HF SERIES
INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS FOR ELECTRIC DUCT HEATERS

INSTALLATION INSTRUCTIONS

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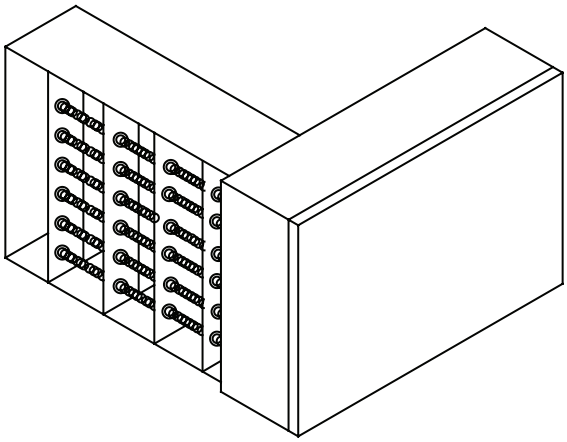


APPLICATION REQUIREMENTS

1. The duct system must provide uniform air flow over the entire face area of the heating elements. See Fig. 5.

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 a accordance with the standard of the National Fire Protection Association for the installation air-conditioning and ventilating systems of other than residence-type (Pamphlet No. 90A) and residence-type warm air heating and air-conditioning systems (Pamphlet No. 90B).

4. The heater should be installed at least 48 inch from the duct flanges of a heat pump of 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.

7. Heaters intended for use in internally lined ducts are identified by an “R” suffix to the model no. plus a number indicating the lining thickness, example 3HF5FR2 for 2” lining. Heaters so marked should be used only in air ducts lined with the designated thickness of insulation.

INSTALLATION PROCEDURES

1. Make sure air flow arrow on heater corresponds to air flow throught the duct and heater is properly postioned if marked with “top”.

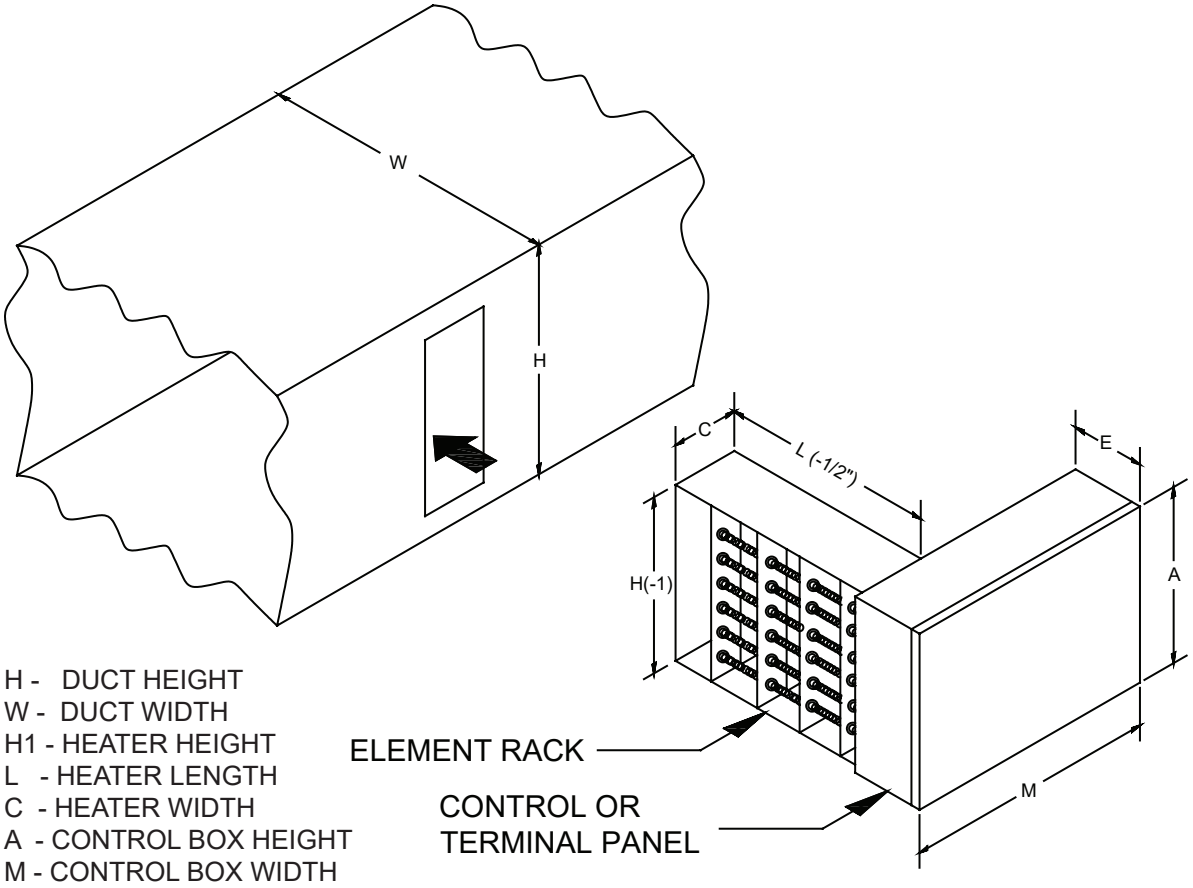
2. The heater terminal compartment should not be enclosed by insulation, etc.

3. Insert Type (Fig. 1) - Cut a hole in the side of the duct 1/8” larger than the element housing (H-1 X C) and insert the heater. Attach the back of the teminal box to the duct.

4. Flanged Type (Fig. 2) - Provide duct flanges to match heater flanges. Attach the heater to duct flanges with screws.

NOTE: Care should be taken in cutting opening in insulated duct to insure that insulation does not become excessively frayed which could create air-stream blockage. It may be advisable to secure the raw edge of insulation facing the air stream.

WARNING: All electrical connections in the heater, including both field and factory made connections, should be checked for tightness.



H - DUCT HEIGHT
W - DUCT WIDTH
H1 - HEATER HEIGHT
L - HEATER LENGTH
C - HEATER WIDTH
A - CONTROL BOX HEIGHT
M - CONTROL BOX WIDTH

FIGURE 1 - INSERT TYPE HEATER

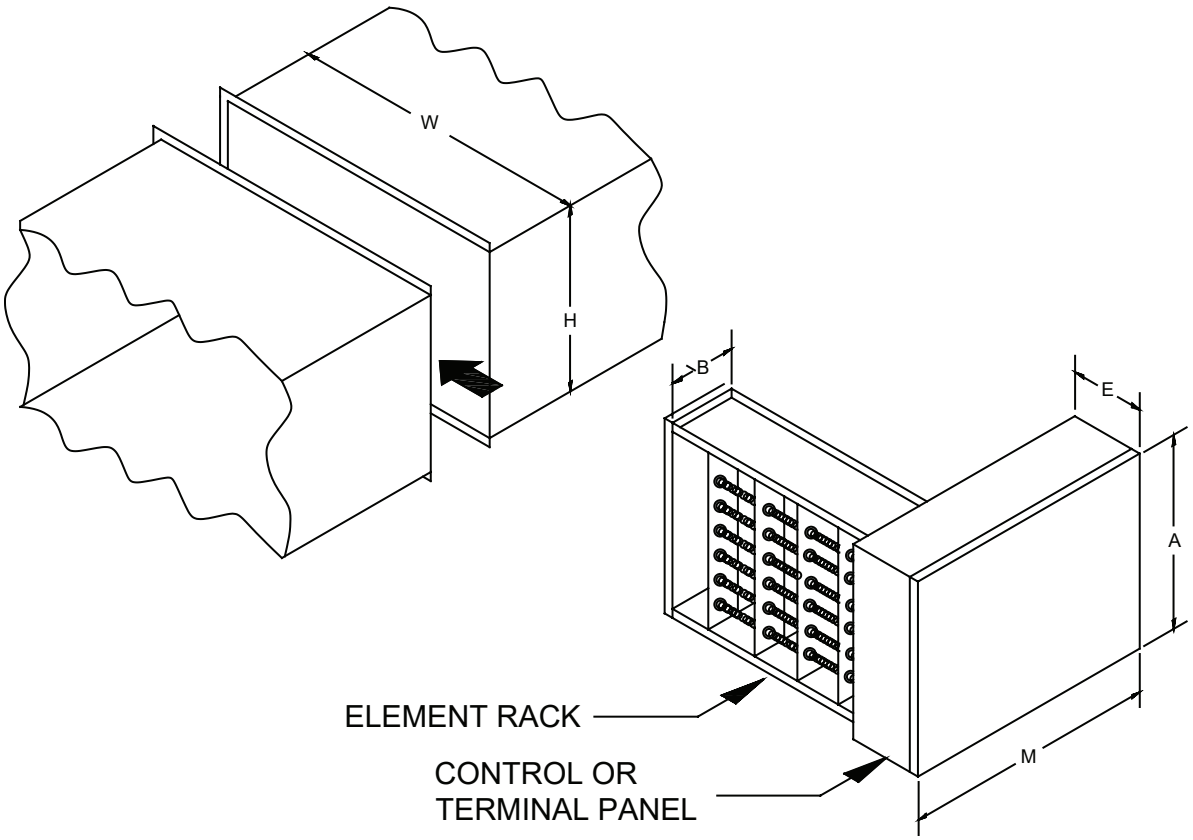


FIGURE 2 - FLANGED TYPE HEATER

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 enerigized in the same sequence as numbered in the heater.
2. All field wiring to the heater must meet the requirements of the N.E.C. 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 energized unless the fan is on. See diagram.
7. If heater does not have a built-in diconnect switch or main circuit breaker, install a remote disconnect (furnished by others) in accordance with the National Electrical Code, Article 424-65.
8. Do not bundle, tie or wrap power wiring in groups as this may cause over-heating and eventual breakdown of insulation.
9. For low voltage control circuits using two supply transformers with a heating-cooling thermostat, one for heating, one for cooling, a thermostat with isolating contacts must be used to prevent interconnection of the two different circuits.
10. When ETL listed duct heaters are used with ETL remote control panels, follow the specific interconnecting labels for matching the specific heater with the specific remote control panel.
11. All electrical connections in the heater, including both field and factory made connections, should be checked for tightness.

OVERCURRENT PROTECTION

UL 1996 requires compliance with paragraph 424-22 (c) of the National Electric Code as follows: “Electric space heating equipment employing resistance type heating elements rated more than 48 amperes shall have the heating elements sub-divided. Each subdivided load shall not exceed 48 amperes and shall be protected at not more than 60 amperes.”

This means that sub-circuit overcurrent 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 overcurrent protection.

MAXIMUM KW PER CIRCUIT FOR OVER-CURRENT PROTECTION (48 AMP)		
VOLTAGE	SINGLE PHASE	THREE PHASE
120	5.7	-----
208	9.9	17.2
240	11.5	19.9
277	13.2	-----
480	23.0	39.9
600	28.8	49.8
Two or more circuits may be paralledled to make one heating stage		

Figure 3

SIZING OF SUPPLY CONDUCTORS

The required minimum size of supply conductors is marked at the field wiring terminal within the heater control box, however for reference the following table is included. The wire gauges are calculated for 125% of the heater line current as required by the National Electrical Code, Article 424.3 (b) based on conductor insulation rated for 75°C (167°F).

SUPPLY WIRE SIZE (NOT MORE THAN 6 CONDUCTORS IN A CONDUIT(1)	
AWG OR MCM	MAX. HEATER LINE CURRENT(2)
	COPPER(3)
14	12
12	16
10	24
8	36
6	52
4	68
3	80
2	92
1	104
0	120
00	140
000	160
0000	184
250	204
300	228
350	248
400	268
500	304
600	336
700	368
750	380
800	392
900	416
1000	436

Figure 4

1. For 7-24 conductors in a raceway or cable reduce allowable heater line currents to 87% of those shown above.
2. Based on 30°C (86°F) ambient temperature. For higher ambient temperature, see N.E.C. Article 310.
3. Based on 80% of ratings in N.E.C. Article 310 for 75°C insulation.

CALCULATION OF LINE CURRENTS (AMPS)

To determine the line current, use the following formula:

(AMPS) SINGLE PHASE CURRENT = $\frac{\text{WATTS}}{\text{VOLTS}}$
Example: Single phase 5kw, 208volts $\frac{5000 \text{ watts}}{208 \text{ volts}}$ = 24 amps
THREE PHASE CURRENT = $\frac{\text{WATTS}}{\text{VOLTS}}$
Example: Three phase 14.4kw, 208 volts $\frac{14400 \text{ watts}}{208 \text{ volts} \times 1.73} = \frac{14400}{360}$ = 40amps

CAUTION - DO NOT OPERATE WITHOUT PROPER AIR FLOW

For efficent 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 insufficent air flow because overheating and subsequent malfuncion may result. The minimum air velocity required at any point should be determined by the graph below.

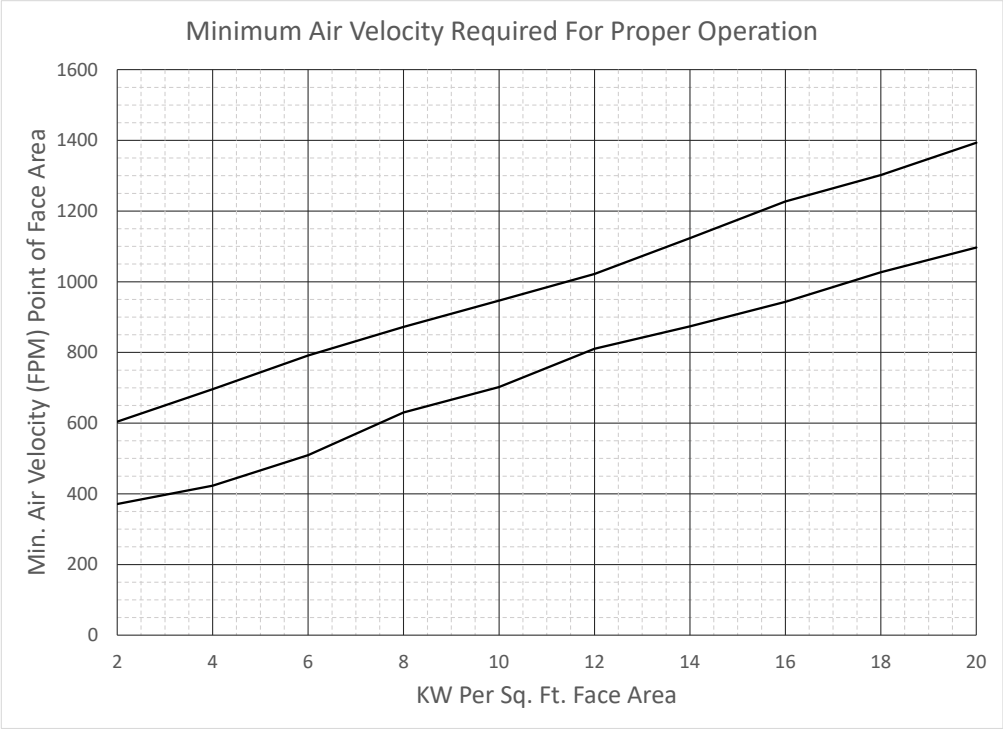


FIG. 5 MINIMUM AIR VELOCITY REQUIRED FOR PROPER OPERATION

Formula: H x W divided by 144=sq. ft./area

KW divided by area = KW/sq. ft. duct area (density)

H = Element Frame height - Inches
W = Element Frame width - Inches

MINIMUM AIR VELOCITY (FPM) AT EVERY POINT OF FACE AREA
(20 KW/sq. ft. is maximum wattage permissable)

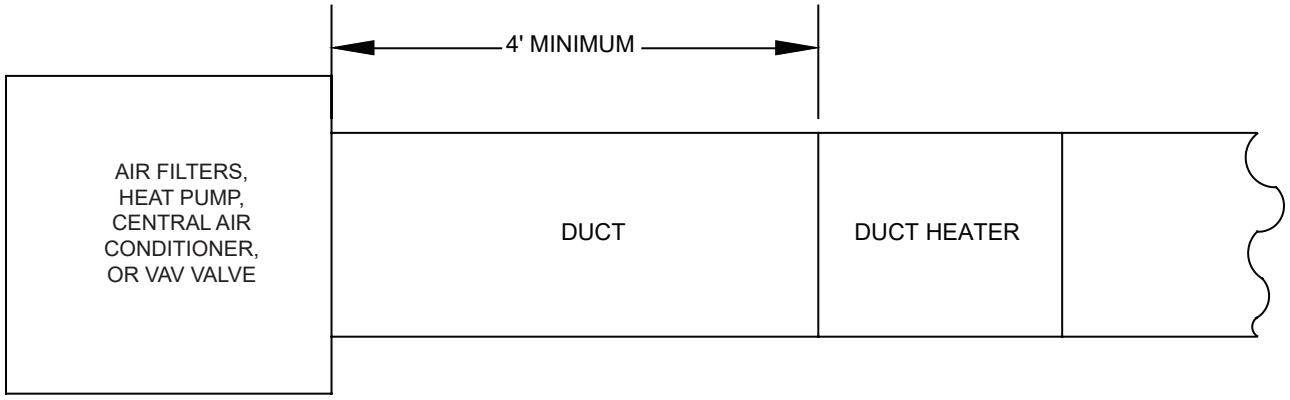


Figure 6
Should be installed at least 4 feet from a heat pump or central air conditioning unit.

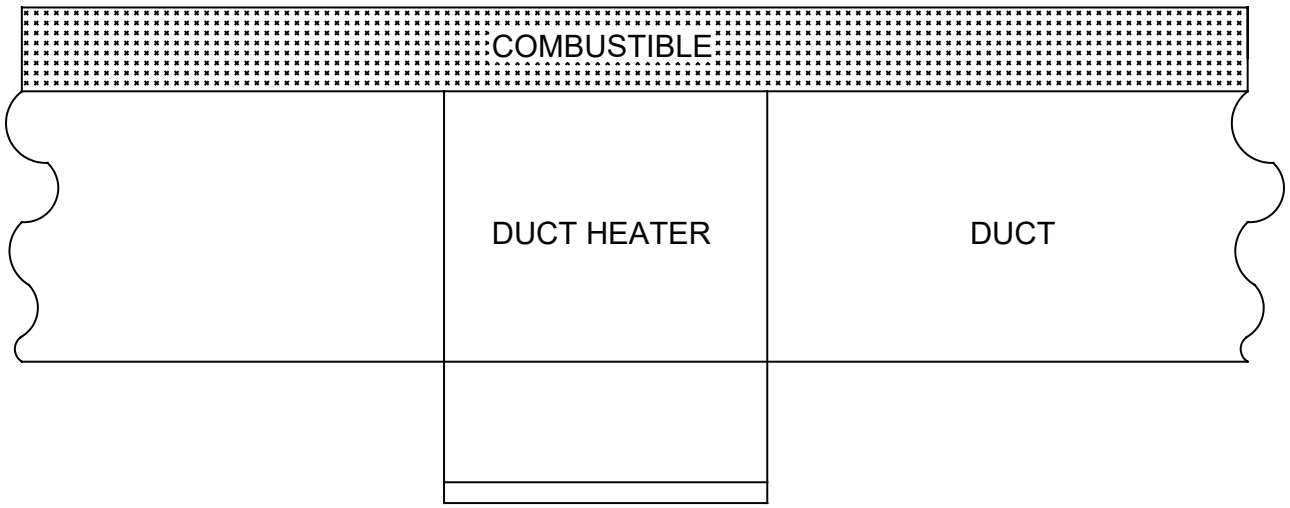


Figure 7
No clearance is required between the duct and combustible surfaces around the duct for HF series duct heaters.

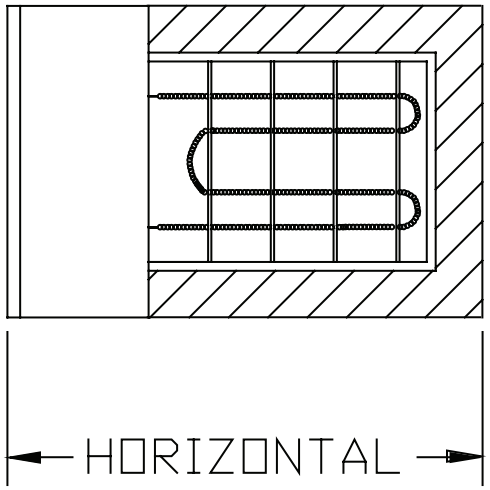


Figure 8
A duct heater must not be installed so that the heating element coils are strung vertically through the supporting racks. Ther terminal compartment must always be installed on the vertical side of the duct.

INSTALLATION RECOMMENDATIONS

The duct heater must be installed to assure uniform air flow through the entire face area of the heating elements. When installed within 4 feet of elbows, blower outlets, duct tranitions, etc., turning vanes or baffle plates may be required. Humidifiers should be located 4 feet downstream of the heater and should not wet electric insulators.

Figure 9

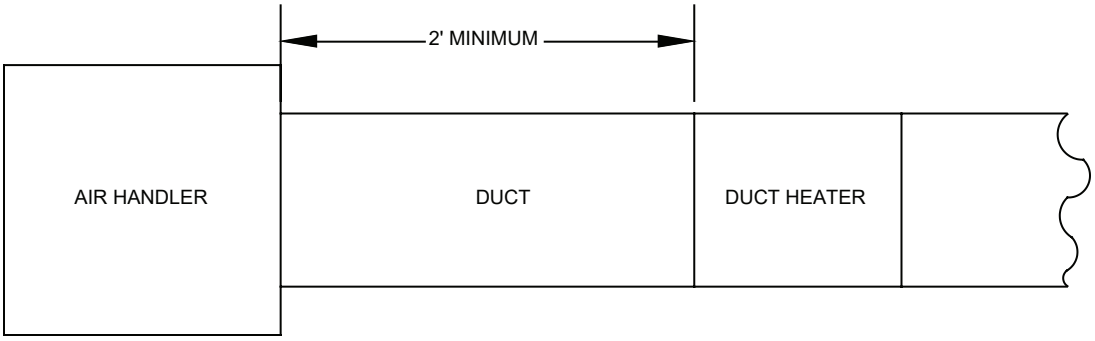


Figure 10

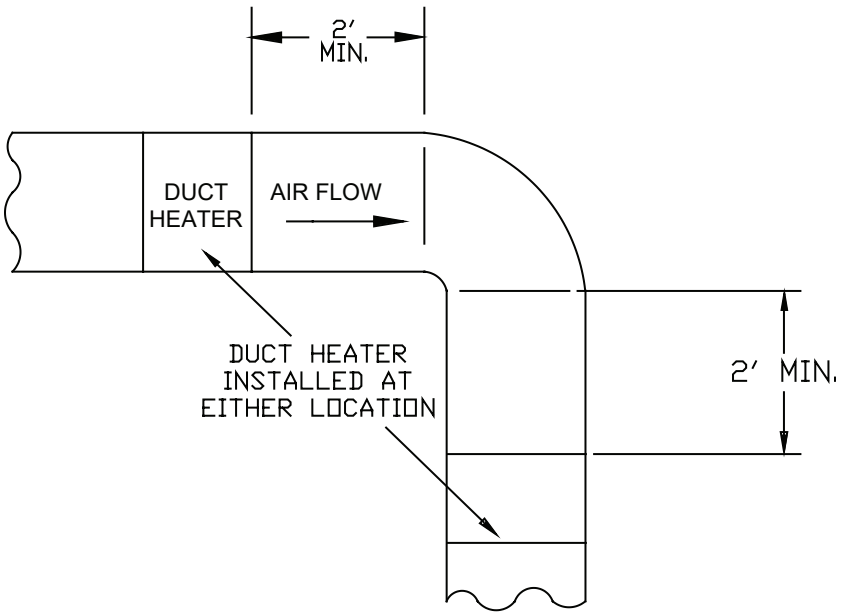
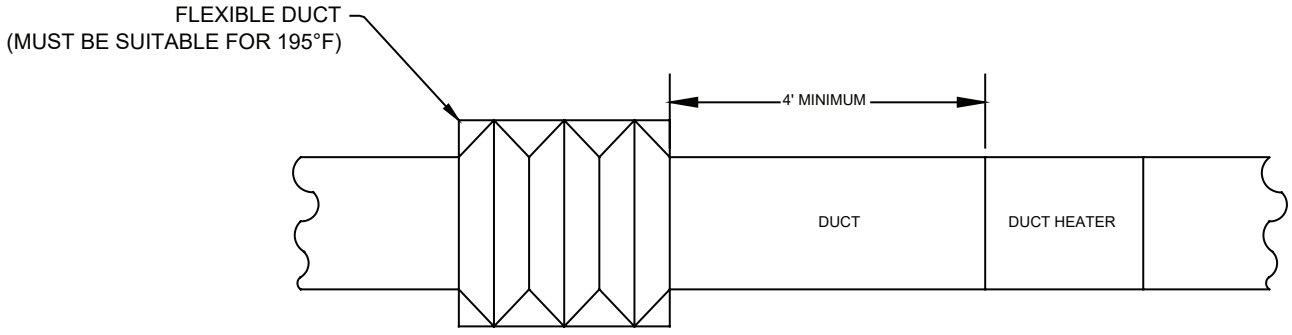


Figure 11



Where a duct heater must be installed near a flexible duct connection, be sure that a 4” minimum distance between duct heater and flexible connector exists and that the connector is suitable for 195 degree temperatures.

DUCT HEATER WIRING DIAGRAM
NOTES AND LEGEND

NOTES:

1. Field installed staging controller shown as typical. Coordinate field wiring with job requirements and actual controls used.
2. Wire so fan must run when heater is energized.
3. When the control circuit is 120 or 277 volt and is is preferable to wire for all switching in the hot line, jumper A2-Z may be removed and the HTCO(x) connected in series with the field installed staging controller. The neutral line must be connected to termainal Z (and B if applicable, see fiqure 2).
   CAUTION: If the A2-Z jumper is removed, the HTCO circuit must be field wired to directly de-energized all controlling contactor coils in the event the HTCO(s) (A1 to A2 circuit) opens. See Figure 1 for proper connections when BUC are not used or when CC and BUC are supplied from different circuits. See Figure 2 for proper connections when BUC and CC are the same voltage.

Figure 1

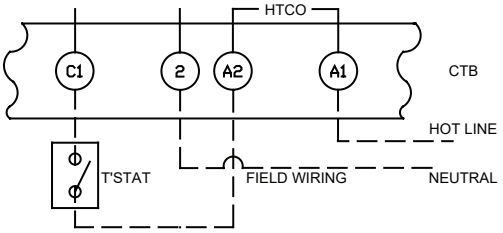
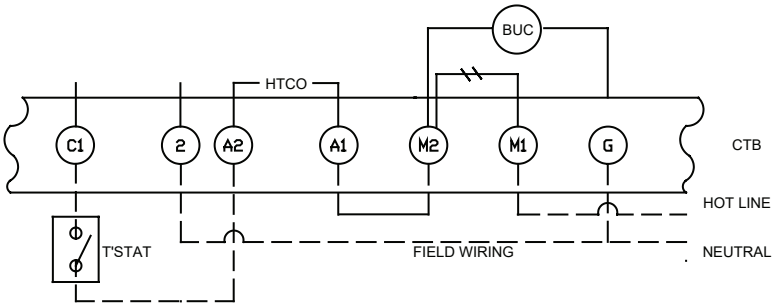


Figure 2



4. Control circuit must be NEC class 1 circuit.
5. Stage ‘C1” must always be first stage on and last stage off. All multiple stage heaters must be controlled to sequence on in ascending order and sequence off in descending order as marked at control terminal block, ie: C1, C2, C3, etc.
6. On P.E. controlled heaters, P.E. switches must be field set so that the sequence of operation is stage 1, first stage on, last stage off.
7. For supply circuit data see markings at supply terminals in the heater.
8. When heater uses a direct connected external control voltage source, that circuit must be N.E.C. class 1 wiring and must be protected by an overcurrent device rated 20 amps or less. That overcurrent device must be external to the heater.
9. On heaters with fusing, see fuse replacement marking showing fuse size and type at fuse block(s) in heater.
10. On heaters with integral pressure differential air flow switches (designated AFS on wiring diagram) note: A minimum air flow equivalent of 0.07 in. W.C. minimum is required for operation.
11. Where applicable, see nameplate for control voltage, VA, etc.

———	Factory Wiring
– – – –	Field Wiring
—wwww—	Heating Element
—○~○—	Overcurrent Protection (Fused or Circuit Breakers)
—○ ○—	Contacts of Contactor (adjacent no. indicates stage number)
——○—	Contactor Holding Coil (adjacent no. indicates stage number)
——o—	Wiring Terminal (adjacent no. indicates stage number)
—☼—	Indicator Light
—N—	Secondary Overtemperature Limit Control
	MRHTCO Manual Reset High Temperature Output
	TCO Thermal Cutoff (one time - replaceable type)
HTCO	Automatic Reset High Temperature Cut-Out (Primary System)
CC	Controlling Contactor (adjacent no. indicates stage number)
BUC	Back-up Contactor
AFS	Air Pressure Type Fan Interlock Switch
FR	Fan Interlock Relay
FTB	Fan Interlock Terminal Block
TD	Time Delay Relay
PE	Pneumatic-Electric Switch
FDS	Fused Disconnect Switch (field Supplied Per Job Requirements)
GND	Connection For Ground Circuit
CTB	Control Circuit Terminal Block
LTB	Line Terminal Block For Power Supply Connections
CIS	Cover Interlock Switch
PR	Pilot Relay
PS	Pilot Switch