

# HACE

Heating & Air Conditioning Ent.



## Duct Heaters

HF Series

CHMS Series

*Tailor Your Atmosphere*

## About Us

Heating & Air Conditioning Enterprises have recently grouped the names of its divisions (HACE – Royal Temp – Golden Star) into (HACE), while preserving the company's good reputation and expertise acquired in the past 30 years for providing high quality HVAC products, supplies and services.

HACE took the advantage of the strongly increasing demand on its high quality products and launched numerous expansion plans to increase the production capacity by double, increase the working staff by 30%, provide totally new products with wider range of choice, release new HVAC products series with new specifications and develop the existing products and services. HACE is based on a production facility of 30'000 m<sup>2</sup> along with a storage area of 5'750 m<sup>2</sup>. HACE team consists of more than 500 highly skillful technical and senior engineers.

In 1976 HACE started the manufacturing of HVAC products and supplies in the Kingdom of Saudi Arabia. In 1980, the primary manufacturing plant was built in the Second Industrial City in Riyadh and from that point, HACE started the manufacture of air conditioning equipment, air devices, heavy duty centrifugal blowers, and pre-insulated pipes under the trade name "Goldenstar". In 2004, the company trade name was changed to "Royal Temp" and to be used for all products. In 2012, the name HACE was chosen to replace the old trade names and declare a new milestone in the company's history.

In continuation of its growth pursuit, HACE is eagerly following the recent HVAC technologies and developments by providing its employees with the best training sessions coupled with its wide knowledge of HVAC sciences and products. HACE high quality equipment has acquired various international certifications like AHRI, ETL, UL, CE, and ISO 9001 along with many vendor approvals from the governmental sector, semi-governmental and leading private companies.

Today, HACE is producing a huge variety of HVAC products, supplies and services that will grant all of its customer's air comfort requirements to the least detail, "Tailor Your Atmosphere".

### **Our Vision**

Become customer's first choice regionally and be recognized globally for providing high quality air comfort solutions.

### **Our Mission**

Ensure total customer satisfaction for Air Comfort requirements by providing high quality, tailored, affordable, energy efficient and eco-friendly products and services.

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## INTRODUCTION

A Duct Heater is a self contained heater designed to be installed in the field in an air stream of a duct system, external to the air moving unit. It is designed to be installed in a duct where an adequate flow of air from a separate, interlocked fan or blower system is insured. Such a heater may be located in a main supply duct of a warm air heating system, in one of the branch ducts, or used as a room heater, at the end of a branch duct.

Diversity makes HACE duct heaters the most flexible type of heating system. all HACE units have individually designed ranges and are custom built from 500 watts to 1.000.000 watts and fit 4"x10" up to 80"x20" ducts. HACE duct heaters are approved for zero clearance to combustibles and meet U.L. and national electrical code specifications. HACE duct heaters are easily installed in both existing and new system. electric duct heaters coils fit most spaces designed for other heating coils with no redesign of existing equipment. Available in flanged and insert models. HACE duct heaters are designed for many applications: Prime heating, air handling equipment, heat pump and zoned application, as well as auxiliary heat, and unattended building.

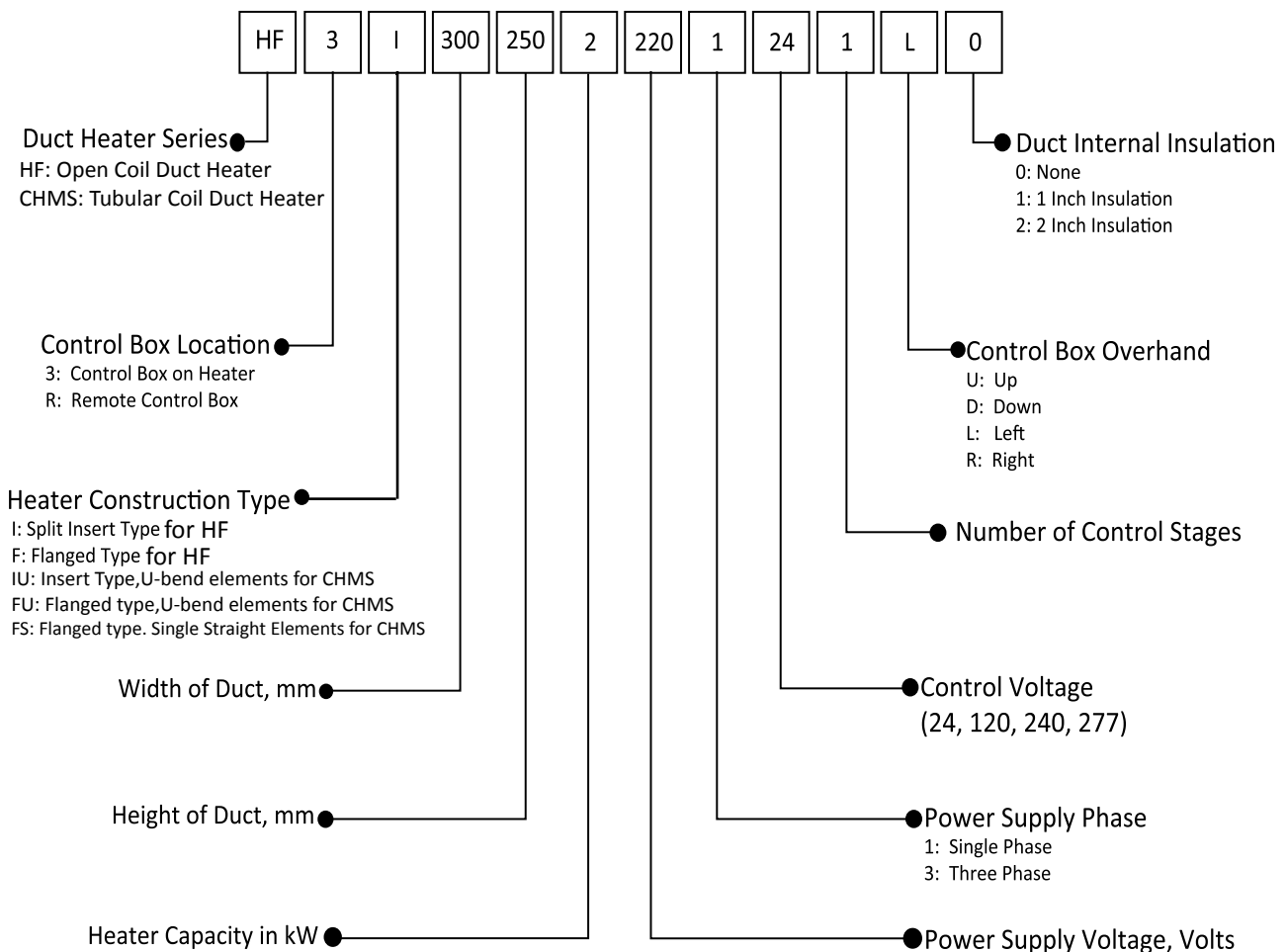
HACE have one standard series of «HF» duct heaters and another optional series «CHMS» to accommodate all applications.

**HF series** : with open type heating element,ETL Listed.

**CHMS series**: with UL listed tubular heating elements and components.

## NOMENCLATURE

### HF Series



## GENERAL FEATURES

### Features of Open Coil Duct Heaters :

- Clean Heat.
- Double Safety Protection.
- Low Cost Factor.
- ETL Listed.
- Instant Heat.
- Custom Design.
- Low Static Pressure Drop.
- Insert or flanged type.

### Features of TUBULAR Type Duct Heaters :

- Solid Cover for Dust Elimination.
- Metal sheath heating elements.
- Heavy duty.
- Commercial and Industrial.
- Low pressure drop.
- Insert or flanged type.

### Standard Components

1. Magnetic controlling contactors .
2. Power terminal block .
3. Control terminal block.
4. Control transformer.
5. Air flow switch.
6. Auto thermal cutout .
7. Manual thermal cutout.
8. Control fuse link and fuses block .
9. power fuse link and fuses block .

### Optional Components And Accessories

1. Room thermostat.
2. Circuit breaker.
3. Door interlock disconnect switch.
4. Weather proof enclosure.
5. Pilot light.
6. BMS fault indicator : dry contact for no air thermal trip ON/OFF indication (Volt free contacts).
7. Step controller .
8. SCR controller .
9. Protective screen.
10. Fan interlock relay.
11. Mercury Contactors.
12. Transformer with Primary & secondary fusing.
13. Fused disconnect switch.
14. Insulated Control Panel.
15. Current Transformer.

GENERAL CONSTRUCTION

**Insert Type Heaters**

Insert heaters are the most generally used type because of the ease of installation in the duct system. The heating element enclosure is inserted in the air stream through an opening cut in the side of the duct, and is secured by means of screws applied from within the terminal box. The terminal compartment extends beyond the element enclosure at least 1/2 inch on all sides so that it will cover the rough opening in the duct. When additional space is required for built-in components the terminal box is extended on the air inlet side as standard, or leaving air side either up or down if specified. The "A" dimension can be extended as an overhang when specified.

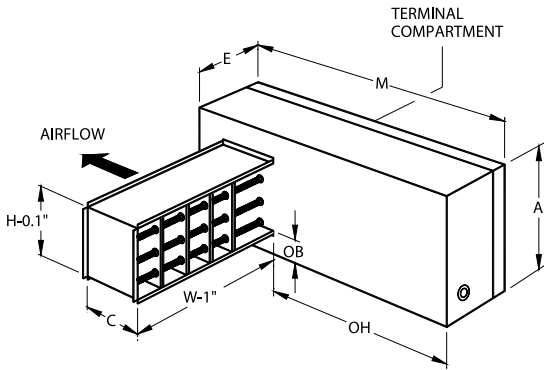


Figure 1: Insert Type Heater

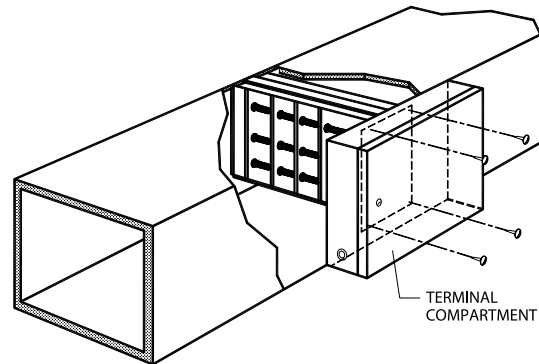


Figure 2: Insert Type Heater Installation

Note: OH can apply to overhang on either side of heater

**Flanged Type Heaters**

Flanged type heaters are custom designed to be installed as an integral part of the duct system. The inside of the flanged frame is the same dimensions as the air duct, allowing for mating with, and securing to the duct flanges. A one inch flange is supplied as standard, unless otherwise specified. The flanged element enclosure and the terminal compartment are flush on the air outlet side. When «M» dimension exceeds «B» dimension, the overhang will be on the air inlet side, as standard, or leaving air side either up or down if specified. The «A» dimension can be extended as an overhang to provide space for components when specified.

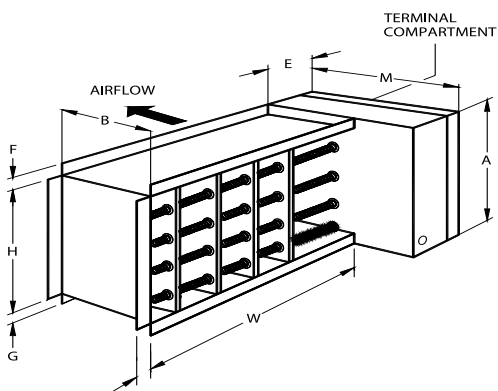


Figure 3: Flanged Type Heater

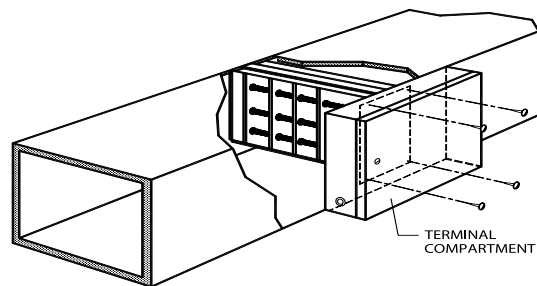


Figure 4: Flanged Type Heater Installation

**Internally Insulated Duct Applications**

Internally Insulated Ducts can affect the operation of insert and flanged duct heaters and therefore, must be specified so that the following design factors can be employed which will allow the air stream to pass over the limit controls and all elements

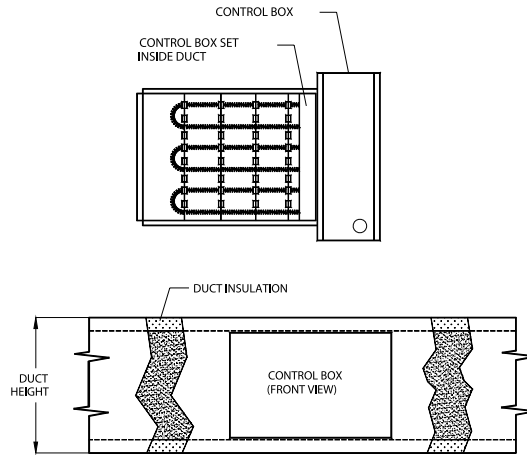


Figure 5

**Insert Type**

The element enclosure is reduced in size enough to allow the entire face of the control box to be recessed into the duct to the depth of the insulation. An angle is installed on all four sides of the terminal compartment to seal the opening and provide a

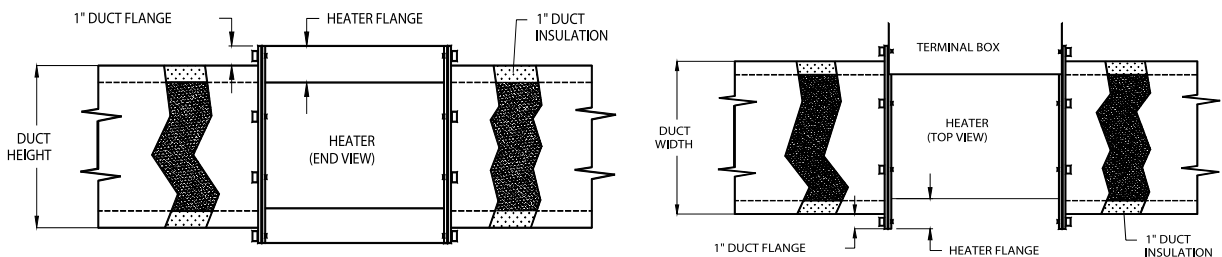


Figure 6

**Flanged Type**

A deeper flange is required so that the inside of the flanged housing is flush with the surface of the insulation and the face of the terminal compartment is recessed to the depth of the insulation.

**Bottom Terminal Box Heaters**

HACE Heaters are specially designed to accommodate installations where side mounting is not possible. Since the resistance element wire must be strung horizontally the safety controls are located in the side terminal compartment. Other controls except mercury contactors and fusing are located in bottom control box. Heaters limited to 60 KW max. Remote fusing required for all heaters over 48 Amps.

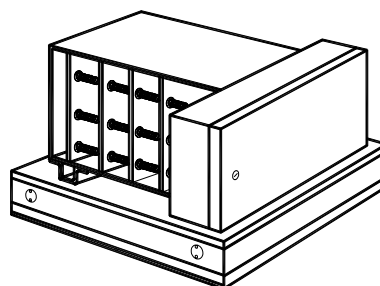


Figure 7: Bottom Terminal Box

## Dust Proof Terminal Box Cover

HACE Heaters are available with a dust tight control box cover where dirt problems could affect the life expectancy of the controls.

## Multiple Heaters In A Single Duct

HACE Duct Heaters are designed as single units in all applications except where height dimension exceed 80". Heaters above 80" will be furnished in two or more flanged sections for stacking one on top of the other, for simplifying shipping and field installation. A special foot design is furnished with these flange units for easy mounting when stacked.

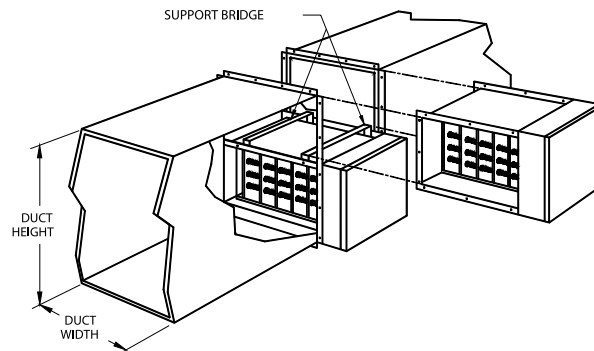


Figure 8: Multiple Heaters In A Single Duct

Automatic resetting temperature limits are furnished in each heater section, with provisions for wiring them in series in the field. Built-in accessories, such as contactors, and fusing, are also available. Separate power lines are required for each section. When preferred, heaters with a long «W» dimension can be divided into two separate units and one installed from each side of the duct.

## Dimensional Data

The HF series terminal compartment depth «E» is normally 4 1/2», however it may be increased when necessary. The «H» and «W» dimensions are the actual duct height and width. «C» and «M» dimensions depend on several factors and must be calculated by the factory engineering department, however where conditions limit the size this must be specified.

The HF series compartment has a solid cover that is hinged on the top or otherwise, also a latch is provided. A support bridge is installed on the bottom of the element enclosure on all heaters when «W» dimension exceeds four (4) feet.

## Corrosion Protection

HACE Duct Heaters are constructed of the highest grade galvanized steel (standard), aluminized (optional). All other metal components are either zinc plated or constructed of stainless steel. This type of protection gives longer life and prevents damage by moisture from cooling systems.

## Insulation

Each heater can be manufactured with a 1/2" fiberglass board insulation between the control box and the duct area. This type of insulation gives maximum protection against moisture condensation as well as thermal insulation. In installations where noise is a factor, such as high rise apartments, this type of insulation absorbs part of the air movement sound.



### Heating Element

**Open Coil Type** The open coil element offers many advantages over the sheath type. One of the greatest assets is its longer life. The open coil releases its heat directly into the air stream, transferring its energy faster, and therefore operating at a cooler temperature. The sheath type element must release its energy through insulation and the metal outside sheath. Due to this slower transfer, life expectancy is reduced and service requirements increased. In some cases, the insulation may contain voids, in which case, the conduction is reduced creating possible burn-outs. The open coil gives greater adaptability in design and lower pressure drop across the unit. This feature can help the systems designer maintain a lower static pressure, and thereby reduce the air handling power requirements, design and system costs.

The low mass coil releases heat immediately after being energized and cools quickly after being deenergized. The low thermal inertia results in more precise temperature control.

### Element Construction

HACE Duct Heater elements are constructed of Nickel (80%) Chromium (20%) alloy high grade resistance wire. Each element is coiled to the customer's wattage specification in our plant, assuring high quality elements with a closely controlled resistance. Each element is checked when produced, and again upon installation in the heater. "HF" heating element coils are designed for low watt density loading of the surface area of the wire (40 to 55 watts per inch). A heavier than normal gauge wire is used, giving a longer coil to maintain required resistance for a given wattage. This results in lower coil operating temperature which eliminates glow under standard operating conditions because of the greatly increased surface area and also gives a sturdier element for longer life.

### Modular Frame And Channel Rack

The HF series heaters are furnished with galvanized steel (zinc coated steel) modular frame, aluminized steel as optional. This design has made it possible for easier servicing in the field should this be necessary. The new HF channel rack has been designed to give added rigidity and also improved heat dissipation due to staggering of the rows of heating elements.

### Element Termination

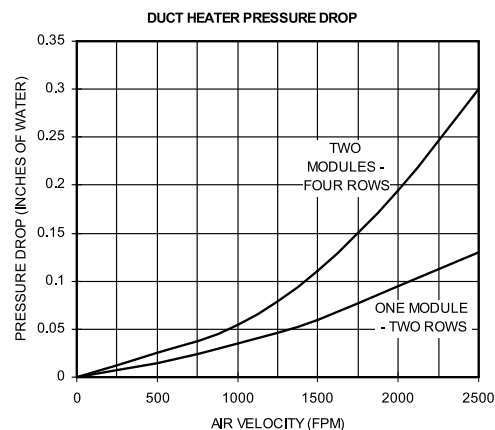
The coil is mechanically connected to the high temperature No. 10 stainless steel terminal screw by means of a loop of element wire being sandwiched between two stainless steel washers. Since a large area of element wire is used in making the connection, burn-outs due to nicked wire at the connection are minimized. The terminal is insulated by a two piece mating male and female ceramic bushing.

### Insulating Bushings

The high temperature special ceramic bushings, which insulate the coils from supporting metal, float freely in specially designed element racks. The floating ceramics will not crack or bind due to heating and cooling of the element.

### Steel Welded Safety Screen

When the requirements for additional safety from possible contact to the heating elements of a duct heater, either from entering air or leaving air side, a screening material is available factory installed.



## INSTALLATION INSTRUCTION

### Application Requirements

1. The duct system must provide uniform air flow over the entire face area of the heating elements.
2. For satisfactory and safe operation the minimum air velocity must be maintained as determined from table.
3. The air duct should be installed in accordance with the standards of the National Fire Protection Association for the installation of air-conditioning and ventilating systems of other than residence cetype (NFPA 90A) and residence-type warm air heating and air-conditioning systems (NFPA 90B).
4. The heater should be installed at least 48 in. from the duct flanges of a heat pump or central air conditioner.
5. Maximum inlet air temperature is 100° F.
6. Series HF heaters may be installed in duct systems having zero clearance to combustible surfaces.

### Installation Procedures

1. Make sure air flow arrow on heater corresponds to air flow through the duct and heater is properly positioned if marked with "top."
2. The heater terminal compartment should not be enclosed by insulation, etc.
3. For Insert Type Heaters (Fig. 17): Cut a hole in the side of the duct 1/8" larger than the element housing ( $[H - 0.1] \times C$ ) and insert the heater. Attach the back of the terminal box to the duct.
4. For Flanged Type Heaters (Fig. 18): Provide duct flanges to match heater flanges. Attach the heater to the duct flanges with screws.
5. Weather proof junction boxes have no knockouts for wire entrance. Provide knockouts for all wiring using field supplied grommets of correct size and type of conduit as required.
6. Where field supplied thermostats are used, isolate circuits to prevent possible interconnection of control circuit wiring.
7. Where field supplied step controller is used, connect step to terminals as marked on wiring schematic. When connecting multi stage heaters, wire stage no.1 so that it is first stage on, last stage off. Connect thermostats as shown.
8. Provide sufficient clearance for convection cooling of heaters with "SCR" controllers. Provide at least 5" of free air space above and below cooling fins extending from heater terminal box.

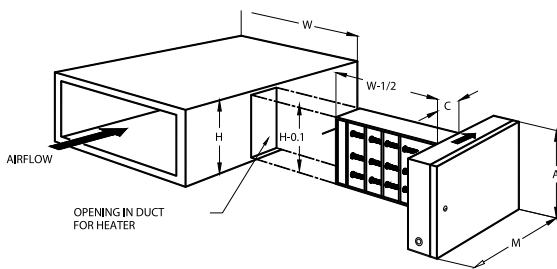


Figure 9: Insert Type

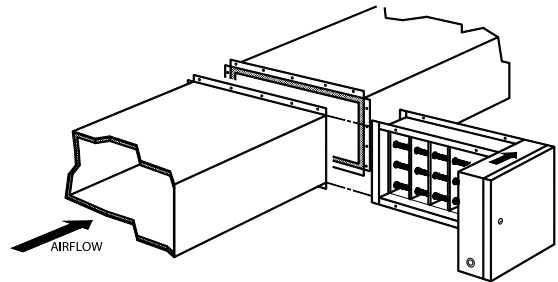


Figure 10: Flanged Type

#### LEGENDS:

H = Duct Height  
C = Heater Width

W = Duct Width  
A = Control Box Height

H - 0.1 = Heater Height  
M = Control Box Width

W - 1/2 = Heater Length

#### Note:

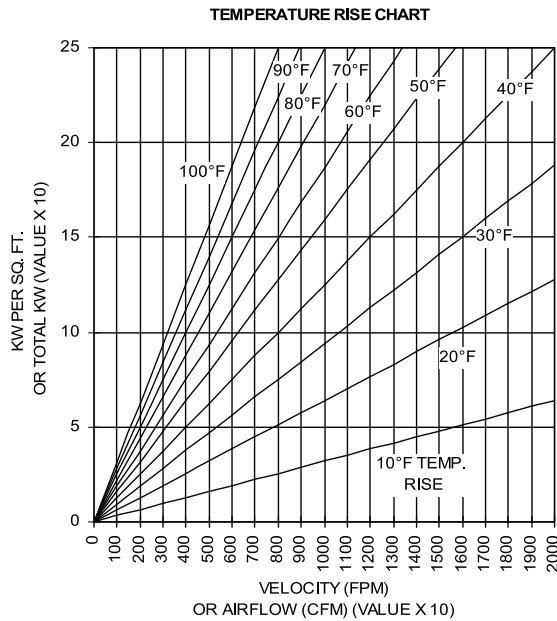
\*All dimensions are in inches.

**GENERAL DESIGN INFORMATION**

**Temperature Rise**

The air temperature rise through the heater is a factor of great importance. The chart should be consulted for the temperature rise expected to result from the air flow and watt density used.

THE TEMPERATURE RISE CHART aids in calculating requirements or results from the known factors of FPM, CFM, Temperature Rise, Total KW, or KW per square foot. If two related factors are known, the others can be determined.



**Notes:**

- A. For values above or below those on the scale, multiply or divide the known factors by a convenient number. Make the necessary calculations on the chart, then multiply or divide the answer by the original number for the actual value.
- B. If any two factors are known the third may be calculated in a similar manner.

**Examples**

**A. Air (Cfm)-(Kw) Total Heat Required**

To find the total heat required at a given temperature rise and CFM, use the top and right scales.

The heat required to achieve a 40°F temperature rise in a duct handling 12,000 CFM.

1. Draw a line vertically down from the 12,000 CFM on the top scale to the 40°F temperature rise line.
2. From the point of intersection draw a horizontal line to the right side scale. Given total heat required 150 kW.

**B. Velocity (Fpm)-Watt Density (Kw / Ft<sup>2</sup>)**

To find the watt density (kW per sq. ft.) at a given temperature rise and FPM of air, use bottom and left scales.

To find the heat input in a duct handling 700 FPM of air, with a temperature rise of 60°F.

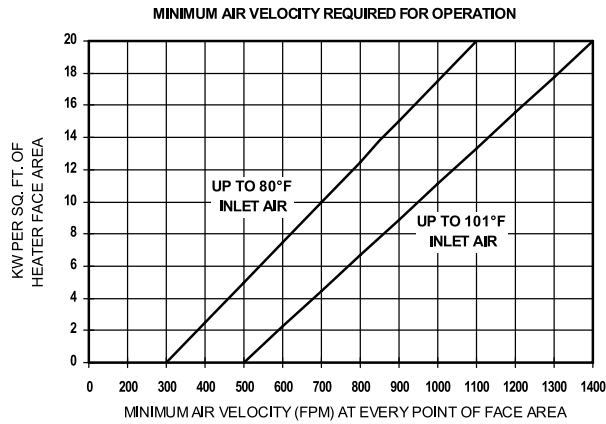
1. Draw a line vertically up from the 700 FPM on the bottom scale to the 60°F temperature rise line.
2. From the point of intersection draw a horizontal line to the left side scale giving 13.5 kW per sq. ft. of duct area.

**Minimum Velocity Requirements**

Electric duct heaters are different from steam or hot water coils, in that the BTU output remains constant as long as the heater is energized. To eliminate overheating and burn out due to low air velocity, an automatic reset temperature limiting control is built into each heater. The minimum velocity required to prevent nuisance tripping of the temperature limiting control is determined from the air velocity chart (Fig. 2 on the basis of entering air temperature, and watts per square foot of cross sectional duct area.

**CAUTION!** Do not operate without proper air flow.

For efficient and trouble free operation it is important that air flow be adequate over the complete heating area and particularly at element terminals. No electric duct heater should ever be operated with insufficient air flow because overheating and subsequent malfunction may result. The minimum air velocity required at any point should be determined from the graph following.



**Note:**

- \*20 kW / sq. ft. is maximum wattage permissible
- \*Formula:  $H \times W$  divided by 144 = sq. ft. / area
- \*kW divided by area = kW/sq. ft. duct area (density)
- \*H = Element Frame Height      W = Element Frame Width

**Available Watt Density**

“HF” series Duct Heaters are built to the wattage and dimensions as specified by the customer. The “HF” series heaters are available to 1000 kW in all wattages up to 20 kW per square foot of cross sectional duct area and are suitable for installation with zero clearance to combustible surfaces and up to 100 degrees Fahrenheit inlet temperature. These heaters are available through 20 feet in width.

**Installation Recommendations**

1. The heater must be installed to assure equal air flow through the entire face area of the heater. Refer to NEC par. 424-59.

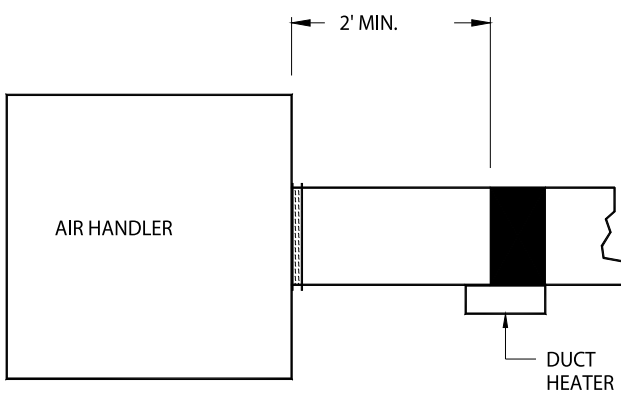


Figure 11

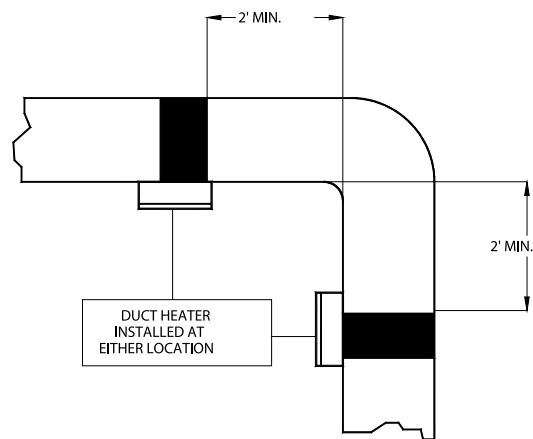


Figure 12

2. A canvas vibration insulation connector should not be located less than 18 inches from a duct heater. If it is located closer, an asbestos connector should be used.

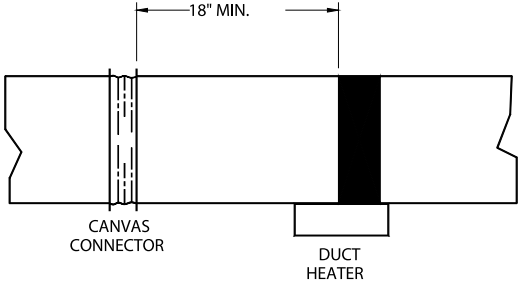


FIGURE 13

**Installation Restrictions**

The following are stated requirements of UL regarding installation of duct heaters.

1. Should be installed at least 4 feet from a heat pump or central air conditioning unit.

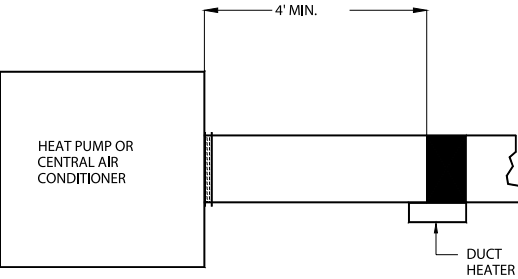


FIGURE 14

2. No clearance is required between the duct and combustible surfaces around the duct for «HF» series duct heaters.

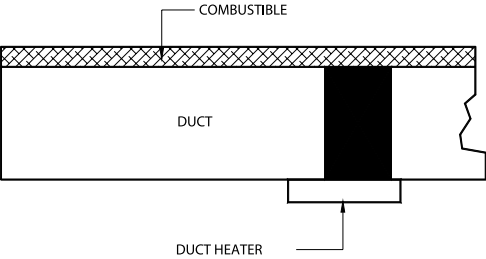


FIGURE 15

## Electrical Wiring Instructions

**WARNING!** DISCONNECT ALL POWER SOURCES BEFORE DOING ANY WORK ON THE HEATER INSTALLATION.

1. Use the wiring diagram supplied with the heater as a guide in correlating field wiring with the heater internal wiring. If there is more than one heating step, wire the unit so the steps are energized in the same sequence as numbered in the heater.
2. All field wirings to the heater must meet the requirements of the NEC and applicable local codes.
3. Wiring to the heater must be rated for 75°C minimum.
4. Supply conductors must be sized to carry at least 125% of the ampere load of the circuit it supplies.
5. For low voltage control circuits, use NEC Class 1 wiring as described in Article 725 of the National Electrical Code.
6. The fan must be interlocked with the heater so that the heater is not energized unless the fan is on. A typical method of accomplishing this is shown on the wiring diagram, if it is not built in.
7. If contactors are field supplied, they must have adequate ratings for the load carried and be UL listed for 100,000 cycles of operation. Do not exceed the control circuit volt-ampere rating marked at the control terminal block.
8. If heater does not have a built-in disconnect switch or main circuit breaker, install a remote disconnect (furnished by others) in accordance with the National Electrical Code, Article 424-65.
9. Do not bundle, tie or wrap power wiring in groups as this may cause over-heating and eventual breakdown of insulation.
10. For low voltage control circuits using two supply transformers with a heating-cooling thermostat, one for heating and one for cooling, a thermostat with isolating contacts must be used to prevent interconnection of the two different circuits.

**CAUTION!** For successful service using aluminum wiring, special treatment of all connections is an absolute necessity in order to prevent high resistance and oxidation problems. For recommended practice, check with your local electrical utility.

### Overcurrent Protection

UL requires compliance with paragraph 424-22 (b) of the National Electrical Code as follows: “Electric space heating equipment employing resistance type heating elements rated more than 48 amperes shall have the heating elements subdivided. Each subdivided load shall not exceed 48 amperes and shall be protected at not more than 60 amperes.” This means that sub-circuit over-current protection must be provided if the total heater load exceeds 48 amperes. If over-current protection is not built-in, all heaters exceeding 48 amperes total line current are divided into a sufficient number of sub-circuits, each provided with line terminals for connection to remote over-current protection

TABLE 1: MAXIMUM KW PER CIRCUIT FOR OVERCURRENT PROTECTION (50 AMP).

VOLTAGE	SINGLE PHASE	THREE PHASE
120	4	-
208	6.95	12
220	7.5	12.7
230	7.7	13.4
240	8	13.85
277	9.3	-
380	15.2	26.3
460	18.4	31.9
480	19.2	33.2
600	24	41.6

Note:

Two or more circuits may be paralleled to make one heating stage.

**Sizing Of Supply Conductors**

The required minimum size of supply conductors is marked at the field wiring terminals within the heater control box however for reference the following table is included. The wire gages are calculated for 125% of the heater line current as required by the National Electrical Code, Article 425-3 (b) based on conductor insulation rated for 90 °C (194 °F).

TABLE 2: SUPPLY WIRE SIZE

SUPPLY WIRE SIZE (NOT MORE THAN 6 CONDUCTORS IN A CONDUIT <sup>(1)</sup> )		
AWG OR MCM	MAX. HEATER LINE CURRENT <sup>(2)</sup>	
	COPPER <sup>(3)</sup>	ALUMINUM <sup>(4)</sup>
14	20	-
12	24	20
10	32	28
8	44	36
6	60	48
4	76	60
3	88	68
2	104	80
1	120	92
1/0	136	108
2/0	156	120
3/0	180	140
4/0	208	164
250	232	184
300	256	204
350	280	224
400	304	244
500	344	280
600	380	308
700	416	336
750	428	348
800	444	360
900	468	384
1000	492	400

1. For 7-24 conductors in a raceway or cable reduce allowable heater line currents to 87 ½ % of those shown above.
2. Based on 30° C (86 °F) ambient temperature. For higher ambient temperature, see NEC table 310-16 and 310-18 Note 13.
3. Based on 80% of ratings in table 310-16 NEC for 90°C insulation.
4. Based on 80% of ratings in table 310-18 NEC for 90°C insulation.

## Calculation Of Line Currents (AMPS)

To determine the line current, use the following formulae:

WATTS	
SINGLE PHASE CURRENT (AMPS) =	----- VOLTS
Example: Single phase 5 KW, 208 Volts	
5000 WATTS	----- = 24 AMPS
208 VOLTS	
WATTS	
THREE PHASE CURRENT (AMPS) =	----- VOLTS x 1.73
Example: Three phase 14.4 KW, 208 Volts	
14400 WATTS	----- = 40 AMPS
208 VOLTS x 1.73	

## Electrical Design

The requirements and practices described below are based on the National Electrical Code and the Space Heating Standard of the Underwriters Laboratories, Inc. (UL). Although UL requirements are uniform throughout the country, local electrical codes may deviate from the National Electrical Code, therefore local inspection authorities should be consulted regarding local requirements. After final assembly and before shipping each "HF" duct heater must pass a 2000 volt minimum dielectric test

## ELECTRICAL DESIGN

### POWER WIRE SIZING:

If a long run of wire is required or more than three wires are run in a conduit the allowable capacity on a given wire size must be reduced as per NEC requirements (see note 13 to NEC Table 310-16 and 310-18).

TABLE 3: Maximum amp load on various wire sizes for field wiring to duct heaters (De-rated 20%)

AWG - MCM Wire Size	Temperature Rating or Insulation			
	75 °C		90 °C	
	Copper	Aluminum	Copper	Aluminum
14	16	-	20	-
12	20	16	24	20
10	28	24	32	28
8	40	32	44	36
6	52	40	60	48
4	68	52	76	60
3	80	60	88	68
2	92	72	104	80
1	104	80	120	92
1/0	120	96	136	108
2/0	140	108	156	120
3/0	160	124	180	140
4/0	184	144	208	164
250	204	164	232	184
300	228	184	256	204
350	248	200	280	224
400	268	216	304	244
500	304	248	344	280



## HEATER POWER CIRCUITRY

See wiring diagrams for details of the various wiring systems mentioned below.  
All stages of a heater are of equal kW unless specified otherwise.

1. Single phase power circuits: Each circuit consists of a heating coil (or coils connected parallel) which cannot exceed 48 amps for over-current protection.

A single stage heater may be controlled directly by a line voltage thermostat without using a controlling contactor if the heater rating is within the rating of the thermostat, the over-temperature protection controls of the fan interlock.

Larger loads are controlled by contactors, SCR controllers or load carrying step controllers.

2. Balanced Three Phase Power Circuits: Each circuit cannot exceed 48 amps for over-current protection and consists of three (or a multiple of three) heating coils factory connected in delta or Wye system at the factory's option. The load will be balanced (equal) among the three phases and the entire circuit is controlled as a unit and operates identically whether the power source is three or four wire. Therefore a neutral terminal is not furnished on balanced circuits.

Each circuit is normally controlled by a contactor which in turn is controlled by a thermostat or step controller in the control circuit.

TABLE 4: Maximum number of conductors in trade size of conduit or tubing  
(Excerpt from Table 3A – NEC) (Based on Table 1, Chapter 9)

Conduit Trade Size (inches)		1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	4-1/2	5	6
Type Letters	Conductor													
RHW and RHH (without outer covering) THW	14	6	10	16	29	40	65	93	143	192				
	12	4	8	13	24	32	53	76	117	157				
	10	4	6	11	19	26	43	61	95	127	163			
	8	1	3	5	10	13	22	32	49	66	85	106	133	
TW, T, THW, RUH (6 thru 2), RUW (6 thru 2), FEPB (6 thru 2), RHW and RHH (without outer covering)	6	1	2	4	7	10	16	23	36	48	62	78	97	141
	4	1	1	3	5	7	12	17	27	36	47	58	73	106
	3	1	1	2	4	6	10	15	23	31	40	50	63	91
	2	1	1	2	4	5	9	13	20	27	34	43	54	78
	1		1	1	3	4	6	9	14	19	25	31	39	57
	0		1	1	2	3	5	8	12	16	21	27	33	49
	00		1	1	1	3	5	7	10	14	18	23	29	41
	000		1	1	1	2	4	6	9	12	15	19	24	35
	0000			1	1	1	3	5	7	10	13	16	20	29
	250			1	1	1	2	4	6	8	10	13	16	23
	300			1	1	1	2	3	5	7	9	11	14	20
	350				1	1	1	3	4	6	8	10	12	18
400				1	1	1	2	4	5	7	9	11	16	
500				1	1	1	1	3	4	6	7	9	14	

TABLE 5: TOTAL AMPERAGE RATING CHART

kW Ratings	BTUH	208V		220V		230V		240V		277V	440V	480V	550V
		1 PH	3 PH	1 PH	3 PH	1 PH	3 PH	1 PH	3 PH	1 PH	3 PH	3 PH	3 PH
0.5	1,706	02.4	01.4	02.3	01.3	02.2	01.3	02.1	01.2	01.8	0.7	0.6	0.5
1.0	3,413	04.8	02.8	04.5	02.6	04.3	02.5	04.2	02.4	03.6	1.3	1.2	1.0
2.0	6,826	09.6	05.6	09.1	05.2	08.7	05.0	08.3	04.8	07.2	2.6	2.4	2.1
3.0	10,239	14.4	08.3	13.6	07.9	13.0	07.5	12.5	07.2	10.8	3.9	3.6	3.1
4.0	13,652	19.2	11.1	18.2	10.5	17.4	10.0	16.7	09.6	14.4	5.2	4.8	4.2
5.0	17,065	24.0	13.9	22.7	13.1	21.7	12.6	20.8	12.0	18.1	6.6	6.0	5.2
6.0	20,478	28.8	16.7	27.3	15.7	26.1	15.1	25.0	14.4	21.7	7.9	7.2	6.3
7.0	23,891	33.7	19.4	31.8	18.4	30.4	17.6	29.2	16.8	25.3	9.2	8.4	7.3
8.0	27,304	38.5	22.2	36.4	21.0	34.8	20.1	33.3	19.2	28.9	10.5	9.6	8.4
9.0	30,717	43.3	25.0	40.9	23.6	39.1	22.6	37.5	21.7	32.5	11.8	10.8	9.4
10.0	34,130	48.1	27.8	45.5	26.2	43.5	25.1	41.7	24.1	36.1	13.1	12.0	10.5
11.0	37,543	52.9	30.5	50.0	28.9	47.8	27.6	45.8	26.5	39.7	14.4	13.2	11.5
12.0	40,956	57.7	33.3	54.5	31.5	52.2	30.1	50.0	28.9	43.3	15.7	14.4	12.6
13.0	44,369	62.5	36.1	59.1	34.1	56.5	32.6	54.2	31.3	46.9	17.1	15.6	13.6
14.0	47,782	67.3	38.9	63.6	36.7	60.9	35.1	58.3	33.7	50.5	18.4	16.8	14.7
15.0	51,195	72.1	41.6	68.2	39.4	65.2	37.7	62.5	36.1	54.2	19.7	18.0	15.7
16.0	54,608	76.9	44.4	72.7	42.0	69.6	40.2	66.7	38.5	57.8	21.0	19.2	16.8
17.0	58,021	81.7	47.2	77.3	44.6	73.9	42.7	70.8	40.9	61.4	22.3	20.4	17.8
18.0	61,434	86.5	50.0	81.8	47.2	78.3	45.2	75.0	43.3	65.0	23.6	21.7	18.9
19.0	64,847	91.3	52.7	86.4	49.9	82.6	47.7	79.2	45.7	68.6	24.9	22.9	19.9
20.0	68,260	96.2	55.5	90.9	52.5	87.0	50.2	83.3	48.1	72.2	26.2	24.1	21.0
21.0	71,673	101.0	58.3	95.5	55.1	91.3	52.7	87.5	50.5	75.8	27.6	25.3	22.0
22.0	75,086	105.8	61.1	100.0	57.7	95.7	55.2	91.7	52.9	79.4	28.9	26.5	23.1
23.0	78,499	110.6	63.8	104.5	60.4	100.0	57.7	95.8	55.3	83.0	30.2	27.7	24.1
24.0	81,912	115.4	66.6	109.1	63.0	104.3	60.2	100.0	57.7	86.6	31.5	28.9	25.2
25.0	85,325	120.2	69.4	113.6	65.6	108.7	62.8	104.2	60.1	90.3	32.8	30.1	26.2
26.0	88,738	125.0	72.2	118.2	68.2	113.0	65.3	108.3	62.5	93.9	34.1	31.3	27.3
27.0	92,151	129.8	74.9	122.7	70.9	117.4	67.8	112.5	65.0	97.5	35.4	32.5	28.3
28.0	95,564	134.6	77.7	127.3	73.5	121.7	70.3	116.7	67.4	101.1	36.7	33.7	29.4
29.0	98,977	139.4	80.5	131.8	76.1	126.1	72.8	120.8	69.8	104.7	38.1	34.9	30.4
30.0	102,390	144.2	83.3	136.4	78.7	130.4	75.3	125.0	72.2	108.3	39.4	36.1	31.5
31.0	105,803	149.0	86.0	140.9	81.4	134.8	77.8	129.2	74.6	111.9	40.7	37.3	32.5
32.0	109,216	153.8	88.8	145.5	84.0	139.1	80.3	133.3	77.0	115.5	42.0	38.5	33.6
33.0	112,629	158.7	91.6	150.0	86.6	143.5	82.8	137.5	79.4	119.1	43.3	39.7	34.6
34.0	116,042	163.5	94.4	154.5	89.2	147.8	85.3	141.7	81.8	122.7	44.6	40.9	35.7
35.0	119,455	168.3	97.2	159.1	91.9	152.2	87.9	145.8	84.2	126.4	45.9	42.1	36.7
36.0	122,868	173.1	99.9	163.6	94.5	156.5	90.4	150.0	86.6	130.0	47.2	43.3	37.8
37.0	126,281	177.9	102.7	168.2	97.1	160.9	92.9	154.2	89.0	133.6	48.6	44.5	38.8
38.0	129,694	182.7	105.5	172.7	99.7	165.2	95.4	158.3	91.4	137.2	49.9	45.7	39.9
39.0	133,107	187.5	108.3	177.3	102.4	169.6	97.9	162.5	93.8	140.8	51.2	46.9	40.9
40.0	136,520	192.3	111.0	181.8	105.0	173.9	100.4	166.7	96.2	144.4	52.5	48.1	42.0
41.0	139,933	197.1	113.8	186.4	107.6	178.3	102.9	170.8	98.6	148.0	53.8	49.3	43.0
42.0	143,346	201.9	116.6	190.9	110.2	182.6	105.4	175.0	101.0	151.6	55.1	50.5	44.1
43.0	146,759	206.7	119.4	195.5	112.8	187.0	107.9	179.2	103.4	155.2	56.4	51.7	45.1
44.0	150,172	211.5	122.1	200.0	115.5	191.3	110.5	183.3	105.9	158.8	57.7	52.9	46.2
45.0	153,585	216.3	124.9	204.5	118.1	195.7	113.0	187.5	108.3	162.5	59.0	54.1	47.2
46.0	156,998	221.2	127.7	209.1	120.7	200.0	115.5	191.7	110.7	166.1	60.4	55.3	48.3
47.0	160,411	226.0	130.5	213.6	123.3	204.3	118.0	195.8	113.1	169.7	61.7	56.5	49.3
48.0	163,824	230.8	133.2	218.2	126.0	208.7	120.5	200.0	115.5	173.3	63.0	57.7	50.4
49.0	167,237	235.6	136.0	222.7	128.6	213.0	123.0	204.2	117.9	176.9	64.3	58.9	51.4
50.0	170,650	240.4	138.8	227.3	131.2	217.4	125.5	208.3	120.3	180.5	65.6	60.1	52.5
51.0	174,063	245.2	141.6	231.8	133.8	221.7	128.0	212.5	122.7	184.1	66.9	61.3	53.5
52.0	177,476	250.0	144.3	236.4	136.5	226.1	130.5	216.7	125.1	187.7	68.2	62.5	54.6
53.0	180,889	254.8	147.1	240.9	139.1	230.4	133.0	220.8	127.5	191.3	69.5	63.8	55.6
54.0	184,302	259.6	149.9	245.5	141.7	234.8	135.6	225.0	129.9	194.9	70.9	65.0	56.7
55.0	187,715	264.4	152.7	250.0	144.3	239.1	138.1	229.2	132.3	198.6	72.2	66.2	57.7
56.0	191,128	269.2	155.4	254.5	147.0	243.5	140.6	233.3	134.7	202.2	73.5	67.4	58.8
57.0	194,541	274.0	158.2	259.1	149.6	247.8	143.1	237.5	137.1	205.8	74.8	68.6	59.8
58.0	197,954	278.8	161.0	263.6	152.2	252.2	145.6	241.7	139.5	209.4	76.1	69.8	60.9
59.0	201,367	283.7	163.8	268.2	154.8	256.5	148.1	245.8	141.9	213.0	77.4	71.0	61.9
60.0	204,780	288.5	166.5	272.7	157.5	260.9	150.6	250.0	144.3	216.6	78.7	72.2	63.0

TABLE 5: TOTAL AMPERAGE RATING CHART (CONT'D...)

kW Ratings	BTUH	208V		220V		230V		240V		277V	440V	480V	550V
		1 PH	3 PH	1 PH	3 PH	1 PH	3 PH	1 PH	3 PH	1 PH	3 PH	3 PH	3 PH
61.0	208,193	293.3	169.3	277.3	160.1	265.2	153.1	254.2	146.7	220.2	80.0	73.4	64.0
62.0	211,606	298.1	172.1	281.8	162.7	269.6	155.6	258.3	149.2	223.8	81.4	74.6	65.1
63.0	215,019	302.9	174.9	286.4	165.3	273.9	158.1	262.5	151.6	227.4	82.7	75.8	66.1
64.0	218,432	307.7	177.7	290.9	168.0	278.3	160.7	266.7	154.0	231.0	84.0	77.0	67.2
65.0	221,845	312.5	180.4	295.5	170.6	282.6	163.2	270.8	156.4	234.7	85.3	78.2	68.2
66.0	225,258	317.3	183.2	300.0	173.2	287.0	165.7	275.0	158.8	238.3	86.6	79.4	69.3
67.0	228,671	322.1	186.0	304.5	175.8	291.3	168.2	279.2	161.2	241.9	87.9	80.6	70.3
68.0	232,084	326.9	188.8	309.1	178.5	295.7	170.7	283.3	163.6	245.5	89.2	81.8	71.4
69.0	235,497	331.7	191.5	313.6	181.1	300.0	173.2	287.5	166.0	249.1	90.5	83.0	72.4
70.0	238,910	336.5	194.3	318.2	183.7	304.3	175.7	291.7	168.4	252.7	91.9	84.2	73.5
71.0	242,323	341.3	197.1	322.7	186.3	308.7	178.2	295.8	170.8	256.3	93.2	85.4	74.5
72.0	245,736	346.2	199.9	327.3	189.0	313.0	180.7	300.0	173.2	259.9	94.5	86.6	73.6
73.0	249,149	351.0	202.6	331.8	191.6	317.4	183.3	304.2	175.6	263.5	95.8	87.8	76.6
74.0	252,562	355.8	205.4	336.4	194.2	321.7	185.8	308.3	178.0	267.1	97.1	89.0	77.7
75.0	255,975	360.6	208.2	340.9	196.8	326.1	188.3	312.5	180.4	270.8	98.4	90.2	78.7
76.0	259,388	365.4	211.0	345.5	199.5	330.4	190.8	316.7	182.8	274.4	99.7	91.4	79.8
77.0	262,801	370.2	213.7	350.0	202.1	334.8	193.3	320.8	185.2	278.0	101.0	92.6	80.8
78.0	266,214	375.0	216.5	354.5	204.7	339.1	195.8	325.0	187.6	281.6	102.4	93.8	81.9
79.0	269,627	379.8	219.3	359.1	207.3	343.5	198.3	329.2	190.1	285.2	103.7	95.0	82.9
80.0	273,040	384.6	222.1	363.6	210.0	347.8	200.8	333.3	192.5	288.8	105.0	96.2	84.0
81.0	276,453	389.4	224.8	368.2	212.6	352.2	203.3	337.5	194.9	292.4	106.3	97.4	85.0
82.0	279,866	394.2	227.6	372.7	215.2	356.5	205.8	341.7	197.3	296.0	107.6	98.6	86.1
83.0	283,279	399.0	230.4	377.3	217.8	360.9	208.4	345.8	199.7	299.6	108.9	99.8	87.1
84.0	286,692	403.8	233.2	381.8	220.4	365.2	210.9	350.0	202.1	303.2	110.2	101.0	88.2
85.0	290,105	408.7	235.9	386.4	223.1	369.6	213.4	354.2	204.5	306.9	111.5	102.2	89.2
86.0	293,518	413.5	238.7	390.9	225.7	373.9	215.9	358.3	206.9	310.5	112.8	103.4	90.3
87.0	296,931	418.3	241.5	395.5	228.3	378.3	218.4	362.5	209.3	314.1	114.2	104.6	91.3
88.0	300,344	423.1	244.3	400.0	230.9	382.6	220.9	366.7	211.7	317.7	115.5	105.9	92.4
89.0	303,757	427.9	247.0	404.5	233.6	387.0	223.4	370.8	214.1	321.3	116.8	107.1	93.4
90.0	307,170	432.7	249.8	409.1	236.2	391.3	225.9	375.0	216.5	324.9	118.1	108.3	94.5
91.0	310,583	437.5	252.6	413.6	238.8	395.6	228.4	379.2	218.9	328.5	119.4	109.5	95.5
92.0	313,996	442.3	255.4	418.2	241.4	400.0	230.9	383.3	221.3	332.1	120.7	110.7	96.6
93.0	317,409	447.1	258.1	422.7	244.1	404.3	233.5	387.5	223.7	335.7	122.0	111.9	97.6
94.0	320,822	451.9	260.9	427.3	246.7	408.7	236.0	391.7	226.1	339.4	123.3	113.1	98.7
95.0	324,235	456.7	263.7	431.8	249.3	413.0	238.5	395.8	228.5	343.0	124.7	114.3	99.7
96.0	327,648	461.5	266.5	436.4	251.9	417.4	241.0	400.0	230.9	346.6	126.0	115.5	100.8
97.0	331,061	466.3	269.3	440.9	254.6	421.7	243.5	404.2	233.4	350.2	127.3	116.7	101.8
98.0	334,474	471.2	272.0	445.5	257.2	426.1	246.0	408.3	235.8	353.8	128.6	117.9	102.9
99.0	337,887	476.0	274.8	450.0	259.8	430.4	248.5	412.5	238.2	357.4	129.9	119.1	103.9
100.0	341,300	480.8	277.6	454.5	262.4	434.8	251.0	416.7	240.6	361.0	131.2	120.3	105.0
105.0	358,365	504.8	291.5	477.3	275.6	456.5	263.6	437.5	252.6	379.1	137.8	126.3	110.2
110.0	375,430	528.8	305.3	500.0	288.7	478.3	276.1	458.3	264.6	397.1	144.3	132.3	115.5
116.0	392,495	552.9	319.2	522.7	301.8	500.0	288.7	479.2	276.7	415.2	150.9	138.3	120.7
120.0	409,560	576.9	333.1	545.5	314.9	521.7	301.2	500.0	288.7	433.2	157.5	144.3	126.0
125.0	426,625	601.0	347.0	568.2	328.0	543.5	313.8	520.8	300.7	451.3	164.0	150.4	131.2
130.0	443,690	625.0	360.9	590.9	341.2	565.2	326.3	541.7	312.7	469.3	170.6	156.4	136.5
135.0	460,755	649.0	374.7	613.6	354.3	587.0	338.9	562.5	324.8	487.4	177.1	162.4	141.7
140.0	477,820	673.1	388.6	636.4	367.4	608.7	351.4	583.3	336.8	505.4	183.7	168.4	147.0
145.0	494,885	697.1	402.5	659.1	380.5	630.4	364.0	604.2	348.8	523.5	190.3	174.4	152.2
150.0	511,950	721.2	416.4	681.8	393.7	652.2	376.5	625.0	360.9	541.5	196.8	180.4	157.5
155.0	529,015	745.2	430.2	704.5	406.8	673.9	389.1	645.8	372.9	559.6	203.4	186.4	162.7
160.0	546,080	769.2	444.1	727.3	419.9	695.7	401.6	666.7	384.9	577.6	210.0	192.5	168.0
165.0	563,145	793.3	458.0	750.0	433.0	717.4	414.2	687.5	396.9	595.7	216.5	198.5	173.2
170.0	580,210	817.3	471.9	772.7	446.1	739.1	426.7	708.3	409.0	613.7	223.1	204.5	178.5
175.0	597,275	841.3	485.8	795.5	459.3	760.9	439.3	729.2	421.0	631.8	229.6	210.5	183.7
180.0	614,340	865.4	499.6	818.2	472.4	782.6	451.9	750.0	433.0	649.8	236.2	216.5	189.0
185.0	631,405	889.4	513.5	840.9	485.5	804.3	464.4	770.8	445.1	667.9	242.8	222.5	194.2
190.0	648,470	913.5	527.4	863.6	498.6	826.1	477.0	791.7	457.1	685.9	249.3	228.5	199.5
195.0	665,535	937.5	541.3	886.4	511.8	847.8	489.5	812.5	469.1	704.0	255.9	234.6	204.7
200.0	682,600	961.5	555.2	909.1	524.9	869.6	502.1	833.3	481.1	722.0	262.4	240.6	210.0

**TROUBLESHOOTING GUIDE**

SYMPTOMS AND PROBABLE CAUSE	POSSIBLE REMEDY
<b>HEATERS WILL NOT OPERATE</b>	
Power supply failure due to faulty wiring or incorrect fusing.	Check power supply starting at main disconnect switch. Check all wiring connections and fuses. Compare this with unit wiring diagrams & electrical data. Refer to Electrical Wiring Instructions found in this catalog.
Unit airflow insufficient to close airflow switch	Check unit fan speed per job specifications. Be sure all ductwork, airways and grilles and registers are clean and clear. Refer to Minimum Velocity Requirements section found in this catalog.
Automatic (or manual) reset thermal cutout may have opened when overheating occurred from insufficient airflow.	Shut off heating power. Operate fans to allow heater temperature to return to ambient so that cutouts may be reset.
<b>HEATER CYCLES</b>	
Airflow marginally insufficient.	Airflow switch may chatter and turn heater circuits on and off a cyclic basis. Or, automatic reset may open and close causing a similar situation. Refer to Minimum Velocity Requirements section found in this catalog. Check that air system is clean.
<b>IMPROPER TEMPERATURE REGULATION</b>	
Intermittent power supply due to improper installation.	Recheck installation procedure. Check contactor operation and safety cutout switches. Refer to unit wiring diagrams.
Erratic thermostat operation due to improper location or frequent resetting.	Check thermostat insulation instructions. Be sure that location is not subjected to adverse temperature changes such as those caused by doors or windows opening. Check that occupants are not tampering with thermostat settings.
Air system characteristics are not in accordance with job requirements.	Check that supply air fan is delivering adequate air volume and velocity. Check air system balance. Be sure that heating coils are operating.

CUSTOMER SELECTION ORDER

**Order No:** .....  
**To :** HACE  
**Atten :** Application Department  
**Tel :** 9661 265 1500  
**Fax :** 9661 265 5121

**Date :** ...../...../.....  
**Company Name :** .....  
**Contact Person :** .....  
**Project Name :** .....  
**Tel :** .....  
**Fax :** .....

Item Reference	Model	Qty	Duct Size		Capacity (KW)	No. Of Steps	Power Supply
			Width (mm)	Height (mm)			

- Magnetic ontrolling contactors ● Standard
- Power terminal block ● Standard
- Control terminal block ● Standard
- Control transformer ● Standard
- Air flow switch ● Standard
- Auto thermal cutout ● Standard
- Manual thermal cutout ● Standard
- Control fuse link and fues block ● Standard
- Power fuse link and fues block ● Standard

**Notes :**  
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**Signature:**  
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**NOTES:**

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# Products Range



**AIR COOLED WATER CHILLER 48 - 486 TR**  
Screw-Reciprocating



**AIR HANDLING UNIT (SINGLE & DOUBLE SKIN)**  
300 - 200,000 CFM



**PACKAGED AIR CONDITIONING UNIT**  
2 - 100 TR



**SLIM DUCTED CEILING FAN COIL UNITS**



**HIGH PRESSURE FAN COIL UNIT**



**AIR COOLED CONDENSING UNITS**  
2 - 160 TR



**FAN COIL UNITS**  
200 - 1,300 CFM



**CASSETTE TYPE AIR-CONDITIONER**



**MINI SPLIT UNIT**  
9,000 - 32,000 Btu/hr



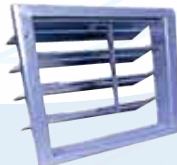
**ROOM A/C UNITS WINDOW SERIES**



**PRE-INSULATED PIPE**



**Ceiling/Side wall Diffusers**



**Back Draft Damper**



**Duct Heater HF Series**



**Duct Heater CHMS Series**



**Variable Air Volume (VAV) MODEL S**



**Variable Air Volume (VAV) MODEL SX**



**Variable Air Volume (VAV) MODEL V**



**Variable Air Volume (VAV) MODEL SR**



**AIRFOIL FANS**  
225 - 340,000 CFM



**VANE AXIAL FAN**  
3,000 - 250,000 CFM



**Sound Attenuator Round Type**



**Sound Attenuator Rectangular Type**

## Contact us

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