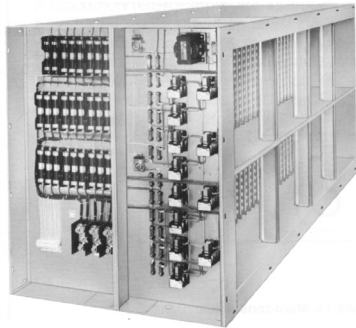


Custom Duct Heaters

Special Applications

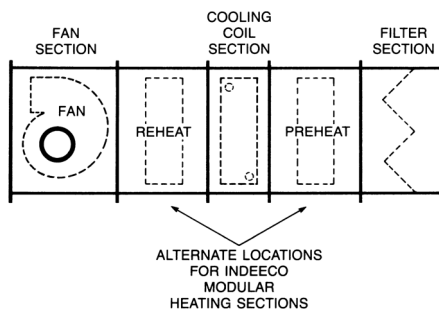
Air Conditioning & Air Handling Units – For more than 65 years, Indeeco has been supplying heaters for use in air handling and air conditioning equipment (Figure 49). A wide range of UL recognized to standard 1995 heaters are available using special construction and design techniques to insure proper operation as well as ease of installation, either in the OEM's plant or in the field. These heaters are typically used in central station, multi-zone or dual duct air handlers.

Figure 49.



Central Station Construction – The heater is designed for installation as an integral component of the air handler adjacent to fans, cooling sections, filter boxes, etc. (Figure 49). Unheated sections can be provided where there is little or no airflow, such as the area blocked by an adjacent cooling coil header. Pressure plates can be used to insure uniform airflow, the use of unheated areas or derated elements can be provided to space the heating coils away from temperature sensitive components or to help assure uniform airflow.

Figure 50.



Multi-Zone or Dual Duct Heaters – These heaters are designed for installation inside multi-zone or dual duct air conditioning equipment, where the airflow is highly variable and unevenly distributed (Figure 51). These heaters use coils derated to approximately 25 watts per square inch (3.8 watts per square cm) of wire surface area (approximately one half normal watt density). Low density coils run cooler, and thus, provide longer life under these stringent operating conditions.

These heaters are supplied with fully proportional SCR control or with many heating stages to insure that no more heat is being supplied than is absolutely necessary. Each heater stage is spread over the entire face area to take advantage of all available airflow.

A perforated pressure plate is factory-installed on the air inlet side of the heater to make the airflow as uniform as possible. Linear limit thermal cutouts protect against serious overheating anywhere along the length of the heater.

When the heater must be installed entirely within the unit, only thermal cutouts are built into the heater, a remote panel is required for controls. When the terminal box can be external, heaters are available with a wide range of built-in controls.

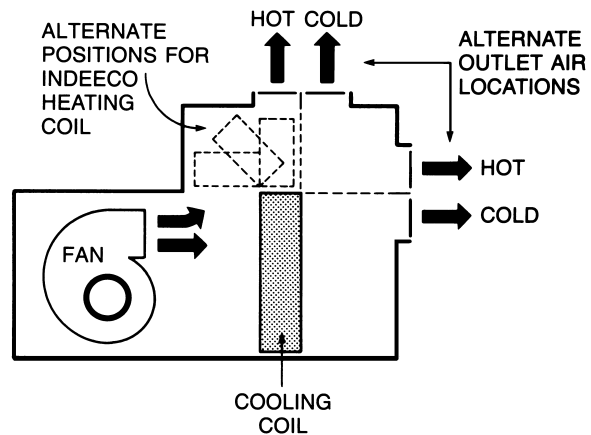


Figure 51

Custom Duct Heaters

Round Duct Construction – Indeeco manufactures UL listed open coil duct heaters specifically designed for installation to commercially rated round ducts. Heaters are available for installation to spiral single and double wall or snap-lock round sheet metal ducts with inside diameters of 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26 and 28 inches. Two square to round male galvanized steel transitions, Figure 53, are supplied for field installation to the inlet and outlet of the duct heater. The transitions are attached directly to the flanges of the heater and to the round duct using sheet metal screws (see Figure 52). The Indeeco transitions have been approved by UL to provide uniform airflow across the open coil elements to avoid hot spots, which could affect the performance of the heater.



Figure 52. Open Coil heater with round duct transitions.

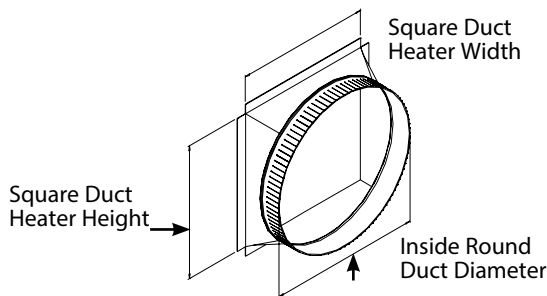


Figure 53. Square to round sheet metal transitions.

Marine Duty – Only Indeeco offers a UL Listed duct heater which is also ABS Design Assessed and meets U.S. Coast Guard Requirements for shipboard use (Figure 54).



Figure 54.

Variable Air Volume (VAV) Units – To serve the fast moving and very competitive VAV market, Indeeco has developed a fully computerized design and construction system, which enables us to ship substantial volumes of heaters in a wide variety of sizes, ratings, and control options quickly. This system was patterned after our methods of designing and producing standard duct heaters, modified to solve the problems unique to the VAV industry. Slip-and-drive sheet metal connections, control packages tailored to VAV systems, and special techniques for fan interlocks are some of the features designed for this market (Figure 55).

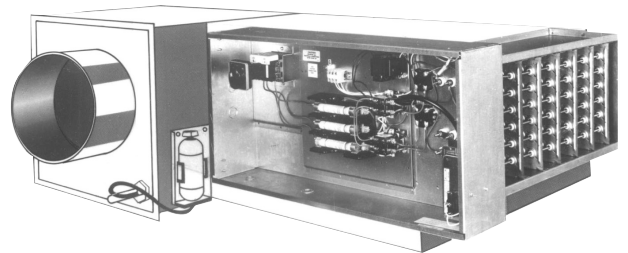


Figure 55.

Railway and Subway Applications – Tough rail car industry standards have been developed to overcome the severe vibration, shock, high operating voltages, and voltage swings routinely encountered. For more than 45 years, Indeeco has built heaters to meet these standards, using heavy gauge corrosion resistant steel frames and oversized coil and terminal support bushings (Figure 56).

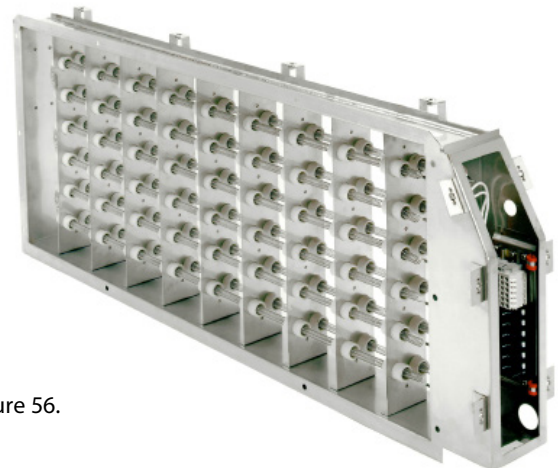


Figure 56.

Custom Duct Heaters

Duct Heaters for Wet, Dusty and Corrosive Areas

Indeeco offers a wide selection of custom built electric duct heater designs for outdoor, wet, dusty, and corrosive areas. Typical applications include use with roof top air handling equipment, in washdown areas such as food processing plants, wet and humid spaces near indoor swimming pools, and marine or casino boat applications including shipboard use.

Features:

- Disconnect switch with door interlock
- Manual reset thermal cutout
- Automatic reset thermal cutout
- Stainless steel frame
- Large diameter stainless steel finned tubular heating elements
- Heavy duty control transformer
- Fusing per NEC
- Airflow switch
- Stainless steel terminal hardware

Outdoor UL Listed 3R



Figure 57.

Outdoor type 3R heaters (Figure 57) are intended for outdoor use to provide a degree of protection against falling rain, sleet, and external ice formation. UL Listed 3R heaters can be used in most HVAC outdoor applications and indoors for protection against dripping water. Water-tight hubs for incoming power and control connections are furnished.

Dust-tight Construction

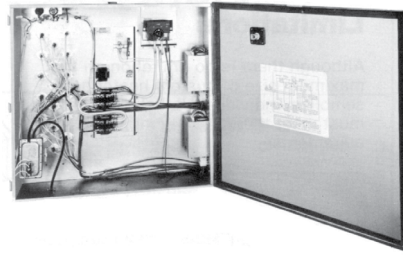


Figure 58.

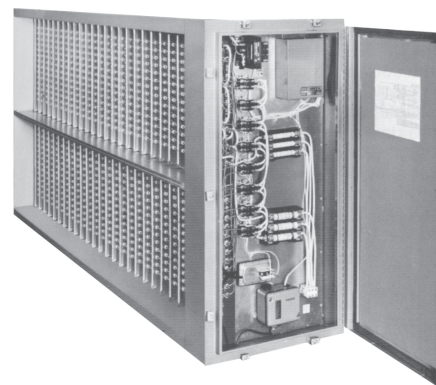
A dust-tight terminal box (Figure 58) is available to meet local codes that require dust-tight construction for a heater installed above a false ceiling when the entire area is used as a return air plenum. It is also suitable for commercial or light industrial applications to avoid dust accumulation inside the terminal box while a building is under construction.

These boxes are spot welded corrosion resistant steel, with all openings sealed. The hinged cover is gasketed and hold-down clamps are provided. (Note that this construction does not meet the more rigid requirements of NEMA 12 described below).

NEMA 12 Type Terminal Box

For heavy duty industrial applications involving both dust and oil, NEMA 12 type construction is available on custom heaters (Figure 59). The all welded, stainless steel terminal box has a hinged, gasketed cover with hold-down clamps. Scru-tite hubs for line and power connections are included.

Figure 59.



NEMA 4 Type Terminal Box

For weatherproof locations and washdown areas, such as food processing plants, a NEMA 4 type construction is available. This all welded stainless steel enclosure is furnished with a hinged, gasketed cover and is provided with water-tight hubs for incoming power and control connections.

Custom Duct Heaters

Bottom Mounted Terminal Box

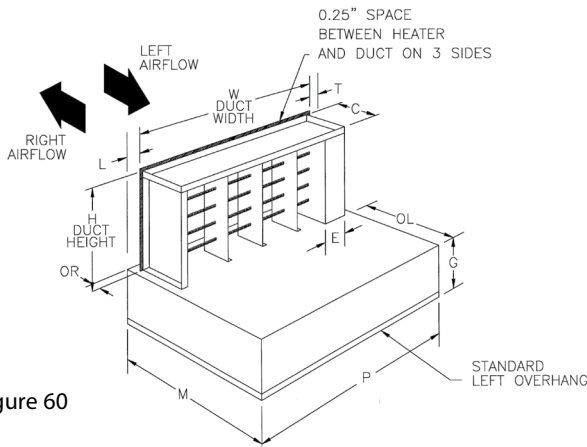


Figure 60

The NEC requires a work space at least 30" (76 cm) wide by 42" (107 cm) deep in front of a heater terminal box for service access. More space is required for large heaters. When this space is not available at the side of a duct, the heater can be installed through the bottom, using a special bottom mounted terminal box construction, which maintains the required horizontal orientation of open coil resistance elements.

Custom heaters of either flanged or slip-in design are available with this feature. However, slip-in is normally preferred for ease of installation (Figure 60). UL Listed heaters are limited to the sizes indicated in Table XIII.

Table XIII

Duct Size Limitations of Bottom Terminal Box Heaters

Heater Type	Minimum W in (mm)	Minimum H in (mm)	Maximum H in (mm)
Open Coil Flanged	5 (127)	3 (76.2)	40 (1016)
Open Coil Flange	8 (208)	4.25 (108)	40 (1016)
Finned Tubular Flanged	4.5 (114)	4 (102)	72 (1829)
Finned Tubular Slip-in	11 (279)	5.25 (133)	72 (1829)

Insulated Terminal Box

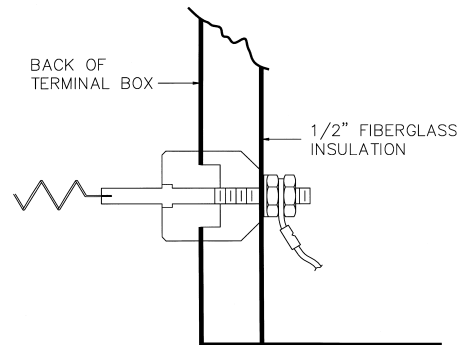


Figure 61.

When the heater is installed in an air conditioning duct which runs through an un-airconditioned space, condensation may form inside the terminal box. To eliminate this condensation or for energy conservation, the back of the terminal box can be factory insulated (Figure 61). This construction is available with all heaters.

Pressure Plates

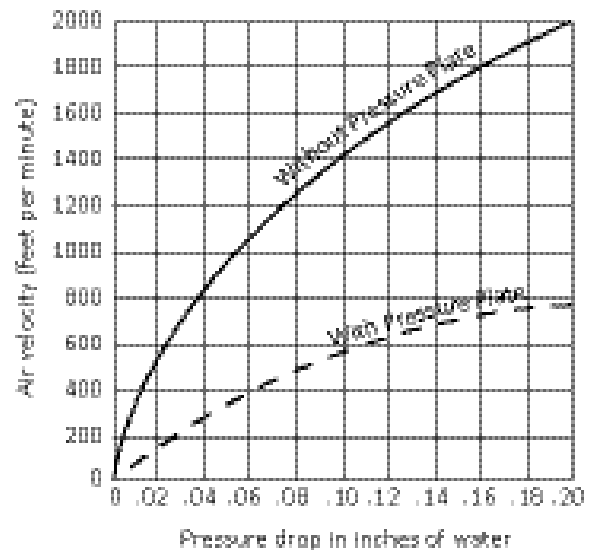


Figure 62.

A 40% open pressure plate on the inlet side of open coil type heaters evens out the airflow pattern in installations where it is not uniform. A pressure plate significantly increases the pressure drop across the heater (Figure 62). This increase must be considered in sizing the fan motor. To assure correct plate location, specify the exact airflow direction as defined in Figures 42 and 43, page 23.

Custom Duct Heaters

Protective Screens

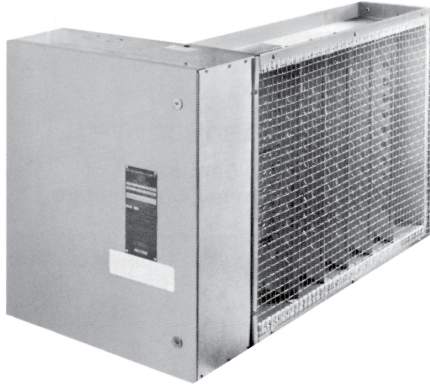


Figure 63.

Protective screens protect personnel from accidental contact with electrically hot open coil elements and prevent large airborne contamination from reaching the elements (Figure 63). The 3/8" (9.5mm) wire mesh screen may be mounted on both sides of the heater. Finned tubular duct heater construction may be more appropriate for these applications.

Unheated Sections

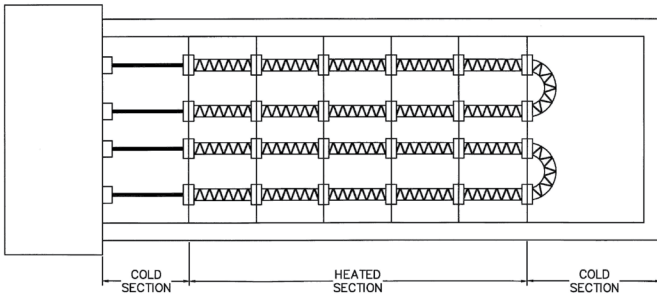


Figure 64.

Indeco custom heaters can be supplied with unheated sections, either open or blocked off (Figure 64). Such constructions are particularly helpful when the heater frame must extend through an area with little or no airflow to maintain accessibility to the terminal box. For example, a heater next to a cooling coil should have extended terminal pins so no heat is generated adjacent to the cooling coil header. Most constructions are available with a UL label.

Construction For Lined Ducts

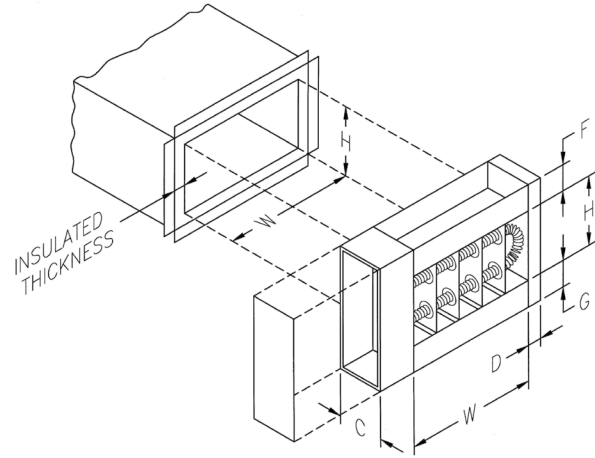


Figure 65. Installation of flange type heater in lined duct

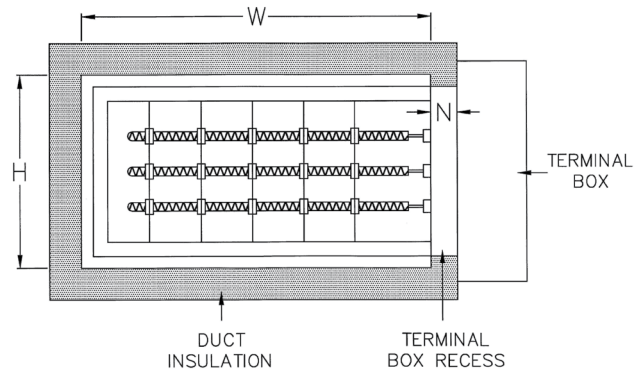


Figure 66. Installation of slip-in heater where insulation is more than 1" (25.4 mm) thick

All Indeco slip-in heaters are suitable for use in ducts lined with up to 1" (25.4 mm) of interior insulation. Extended terminals and the design of the thermal cutout system make standard slip-in heaters suitable for such installations without any deterioration in performance or life. Be sure that the duct dimensions specified are those inside the duct lining.

For slip-in heater applications where the insulation is more than 1" (25.4 mm) thick or where flanged heaters are required, the special constructions illustrated in Figures 65 and 66. Dimensions inside the insulation must be specified as well as the insulation thickness.

Custom Duct Heaters

Slip-and-Drive Construction

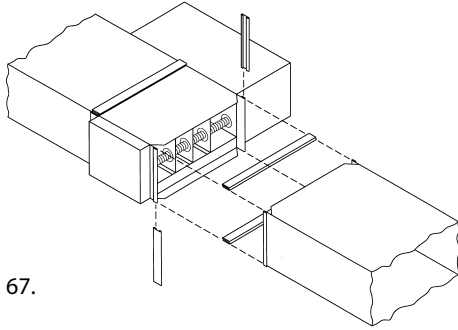


Figure 67.

This option for custom flanged heaters, allowing installation with conventional HVAC slip-and-drive connections, offers the rugged and secure mounting of a flanged heater, yet requires less installation labor than a slip-in heater. It is particularly useful when other equipment in the duct system uses slip-and-drive connections, as the contractor can standardize throughout (Figure 67).

By using Indeeco's slip-and-drive construction in variable air volume (VAV) units, the manufacturer can offer the same standard VAV box for electric heat, hot water heat, or no heat.

Remote Panelboard

When specifying remote panelboards (Figure 68), we recommend the following changes in control and safety components to insure the safety of the installation and to minimize the field labor costs.

- Contactors – Use disconnecting controlling contactors which break all ungrounded lines. Thus, when heat is not being called for, all terminals in the heater will be dead.
- Pilot Switch – Add a dead front pilot switch to the heater terminal box to make it safe for servicing by simply tripping the pilot switch. This shuts off power to the heater circuits through the disconnecting contactors in the panel.
- Fuses – Built-in fusing for each panelboard will be in accordance with UL and NEC requirements.

Except for SCR's, which are mounted through the panelboard side wall, control components are mounted on a sub-panel. Labeled terminal blocks are provided for all field wiring, both in the panel and in the heater. Knockouts and wiring gutter spaces are supplied in all panelboards.

NEMA 1 panels are made from heavy gauge steel, welded and painted (as required), and are provided with a lock and key. Wall mounting, flush mounting, or floor mounting on legs are available.

NEMA 3R type panelboards for outdoor use are UL Listed. These are intended for outdoor use to provide protection against falling rain, sleet, and external ice formation.

NEMA 4 and NEMA 12 UL Listed panelboards for outdoor, dusty, and oil atmospheres are also available. Explosion-proof panels furnished with cast aluminum enclosures are available.

All standard type QUA and QUZ heaters are available with remote panels. Panels for these standard heaters are available in NEMA 1 wall or floor mounting. Fusing, disconnecting contactors, and a heater-mounted pilot switch, all as described above, are supplied.

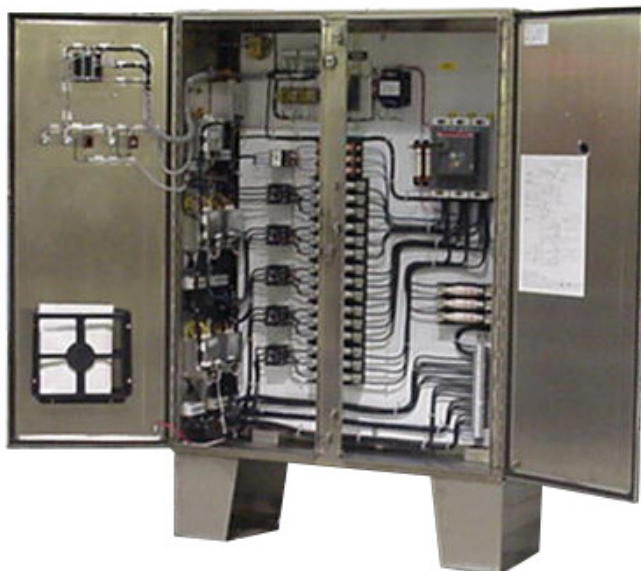


Figure 68.

Custom Duct Heaters

Minimum & Maximum Duct Dimensions

Although there is no limitation on the maximum size of custom heater assemblies, individual UL Listed heaters must meet the following minimum and maximum requirements (see tables below).

UL Listed custom heaters are also available in virtually any KW rating. However, heaters are restricted to maximum KW ratings based on the square feet of heated area.

Indeeco has built individual duct heaters for space heating applications ranging from 0.1 KW to over 900 KW, multi-section units with up to 2000 KW in one assembly, and face areas as large as 40' wide x 14' high. Exact dimensional and KW limits can be determined by contacting your local Indeeco representative.

Table XIV
Open Coil Custom Heaters

	Slip-in Type in (mm)	Flanged Type in (mm)
Minimum Duct Width (W)	5.25 (133)	5 (127)
Minimum Duct Height (H)	4.25 (108)	3 (76)
Maximum Duct Width (W)	240 (6100)	240 (6100)
Maximum Duct Height (H)	120 (3050)	120 (3050)

Table XV
Finned Tubular Custom Heaters

	Slip-in Type in (mm)	Flanged Type in (mm)
Minimum Duct Width (W)	4.75 (121)	4.5 (114)
Minimum Duct Height (H)	5.25 (133)	4 (102)
Maximum Duct Width (W)	175 (4450)	175 (4450)
Maximum Duct Height (H)	120 (3050)	120 (3050)

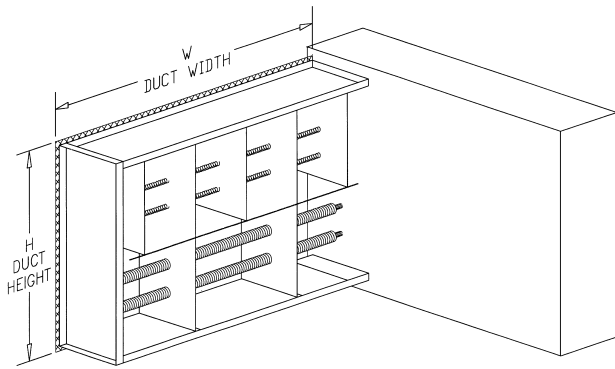


Figure 69. Slip-in Duct Heater

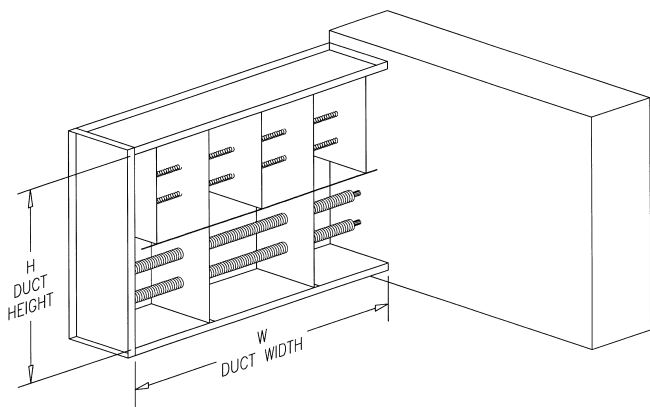


Figure 70. Flanged Duct Heater

Open Coil Custom Heater – Sample Specification

A job specification can be prepared by using the following information. Simply darken the applicable circles. Material which is part of the basic specification has already been darkened. Additional copies of this specification guide are available from your local Indeeco representative.

- 1. Duct heaters shall be Indeeco:
 - Type XUB Custom Slip-in Heater
 - Type ZUB Custom Flanged Heater
- 2. Approvals – Heaters and panelboards (if required) shall meet the requirements of the National Electrical Code and shall be listed by Underwriters Laboratories for zero space between the duct and combustible surfaces and for use with heat pumps and air conditioning equipment.
- 3. Heating elements shall be open coil, 80% nickel, 20% chromium, Grade A resistance wire. Type C alloys containing iron or other alloys are not acceptable. Coils shall be machine crimped into stainless steel terminals extending at least 1" into the airstream and all terminal hardware shall be stainless steel. Coils shall be supported by ceramic bushings staked into supporting brackets.
- 4. Heater frames and terminal boxes shall be corrosion resistant steel. Unless otherwise indicated, the terminal box shall be NEMA 1 type construction and shall be provided with a hinged, latching cover and multiple concentric knockouts for field wiring.
- 5. All heaters shall be furnished with a disc type, automatic reset thermal cutout for primary overtemperature protection. All heaters shall also be furnished with disc type, load-carrying manual reset thermal cutouts, factory wired in series with heater stages for secondary protection. Heat limiters or other fusible overtemperature devices are not acceptable.
- 6. Heaters shall be rated for the voltage, phase, and number of heating stages indicated in the schedule. All three-phase heaters shall have equal, balanced, three-phase stages. All internal wiring shall be stranded copper with 105°C insulation and shall be terminated in crimped connectors or box lugs.
- 7. Terminal blocks shall be provided for all field wiring and shall be sized for installation of 75°C copper wire, rated in accordance with NEC requirements.
- 8. Heaters shall be furnished, either with the Control Option specified in the schedule and described below, or with the specific components listed in the schedule.
 - Option G – Thermal cutouts, airflow switch, contactors, fuses (if over 48 amps), control circuit transformer (where required) and built-in snap-acting door interlocked disconnect switch.
 - Option J – Thermal cutouts, airflow switch, PE switches, contactors (where required), fuses (if over 48 amps), control circuit transformer (where required) and built-in snap-acting door interlocked disconnect switch.
 - Option K – Thermal cutouts, airflow switch, contactors (where required), SCR (with step controller and contactors, if heater draws over 96 amps, three-phase or 192 amps single-phase), fuses (if over 48 amps), control circuit transformer (where required), and built-in snap-acting door interlocked disconnect switch.

9. When specified in the schedule, or below, heaters will be supplied with the following Special Features:

- Airflow switch for negative pressure operation
- Insulated terminal box
- Dust-tight terminal box
- Special terminal box construction
 - NEMA 1 UL3R NEMA 12 NEMA 4 NEMA 4X
- Stainless steel frame and terminal box
- Aluminized steel frame and terminal box
- Insulated duct construction for slip-in heaters
- Unheated section
- Pressure plate
- Protective screen(s); one side both sides
- Controls mounted in remote panelboard
 - NEMA 1 UL3R NEMA 12 NEMA 4 NEMA 4X
- Deletion of transformer
- Deletion of transformer and contactor
- Transformer primary fusing (standard for Class I)
- Transformer secondary fusing (Class II)
- Additional user control circuit voltage (specify user VA)
- Deletion of disconnect switch
- Fused disconnect switch (≤ 48 amps)
- Fusing for heaters rated 48 amps or less
- "Low Airflow" pilot light
- "Heater On" pilot light
- "Overtemperature" pilot light
- Each "Stage On" pilot light(s)
- Fan relay (instead of airflow switch)
- Fan relay (in addition to airflow switch)
- Remote enable heater operation
- Step controller
- Linear limit automatic reset thermal cutout
- 25 watts per square inch resistance coils
- 35 watts per square inch resistance coils
- Built-in PE transducer
- Round Duct Construction

10. When specified in the schedule, or below, heaters shall be supplied with the following thermostats:

- Pilot duty single stage room thermostat
- Pilot duty digital display single stage room thermostat
- Pilot duty two stage digital display room thermostat
- Pilot duty two or three stage programmable with digital display room thermostat
- Proportional electronic room thermostat
- Pilot duty single stage duct thermostat
- Pilot duty two stage duct thermostat
- Proportional electronic duct thermostat with set point adjuster
- Special inputs (135 ohms, 2200 ohms, 4-20 mA, 0-10 VDC)

Custom Duct Heaters

Finned Tubular Custom Heater – Sample Specification

A job specification can be prepared by using the following information. Simply darken the applicable circles. Material which is part of the basic specification has already been darkened. Additional copies of this specification guide are available from your local Indeeco representative.

- 1. Duct heaters shall be Indeeco:
 - Type TFXU Custom Slip-in Heater
 - Type TFZU Custom Flanged Heater
- 2. Approvals – Heaters and panelboards (if required) shall meet the requirements of the National Electrical Code and shall be listed by Underwriters Laboratories, for zero spacing between the duct and combustible surfaces, and for use with heat pumps, and air conditioning equipment.
- 3. Heating elements shall consist of coil, 80% nickel, 20% chromium, Grade A resistance wire, precisely centered in a 304 stainless steel tube filled with granular magnesium oxide. A stainless steel fin is to be helically wound onto the tube. Elements are to be furnished with mounting flanges, making them individually removable through the terminal box.
- 4. Heater frames and terminal boxes shall be corrosion resistant steel. Unless otherwise indicated, the terminal box shall be NEMA 1 construction and shall be provided with a hinged latching cover and multiple concentric knockouts for field wiring.
- 5. All heaters shall be furnished with triple overtemperature protection. A disc type and linear, automatic reset thermal cutout are included for primary overtemperature protection. All heaters must also be furnished with a linear type manual reset thermal cutout with backup contactors (as required). For secondary overtemperature protection, heat limiters or other fusible overtemperature devices are not acceptable.
- 6. Heaters shall be rated for the voltage, phase, and number of heating stages indicated in the schedule. All three-phase heaters shall have equal balanced three-phase stages. All internal wiring shall be stranded copper with 105°C insulation and shall be terminated in crimped connectors or box lugs.
- 7. Terminal blocks shall be provided for all field wiring and shall be sized for installation of 75°C copper wire rated in accordance with NEC requirements.
- 8. Heaters shall be furnished either with the Control Option specified in the schedule and described below or with the specific components listed in the schedule.

Option G – Thermal cutouts, airflow switch, contactors, fuses (if over 48 amps), control circuit transformer (where required) and built-in snap-acting door interlocked disconnect switch.

Option J – Thermal cutouts, airflow switch, PE switches, contactors (where required), fuses (if over 48 amps), control circuit transformer (as required), and built-in snap-acting door interlocked disconnect switch.

Option K – Thermal cutouts, airflow switch, contactors (where required), SCR (with step controller if heater draws over 96 amps three-phase or 192 amps single-phase), fuses (if over 48 amps), control circuit transformer (where required) and built-in, snap-acting, door interlocked disconnect switch.

9. When specified in the schedule, or below, heaters will be supplied with the following Special Features:

- Airflow switch for negative pressure operation
- Insulated terminal box
- Dust-tight terminal box
- Special terminal box construction
 - NEMA 1 UL3R NEMA 12 NEMA 4 NEMA 4X
- Stainless steel frame and terminal box
- Upgraded element sheath material
 - 316SS Monel
- Aluminized steel frame and terminal box
- Insulated duct construction for slip-in heaters
- Unheated section
- Controls mounted in remote panelboard
 - NEMA 1 UL3R NEMA 12 NEMA 4 NEMA 4X
- Deletion of transformer
- Deletion of transformer and contactor
- Transformer primary fusing (standard for Class I)
- Transformer secondary fusing (Class II)
- Additional user control circuit voltage (specify user VA)
- Deletion of disconnect switch
- Fused disconnect switch (≤ 48 amps)
- Fusing for heaters rated 48 amps or less)
- “Low Airflow” pilot light
- “Heater On” pilot light
- “Overtemperature” pilot light
- Each “Stage On” pilot light(s)
- Fan relay (instead of airflow switch)
- Fan relay (in addition to airflow switch)
- Remote enable heater operation
- Step controller
- Built-in PE transducer

10. When specified in the schedule, or below, heaters shall be supplied with the following thermostats:

- Pilot duty single stage room thermostat
- Pilot duty digital display single stage room thermostat
- Pilot duty two stage digital room thermostat
- Pilot duty two or three stage programmable with digital display room thermostat
- Proportional electronic room thermostat
- Pilot duty single stage duct thermostat
- Pilot duty two stage duct thermostat
- Proportional electronic duct thermostat with set point adjuster
- Special inputs (135 ohms, 2200 ohms, 4-20 mA, 0-10 VDC)