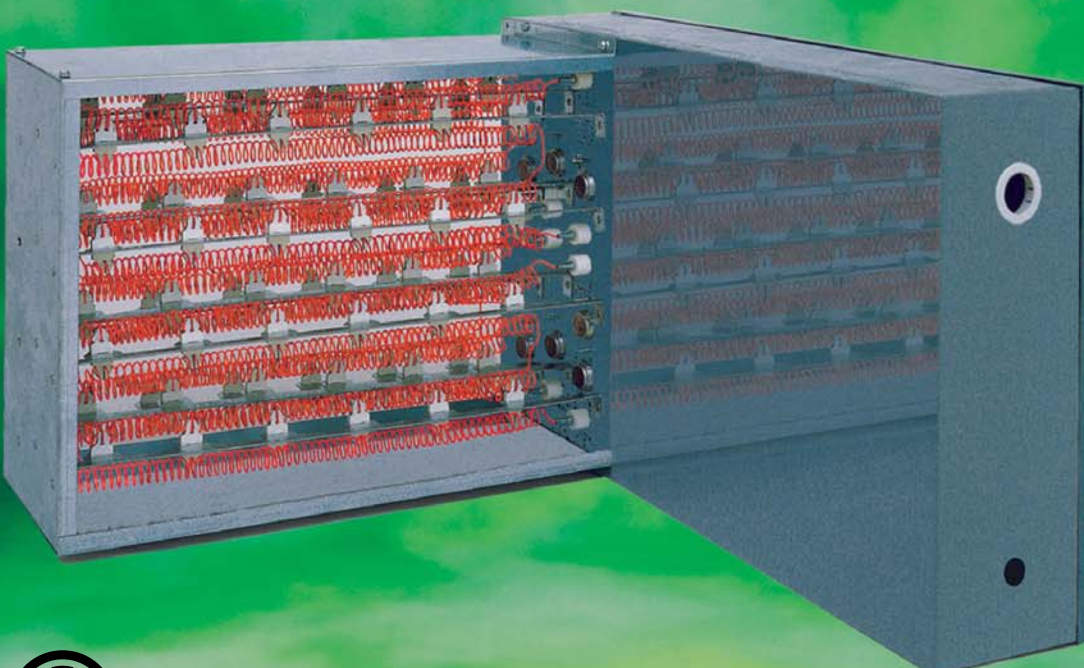
ELECTRIC DUCT HEATERS

NEW PRODUCT!



LISTED

- CUSTOM BUILT TO ORDER
- STOCK MODELS
- STANDARD RIBBED OR HIGH PERFORMANCE ARROWHEAD CERAMIC INSULATORS

MODEL SERIES: DH

Nailor Industries Inc.

CONTENTS

ETL LISTED   C ETL LISTED

Nailor Industries Inc. Electric Duct Heaters have been tested and approved to the following standards by ETL Testing Laboratories Inc., Courtland, N.Y.
(Listing Report No. 554250. Category: Duct Heaters 327 U.S.A. and 328 Canada)

ANSI/UL Standard 1996, 1st ed.

CSA Standard C22.2 No. 155-M1986.

Catalog No. DH June, 1999. Printed in Canada.

WARRANTY

Nailor Industries Inc. standard warranty extends only to the first purchaser of each new Electric Duct Heater. Nailor Industries Inc. guarantees that its products and components when installed correctly and in accordance with the manufacturer's installation instructions and when properly maintained, will be free from defects in workmanship and materials for one year after installation, but not to exceed 18 months after manufacture.

If a product or a component is found not to comply with this warranty, the duct heater shall be returned with a Return Material Authorization number freight pre-paid to the factory for examination. If failure is due to causes other than faulty installation or abuse, Nailor Industries Inc. will solely at their own option, repair or replace components parts found to be defective at no charge and return to the buyer with shipping charges pre-paid.

Nailor Industries Inc. will not be obligated in any way for any charges or costs in connection with trouble-shooting, removal, re-installation or return transportation of heaters or for any direct or indirect damages, loss of profits or incidental or consequential damages, howsoever caused.

Extended Warranty: Nailor Industries Inc. will offer an extended warranty of three years from ship date for all duct heaters so specified in the original engineering specification with 'Arrowhead' type insulators.

This extended warranty is also optionally available when requested on any and all duct heaters purchased with 'Arrowhead' type insulators regardless of original engineering design specification. Contact your Nailor Industries Inc. representative for further details.

INTRODUCTION

Nailor Electric Duct Heaters are self-contained heating units designed for installation in air handling systems. Some heaters are an integral part of other equipment, some have been approved for direct attachment to other equipment such as heat pumps, fans and variable air volume terminals, while others are approved for use as complete heating units to be mounted in air ducts.

Nailor Electric Duct Heaters provide precision heating for proper space control by handling dynamic heating load demands. Multiple locations within a single building allows maximum potential for individual control of each zone.

Nailor Electric Duct Heaters can be used as primary heat, preheat, reheat and supplemental heat or auxiliary heat.

Primary heat is the heat source for the entire building.

Preheat is used to temper air where it enters the building and prior to another air conditioning source.

Reheat is used to raise the air temperature of air previously conditioned by another process before distribution to the zone.

Supplemental or auxiliary heat is used to temporarily boost the heating capacity of another piece of equipment such as a heat pump.

Nailor Electric Duct Heaters are designed with electrical resistance elements arranged in the most advantageous pattern for heat transfer to the air stream. Nailor Duct Heaters provide constant heat as long as the heater is energized and the air velocity over the elements is constant. The wire surface temperature may vary from 800°F to 1200°F (427°C to 649°C) under normal conditions so that the operating temperature is below that which would produce a red glow.

Nailor Electric Duct Heaters are available with open coil, helically wound resistance heating elements exposed directly to the air stream. The elements are supported by ceramic insulators, either ribbed type that surround the element, or arrowhead type that leave the element completely exposed to the air stream. Open coil elements offer little resistance to airflow and provide a very small surface to attract dirt or lint.

RUSH PROGRAM

When time is at a premium and you need rapid delivery, Nailor can be relied upon to solve your problem.

Either choose from one of the select range of "Nailor stock" models or alternatively take advantage of one of the Nailor express shipping programs for custom "built to order" duct heaters:

One week shipment (5 working days)

48 hour shipment (2 working days)

Consult your local Nailor representative for further information.

TWO BASIC CONFIGURATIONS

Slip-in/Insert Type (standard):

Slip-in type heaters are constructed to slide the entire frame, excluding the terminal box, into an opening in one side of a duct without removing or disturbing the duct section.

Flanged Type (optional):

Flanged heaters are constructed with flanges on the heater frame. They become a section of the duct when installed. The inside dimensions of the frame match the inside dimensions of the duct.

THE NAILOR MODELS

Model DHR:

The basic ETL listed slip-in model with all controls in an enclosed panel attached to the heater. The element wire is encapsulated in ribbed ceramics. Model DHR is available in custom sizes and all kW ranges. All controls and accessories can be used with the model DHR.

Model DHA:

Same as the Model DHR except with arrowhead insulators that leave the entire element wire exposed to the air stream. Model DHA is ETL listed and available in custom sizes and all kW ranges. All controls and accessories can be used with the model DHA.

Models DRR & DRA :

The same as Models DHR and DHA respectively, except arranged for remote panels. These units must be sold and shipped with the ETL listed Model DRP Remote Panel.

Model DRP:

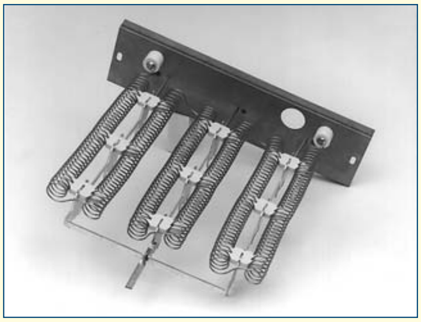
An ETL listed Remote Panel Assembly for use with one of the heaters (Model DRR or DRA) by Nailor. The panel assembly can be wall or floor mounted. All controls for the heater are housed in this panel with the exception of the high temperature limit switches and the airflow switch.

OEM Strip Heaters:

Nailor manufactures and supplies electric heater sub-assemblies on an OEM basis for various applications to the appliance, air conditioning and heating industries.

Nailor welcomes all inquiries as a manufacturer's manufacturer. Our products are custom designed for our clients. Our engineering staff will work closely with you to solve either a specific problem, improve or cost reduce a product or design and develop an entirely new product.

Typical OEM Strip Heater



CONSTRUCTION FEATURES

Main power supply terminal blocks are provided as standard for field connection.

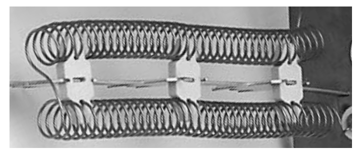
Fuses are provided as standard equipment on all heaters exceeding 48 amps. The total load will be equally divided into circuits of no more than 48 amps each. Each circuit will be fused at a maximum of 60 amps. Fuses are optional on all other heaters.

Fuses are required on non-Class 2 transformers. Class 2 transformers do not require fuses.

Nailor manufactures every element wire for each application from highest grade nickel/chromium wire for longer life and elimination of coil sag and oxidation. Conservative rating assures low operating temperatures, and coils do not glow if there is adequate airflow across the entire face.

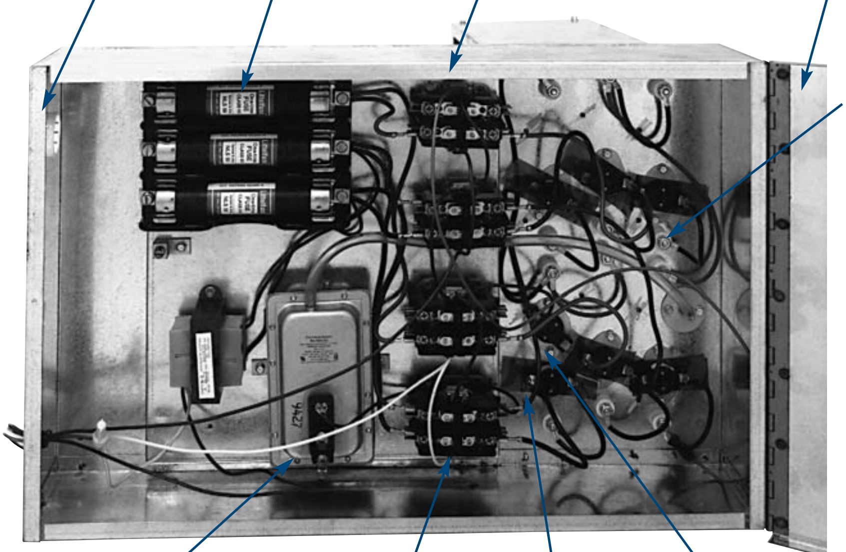
Ribbed type insulators with ceramic bushings feature support brackets that are specially reinforced along the edges. Holes are upset for extra strength.

Arrowhead type insulators (shown) optimize heat transfer.



Power knock-outs are properly sized for conduit connection.

Terminal box is heavy gauge, corrosion-resistant steel. (Galvanized is standard).



Solid, non-perforated box cover protects built-in contactors from dust; assures trouble-free operation. Screws are accessible from front. Cover is hinged.

Coil terminations are designed to provide trouble-free connections. Corrosion-resistant terminals and ceramic bushings resist high temperatures. Coil connection is mechanically crimped and nuts are tightened to specific torque. (See page 7).

- Corrosion-resistant terminal
- Resistance coil mechanically crimped to terminal

- High temperature ceramic bushings

Differential pressure airflow switch provides positive protection against loss of airflow.

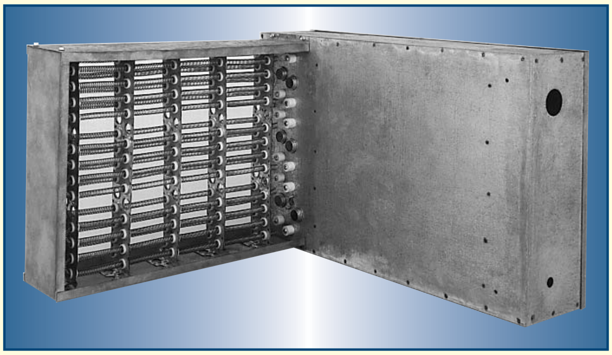
Magnetic contactor is built-in. (See contactors, magnetic, page 6; mercury, page 9).

Primary auto-reset

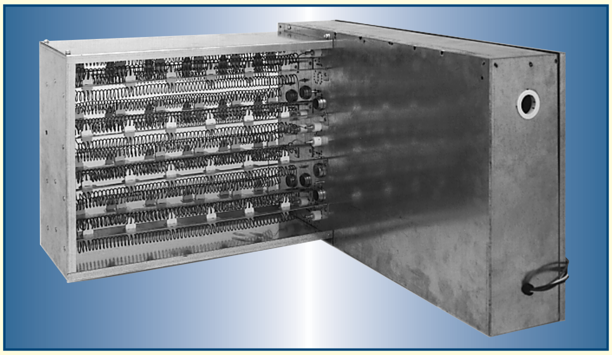
Secondary manual reset

Every Nailor Electric Duct Heater is complete with both primary and secondary over-temperature protection. An automatic resetting open disk high temperature limit will open the control circuit on the entire heater if an over-temperature condition exists. In case of failure, a secondary set of manually resetting or replaceable high temperature limits are wired in series with each element wire. These are set for higher temperatures than the automatic device to preclude nuisance tripping. A sufficient number of secondary limits are available to de-energize the heater in case of primary failure. All limits may be serviced through the control box. No back-up contactors are required. (See page 7).

MODELS DHR AND DHA
Basic Custom Heater Models
.1 to 1000 kW



Model DHR – Ribbed Insulators



Model DHA – Arrowhead Insulators

ELECTRICAL OPTIONS:

kW Range	.1 to 1000
Power Voltage:	120 to 600 VAC
Phase:	Single or Three
Control Voltage:	24, 120, 208, 240 or 277 VAC

ACCESSORIES:

1. Air Pressure Switch
2. Fan Interlock Relay
3. Manual Reset Limits
4. Insulation on Panel
5. Control Transformer (Class 2)
6. Control Transformer (Fused per NEC)
7. Circuit Fusing per NEC
8. Circuit Fusing in excess of NEC requirements
9. Circuit Breakers
10. Disconnect Switch (Toggle Type)
11. Disconnect Switch (Door Interlocking)
12. Quiet Contactors
13. Mercury Contactors
14. P.E. Switches
15. Step Controller
16. SCR Controller
17. Back-up Contactors
18. Pilot Light
19. Pilot Relay
20. Pilot Switch
21. 80 - 20 Wire
22. Recessed Terminal Box
23. Weather Protected Panel
24. Flanged Heater
25. Derated Coils
26. Top or Bottom Box

BASE HEATER INCLUDES:

- ETL Label
- Heating Elements
- Primary Auto Reset Disc Type Limit
- Secondary Disc Type Limit (manual reset or replaceable)
- Magnetic Contactors (for loads over 15 amperes)
- Air Pressure Switch or Fan Interlock Relay
- Circuit Fusing on heaters with loads over 48 amperes
- Field Terminal Connections for:
  input power source
  input control source, if required
  fan interlock relay, if required
- Enclosed Electrical Panel
- Element Wrapper
- Grounding Terminal
- Wiring Diagram
- Galvanized Steel Panel and Frame

UL STANDARD 1996 AND NEC REQUIREMENTS

Heaters with current loads over 48 amperes must be subdivided into multiple circuits, each of which must not exceed 48 amperes. Each sub-circuit must be internally fused or supplied with other overcurrent devices (circuit breakers) furnished by the heater manufacturer.

Heaters must be provided with a grounding terminal or lug.

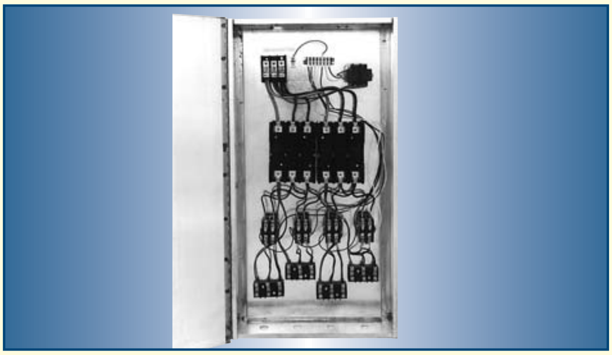
Heaters must be furnished by the manufacturer with an airflow switch (pressure type) or with fan interlock relays in the heater control panel.

Heaters must be furnished with an individual and specific wiring diagram permanently fixed to the control panel of the heater.

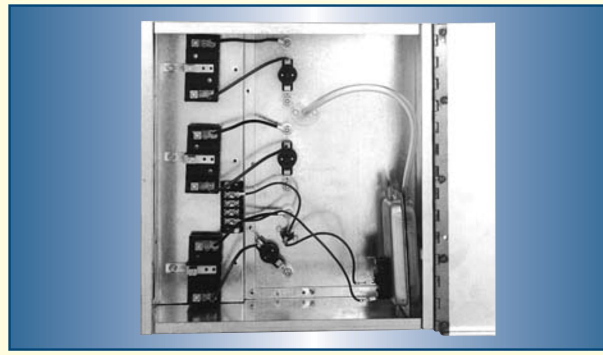
Heaters must be furnished with proper safety and warning labels to warn of electric shock hazard.

Heaters must be furnished by the manufacturer with installation instructions.

MODEL DRP
Basic Custom Remote Panels for Heater Models DRR and DRA
.1 to 1000 kW



Model DRP – Remote Panel



Model DRR/DRA Heater

ELECTRICAL OPTIONS:

kW Range	.1 to 1000
Power Voltage:	120 to 600 VAC
Phase:	Single or Three
Control Voltage:	24, 120, 208, 240 or 277 VAC

Model DRP remote panels are designed for use with Models DRR and DRA heaters to provide all necessary controls for the heater. Remote panels are most practical when space limits the size of the heater or when the heater is located in an area inconvenient for servicing.

ACCESSORIES:

1. Air Pressure Switch
2. Fan Interlock Relay
3. Manual Reset Limits
4. Insulation on Panel
5. Control Transformer (Class 2)
6. Control Transformer (fused per NEC)
7. Circuit Fusing per NEC
8. Circuit Fusing in excess of NEC requirements
9. Circuit Breakers
10. Disconnect Switch (Toggle Type)
11. Disconnect Switch (Door Interlocking)
12. Quiet Contactors
13. Mercury Contactors
14. P.E. Switches
15. Step Controller
16. SCR Controller
17. Back-up Contactors
18. Pilot Light
19. Pilot Relay
20. Pilot Switch
21. 80 - 20 Wire
22. Recessed Terminal Box
23. Weather Protected Panel
24. Flanged Heater
25. Derated Coils
26. Top or Bottom Box

BASE HEATER AND PANEL INCLUDES:

- ETL Label
- Heating Elements
- Primary Auto Reset Disc Type Limit
- Secondary Disc Type Limit (manual reset or replaceable)
- Magnetic Contactors (for loads over 15 amperes)
- Air Pressure Switch or Fan Interlock Relay
- Circuit Fusing on heaters with loads over 48 amperes
- Field Terminal Connections for:
  input power source
  input control source, if required
  fan interlock relay, if required
  interconnecting power from the heater to the remote panel
- Enclosed Electrical Panel
- Element Wrapper
- Grounding Terminal
- Wiring Diagram
- Galvanized Steel Panel and Frame

UL STANDARD 1996 AND NEC REQUIREMENTS

Heaters with current loads over 48 amperes must be subdivided into multiple circuits, each of which must not exceed 48 amperes. Each sub-circuit must be internally fused or supplied with other overcurrent devices (circuit breakers) furnished by the heater manufacturer.

Heaters must be provided with a grounding terminal or lug.

Heaters must be furnished by the manufacturer with an airflow switch (pressure type) or with fan interlock relays in the heater control panel.

Heaters must be furnished with an individual and specific wiring diagram permanently fixed to the control panel of the heater.

Heaters must be furnished with proper safety and warning labels to warn of electric shock hazard.

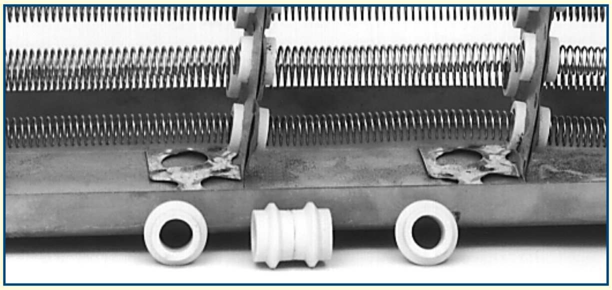
Heaters must be furnished by the manufacturer with installation instructions.

CONSTRUCTION COMPONENTS

Element Insulators – Two Options

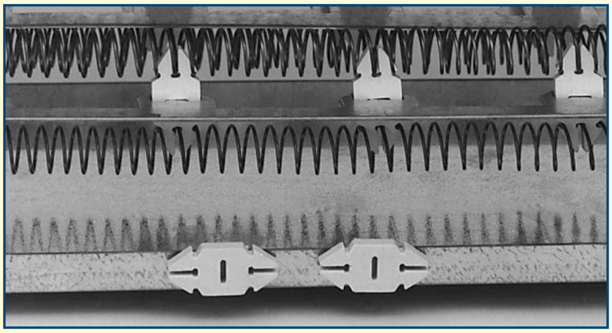
Nailor uses the highest grade ceramic insulators to hold the element wires in the air stream. One of two types of insulator are used.

Ribbed Type Insulators



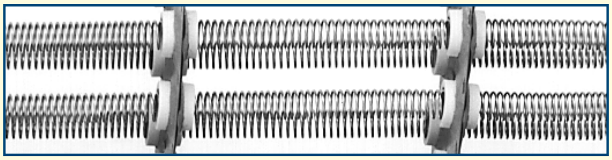
Nailor offers rack assemblies with ribbed insulators that are encapsulated within two layers of galvanized steel and allow the ceramic bushings to float within their own enclosures without allowing the rack to warp. They surround the element wire. These are generally used on larger size heaters as standard.

Arrowhead Type Insulators



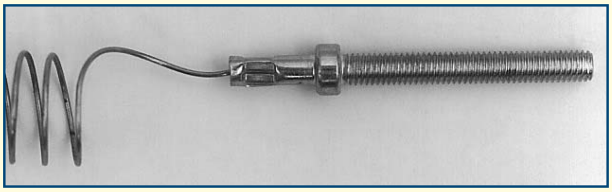
Nailor offers rack assemblies with arrowhead insulators that hold the element wire in the air stream while exposing the entire element surface to the air stream for improved heat transfer.

Element Wires



Every element wire is manufactured for each application from high quality nickel-chrome alloy wire. Element wires have limited densities to keep the surface temperature low for longer life and to eliminate coil sag. Conservative ratings assure low operating temperatures, and coils do not glow if adequate airflow is supplied to the entire face of the heater. Class 'A' 80/20 nickel/chrome wire is available as an option.

Element Termination



Nailor provides electrical and mechanical bonding between the element wires and the corrosion-resistant hardware for long lasting connections on both ends of each element wire.

Control Box

Electric Duct Heaters are supplied with sturdy control enclosures that have sealed seams; however, when required for dust tight applications, a gasket can be added between the enclosure and the door to improve the seal when the door is closed.

Primary High Limit Switch (auto-reset)

Nailor provides a disc type, automatic reset, high limit control device standard on all heaters for primary high temperature protection. This control automatically cuts the heater off if overheating should occur. It will automatically bring the heater back on after a cool down period. The disc type cut-offs are required by UL 1996 and NEC Article 424.

Secondary High Limit Switch (Manual Reset Or One Time Fuse)

Nailor provides either manually re-settable limit switches or one time fuses which are replaceable in the heater control panel. Replacement or servicing does not require removing the heater from the duct.

CONTROL COMPONENTS

Contactors

Used to energize individual steps of heat when a heater is electrically or electronically controlled. They are also used in pneumatically controlled heaters when the heater load exceeds the pneumatic-electric switch amp rating. One, two, three and four pole contactors are available with coil ratings of 24, 120, 240 and 277 VAC.

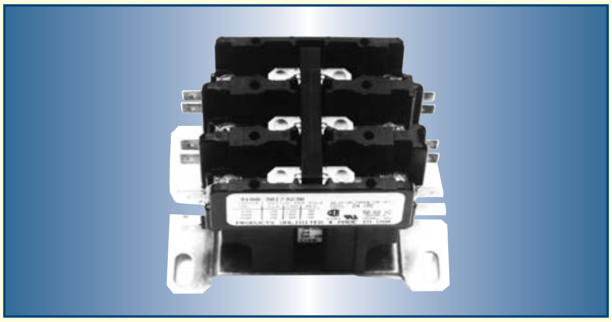
In some applications, a safety or back-up contactor is required to disconnect the heater when the circuit includes devices such as SCR or sequencers that carry the current load of the heater.

Contactors may be classified as de-energizing or disconnecting. De-energizing contactors are widely used and meet all NEC safety requirements. They interrupt service to all but one ungrounded power leg in the heater. Disconnecting contactors break all ungrounded power legs in the heater.

A one pole contactor is inherently a disconnecting type on all 120 and 277 volt single phase heaters, since these services have only one ungrounded power leg. 208, 240 and 480 volt single phase electrical services have two ungrounded power legs and therefore a single pole contactor would be de-energizing, a two pole contactor disconnecting. Three phase, 3-wire electrical services have three ungrounded power legs and therefore a two pole contactor used with these voltages is de-energizing and a three pole, disconnecting.

Certain local codes and specifications may overrule NEC requirements and require disconnecting contactors. This should be verified and stated on the order.

Magnetic Contactors



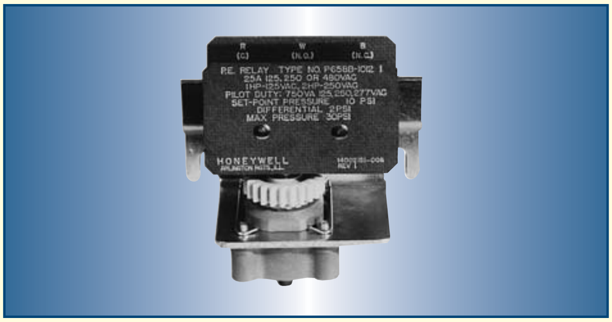
Magnetic contactors are the industry standard and are used in the vast majority of applications. They are reliable and very cost effective. However, their electro-magnetic action creates a clicking noise or chatter which may be audible in quiet surroundings.

Quiet contactors (not silent) of the magnetic type are also available.

Mercury Contactors

Nailor Electric Duct Heaters can be supplied with mercury contactors when control systems require frequent cycling or silent operation. Because of the sealed mercury contacts, chattering, arcing and noise are completely eliminated. Mercury contactors are durable with long life expectancies, however they are substantially more expensive than the magnetic type and are also position sensitive.

Pneumatic Electric (PE) Switches



Like contactors, PE switches are used to energize stages of electric heat. They are used exclusively on heaters that are pneumatically controlled and convert pneumatic pressure signals to electric or electronic signals. One PE switch is required per step of heat. Small heaters may often use a load carrying PE switch as the only control component. Local codes however may prohibit this practice and require back-up contactors. At a specified and factory pre-set input pressure, the electrical contacts on the switch make and so energize the heater. The switch can be wired to energize the heater on either a rising or falling pressure signal. The industry standard is for the switch to fail normally open with a reverse acting thermostat and normally closed with a direct acting room thermostat. The fail position must therefore be specified. A single pneumatic field connection is required, regardless of the number of stages in the heater.

CONTROL COMPONENTS

Air Proving Switches

Airflow Switch – Standard

UL Standard 1096 requires that a fan interlocking method must be provided as an integral part of the heater. This protects the heater and prevents it from being energized unless the fan is energized.

An airflow switch of the pressure type above is the best and most positive method of protection against loss of airflow. The switch has a built-in diaphragm that senses the pressure difference from the inside to the outside of the duct via a probe placed in the airstream facing against the direction of airflow and measuring total pressure. The airflow switch is wired in series with the primary auto-reset limit switch. If airflow stops or falls below 0.07" w.g. (17 Pa), contact is broken and the heater is de-energized.

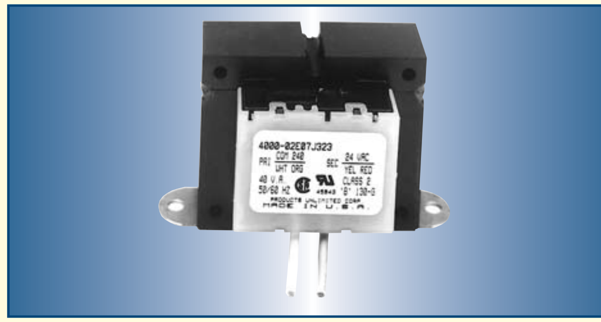
The air pressure switch is superior to a fan interlock relay as it protects against fan belt failure whereas the fan relay does not and it eliminates dependency on field wiring that the fan relay requires. For these reasons, Nailor Electric Duct Heaters are supplied with airflow switches as standard.

Fan Relay – Option

Nailor will provide a fan relay in lieu of an airflow switch when required or requested. There are two methods. *Standard Option A* – Fan Control Relay. The heater control circuit energizes the fan simultaneously with first stage of heater. An extra set of open contacts are provided on the first stage heater contactor and wired to a two pole terminal block with both poles marked 'fan'. In some applications a separate relay is provided with contacts wired to a terminal block and the holding coil wired into the common wire of the heater control circuit. This option is normally used where there is an individual fan for each heater and intermittent fan operation is desired.

Alternate Option B – Fan Interlock Relay. Prevents heater from operating unless the fan is energized. Utilizes a separate external power source, either from the load side of the fan starter or from the fan control voltage circuit. A separate relay with open contacts is wired to the common wire in the control circuit of the heater and the holding coil is wired to a terminal block. The fan interlock voltage must be specified when this option is ordered. This method is often used with continuous fan applications or where a common fan supplies several heaters.

Transformers



A control transformer is required on most electrically or electronically controlled heaters, when the control voltage differs from the line voltage and a separate control source is not available. The usual control voltage is 24 or 120 volts, reduced from the higher line voltage being used to power the heater.

Pneumatically controlled heaters also require a transformer where back-up contactors are required and a control voltage cannot be tapped directly from a three phase four wire or single phase three wire service.

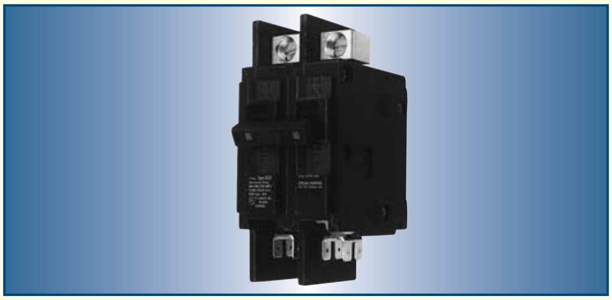
Class 2 transformers reduce line voltage to 24 volts, have built-in internal overcurrent protection and are used as standard when control power supply requirements are less than 100VA. When 24 volt control power supplies require more than 100 VA or the control voltage requirement is 120 volts, a transformer with primary fusing will be supplied per NEC requirements.

Fuses and Fuse Blocks

Nailor Electric Duct Heaters will be supplied standard with fuses and fuse blocks whenever the total load exceeds 48 amperes as required by NEC Article 424. Heaters with loads below 48 amperes can be supplied with fuses if requested. Heaters with loads in excess of 48 amperes must be subdivided into circuits of 48 amperes or less. Each circuit must be individually fused per NEC Article 424 for its individual load.

CONTROL COMPONENTS

Circuit Breakers

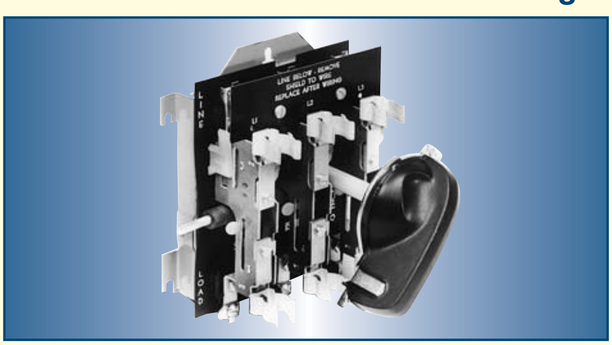


Nailor Electric Duct Heaters can be supplied with automatic circuit breakers in lieu of fuses and fuse blocks. Circuit breakers provide a convenient method of re-energizing heater circuits after the condition causing the trip has been corrected. If the total heater load is 48 amperes or less, a single circuit breaker can be substituted for a disconnect switch. In case of multiple circuits, usually over 48 amperes, multiple circuit breakers will be supplied.

Terminal Blocks (Power Distribution Blocks)

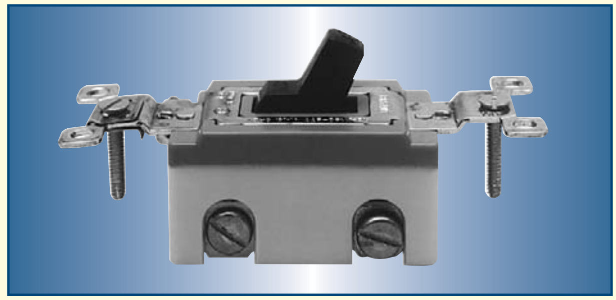
Nailor supplies terminal blocks or power distribution blocks for all field connections exceeding 24 VAC for convenient field connections. These blocks are sized to accept the correctly sized field wiring.

Disconnect Switch – Door Interlocking



Nailor Electric Duct Heaters can be supplied with Door Interlocking Disconnect Switches that will completely disconnect all components within the control enclosure before the door or cover will open. These switches can be furnished fused or non-fused and are available in single and three phase.

Disconnect Switch – Toggle type



Nailor Industries Electric Duct Heaters can be supplied with Toggle Disconnect Switches wired into the power circuit, as long as the total load on the switch is not in excess of 48 amperes which requires a 60 amp disconnect switch. Toggle type are available only as non-fused and are not door interlocking.

Toggle Switches (Pilot Duty)

Nailor Electric Duct Heaters are available with Toggle Switches that can be mounted in the control enclosure, allowing all or any part of the controlling contactors to be manually switched or locked out. These switches are wired into the control voltage circuit only. They are not available in the line voltage circuit.

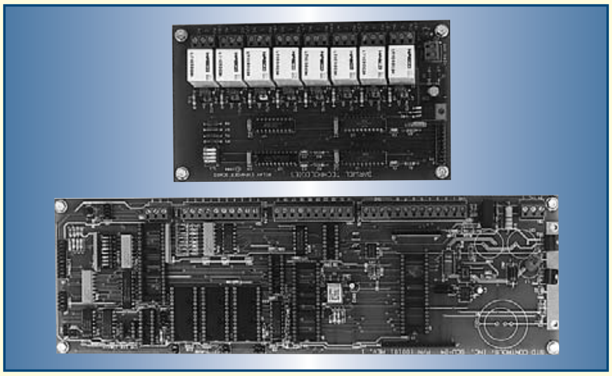
Pilot Lights

Nailor Electric Duct Heaters are available with pilot lights wired in the control voltage circuit and mounted in the control enclosure. Using these lights as signals, the operator can instantly visually note:

1. Heater on,
2. Number of stages on,
3. Airflow Switch open (or closed),
4. Control voltage on.

CONTROL COMPONENTS

Step Controllers

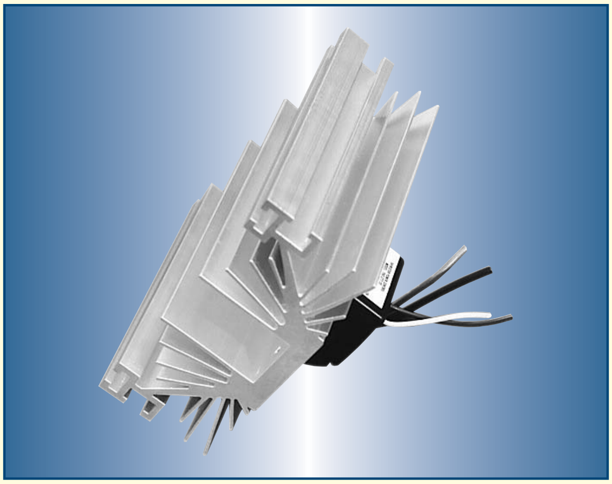


Nailor Electric Duct Heaters are available with electronic step controllers if required. They are used to stage multiple steps of heat with electric (beyond the capability of a traditional 2 or 3 stage thermostat) or pneumatic control. Switching multiple stages with step controllers ensures that the room set point does not drift as load requirements change.

A built-in transformer is required and provides a 24 volt control circuit. Pneumatic control includes a transducer to convert the air pressure changes to the electrical signal needed for the controls. For electric control, input may be either 0 – 135 ohm or thermistor.

These controls are such that if the power is interrupted, all the stages will recycle to off and upon restoring power, re-energize the switches in a stepping sequence.

SCR Controls



Nailor Electric Duct Heaters can be equipped with SCR controls. One hundred percent solid state proportioning control is noiseless and contains no mechanical switching devices. SCR controlled duct heaters provide very fine space temperature control and are designed for the highest reliability.

Modulation from 0 to 100% is achieved by time base proportional firing which is varied in response to the thermostat demands. Proportioning is achieved by varying the number of on cycles with regard to the off cycles. SCR controls are available for single or three phase heaters and can be operated with any available variable input source.

VOLTAGE/PHASE	MAXIMUM kW
120/1	10.0
208/1	20.0
240/1	24.0
277/1	21.0
480/1	18.0
208/3	45.0
240/3	55.0
480/3	54.0

Kilowatt Limitations For SCR Controllers

For large kW loads, the same fine control can be obtained by using a solid state Vernier Control System which utilizes both a SCR and an electronic step controller to control magnetic contactors.

The SCR operates first and will fine tune between the steps controlled by the step controller. It still offers 100% modulation, but only one stage is actually controlled by the SCR. The others are switched on and off by the step controller, as required by the room thermostat.

Miscellaneous Options

Derated Coils

Typically, Nailor Duct Heaters are derated to operate in the 40 to 60 watts per square inch of element surface density range. This is conservative enough to ensure a long service life. Nailor heaters may optionally be ordered with 35 or 25 watts per square inch element wire if 'very low' watt density is required. While derating of coils reduces the wire surface temperature, it is no substitute for good even air distribution and maintenance of minimum recommended airflow.

Bottom Mount Heaters

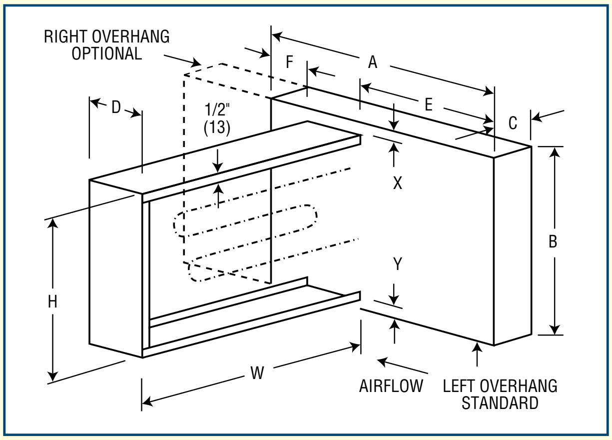
Bottom mounted, slip-in or flanged construction is optionally available, where due to space considerations, the control enclosure must be located below the duct.

Insulation On Panel (Vapor Barrier)

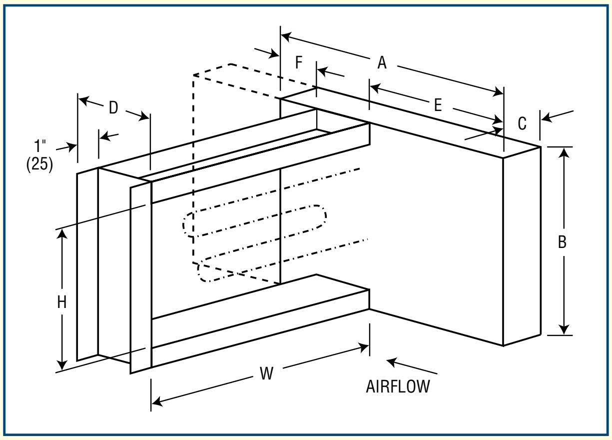
On the rare occasion when the heater is to be installed in un-insulated ductwork, condensation may form inside the control box. To eliminate this problem, the back of the control box can be factory insulated.

CONSTRUCTION – DIMENSIONAL DATA

Type DH – Slip-in (Standard)



Type DH – Flanged (Option)



Notes:

1a. For Slip-in:

W = Duct width – 1" (25).

H = Duct height – 2" (51).

B = H + 2" (51) standard.

X and Y = 1" (25) standard.

1b. For Flanged:

W and H = Duct size.

B = Duct height + 2" (51) standard.

2. F = 1" (25) standard.

3. A, B, C, D and E dimensions vary dependent upon controls.

If there is a critical dimension that the control panel may not exceed due to clearance restrictions, please note this information on the order form, otherwise the computer designed control panel will be supplied.

Nailor Electric Duct Heaters are available in custom sizes to suit any ductwork installation. Minimum size is 8" x 6" (203 x 152). Maximum size is unlimited.

Control enclosures and control layouts are custom computer designed for each heater. Sufficient space is provided for the mounting and wiring of the required components and to allow satisfactory heat dissipation.

They are furnished with left to right horizontal airflow and a left hand control panel overhang as standard (viewed when facing the panel). Standard position for the control panel is on the right side of the element rack when looking in the direction of airflow. Refer to the illustrations on the submittal form (page 31) for the various optional configurations available.

Nailor Electric Duct Heaters are available in two basic designs:

Slip-in (Standard)

The standard unit is a slip-in (insertion) design. Suitable for the majority of applications, the heater is installed into existing ductwork through a rectangular cut-out in the side of the duct. The duct cut-out should be approximately 1/2" (13) larger than the heater element rack depth and height for ease of installation.

The standard slip-in heater ordered by nominal duct size is built and undersized to accommodate the industry predominant 1" (25) internal duct installation.

They are undersized approximately 1" (25) in width and 2" (51) in height. This allows 1" (25) clearance around the three sides of the element rack. For other insulation thicknesses, deduct one insulation thickness from the actual duct width and two insulation thicknesses from the actual duct height and order by heater (not duct) size.

Example: Duct size is 18" (457) W x 12" (305) H with standard 1" (25) thick internal insulation. Standard slip-in heater is built as 17" (432) W x 10" (254) H.

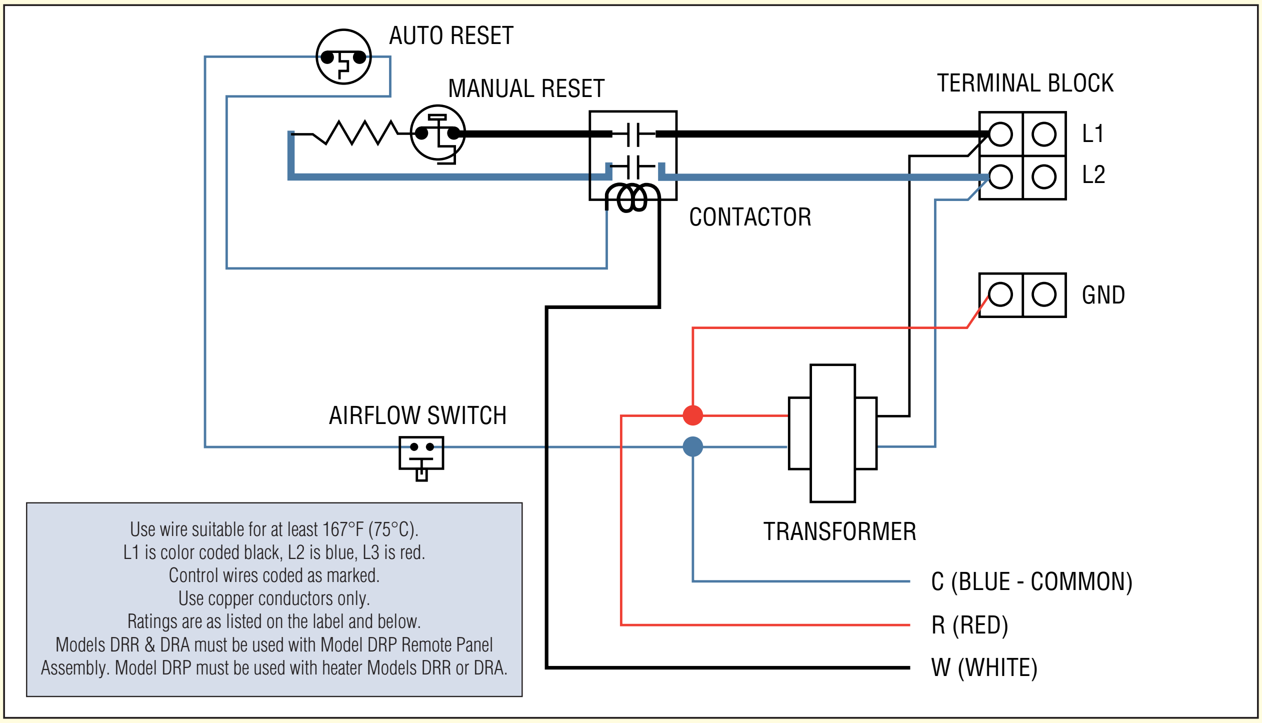
ORDER HEATERS BY NOMINAL DUCT DIMENSIONS UNLESS THE DUCT IS UNINSULATED OR HAS OTHER THAN 1" (25) INTERNAL INSULATION.

Flanged (Option)

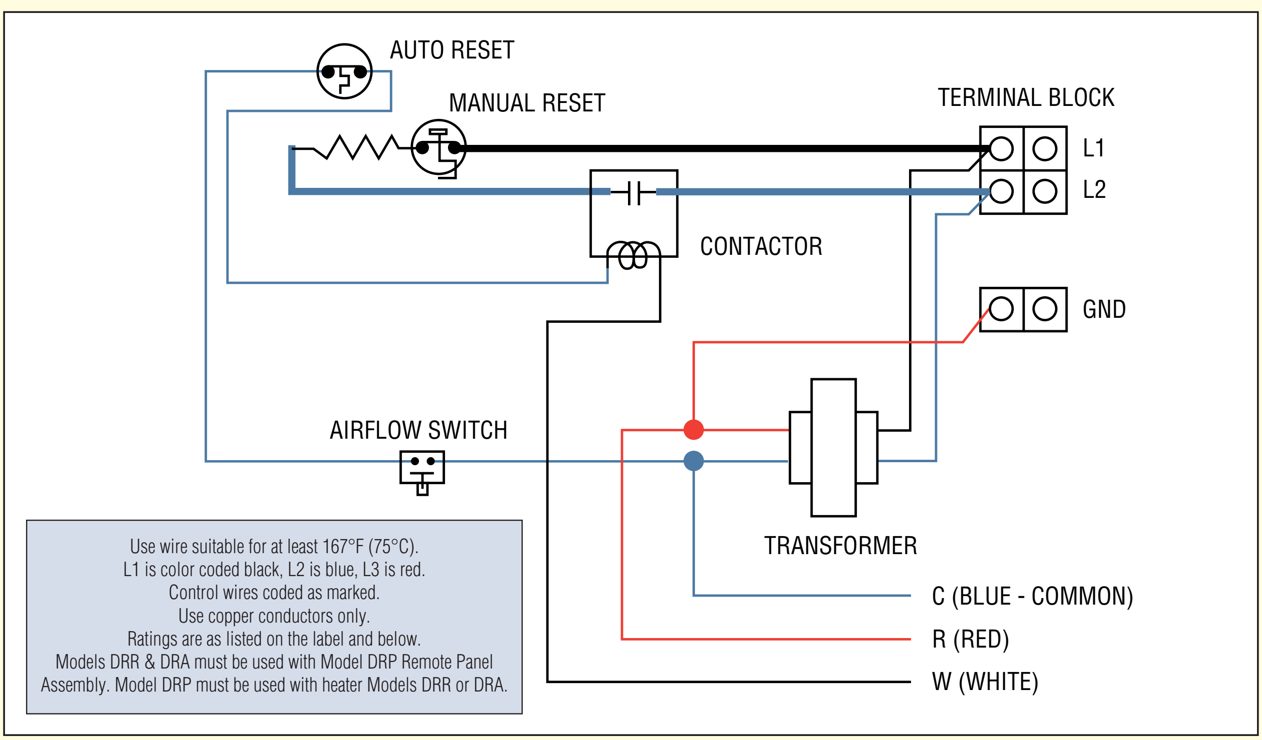
Flanges are turned out 1" (25) around three sides of the element rack, providing a mounting surface for the heater and adding additional rigidity for larger ducts. Bolts are generally run through the matching duct (which should also be flanged on three sides) and heater flanges to support the weight of the heater. Additional screws through the control cabinet into the duct complete the installation.

ORDERS FOR FLANGED HEATERS MUST SPECIFY ACTUAL DUCT SIZE.

WIRING DIAGRAMS

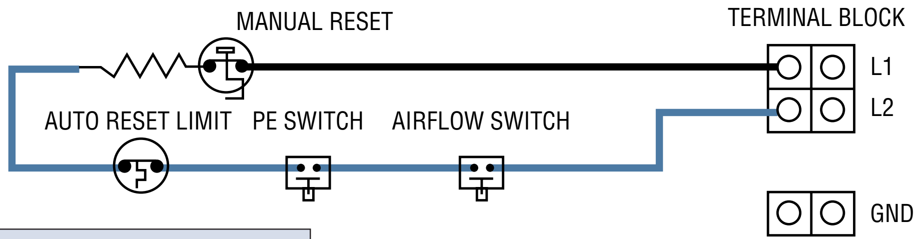


Typical Wiring Diagram No. 1
Single Stage – Airflow Switch – Disconnecting Contactor



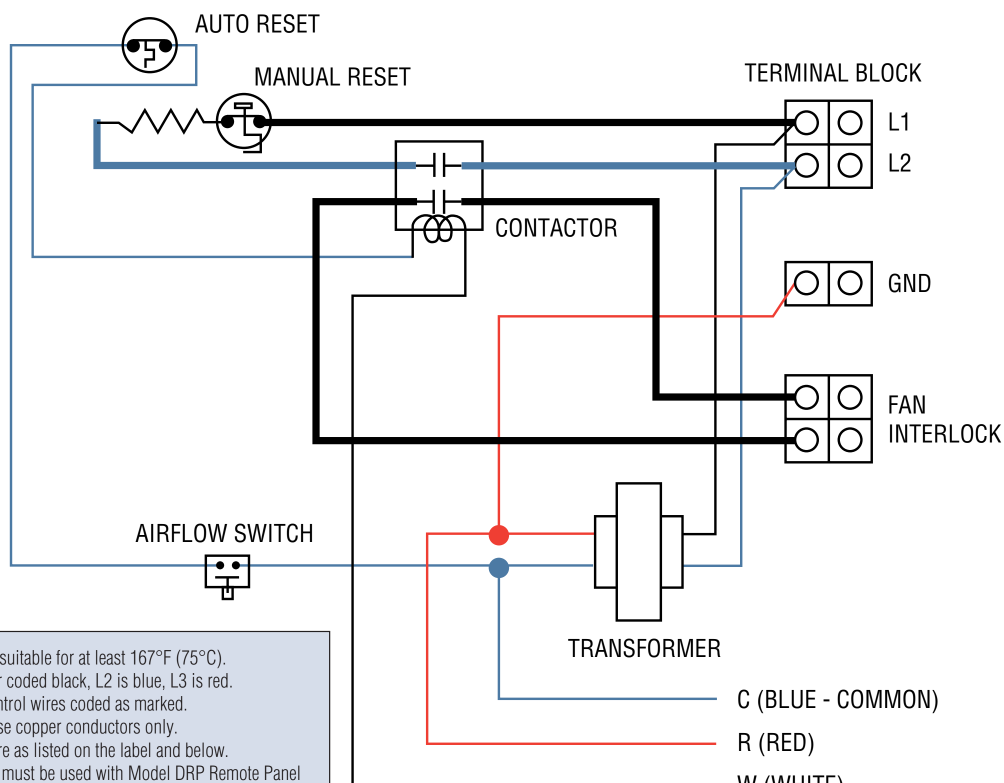
Typical Wiring Diagram No. 2
Single Stage – Airflow Switch – De-energizing Contactor

WIRING DIAGRAMS



Use wire suitable for at least 167°F (75°C).
L1 is color coded black, L2 is blue, L3 is red.
Control wires coded as marked.
Use copper conductors only.
Ratings are as listed on the label and below.
Models DRR & DRA must be used with Model DRP Remote Panel Assembly. Model DRP must be used with heater Models DRR or DRA.

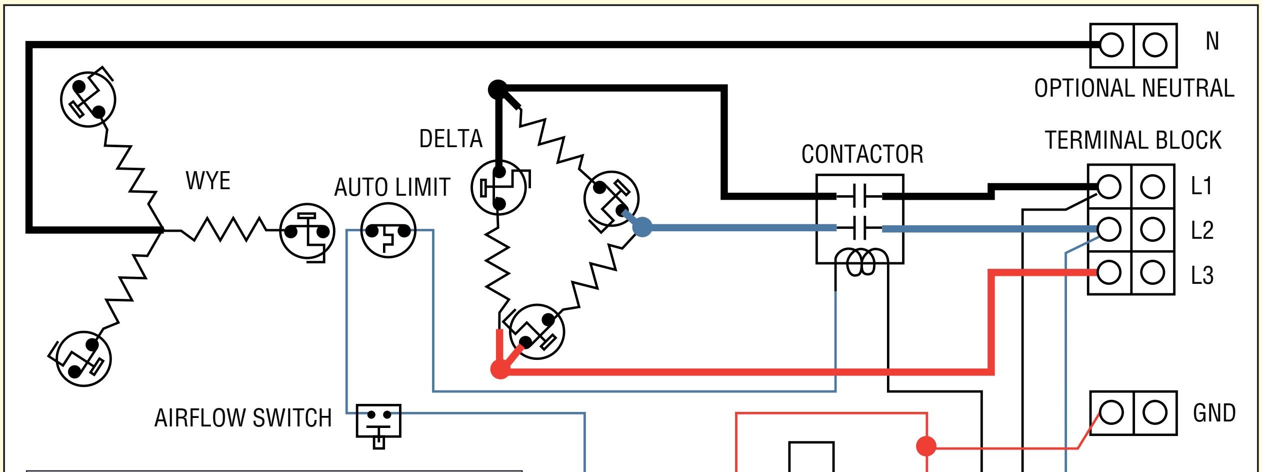
Typical Wiring Diagram No. 3
Single Stage – Airflow Switch – Pneumatic Controls



Use wire suitable for at least 167°F (75°C).
L1 is color coded black, L2 is blue, L3 is red.
Control wires coded as marked.
Use copper conductors only.
Ratings are as listed on the label and below.
Models DRR & DRA must be used with Model DRP Remote Panel Assembly. Model DRP must be used with heater Models DRR or DRA.

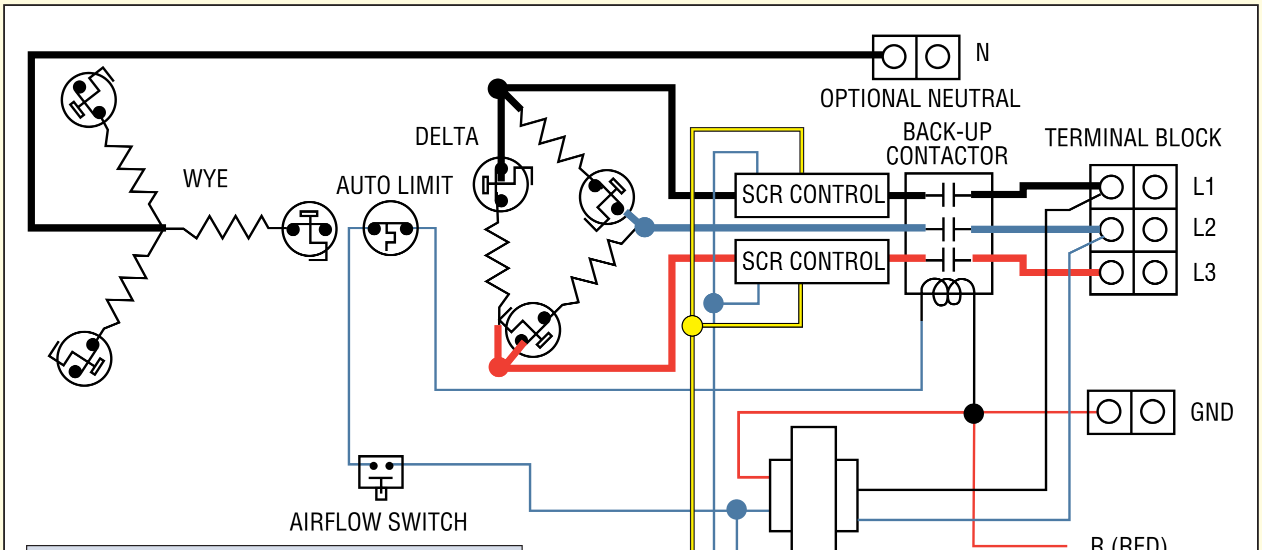
Typical Wiring Diagram No. 4
Single Stage – Fan Interlock – Contactor

WIRING DIAGRAMS



Use wire suitable for at least 167°F (75°C).
L1 is color coded black, L2 is blue, L3 is red.
Control wires coded as marked.
Use copper conductors only.
Ratings are as listed on the label and below.
Models DRR & DRA must be used with Model DRP Remote Panel Assembly. Model DRP must be used with heater Models DRR or DRA.

Typical Wiring Diagram No. 5 – Three Phase Delta or Wye
Airflow Switch – De-energizing Contactor – Transformer



Use wire suitable for at least 167°F (75°C).
L1 is color coded black, L2 is blue, L3 is red.
Control wires coded as marked.
Use copper conductors only.
Ratings are as listed on the label and below.
Models DRR & DRA must be used with Model DRP Remote Panel Assembly. Model DRP must be used with heater Models DRR or DRA.

Typical Wiring Diagram No. 6 – Three Phase Delta or Wye – Airflow Switch
Disconnecting Back-up Contactor – Transformer – SCR Control

ENGINEERING – HEATER SELECTION

Calculating kW, Amps and Resistance

Voltage is the energy available to push the current through the element wire and overcome the resistance. It is measured in volts and is constant within a building. Voltage within a building is whatever the power company provides unless the building occupant changes it with a transformer.

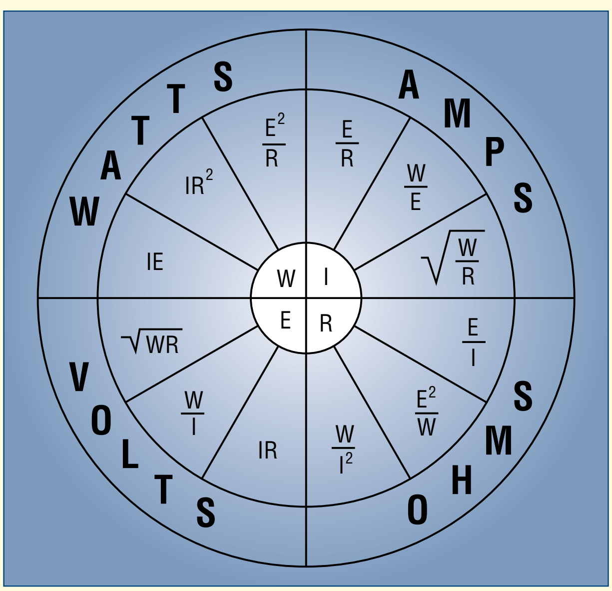
Amperage is the current (the number of electrons) flowing through the element wire. Current is measured in amps and depends on the voltage available and the resistance of the element wire.

Resistance is the resistance of the element wire. It is measured in Ohms. Resistance resists the flow of electrons and creates heat when voltage is applied to the element wire. Copper wire is usually sized by the amount of current that will flow through it when the heater is operating.

Wattage is the power produced when current flows through the element wire. Power is generally measured in kilowatts (watts x 1000). Work is power per unit of time, usually kW per hour for electric heaters. Power companies charge in units of kW-hours, or kW per hour x the number of hours the power was used.

Single Phase:

The relationships between power, voltage, amperage and resistance are defined for single phase electric heaters as shown in the chart below.



Ohms Law (applicable to single phase current).

Three Phase:

For three phase heaters, line current should be calculated using the following equation:

$$\text{Amperes (I)} = \frac{\text{Watts (W)}}{\text{Line Voltage (V)} \times 1.732}$$

Heat Capacity Calculations

$$\Delta T = \frac{kW \times 3160}{CFM}$$

$$kW = \frac{CFM \times \Delta T}{3160}$$

$$CFM = \frac{kW \times 3160}{\Delta T}$$

Where ΔT is the difference between discharge and inlet air temperature (temperature rise $T_2 - T_1$) in °F.

The above equations are based upon standard air at 13.33 ft^3/lb. density and a specific heat of 0.237 BTU/lb. - °F.

Ex.: 10 kW heater, 20" x 10" duct, 1000 cfm, inlet air = 75°F.

1. Determine temperature rise/outlet temperature.

$$\Delta T = \frac{kW \times 3160}{CFM} = \frac{10 \times 3160}{1000} = 31.6°F$$

Therefore, outlet air temperature = 75 + 31.6 = 106.6°F.

2. Determine heat requirement.

$$kW = \frac{CFM \times (T_2 - T_1)}{3160} = \frac{1000 \times (106.6 - 75)}{3160} = 10.0\ kW$$

3. Determine air volume.

$$CFM = \frac{kW \times 3160}{(T_2 - T_1)} = \frac{10 \times 3160}{106.6 - 75} = 1000\ CFM$$

Minimum Air Volume

Minimum airflow should be maintained at every point on the face of the heater. Since an electric duct heater maintains a constant BTU output while the heater is energized, minimum air velocity through the heater must be maintained in order to: a) achieve good heat transfer; b) prevent over-heating and nuisance tripping of the protection devices; and c) maintain life expectancy. Minimum acceptable uniform airflow across an electric duct heater is directly related to the temperature of the inlet air. The table below shows the minimum volume of air per kW for different inlet air temperatures. For non-standard air conditions or if unusually low outdoor air temperatures are to be tempered by electric heat, consult Nailor.

INLET AIR TEMPERATURE		MINIMUM AIRFLOW IN CFM PER kW (FOR DUCT AREA kW DENSITIES SHOWN)		
°F	°C	≤17 kW/sq. ft.	≤20 kW/sq. ft.	≤25 kW/sq. ft.
85	29	90	110	150
75	24	70	82	103
55	13	50	55	62
40	4	40	44	48
25	-4	33	36	39
0	-18	27	28	30

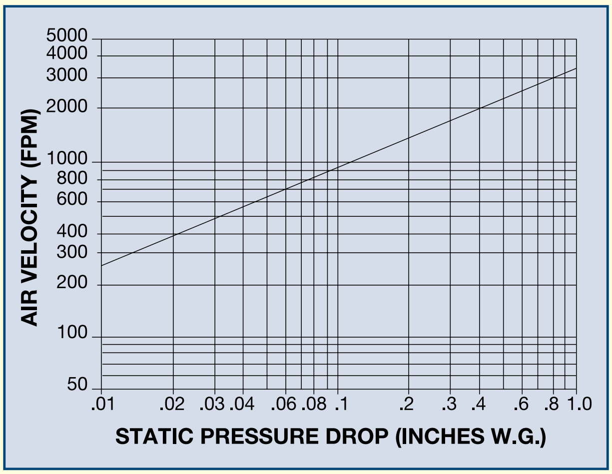
ENGINEERING – HEATER SELECTION

Maximum Heater kW

The maximum heat density permissible for Nailor Electric Duct Heaters is 25 kW/square foot, as shown in table on the previous page.

Pressure Drop

Static pressure drop through the duct heater may be conservatively estimated by using the 'Pressure Drop Through Heater' graph shown below. Pressure drop depends on the number of rows of heating elements and their density. This may vary widely dependent on coil size and capacity. The graph is based on an 8" (203) coil depth and will suffice for most applications.



Pressure Drop Through Heater (8" (203) Coil Depth)

Typical Contactor Power Circuitry

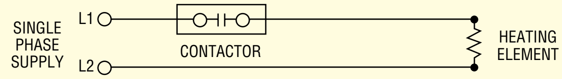
(only power circuit shown. Safety devices etc. omitted).

It is important to understand the difference between a full line break vs. a partial line break. In the partial line break arrangement, the contactor opens the current path, thus de-energizing the heater. De-energized elements deliver no heat but are electrically live. This arrangement is UL/CSA approved and because of its economy is offered as standard by Nailor. In order to make servicing safe, the disconnect switch must be opened.

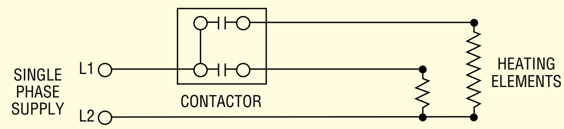
Some specifiers prefer, and some local electrical regulations require, the alternative full line break contactor arrangement. This may be ordered as an option. Note that it is not safe to service even a full line break duct heater without opening the disconnect switch.

The following diagrams present the most commonly used arrangements.

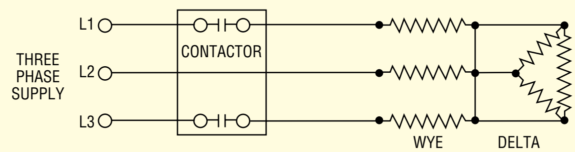
De-energizing Type:



Heater is de-energized by breaking only one side of the line through the action of the single contact. This type would be disconnecting for 120 V and 277 V.

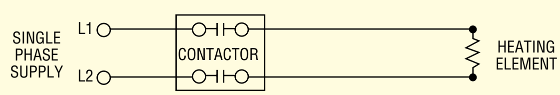


The above illustrates using a two pole contactor to de-energize one side of the line. This type of circuitry doubles the contactor capacity. This type would be disconnecting for 120 V and 277 V.

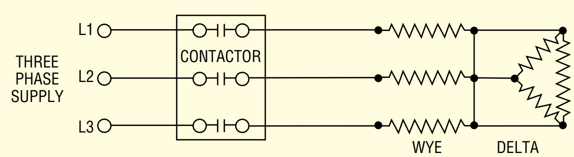


Illustrates a two line break which will de-energize the heater. Both Wye and Delta heating element configurations are shown. Unless specified, optimum configuration is determined by Nailor.

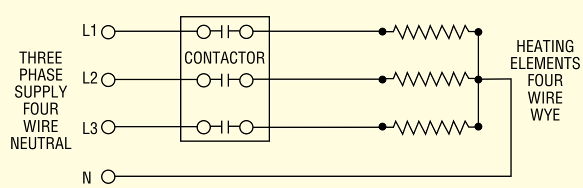
Disconnecting Type:



Heating power is completely disconnected by breaking both sides of the power source. All ungrounded power conductors are disconnected.



All ungrounded conductors disconnected. Both Wye and Delta configurations shown.



One of several special element configurations. This method allows element switching as a three phase balanced load or each element may be operated independently through individual contacts. To completely disconnect heating elements from power, a three pole contactor must be used.

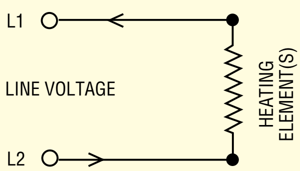
Number of Poles Required per Contactor or Disconnect Switch

The following table may be used to determine the number of poles required per contactor or discount switch to either de-energize or disconnect.

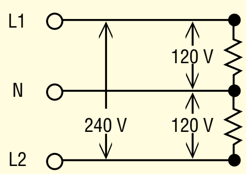
VOLTAGE	PHASE	NO. OF OF WIRES	NUMBER OF POLES TO DE-ENERGIZE	NUMBER OF POLES TO DISCONNECT
120		2	1	1
208		2	1	2
240	1	2	1	2
277		2	1	1
480		2	1	2
208		3	2	3
208		4	3	3
240	3	3	2	3
480		3	2	3
480		4	3	3

Heating Element Wiring Configurations and Properties

SINGLE PHASE:



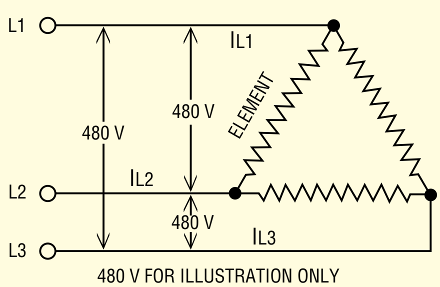
1. Element Voltage = Line Voltage.



"Edison" Connection

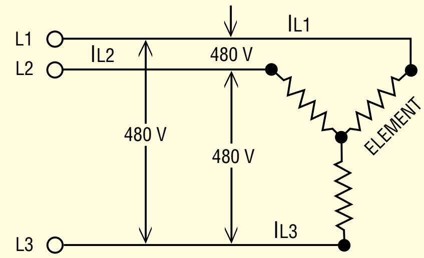
1. Element Voltage $= \frac{\text{Line Voltage}}{2}$

THREE PHASE:



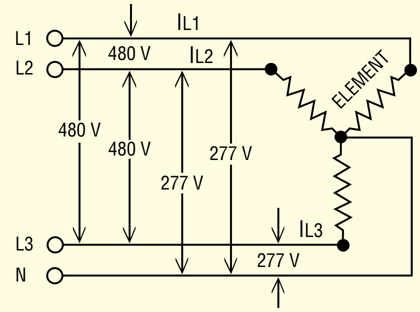
Three Wire "Delta" Connection

1. Element Voltage = Line Voltage.
2. Phase Currents IL1 = IL2 = IL3.
3. Voltage measured between any two power legs (L1 to L2 etc.) should be equal to the three phase line voltage.



Three Wire "Wye" Connection

1. Element Voltage $= \frac{\text{Line Voltage}}{1.73}$
2. Phase Currents IL1 = IL2 = IL3.
3. Voltage measured between any two power legs (L1 to L2 etc.) should be equal to the three phase line voltage.



Four Wire "Wye" Connection

1. Element Voltage $= \frac{\text{Line Voltage}}{1.73}$
2. Phase Currents IL1 = IL2 = IL3.
3. The voltage between any power leg and neutral (N) $= \frac{\text{Line Voltage}}{1.73}$
4. Voltage measured between any two power legs (L1 to L2 etc.) should be equal to the three phase line voltage.

Heating elements, namely those used in three phase, balanced, configurations are factory wired, as manufacturers standard in two basic configurations Delta or Wye. A variation of Wye called 4 wire wye must be specified.

Formula For Calculating Line Currents

The following formula may be used to quickly determine total amps. It is common practice to select voltage/phase in order to keep total amps below 48 where possible and so eliminate the NEC requirement for circuit fusing and hence minimize heater cost.

Single Phase:	Three Phase:
120 V: kW x 8.333 = Total amps	208 V: kW x 2.776 = Total amps
208 V: kW x 4.808 = Total amps	240 V: kW x 2.406 = Total amps
240 V: kW x 4.167 = Total amps	460 V: kW x 1.255 = Total amps
277 V: kW x 3.610 = Total amps	480 V: kW x 1.203 = Total amps
480 V: kW x 2.083 = Total amps	600 V: kW x 0.962 = Total amps

$$\text{Kilowatts} = \frac{\text{BTU's}}{3{,}412} \quad \text{or} \quad \frac{\text{MBH}}{3.412}$$

DUCT HEATER LOCATION

After determining the use of a heater, a location in the air system must be selected that will permit satisfactory performance. The heater must be installed in a location having suitable airflow characteristics. Where non-uniform airflow conditions exist at duct fittings, at equipment connections, at air terminals, or other sections, minimum lengths of straight runs of duct must be installed before and after the heater.

Elbows

The preferred location for duct heaters adjacent to elbows is upstream of the elbow as illustrated in Figure 7.7. When the heater must be downstream, Figure 7.8 illustrates the minimum requirements.

Equipment

Electric heaters installed in a duct outlet downstream from a heat pump, an air conditioning unit, or a fan unit must comply with the minimum distances illustrated in Figures 7.15 and 7.16 unless the heater is specifically approved for installation at a lesser distance and is so marked.

Branch Ducts

Branch connections are also particularly susceptible to turbulent airflow conditions. In order to reduce the need for derated coils on the entering air side of the branch duct, the heater should be placed as far from the branch connection as practicable and not less than the minimum distances illustrated in Figures 7.10, 7.11, 7.12, 7.13 and 7.14. When the aspect ratio exceeds recommended practice, the minimum distances from the heater to turbulent flow duct fittings should be increased.

Grilles

Whenever electric duct heaters must be located near grilles, registers or diffusers, the exposure and visibility should be evaluated. Increased spacing or the use of a screen should be considered where protection against probes or other foreign objects is advisable or where visibility of the heater is objectionable. Figures 7.10, 7.11, 7.12 and 7.14 illustrate the minimum recommended distance from a heater to a grille or register regardless of the length of the duct branch. Figure 7.9 illustrates the 12" (305) minimum recommended distance that a heater should have from the diffuser collar in a duct.

Fibrous Glass Ducts

When Electric Duct Heaters are to be located in fibrous glass ducts, the requirements for location are similar to those for sheet metal ducts. For special installation details, see the "Installation" section of this catalog and Figures 7.4 and 7.5.

Special Locations

When Electric Duct Heaters are used in preheat or reheat applications in plenums or casings, a special study of the location is recommended. Irregular airflow patterns are often found in the air movement through outside air louvers, filters, mixed air plenums and associated dampers. At fresh air intakes, for example, the air entry should be rain-tight. As a precaution against water damage, it is recommended that the bottom elevation of the Electric Duct Heater be above the floor. Another important consideration is the safety of individuals entering a plenum or casing chamber. Reasonable provisions for protection should be made and these should include warning signs outside the electric coil chamber.

Other Factors

Other factors to be considered in locating the heater are:

a) Heat loss from the duct before the tempered air reaches its destination.

b) The temperature and humidity of the space surrounding the heater. If a section of duct containing an electric heater is installed in an atmosphere conducive to the collection of moisture either inside the duct or on the outside of the duct, special provisions must be made to insure that moisture does not damage either the heater or the controls.

c) The accessibility of the heater and its control panel. Terminal boxes are often integral with the heater and may exceed the height of the duct. The total installation must be designed to accommodate the space and access requirements of this component. Remote control panels may be used where conditions dictate.

d) Hazards. To avoid damage and insure safety, special consideration must be given to the proximity of combustible material. Minimum clearance required by the manufacturer or applicable codes, whichever is greater, must be maintained.

Heater Position

Standard open coil Electric Duct Heaters are designed for the elements to be in a horizontal position, whether the heater is installed in a horizontal duct or in a vertical duct. The coils would not be properly supported if the elements were oriented in the vertical position. SPECIALLY CONSTRUCTED HEATERS ARE AVAILABLE FOR VERTICAL INSTALLATION.

Reprint from SMACNA Ducted Electric Heat Guide for Air Handling Systems, 2nd Edition.

Clearance

Duct heaters rated 50 kW or less are normally suitable for installation with zero distance between the heater and combustible materials. Heaters larger than 50 kW should be installed with regard to minimum spacing requirements. (All Nailor Duct Heaters are rated for zero clearance).

Airflow Direction

Airflow direction is determined by facing the terminal box side of the duct and should be specified for all types of heater. The manufacturer and the installer should know whether the airflow is horizontal (that is, to the right or left) or vertical (that is, up or down) since safety devices are located differently in each case. Furthermore, since terminal boxes vary in width and since space conditions may be limited, the terminal box overhang should be designed as left hand or right hand.

DUCT HEATER INSTALLATION

This section concerns the suspension, positioning, fastening and connecting of electric duct heaters. Certain additional features not covered elsewhere are included. Furthermore, although Figures 7.6 through 7.16 illustrate flanged heaters, the installation requirements are equally applicable to slip-in heater installations.

Slip-In Heaters

Figure 7.2 illustrates a slip-in heater installation for both lined duct and unlined duct.

For the lined duct, a sheet metal channel should be placed on the interior surface of the lining to protect the lining and support the heater. Care should be exercised to prevent tearing of penetration of the lining. A recessed terminal box should be used in order to:

a) use the entire face of the heating elements; and
b) correctly position the thermal cutouts.

Furthermore, to prevent condensation on lined duct and insulated duct installations, terminal boxes should be provided with interior insulation. However, to prevent overheating of electrical components, the exterior of the terminal box must not be insulated.

When a slip-in heater is necessarily smaller than the cross-sectional area of the duct as illustrated in Figure 7.3, an equalizing grid should be used to maintain bypass air velocity at approximately the same rate as the velocity through the heater. The grid (wire mesh or perforated plate) should have approximately the same friction loss as the heater and should be fastened to the sides of the duct.

Flanged Heaters

Flanged heaters are connected to unlined and lined ducts in the manner illustrated in Figure 7.1. For flow and performance considerations, the inside dimensions of the duct must match the inside dimensions of the heater. Furthermore, on lined ducts, heaters must have wide flanges, insulated terminal boxes, and insulation on the exposed exterior of the frame.

On lined duct and insulated duct installations, terminal boxes should be provided with interior insulation. However, to prevent overheating of electrical components, the exterior of the terminal box should not be insulated.

General Requirements

Refer to SMACNA's *Duct Construction Standards, Metal and Flexible* for all sheet metal fabrication and construction details.

For installations in fibrous glass ducts, refer to SMACNA's *Fibrous Glass Duct Construction Standards.*

If alternate corrections or locations are not available when turbulent flow conditions exist and critically low velocities are experienced (or anticipated) in the duct cross-section on the entering side of the heater, a flow equalizing device (such as a perforated plate having 50% or more free are) may be installed in the duct in front of the heater. However, consideration should be given to the pressure drop that such a device will add to the system.

When transitions are necessary on the inlet or outlet of a heater, the flow must be controlled within the limits illustrated in Figure 7.6.

The design of the installation must include adequate provision for support of the duct heater.

Terminal boxes are integral with the heater and may often exceed the height of the duct. The total installation must be designed to accommodate the space and access requirements of this component. Remote control panels may be used where condition dictates.

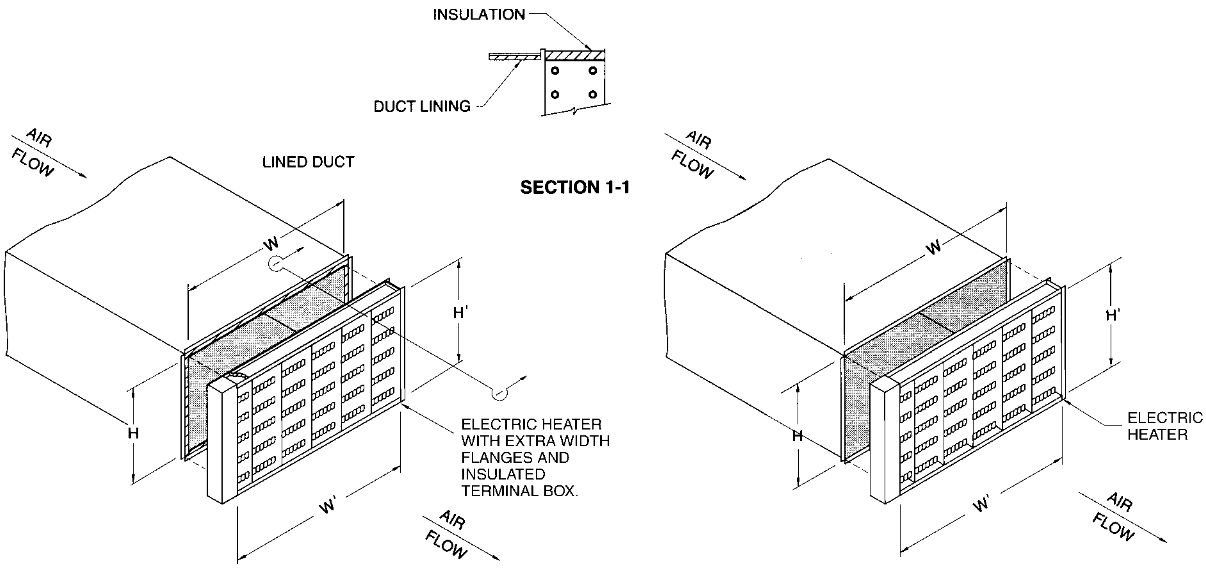
Airflow direction through the heater should be verified immediately preceding installation in a duct. Particular attention should be given to the designated location of built-in thermal cut-outs.

Electric duct heaters are not generally designed for installation in series; that is, consecutively in a duct. This arrangement may be used in special applications in which the air temperature leaving the first heater does not exceed the maximum recommended air temperature entering the second heater.

Access for servicing or for removal of electric duct heaters must be provided. When ducts are in concealed spaces, provision must be made for suitable access panels in walls or ceilings as necessary.

The installation should be reviewed for compliance with the recommendations of the heater manufacturer.

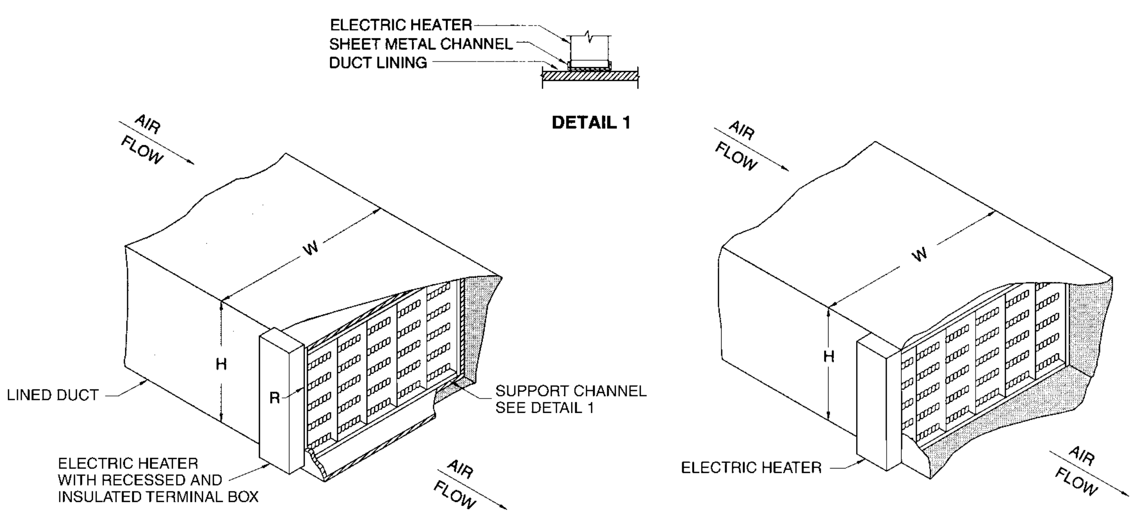
Reprint from SMACNA Ducted Electric Heat Guide for Air Handling Systems, 2nd Edition.



NOTES:

1. H = H' and W = W'.
2. To prevent condensation when duct is insulated use insulated terminal boxes.

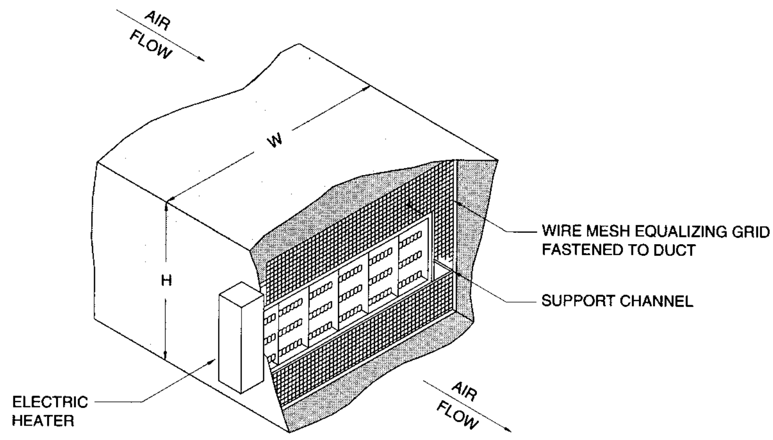
FLANGED DUCT HEATER — SMACNA FIG. 7-1



NOTES:

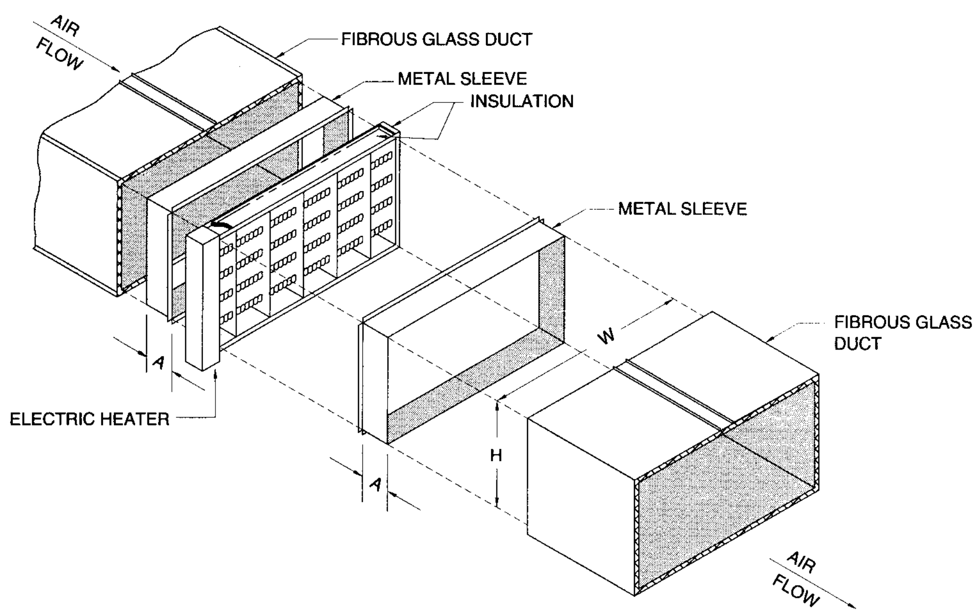
1. To prevent condensation when duct is insulated use insulated terminal boxes.
2. R = Dimension of terminal box recess.

SLIP-IN DUCT HEATER — SMACNA FIG. 7-2



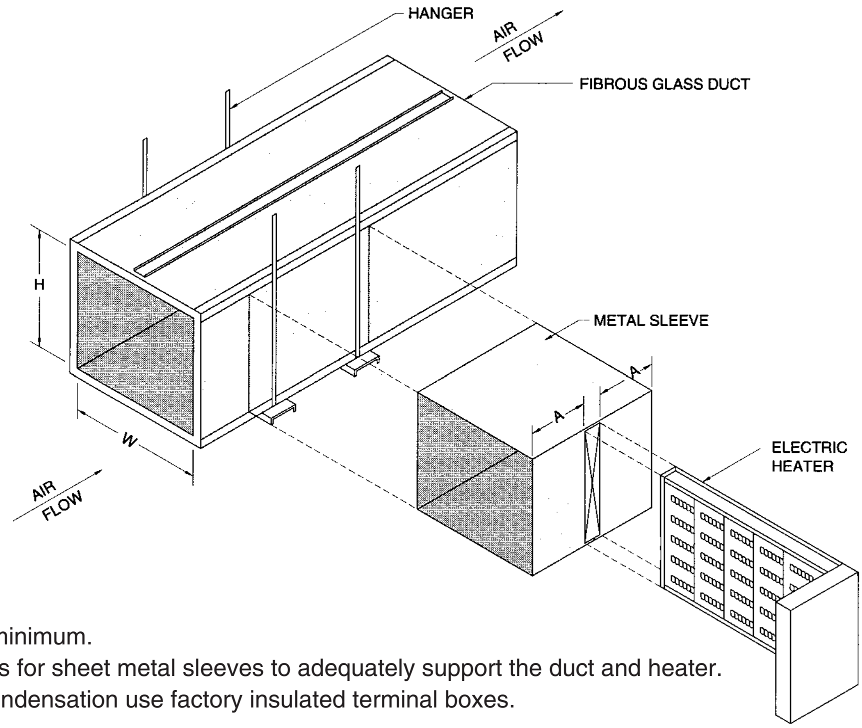
NOTE:
1. The equalizing grid should have the same pressure drop as the duct heater.

EQUALIZING GRID SMACNA FIG. 7-3



NOTES:
1. A = 6" (152) minimum.
2. Install hangers for sheet metal sleeves to adequately support the duct and heater.
3. To prevent condensation when duct is insulated use insulated terminal boxes.

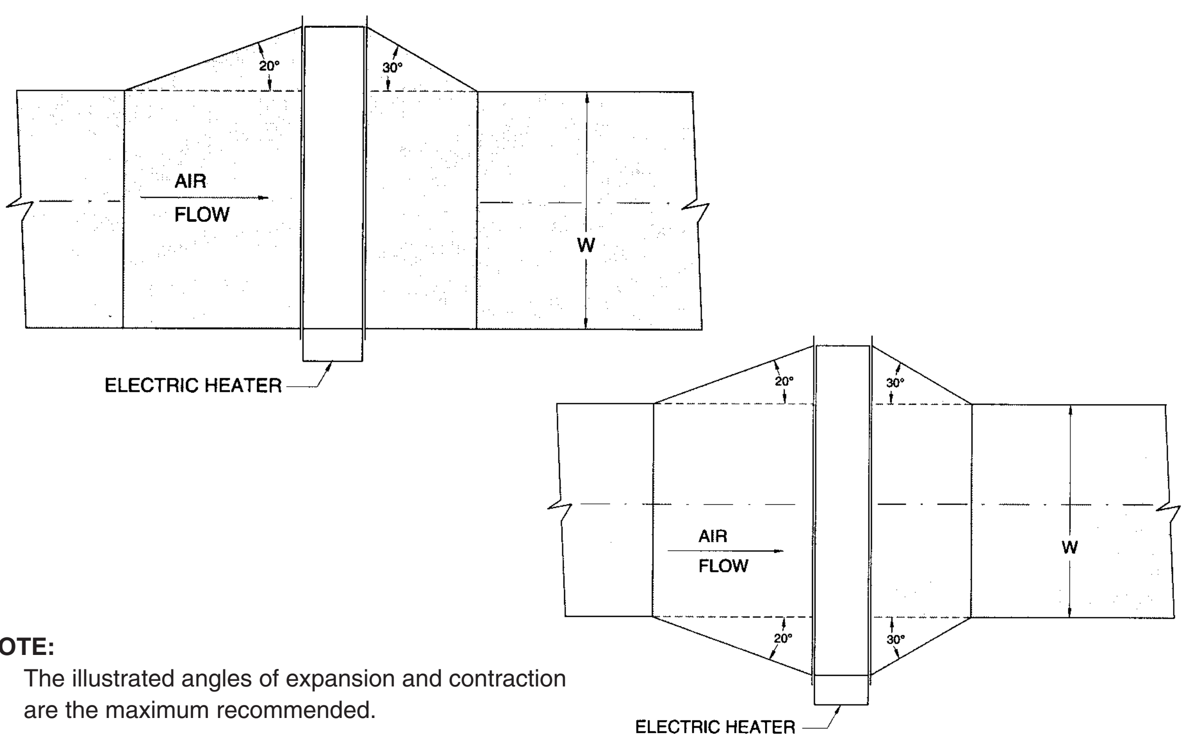
FLANGED HEATER IN FIBROUS GLASS DUCT SMACNA FIG. 7-4



NOTES:

1. A = 6" (152) minimum.
2. Install hangers for sheet metal sleeves to adequately support the duct and heater.
3. To prevent condensation use factory insulated terminal boxes.

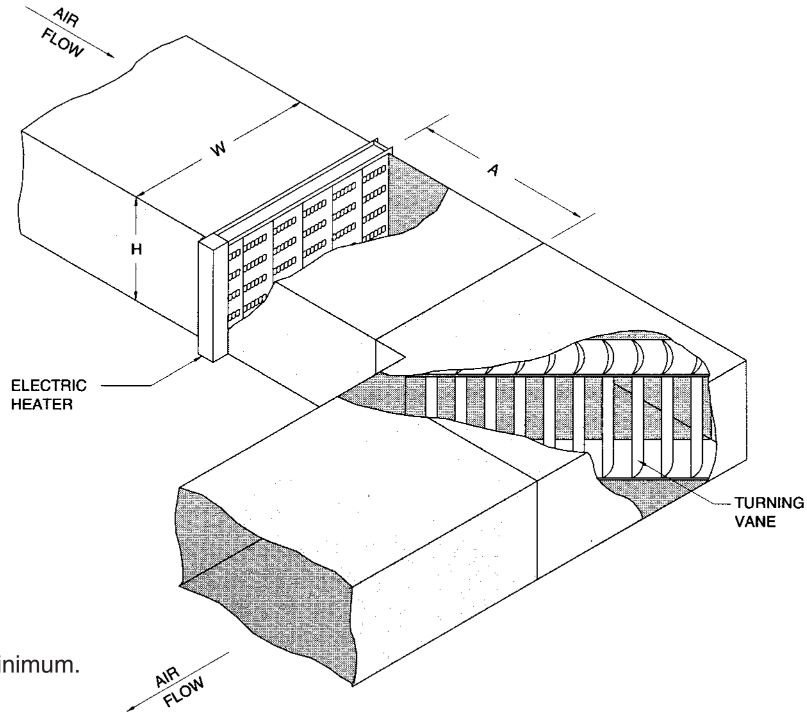
SLIP-IN HEATER IN FIBROUS GLASS DUCT — SMACNA FIG. 7-5



NOTE:

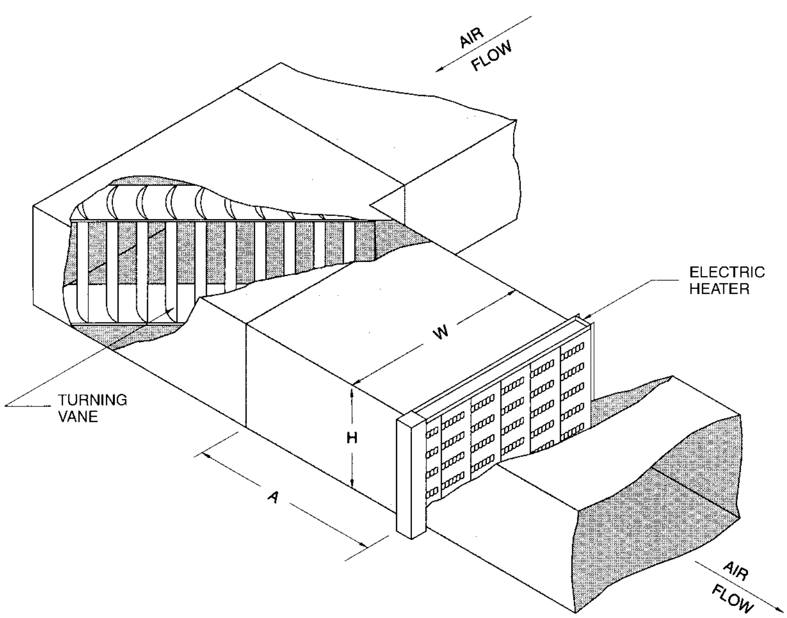
1. The illustrated angles of expansion and contraction are the maximum recommended.

DUCT TRANSITIONS – PLAN VIEW — SMACNA FIG. 7-6



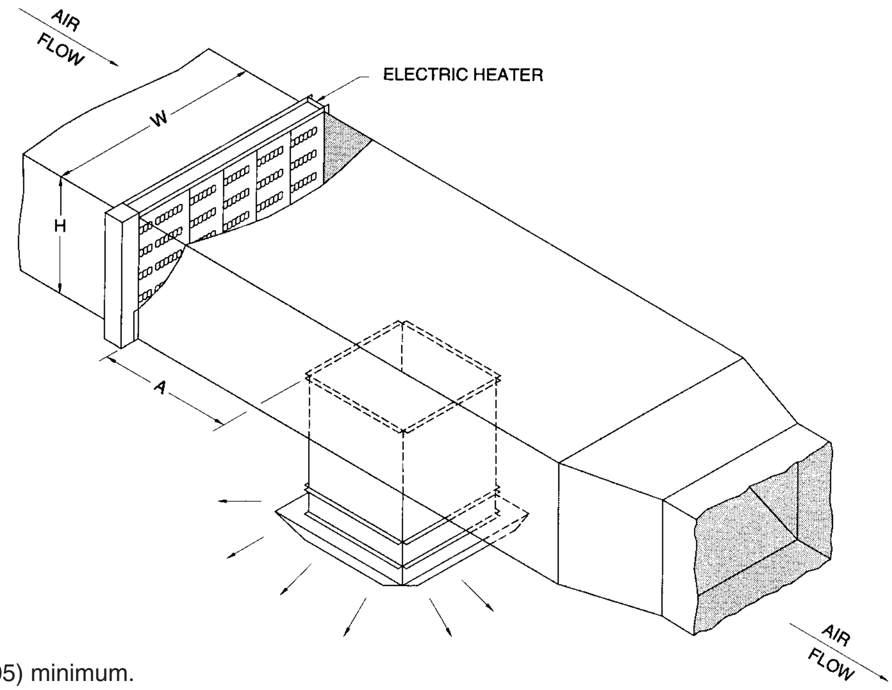
NOTE:
1. A = 12" (305) minimum.

HEATER UPSTREAM FROM ELBOW **SMACNA FIG. 7-7**



NOTES:
1. $A = \frac{H + W}{2}$ with 12" (305) minimum.

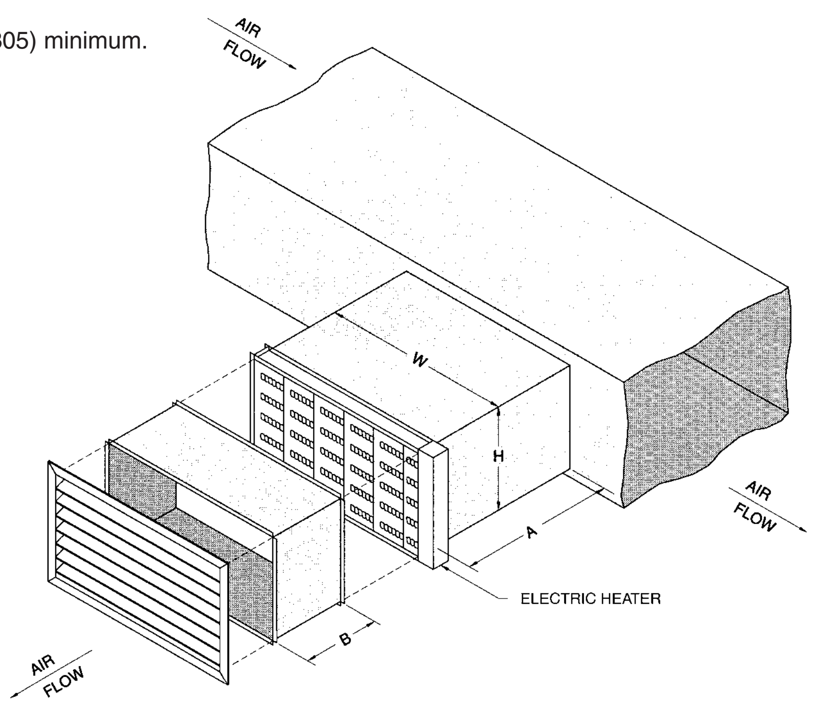
HEATER DOWNSTREAM FROM ELBOW **SMACNA FIG. 7-8**



NOTE:
1. A = 12" (305) minimum.

HEATER UPSTREAM FROM OUTLET CONNECTION **SMACNA FIG. 7-9**

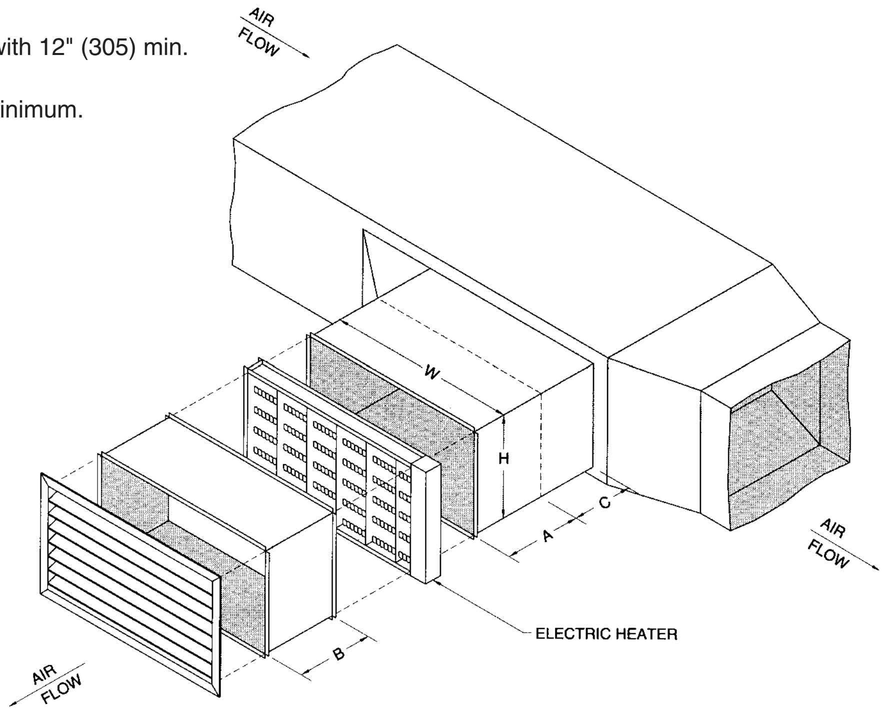
NOTES:
1. $A = \frac{H + W}{2}$ with 12" (305) minimum.
2. B = 6" (152) minimum.



HEATER IN BRANCH DUCT **SMACNA FIG. 7-10**

NOTES:

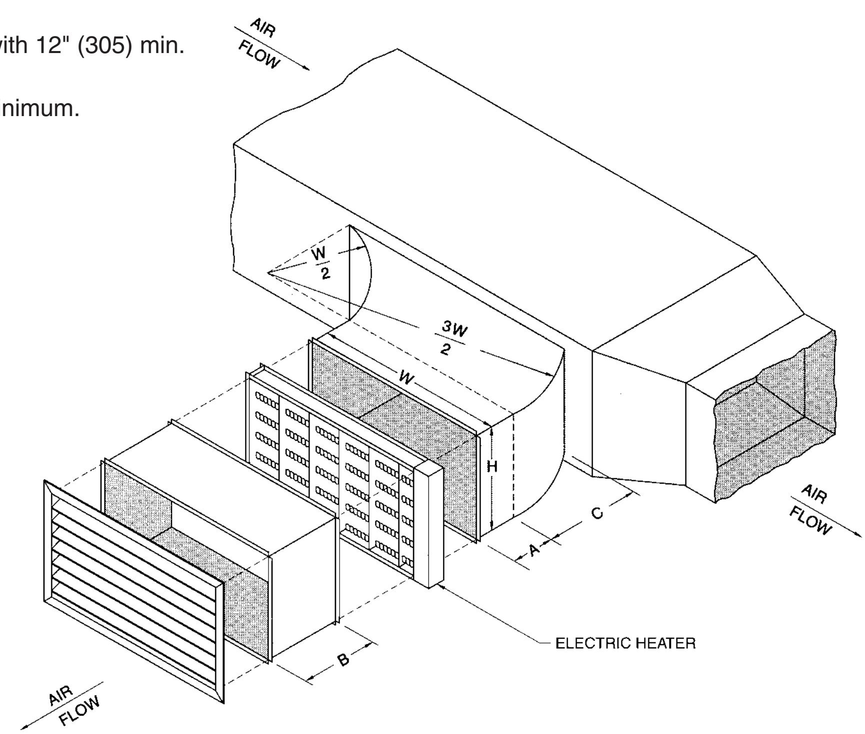
1. $A = \frac{H + W}{2}$ with 12" (305) min.
2. B = 6" (152) minimum.
3. $C = \frac{W}{2}$



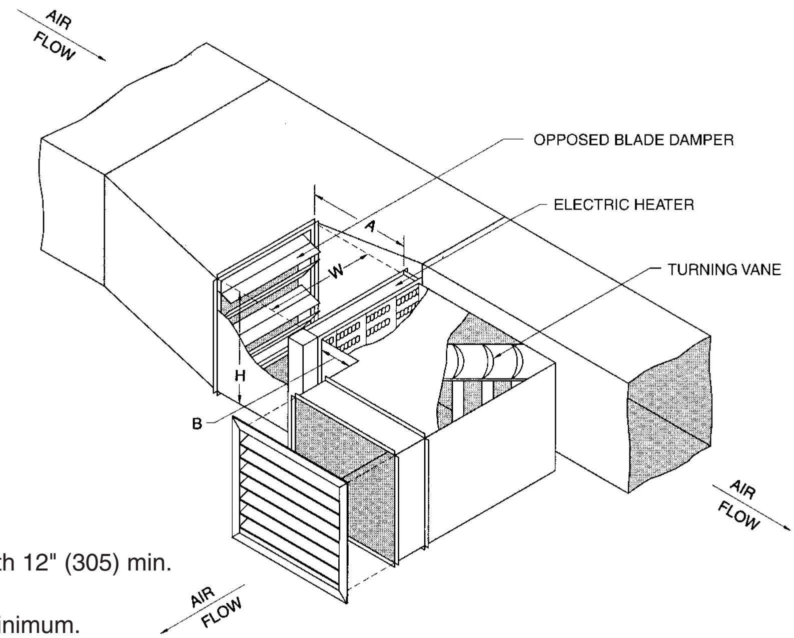
HEATER IN BRANCH DUCT **SMACNA FIG. 7-11**

NOTES:

1. $A = \frac{H + W}{2}$ with 12" (305) min.
2. B = 6" (152) minimum.
3. $C = \frac{W}{2}$



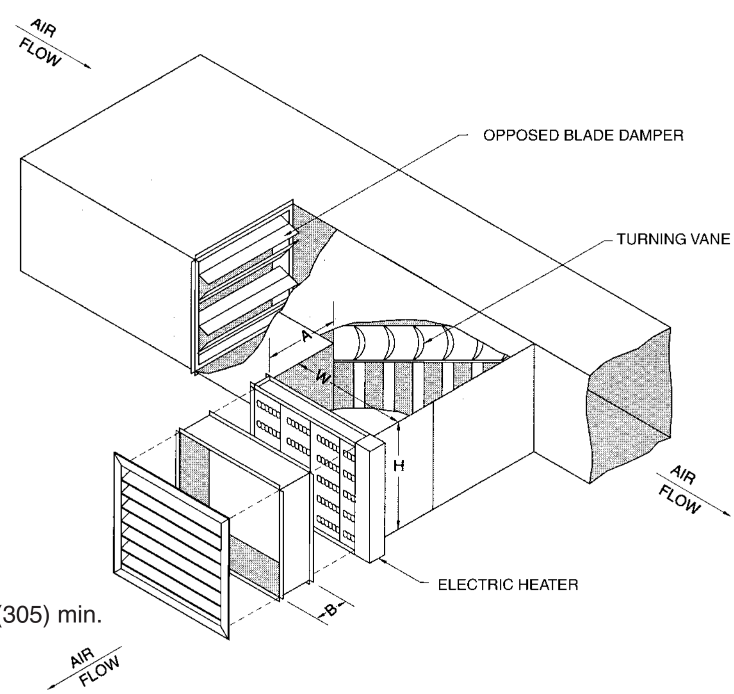
HEATER IN BRANCH DUCT **SMACNA FIG. 7-12**



NOTES:

1. $A = \frac{H + W}{2}$ with 12" (305) min.
2. B = 12" (305) minimum.

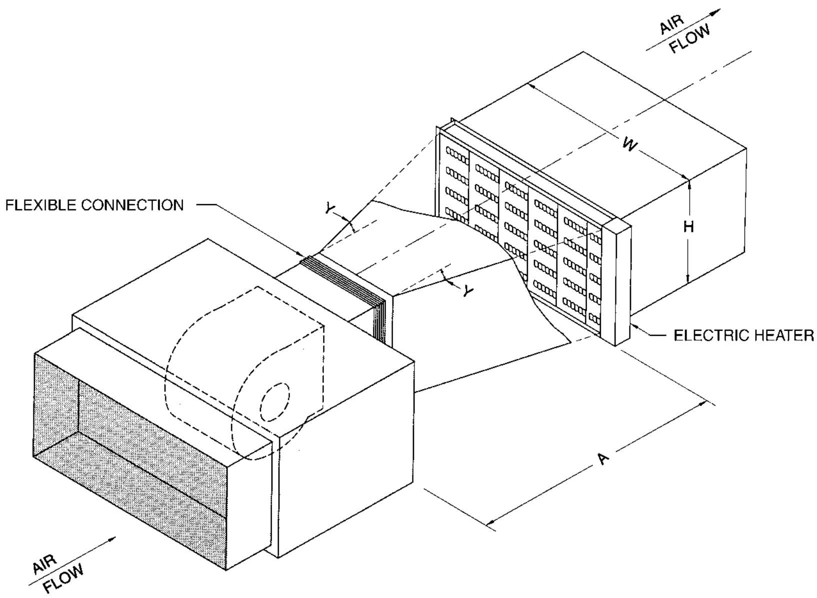
HEATER IN DIVIDED DUCT **SMACNA FIG. 7-13**



NOTES:

1. $A = \frac{H + W}{2}$ with 12" (305) min.
2. B = 6" (152) minimum.

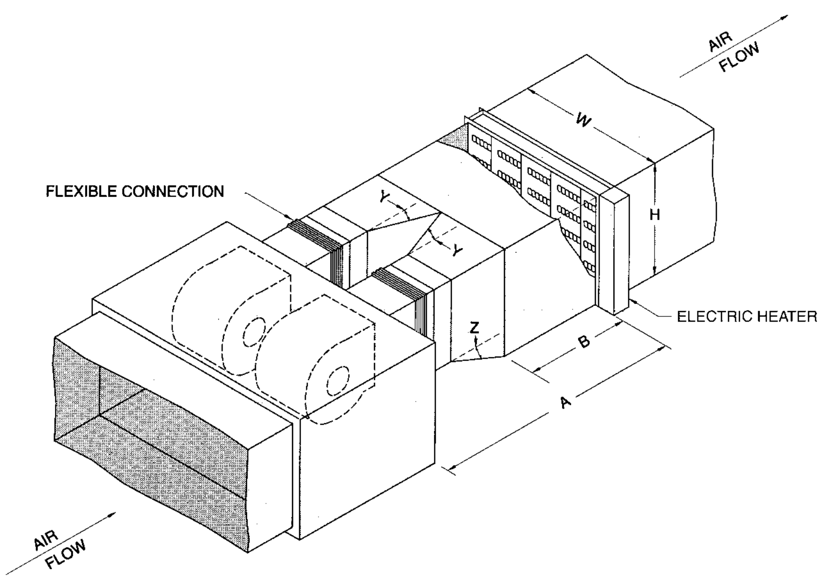
HEATER IN DIVIDED DUCT **SMACNA FIG. 7-14**



NOTES:

1. $A = \frac{H + W}{2}$ with 48" (1219) minimum for heat pumps and air conditioners and with 24" (610) minimum for fan units.
2. Angles Y are 20° maximum.

HEATER DOWNSTREAM FROM AIR HANDLER — SMACNA FIG. 7-15



NOTES:

1. $A = \frac{H + W}{2}$ with 48" (1219) minimum for heat pumps and air conditioners and with 24" (610) minimum for fan units.
2. B = 12" (305) minimum.
3. Angles Y and Z are 20° maximum for all units.

HEATER DOWNSTREAM FROM AIR HANDLER — SMACNA FIG. 7-16

National Electric Code (NEC) and UL 1996 Requirements for Duct Heaters

Location of Disconnecting Means:

(NEC 424-65) "Duct heater controller equipment shall be accessible with the disconnecting means installed at or within sight of the controller."

Overcurrent Protection:

(UL 1996 23.2.1)

"A duct heater employing resistance type heating elements shall be protected at no more than 60 amperes, and the protected circuit shall not have a concurrent load exceeding 48 amperes. These heating elements shall be connected in protected subdivided circuits if any total concurrent load of the unit exceeds 48 amperes based on nameplate ratings. If the overcurrent protective devices are in a separate assembly for independent mounting, ... the rating of the overcurrent protective devices also shall not exceed 1.5 times the current rating of the connected load, if such rating is more than 16.7 amperes."

(UL 1996 23.2.3) "the overcurrent protection specified in 23.2.1 and 23.2.2 shall be circuit breakers, cartridge fuses, or type S plug fuses, of a type and rating appropriate for branch circuit protection, in accordance with the requirements of the National Electric Code, ANSI/NFPA 70-1990. Plug fuses shall not be used in circuits exceeding 150 V to ground; screw shells of plug fuses shall be connected to the load side of the circuit."

Transformer Overcurrent Protection:

(UL 1996 22.7) " ... a transformer having a high voltage primary shall be protected by an overcurrent device (or devices) located in the primary circuit, and rated or set as indicated in Table 22.1."

Rated Primary Current. (Amps)	Maximum rating of overcurrent device. (percent of transformer primary current rating)
less than 2	300%
2 to less than 9	167%
9 or more	1.25%

Table 22.1 Rating of Overcurrent Device

(UL 1996 22.9) "Except as indicated in 22.10, a transformer having a rated output of not more than 30 volts and 100 volt-amperes shall be protected by an overcurrent device located in the primary circuit. The overcurrent device shall be rated or set at not more than 167% of the primary current rating of the transformer."

(UL 1996 22.10) "If the transformer is Class 2, compliance with 22.9 is not required."

(UL 1996 22.12) "Overcurrent protection in the secondary circuit of a transformer ... shall be provided as part of the equipment."

Transformer Grounding:

(UL 1996 22.15) "The secondary of a transformer supplying power to low-voltage circuits shall be grounded if: a) The primary is energized from a source rated at more than 150 volts-to-ground; or b) It supplies power to a control circuit that is a safety circuit."

Fan Control:

(UL 1996 21.5) "A duct heater shall have terminal or leads for field connection of an interlock circuit for a circulating fan motor unless an airflow interlock is provided as an integral part of the heater and arranged so that no heating element circuit can be energized unless the interlocking contacts are closed or the interlocking power supply energized. This does not preclude the use of a fan delay control that complies with the applicable requirements for a fan control."

Nailor Industries Inc.

ELECTRIC DUCT HEATER SUBMITTAL FORM

Date: ____________

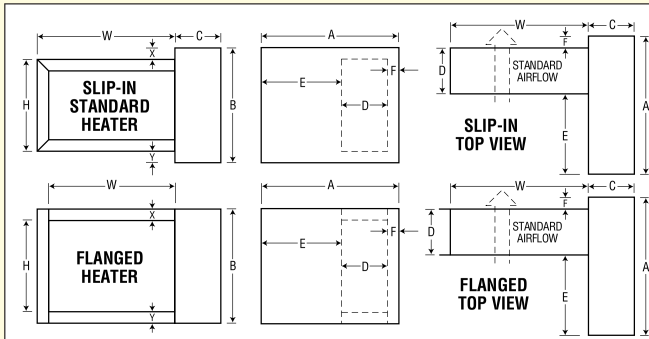
Customer: ____________ P.O. No.: ________ Project: ____________ Page ___ of ____

TAG	QTY.	MODEL	KW	DUCT SIZE W x H	HEATER SIZE W x H	LINE		CONTROL VOLTAGE	STG.	HEATER DIMENSIONS (IF CRITICAL)								FIG. NO.	ACCESSORIES (LIST BY NUMBER)
						VOLTS	PH			A	B	C	D	E	F	X	Y		

OPTIONAL ACCESSORIES:

(List by number)

1. Air Pressure Switch
2. Fan Relay
3. Manual Reset Limits
4. Insulation On Panel
5. Control Transformer (Class 2)
6. Control Transformer (Fused)
7. Circuit Fusing per NEC
8. Circuit Fusing in excess of NEC req.
9. Circuit Breakers
10. Disconnect Switch (Toggle)
11. Disconnect Switch (Door Int.)
12. Quiet Contactors
13. Mercury Contactors
14. PE Switches
15. Step Controller
16. SCR Controller
17. Back-up Contactors
18. Pilot Light
19. Pilot Relay
20. Pilot (Toggle) Switch
21. 80–20 Wire
22. Recessed Terminal Box
23. Weather Protected Panel
24. Flanged Heater
25. Derated Coils
26. Top or Bottom Box



Standard Construction:
X, Y & F = 1" (25)

Standard Slip-in:
Heater is approximately 1" (25) smaller than the duct.

HEATER CONFIGURATIONS

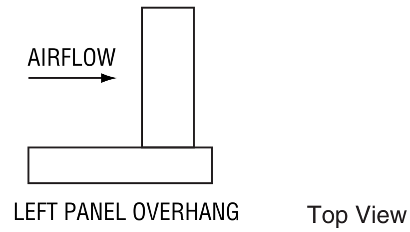


Fig. 1 **Slip-in Heater (standard).**

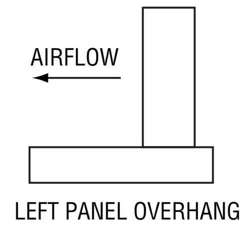


Fig. 2 **Slip-in Heater (option).**

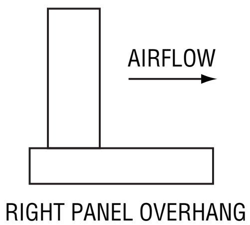


Fig. 3 **Slip-in Heater (option).**

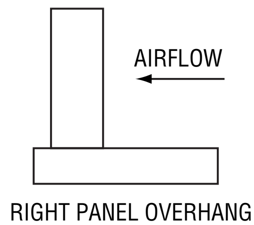


Fig. 4 **Slip-in Heater (option).**

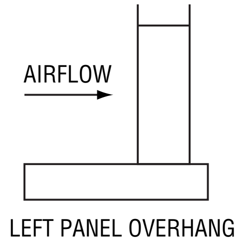


Fig. 5 **Flanged Heater (standard).**

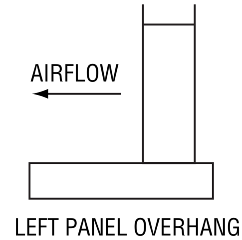


Fig. 6 **Flanged Heater (option).**

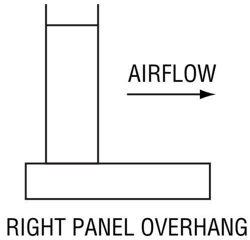


Fig. 7 **Flanged Heater (option).**

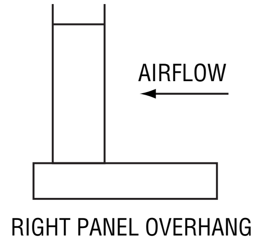


Fig. 8 **Flanged Heater (option).**

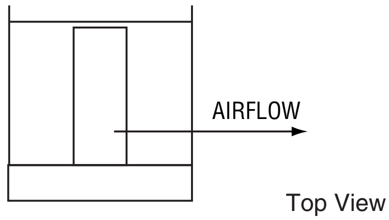


Fig. 9 **Flanged Heater with Full Sleeve (option).**

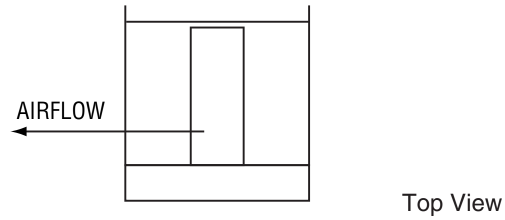


Fig. 10 **Flanged Heater with Full Sleeve (option).**

SUGGESTED SPECIFICATIONS

Electric Duct Heaters shall be of the size, type and capacity as shown on the drawings.

Heaters shall be ETL listed for zero clearance from all combustibles and shall bear the ETL listing mark. Each heater shall meet the requirements of NEC and shall be of the open coil design and shall be as manufactured by Nailor Industries, Inc.

Each heater shall be furnished with two levels of over temperature safety devices serviceable and/or replaceable in the terminal box without removing the heater from the duct. The primary safety device shall be a disc type automatic reset that will cut the heater off on an over-temperature condition and automatically bring the heater back on when the condition is corrected. The secondary safety device shall be of the disc type, manually resettable or replaceable, and wired in the power lines in series with the heater elements such that failure of a sufficient number of these devices will de-energize or disconnect the heater until service is rendered if the primary device should fail.

The heater terminal box and frame shall be of heavy gauge (minimum 20 gauge) galvanized steel sufficiently formed and braced to assure structural rigidity of the entire heater assembly. Terminal box and lid must be totally enclosed and free from any perforations or louvers. The terminal box shall have Nailor sub-panel design for greater cooling effect and rigidity.

Elements shall be of high grade nickel chrome alloy. Elements shall be held in place with high grade ceramic insulators that expose the entire heating element to the air stream. Brackets shall be of sufficient strength so the element wire, when in place, cannot cause brackets to bend.

Each heater shall be furnished with an exact 'as is' wiring diagram. Typical wiring diagrams are not acceptable.

Heaters shall be constructed as slip-in, flanged, top or bottom boxes as shown on the drawings.

Built-in components shall include:
(write in the desired options)

1. Built-in Air Pressure Switch or Fan Interlock Relay. (Specifier select one).
2. Magnetic Contactors, Quiet Contactors or Mercury Contactors for silent operation or excessive switching. (Specifier select one).
3. Manual reset or one time fusible link secondary hi-limit protection. (Specifier select one).
4. Insulated Terminal Box
5. Control Transformer
6. Overcurrent Protection as required by NEC and UL (on heaters over 48 amperes), or Overcurrent Protection for each stage, or Overcurrent Protection for all heaters regardless of amp ratings. (Specifier select one).
7. Circuit Breakers in lieu of fuses for any of the above.
8. Built-in Disconnect Switches that will disconnect all power lines prior to the heater control enclosure opening.
9. Pneumatic Electric Switches factory mounted and wired for each stage.
10. Electronic Step Controllers with modulating thermostats that will control each stage of heat.
11. SCR Controllers complete with back-up contactors and factory supplied thermostats that will modulate the heat output of the heaters from 0 to 100% as required by the room thermostat.
12. Pilot Lights showing:
    heater on or
    stages on or
    Airflow Switch off, etc.
13. Pilot relays to switch heater stages as required from building controls.
14. Toggle Switches to manually operate or lock-out stages of heat.
15. Heaters so specified on the drawings or in the schedules shall be supplied with remote control panels manufactured by the heater manufacturer for use with the heaters.

DH – R9.03