils are of the extended surface type, utilizing aluminum fins and DLP-type copper tubes with malleable iron supply and return connections for HSB units, cast bronze connections for HC models and Schedule 40 steel pipe for V/PT models. Tubes are mechanically bonded to the collars of the fins. The condensers are warranted for operation at steam or hot water pressures and temperatures up to 150 psig and 375°F for copper coils and 250 psig and 400°F for 90/10 cupro-nickel coils.

Fins are continuous across the width and depth of the condenser and are vertically oriented to minimize the collection of dirt and dust.

Canadian Standards Association (CSA) requirements state that explosion-proof units (Power Codes 06 and 09) may not be used with fluid temperatures in excess of 329°F or pressures in excess of 87 psig and still maintain their explosion proof rating for National Electric Code ignition temperature rating T3B for grain dust.

All coils are leak tested at 165 to 200 psig, air under water.

Horizontal models - Coils are of serpentine design with horizontal tubes, vertical fins and center supply and return connections at top and bottom of unit (except HC models, which have side connections). All tube bends are brazed. All tubes have individual expansion bends. Copper tubes are 1" O.D. with 0.030" wall thickness (except HSB/HC-18 and 24 which are 5/8" O.D. with 0.028" wall thickness).

Vertical and Power-Throw™ models - Coils are circular, providing for natural expansion. Each tube is continuous between supply and return header. All tube joints are silver soldered. Copper tubes are 5/8" O.D. with 0.028" wall thickness.

Motors - See page 8 for Power Code and motor descriptions and page 23 for motor amp draw information. Motors are designed for continuous duty and can operate in a maximum ambient temperature of 104°F(40°C).

Fans/Fan Guards - Fans are aluminum on all units and are secured to a steel hub. Each fan is balanced and is designed specifically for the unit heater on which it is installed. Horizontal units are equipped with a combination fan guard/motor-mounting bracket. The guard is constructed of steel rod. Vertical units are supplied with an outlet fan guard covering the opening in the bottom of the unit.

Air Deflectors - Horizontal units, including the Power-Throw™ units, are furnished with horizontal air deflectors as standard. The deflectors are adjustable to almost any desired position for downward, straight or upward airflow. Vertical deflectors are available as an accessory for HSB/HC models through size 193, standard on model sizes 258-340. See page 22 for air outlet accessories for vertical models.

The Modine brand has been the industry standard since Arthur B. Modine invented and patented the first lightweight, suspended hydronic unit heater in 1923. No other manufacturer can provide the combined application flexibility, technical expertise and fast delivery found at Modine. Consult your local Modine distributor for help in solving your indoor air problems.

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Products from Modine are designed to provide indoor air-comfort solutions for commercial, institutional and industrial applications. Whatever your heating, ventilating and cooling requirements, Modine has the product to satisfy your needs, including:

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- Gas-fired duct furnaces
- Gas-fired high-intensity infrared heaters
- Gas-fired low-intensity infrared heaters
- Steam/hot water unit heaters
- Steam/hot water cabinet unit heaters
- Steam/hot water commercial fin tube radiation
- Oil-fired unit heaters
- Electric unit heaters
- Indoor gravity vented single and multiple duct furnace make-up air units
- Indoor separated combustion single and multiple duct furnace make-up air units
- Outdoor single and multiple duct furnace make-up air units
- Direct-fired make-up air units
- Ductless split ceiling cassettes

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