THERMOLEC

Certificate of Compliance

Certificate Number: LR 30551-1

Revision: LR 30551-35

Issued to: **THERMOLEC LTÉE/LTD**
2060 Place Thimens
St-Laurent, Québec
H4R 1L1

The products listed below are eligible to bear the CSA Mark
NOTE: The "NRTL/C" indicator also appears adjacent to the CSA Mark.

Issued by: G. Raymond, Eng.
Montréal, QC Canada

Signature: G. Raymond

PRODUCTS

CLASS 2811 03 - HEATERS - Air - Stationary Type
CLASS 2811 83 - HEATERS - Air - Stationary Type - CERTIFIED TO U.S. STANDARDS

Open coil duct heaters for horizontal or vertical air flow, rated up to 600V, 60Hz, 1 or 3 phases, 1000KW and less: With temperature limiting controls, Series SC (slip-in) and FC(flanged); Without temperature Controls (construction evaluation only) Series FE and SE.

APPLICABLE STANDARDS

CSA Std C22.2	No.	155-M1986	-	Electric Duct Heaters
UL std. No.		1996	-	Electric Duct Heaters

*The "NRTL/C" indicator adjacent to the CSA Mark signifies that the product has been evaluated to the applicable ANSI/UL and CSA Standards, for use in the U.S. and Canada. NRTL, i.e. Nationally Recognized Testing Laboratory, is a designation granted by the U.S. Occupational Safety and Health Administration (OSHA) to laboratories which have been recognized to perform certification to U.S. Standards.

THERMOLEC

Certificate of Compliance

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PRODUCTS

CLASS 2811 03 - HEATERS - Air - Stationary Type
CLASS 2811 83 - HEATERS - Air - Stationary Type - CERTIFIED TO U.S. STANDARDS

Duct heaters with Sheathed Elements, for horizontal or vertical air flow, rated up to 600V, 60Hz, 1 or 3 phases, 1000KW and less: With temperature limiting controls, Series FT (flange mount) and ST (slip-in); without limit controls, series TFE (flange mount) and TSE (slip-in).

APPLICABLE STANDARDS

CSA Std C22.2	No.	155-M1986	-	Electric Duct Heaters
UL std. No.		1996	-	Electric Duct Heaters

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THERMOLEC FEATURES

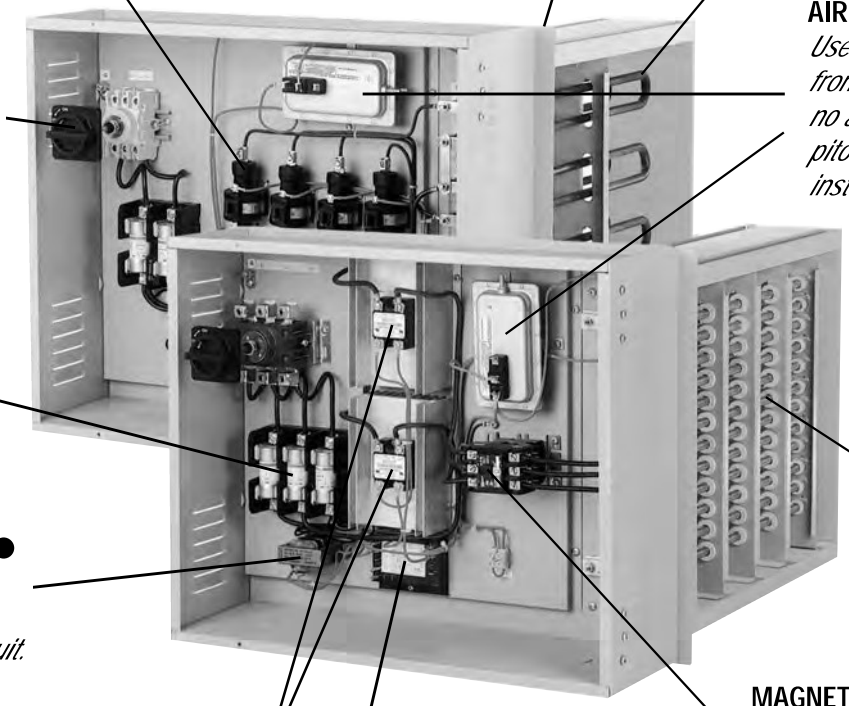
Standard ● *Optional* ❒

MERCURY CONTACTORS ❒
Used to power individual stages of heating. They allow a silent operation and are exceptionally reliable.

AUTOMATIC RESET CUT-OUT ●
The automatic reset thermal cut-out is a fail-safe, fixed temperature, disc type safety device that opens the circuit when it's set point is reached. It automatically resets and returns the heater to operating conditions.

TUBULAR INCOLOY ELEMENT ●

DISCONNECT SWITCH ❒
A built-in disconnect switch allows user to disconnect heaters individually in order to safely perform maintenance tasks.



AIRFLOW SWITCH ●
Used to prevent a heater from operating if there is no airflow. Provided with a pitot tube which, when installed into the duct, makes it sensitive to velocity pressure as well as to static pressure.

FUSES ❒
Used to protect the total load or individual stages.

HIGHEST GRADE OPEN COIL ●

TRANSFORMER ●
Built-in control transformer supplies 24 volts to the control circuit.

MAGNETIC CONTACTORS ●
Used to power individual stages of heating or as back-up for safety switches.

SOLID STATE RELAY ❒
Electronic contactor used to silently and proportionally control the heater in response to a pulsed signal.

All Thermolec Heaters are CSA and NRTL/C approved.

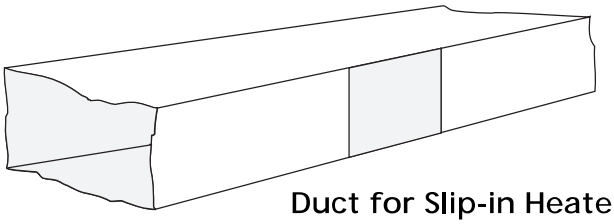
The NR TL/C indicator adjacent to the CSA Mark signifies that the product has been evaluated to the applicable ANSI/UL and CSA Standards, for use in the U.S. and Canada. NRTL, i.e. Nationally Recognized Testing Laboratory, is a designation granted by the U.S. Occupational Safety and Health Administration (OSHA) to laboratories which have been recognized to perform certification to U.S. Standards.

SCR CONTROLLER ❒
The SCR is a time proportioning type controller that modulates the heater and supplies the exact amount of power to match the heat demand. It is compatible with thermistor thermostat (RT or DT), 0-10 Vdc, 4-20 mA, 0-135 ohms input signals.

MODELS

SLIP-IN TYPE DUCT HEATERS AND FLANGED TYPE DUCT HEATERS

SC Slip-in Open Coil *(Fig. 1)*
ST Slip-in Tubular
FC Flanged Open Coil
FT Flanged Tubular *(Fig. 2)*
RFC Round collar open coil *(Fig. 3)*
RFT Round collar with Tubular elements



Duct for Slip-in Heater

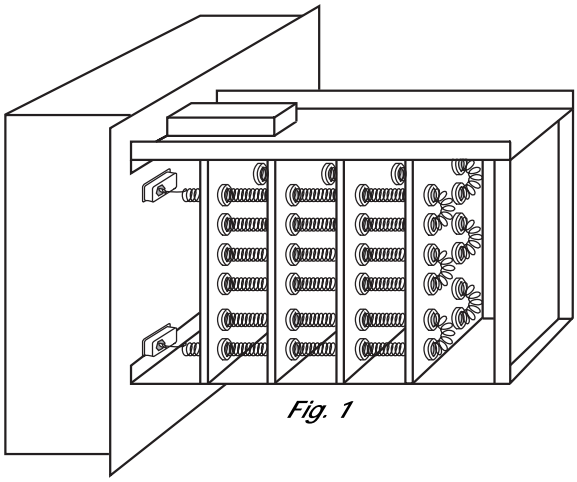
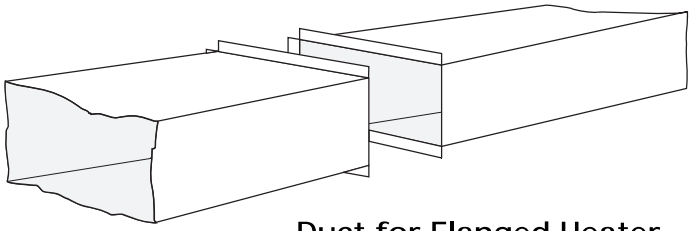


Fig. 1



Duct for Flanged Heater

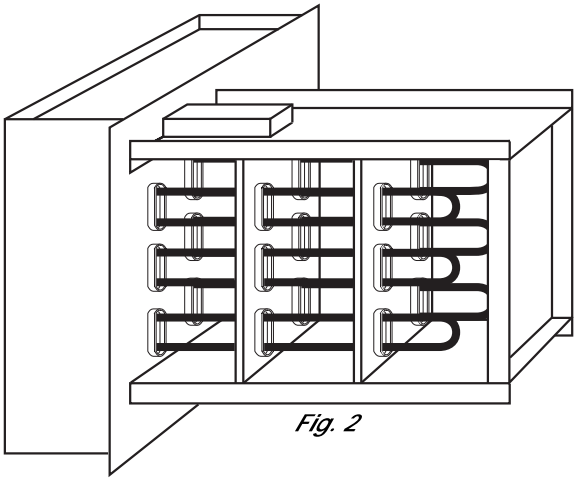


Fig. 2

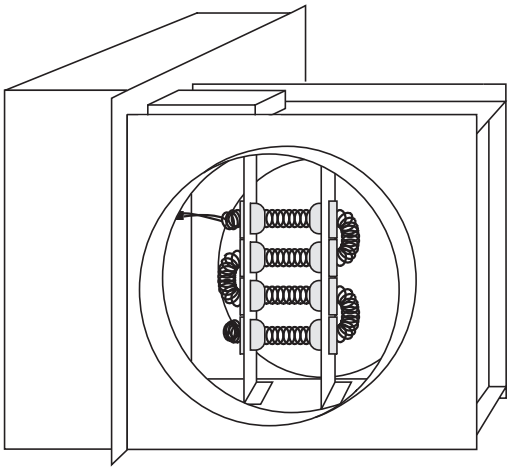


Fig. 3

All Thermolec heaters are CSA and NRTL/C approved

HOW TO SELECT AND SPECIFY IN THREE EASY STEPS

Selecting the heater for your application can be done in three easy steps:

1- Determine heater capacity, voltage and electrical components

2- Determine duct dimensions, air requirements and mechanical options

3- Determine method of control, then select control components

---

STEP 1 -

DETERMINE HEATER CAPACITY, VOLTAGE AND ELECTRICAL COMPONENTS

Heater capacity

Given CFM (volume of air in cubic feet per minute) and ΔºT (temperature rise in º F), the KW capacity can be determined from the formulas:

$$KW^{**} = \frac{CFM \times \text{Temperature Rise, } ^\circ F^*}{3000}$$

$$\text{Temperature Rise, } ^\circ F = \frac{KW \times 3000}{CFM}$$

NOTE:
The above formulas are for standard air. Consult your Thermolec representative for non-standard air conditions.

** Maximum air temperature rise for which the heater is designed*

*** This formula is for quick calculation and contains a loss allowance of 5%.*

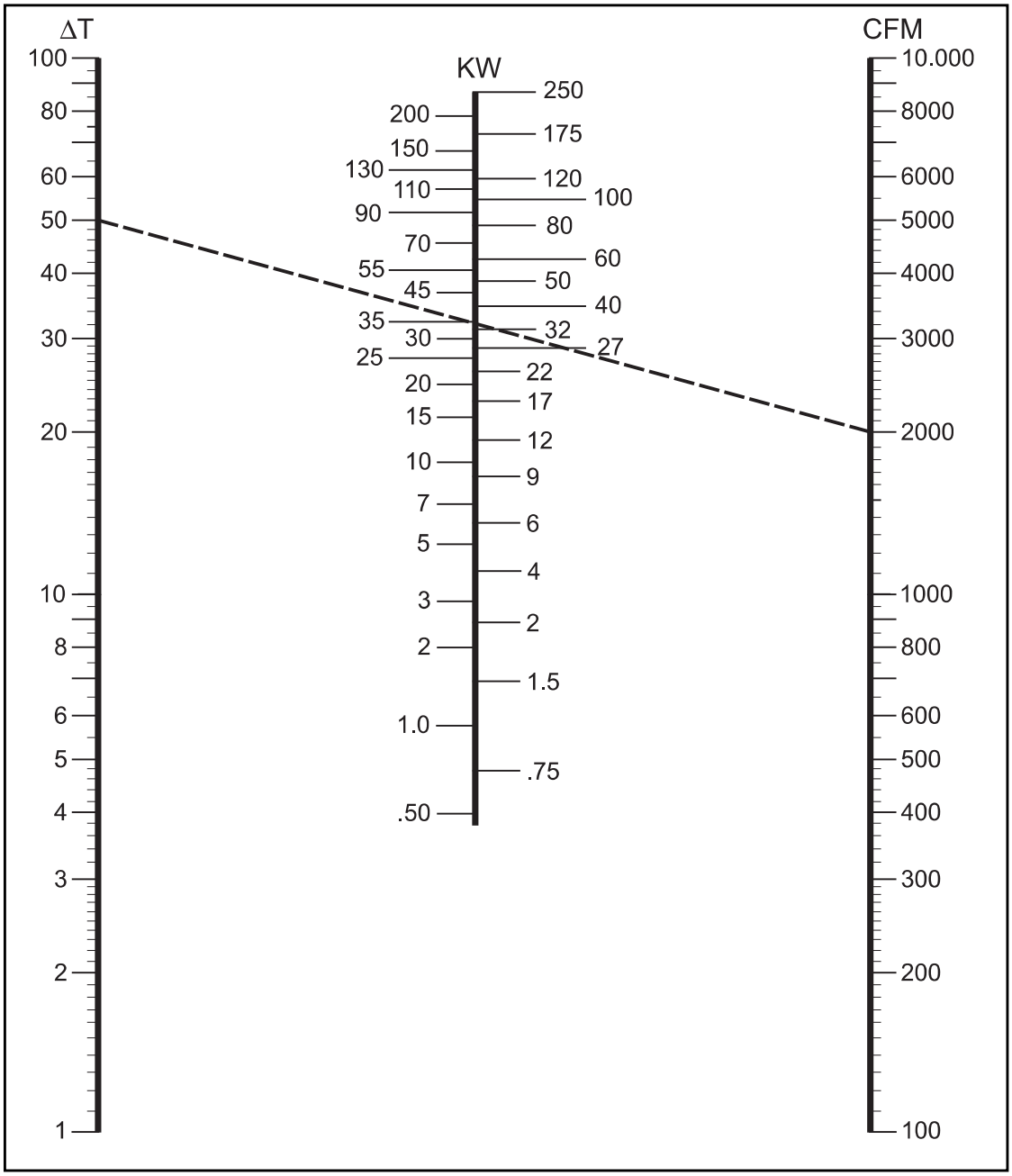


Chart to determine the required kilowatts

For a rough estimate, use the chart above.

Example:

Find the KW required to raise 2000 CFM from -10 to 40 ºF.

ΔT = 40 + 10 = 50 ºF.

Lay a straightedge across the chart from 50 on the ΔT scale to 2000 on the CFM scale.

Find the required KW where the straightedge intersects the KW scale.

For this example, the KW required is approximately 35 KW.
You may decide to add any safety factor or loss allowance.

STEP 1 - (continued)

Power and Voltage Requirements

Nominal and Standard Supply Voltages

While a utility's voltage may be referred to by means of a nominal figure, actual applied voltage may vary over a fairly wide range depending on factors like the system's power distribution lines, and many others. For instance, a nominal voltage of 575V / 3PH / 60Hz may variously be called 550V, 575V or 600V depending more on what the specification writer is accustomed to calling it than on the actual voltage supplied to the heater. Designing a heater for 550V when in fact 600V is supplied to it will result in almost 10% more current and 20% more KW capacity since current is proportional to the voltage and KW is proportional to the square of the voltage. Conversely, application of a lower voltage results in a corresponding under-performance of the heater. It is therefore of the utmost importance to ensure that the correct voltage is specified.

For safety reasons Thermolec standard supply voltages have been chosen to be the highest for each voltage range, as shown in the table below. Heaters designed for lower voltages in each range are available and will be supplied when customer expressly specifies a lower supply voltage.

Common Nominal Voltages	110 115 120	208		220	230 240		277	318 332 347	380		416		440 460 480		550 575 600	
Thermolec Standard Voltages	120 1 Ph	208 1 Ph	208 3 Ph	220 1 Ph	240 1 Ph	240 3 Ph	277 1 Ph	347 1 Ph	380 1 Ph	380 3 Ph	416 1 Ph	416 3 Ph	480 1 Ph	480 3 Ph	600 1 Ph	600 3 Ph

STANDARD VOLTAGES

This standardization reduces the risk of overheating due to a heater subjected to an overvoltage with the resulting nuisance tripping of high-temperature cut-outs.

Examples of risk:

Example 1:

A 575V/3 PH heater in a 600V/3PH installation would carry 5% more current and produce 10% more KW than it is designed for.

Example 2:

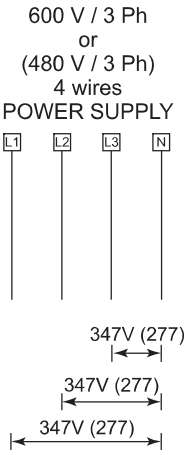
A 220V/1 PH heater in a 240V/1PH installation would carry 10% more current and produce 20% more KW than it is designed for.

Under such conditions, these heaters would overheat and thermal cut-outs would trip.
In order to avoid any risk of overheating, it would be advisable to verify the existing conditions on the job site.
In case of doubt about the required voltage, always specify one of the Thermolec Standard Voltages.

STEP 1 - (continued)

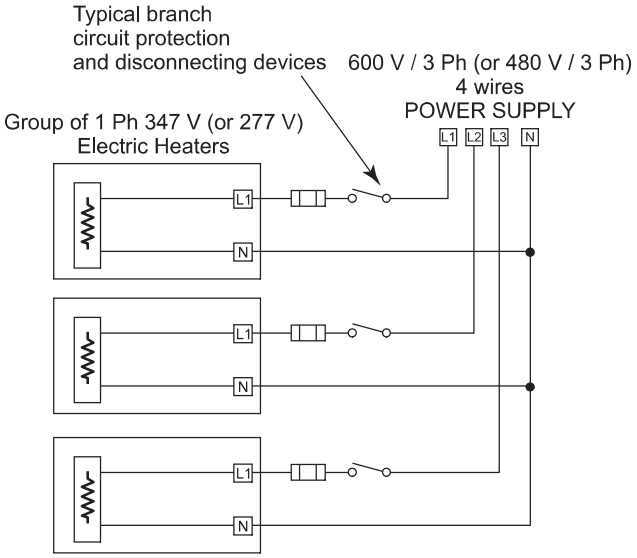
347 (277) V, Single Phase Power Supply

When capacities are below 7 KW at 277 V and 8 KW at 347 V Thermolec recommends the use of the following arrangements to obtain the most economical cost for heaters and electrical distribution.



347 / 600V
4 wire power supply
(also 277 / 480)

These voltages are generally derived from a 600 (480) volts - 3 phase - 4 wire power supply.
A group of 347 (277) volt - 1 phase heaters should be distributed as equally as practical over the three phases in order to keep current imbalance to a minimum.
Neutral conductor should not be broken by any switching or protective device, be it internal or external to the heater.



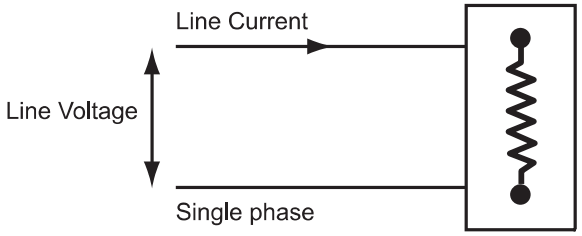
Equal distribution of heaters

Line Current

The table below shows line current per one KW capacity at various voltages. The following formulas apply:

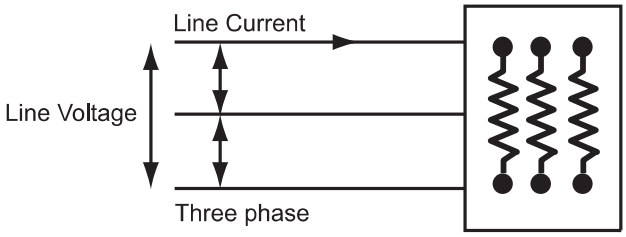
SINGLE PHASE

$$\text{Line Current in Amperes} = \frac{\text{Watts}}{\text{Line Voltage}}$$



THREE PHASE (Star or Delta loads)

$$\text{Line Current in Amperes} = \frac{\text{Watts}}{1.73 \times \text{Line Voltage}}$$



Thermolec Standard Voltages	120 1 Ph	208 1 Ph	208 3 Ph	220 1 Ph	240 1 Ph	240 3 Ph	277 1 Ph	347 1 Ph	380 1 Ph	380 3 Ph	416 1 Ph	416 3 Ph	480 1 Ph	480 3 Ph	600 1 Ph	600 3 Ph
Multiplier Amp./KW	8.33	4.81	2.78	4.55	4.17	2.41	3.61	2.88	2.63	1.52	2.40	1.39	2.08	1.20	1.67	0.96

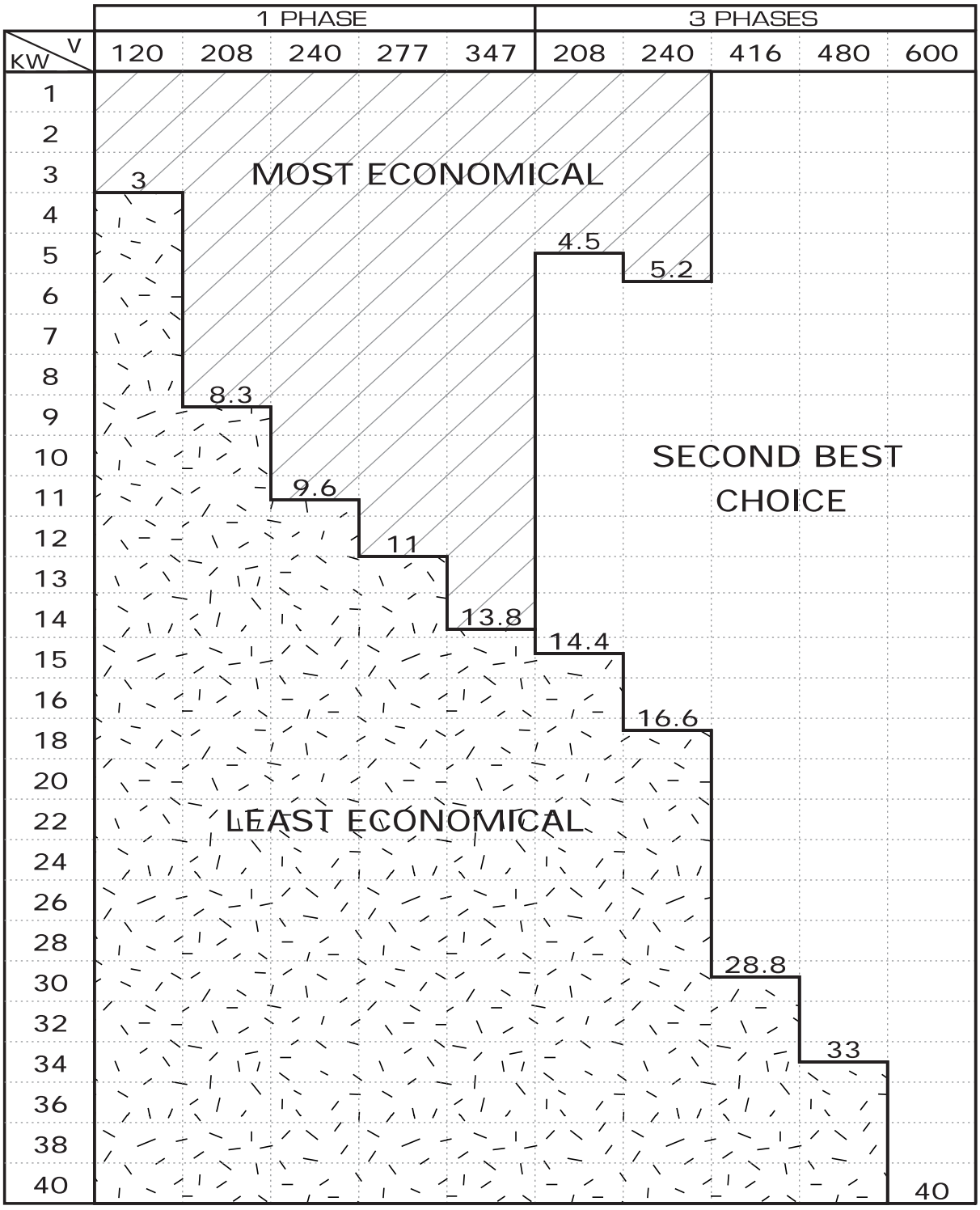
Multipliers to calculate Line Currents

(Line current in amperes = Multiplier x KW capacity)

Example: The Line current for a 40 KW / 600V / 3 phases heater is : 40 x 0.96 = 38.4 amperes.

STEP 1 - (continued)

Selection chart of most economical design for THERMOLEC modulating heaters KW/Voltage combination



STEP 1 - (continued)

FUSING

The National Canadian and Electrical Code requires that each power supply to a heater be individually protected by either fuses or circuit breakers external to the heater. Please see Pertinent Regulations.

Additional sub-circuit fusing within the heater (built-in load fuses) may be either mandatory or optional and if optional, may or may not be recommendable. The following table supplies the information necessary for decisions on built-in sub-circuit over-current protection.
As a general rule, built-in load fuses are rated 30 Amps for circuits up to 24 Amps and 60 Amps to protect one or more internal circuits totaling up to 48 Amps.

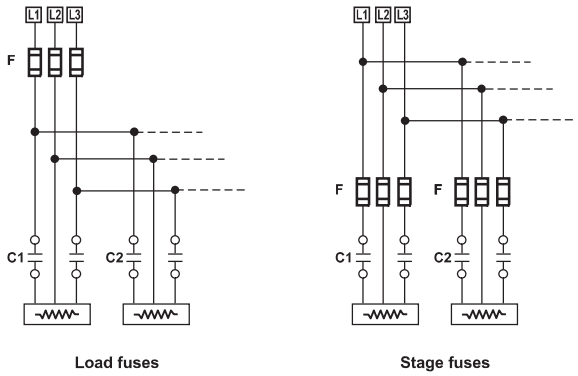
TABLE FOR LOAD FUSING

SUPPLY VOLTAGE & PHASE						HEATER RATED AMPS.	NEC ELECTRICAL CODE	INTERNAL LOAD FUSING MANDATORY	THERMOLEC RECOMMENDS BUILT-IN LOAD FUSES	THERMOLEC COMMENTS
240 / 1 PH	208 / 3 PH	277 / 1 PH	347 / 1 PH	480 / 3 PH	600 / 3 PH					
HEATER TOTAL KW * UP TO										
12	17	13	17	40	50	0 - 48	NO	NO	NO	OPTIONAL LOAD FUSES NOT RECOMMENDED - ONLY ONE POWER SUPPLY ECONOMICALLY JUSTIFIED.
38	57	44	55	133	166	49 - 160	YES	NO	YES	FUSES LIMIT EXTENT OF DAMAGE IN TERMINAL BOX IN CASE OF SHORT CIRCUIT.
39 & +	58 & +	45 & +	56 & +	134 & +	167 & +	161 & +	YES	YES	YES	MANDATORY IN CASE OF SHORT CIRCUIT.
* For higher KW capacities consult factory regarding the most economical number of power supplies.										

LOAD FUSES: The minimum required sets of 60 Amp fuses for proper protection (Option U1).
Example of load fusing: A one stage, three phase heater rated 40 amps will use one set (3 fuses of 60 Amps).

STAGE FUSES: Mostly optional, one or more sets of fuses per stage (Option U2).
Thermolec standard fuses are 30 Amps for circuits up to 24 Amps and 60 Amps for circuits up to 48 Amps.
Example of stage fusing: A three phase heater rated 48 amps will use one set (3 fuses of 60 Amps) if the heater is designed with one stage.
For two stages (24 Amps per stage), two sets (6 fuses of 30 Amps) will be used.
For three stages (16 Amps per stage), three sets (9 fuses of 30 Amps) will be used.

Because fuses require ventilation, the control box must be louvered. If the control box is specified as Nema 4 or 12, then the box must be oversized.



Typical sub-circuit fusing arrangements

For more detailed information, please refer to section 2 in brochure " Power supply and fusing considerations "

STEP 1 - (continued)

Contactors

Contactors are used to power individual stages of heat or as back-up for safety switches.

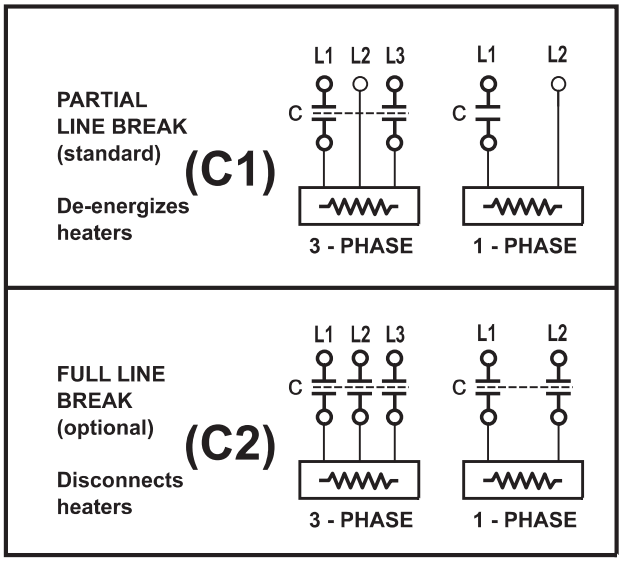
Contactors may be of two types:

Partial line-break (or de-energizing)

In the partial line-break arrangement the contactor opens the current path, thus de-energizing the heater.

Full line-break (or disconnecting)

The full line-break type contactor opens all ungrounded power lines in the heater. This may be ordered as an option (Request option C2).



Partial and Full Break Figures

Special power lugs

Heaters are supplied with power terminal blocks rated for copper conductors with 75 ºC insulation. Aluminum conductors are not recommended and the standard terminal blocks are not sized for aluminum. Please consult Thermolec if the use of aluminum conductors is considered.
For very high amperages, Thermolec can supply terminal blocks for two or more parallel conductors per phase.
For more detailed information, please refer to section 2 in brochure "Power supply and fusing considerations".

STEP 2 -

DETERMINE DUCT DIMENSIONS, AIR REQUIREMENT AND MECHANICAL OPTIONS

Air Flow requirements and Minimum Velocity

When there is a choice in heater face dimensions the specification writer has several good reasons for favoring the smaller rather than the larger heater face area: The smaller sized, higher velocity electric coil will perform better, weigh less and cost less per KW than an otherwise identical larger coil.

The main selection criteria are KW per square foot of face area (or duct size) and Design Velocity.

KW per Square Foot Range	COMMENTS
Less than 5	High cost per KW
5 to 12	Medium cost per KW
12 to 20	Low cost per KW
Over 20	Medium cost per KW

Kilowatts per square foot Table

Face velocity in Feet Per Minute (FPM)	COMMENTS
Less than 400	Requires derating of watts density on elements. Specify proportional control.
400 to 2000	Most economical range
Over 2000	Specify special coil supports

Design Velocity Table

Unlike hot water or steam coils, electric coils will generate 100% of the heating capacity (i.e. the heat output is constant as long as the heater is energized) regardless of the air flow. A drop in air flow through an electric coil below the minimum required FPM (feet per minute) will increase both the coil temperature and the exhausted air, which may result in high limit cut-outs tripping.
Another frequent cause of unnecessary cut-out tripping is the uneven distribution of air flow over the coil surface, resulting in "hot spots". In order to achieve trouble-free performance, provide adequate air flow as per "air flow requirement" chart (on page 14) and ensure even air flow distribution by following sound industry practice in design and installation of ductwork and equipment.

The Thermolec CSA NRTL/C listing is limited to 22.5 KW per square foot of duct area for open coil heaters and 13 KW per square foot of duct area for tubular element heaters.

Air flow requirements for ON-OFF Control

The minimum air flow required through a duct heater depends on the KW per square foot of face area for the highest capacity ON-OFF stage. In general **400 FPM** is adequate in most applications.

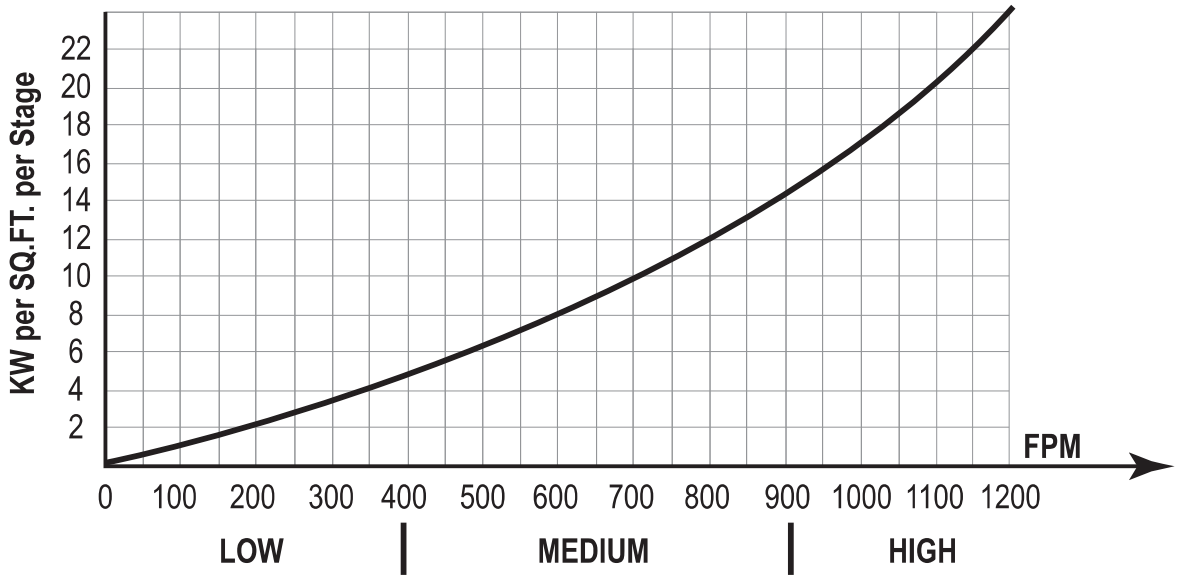
Air flow requirement for Full SCR control

An SCR controlled heater may be considered as having an "infinite" number of control stages, and consequently the air flow requirements of the chart (on page 14) for minimum air flow does not apply.
As a general rule, heaters equipped with FULL SCR will require an air velocity of at least **300 FPM.** For lower design velocities please consult factory.

Exclusive Feature:

The special **Thermo-V** unit for VAV applications allows the heater to perform down to **50 FPM.**
Please see pages *25 and 26.*

STEP 2 - (continued)



Air Flow Requirement for Open Coil Heaters

Net FACE AREA = Duct width in inches x Duct Height in inches / 144
KW per SQ.FT. per STAGE = KW of the largest stage / net FACE AREA in SQ.FT.

Please refer to the table on page 16 for tubular elements.

Example:
Find the minimum air flow requirement for a 65 KW 1 stage heater in a 24" wide by 18" high duct.

Ⓐ Calculate duct area in square feet.

$$\text{Duct Area} = \frac{24" \times 18"}{144} = 3 \text{ square feet}$$

Ⓑ Calculate KW per square foot per stage.

$$\text{KW per square foot per stage} = \frac{65 \text{ KW}}{3 \text{ sq.ft.} \times 1 \text{ stage}} = 21.66$$

Ⓒ Using the Air flow requirement curve above, find 21.66 on the vertical scale.
Read the minimum velocity required on the horizontal axis, which is approx. 1150 FPM.

Ⓓ If it is a 2 stage heater then KW per square foot per stage $= \frac{65 \text{ KW}}{3 \text{ sq.ft.} \times 2 \text{ stages}} = 10.83$
In this case 750 FPM are required.

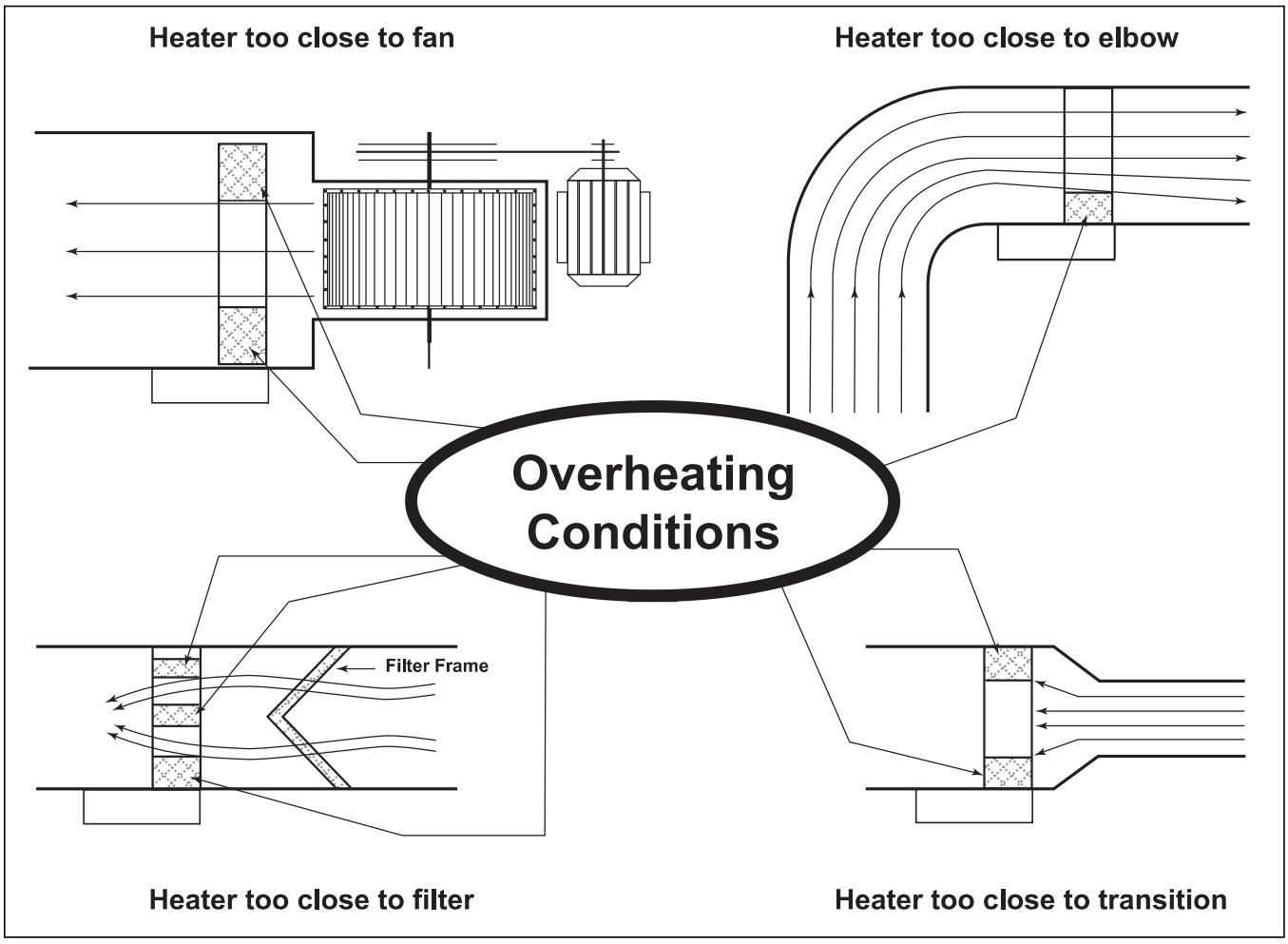
Ⓔ If it is an SCR Controlled heater then 300 FPM are required.

STEP 2 - (continued)

Airflow Uniformity

In order to prevent hot spots, the air flow must be uniformly distributed across the heater area. The following figures illustrate typical heater mis-application where the airflow is not uniform. An NEC article (please see below *) specifies that a heater should not be installed closer than 4 feet downstream or 2 feet upstream from a fan outlet, an abrupt transition, an elbow or any other kind of obstruction in the duct. If your application is such that one of the mentioned installations cannot be avoided, THERMOLEC can help you by designing around it.

* 1071 NEC Article 424-59:
"Means shall be provided to assure uniform and adequate airflow over the face of the heater. Heaters installed near (within 4 feet) a fan outlet, elbows, baffle plates or other obstruction in duct work may require turning vanes, pressure plates or other devices in the inlet side of the duct heater to assure an even distribution of air over the face of the heater".



STEP 2 - (continued)

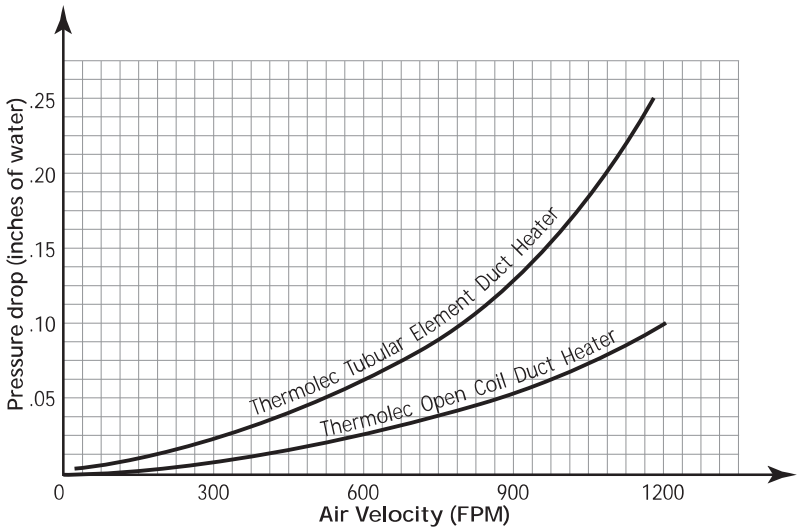
OPEN COIL vs TUBULAR elements

THERMOLEC manufactures both open coil and tubular duct heaters.

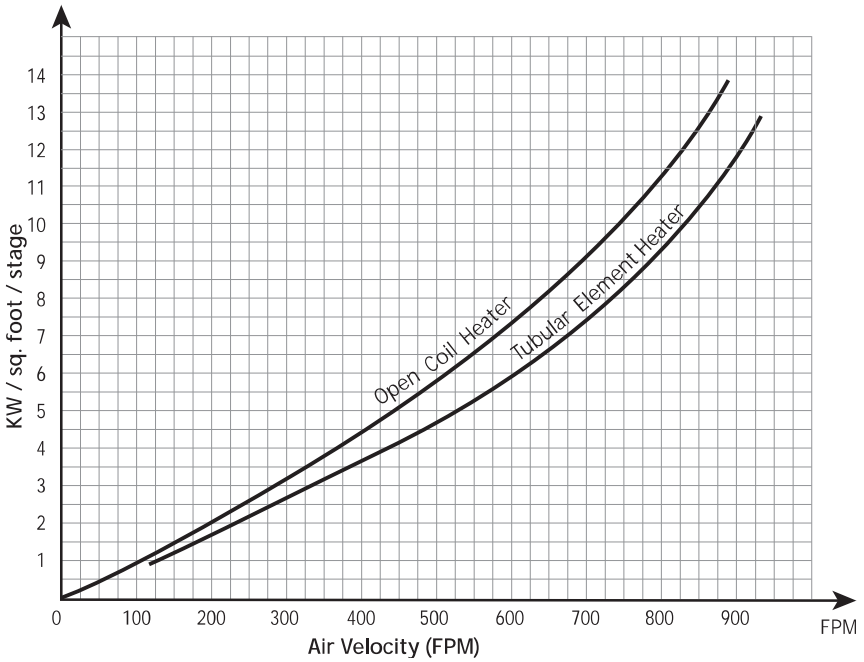
It is widely acknowledged that tubular elements find practical application under certain circumstances (service conditions include possible contact by personnel, presence of dust or particles in the air flows or atmospheric conditions).

But, where heating filtered air is the sole function, the open coil heater is superior for many reasons:

- Longer life
- More kilowatts per square foot
- Less stratification by equal distribution of the elements
- Lower wire surface temperature
- Less maintenance
- Greater serviceability
- Better heat distribution across heater face
- Less pressure drop
- Lighter weight
- Low shipping costs
- Less sensitivity to moisture
- More flexibility of size and capacity
- Cost effective
- Smaller size
- Large electrical clearance

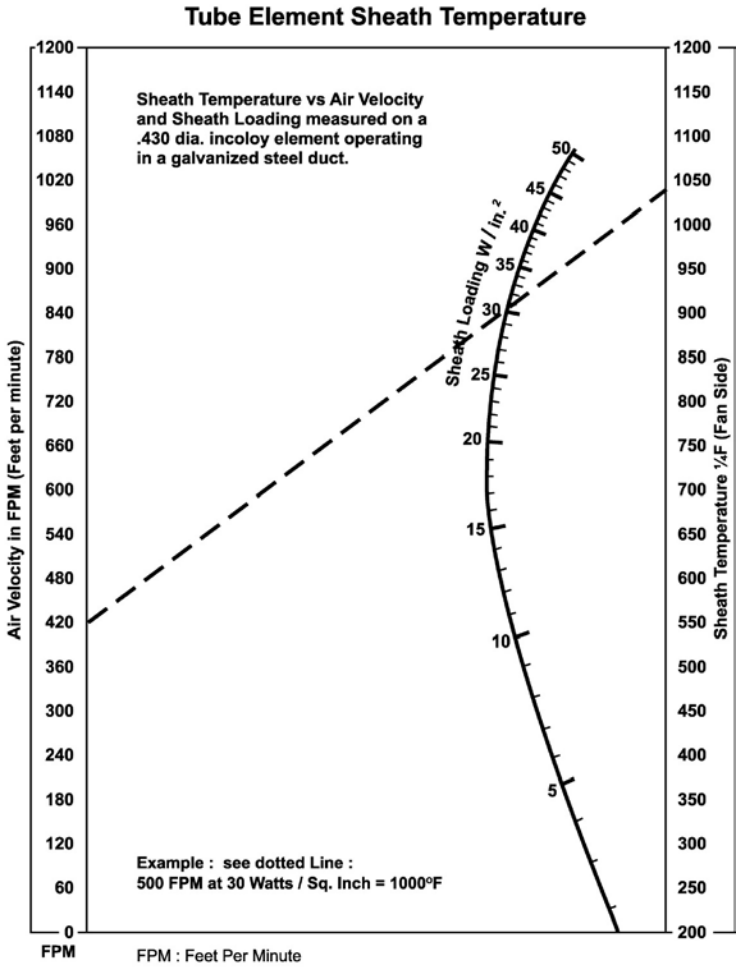


Pressure Drop for Tubes



Minimum Air Velocity for tubes

STEP 2 - (continued)



Exclusive Design advantage of the Thermolec Tubular heater construction

Thermolec Tubular elements can be removed through the control box, which avoids the need to remove the heater from the duct and thus reduces maintenance costs. However, precautions must be taken in terms of clearance when installing the heater in order to take advantage of this feature.

Please refer to SECTION 2 of this catalog for more detailed considerations about open coil and tubular elements.

STEP 2 - (continued)

Size Limitations

Although there are practically no limitations to the maximum size of Thermolec custom-built heaters, all CSA listed heaters must comply to the following minimum dimensions:

	Slip-in Type Open Coil	Flanged Type Open Coil	Slip-in Type Tubular	Flanged Type Tubular
Minimum Duct Width Dimension "W"	6″	5″	8″	7″
Minimum Duct Height Dimension "H"	5″	4″	6″	6″

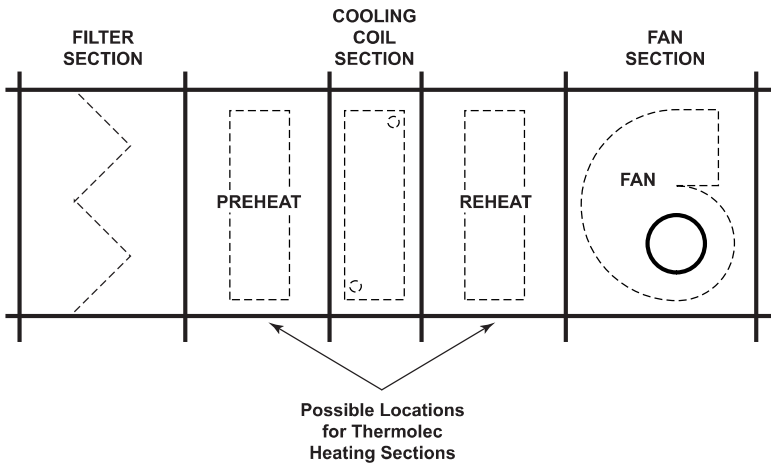
Size Limitation Table

CSA listed custom heaters are available in virtually any KW rating. However, Thermolec listing is restricted to a maximum KW density of 22.5 KW per square foot of heated area for open coil and 13 KW per square foot for tubular. For a quick approximation of the maximum KW available in a particular duct size, please use the following formulas:

Open Coil Type SC or FC	Maximum KW =	$\frac{22.5 \times \text{width in inches} \times \text{height in inches}}{144}$
Tubular Type ST or FT	Maximum KW =	$\frac{13 \times \text{width in inches} \times \text{height in inches}}{144}$

Modular Construction for Air Handling Units

Thermolec heaters can be part of large air handling units. In this case, a heater becomes a module of a bigger unit and is designed to match the other components: filter frames, fans, cooling coils, VAV boxes, etc. Flanged units can be bolted directly to adjacent sections or slip-in models are inserted into a bigger unit. Since there can be several special conditions in such big units, the heater has to be designed to accommodate them. Special features can be installed upon request: section with no heat, pressure plates to equalize air flow, buffer sections to space the heater away from other components, etc.



Modular Heating Sections

STEP 2 - (continued)

Variable Air Volume units (VAV)

The ***"Thermo-V"*** electric heater developed by Thermolec eliminates the common problems that are encountered in the application of an electric heater to a VAV box as described below:

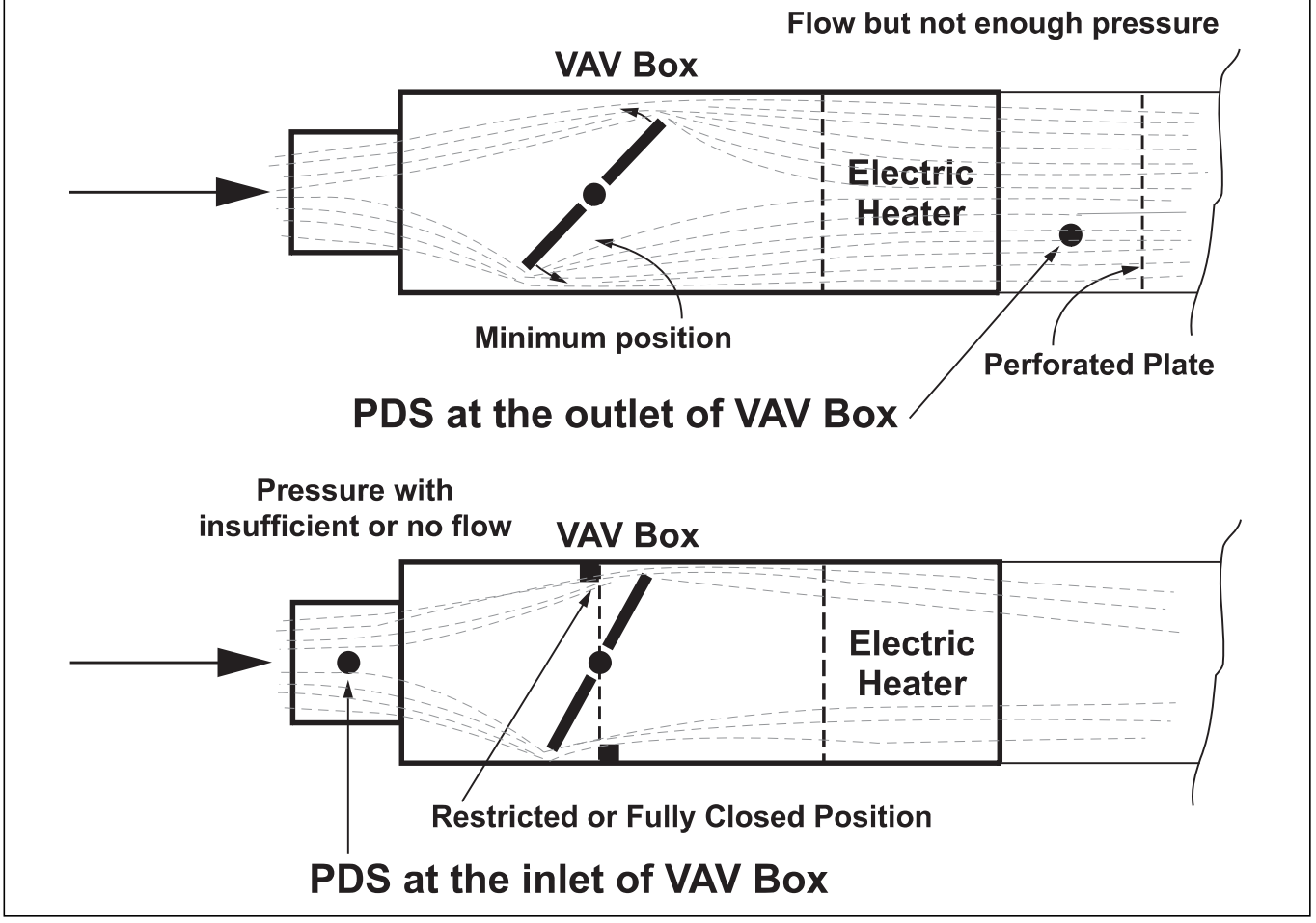
A. When the VAV Box is in the minimum opening position, the air flow is often below the minimum required to operate a standard electric heater, causing element overheating and possible tripping of the thermal cut-outs. The common solution is to increase the minimum ventilation air flow to accommodate the minimum air flow required to operate the heater which translates into energy waste.

B. The static pressure in the duct downstream is so low that even the most sensitive pressure differential switch is unable to detect sufficient pressure to activate the electric heater. The common solutions are:

1. To create an artificial pressure by adding restrictions at the outlet (perforated plate), which creates a costly and unnecessary pressure loss when the box is in a fully open position.

2. To measure the pressure upstream of the VAV box, which could be dangerous, since, with a restricted or totally closed box, there is pressure without air flow. The electric heater will have to rely solely on it's safety thermal protections to shut off.

Common Problems Encountered



STEP 2 - (continued)

Thermolec has developed and patented an innovative solution to eliminate these problems:

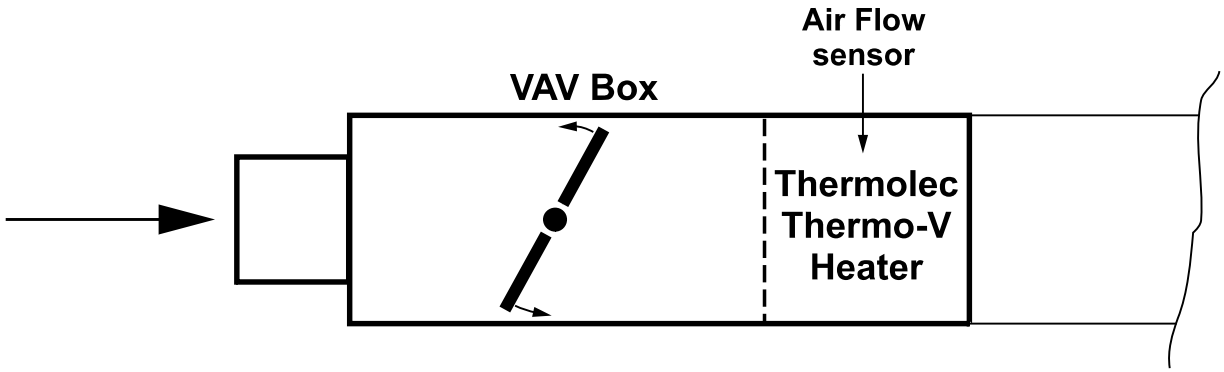
The Proportional Electronic Air Flow Sensor.

The Air Flow Sensor responds to the radiant heat of the heating element which, in turn, is influenced by the air flowing through the heater to dissipate the heat.

The patented sensor and associated electronic controller modulate the power to the heater, adjusting the heater's capacity to accurately match the air flow available.

This unique concept allows the heater to respond exactly to the quantity of air flowing through it and safely shut down in case of a total loss of air flow.

The heater delivers maximum heating when needed with normal minimum air flow, reduced heating with lower than minimum air flow and stops heating with no air flow.



The Thermolec VAV Solution

The electronic controller also allows a proportional control of the heater, and is compatible with the following input signals:

1- Variable voltage signal 0 -10VDC.
2- Pulse Signal 24VAC or VDC.

Benefits of the Proportional Electronic Air Flow Sensor :

- The heater will operate with extremely low air flow. VAV boxes can then be set to minimum air to satisfy ventilation requirements rather than increased to accommodate conventional heater velocity requirements.
- Allows the heater to operate safely regardless of the duct static pressure.

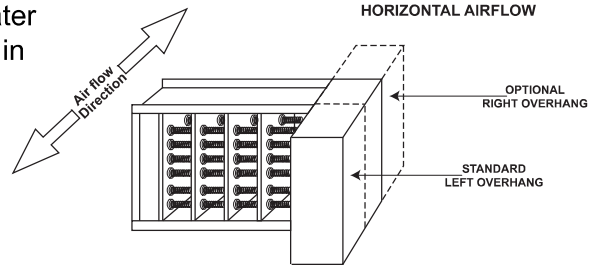
STANDARD CAPACITIES	STANDARD DIMENSIONS
up to 2 Kw 120V / 1Ph	
up to 5 Kw 208V / 1Ph	Round: from 6" to 12" dia.
up to 6 Kw 240V / 1Ph	
up to 7 Kw 277V / 1Ph	Rectangular: from 6" x 6" to 24" x 18"
up to 8 Kw 347V / 1Ph	
Other dimensions, capacities and voltages up to 40 KW and 600V / 3Ph available upon request.	

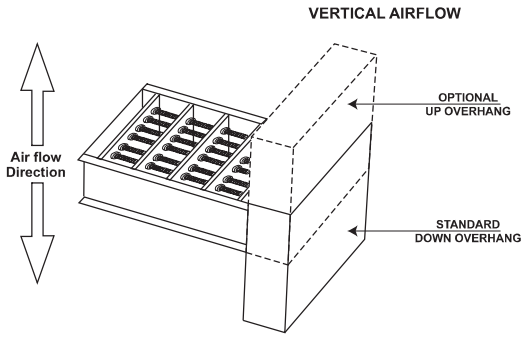
STEP 2 - (continued)

Universal mounting of Thermolec heaters

Unique feature

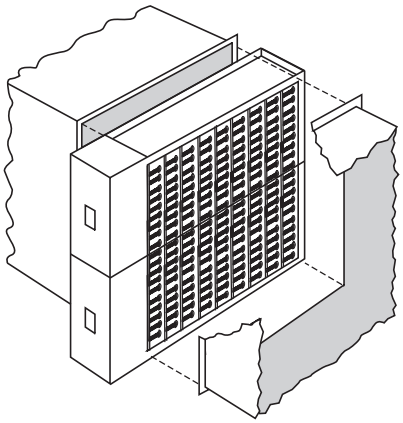
By design, all Thermolec heaters are made non-sensitive to air flow direction. The built-in high limit thermal cut-outs are located in such a way that the air flow could be in any direction without impairing safety and the same heater could be installed in a horizontal or vertical duct.





Multiple Heaters in a duct

Normally, electric heaters are not designed to be used in series in a heating installation. For very large heaters, manufacturing, shipping, field handling and installation, can be simplified by using two or more units specially designed for parallel installation. Each section has its own cut-outs and terminal blocks are provided to interconnect the controls in the field.

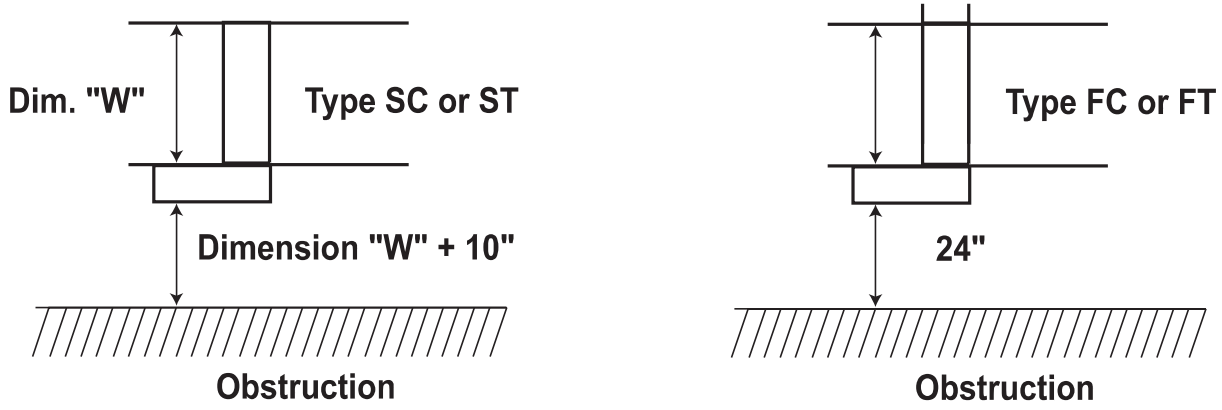


Two stacked sections in a duct

Clearance

Thermolec heaters are CSA and NRTL/C approved for zero clearance to combustible material. This means that there is no distance restrictions between the section of the duct housing the heater and combustible material. However, space should be provided to install and service the duct heater. Please see the minimum recommended installation clearances figures below.

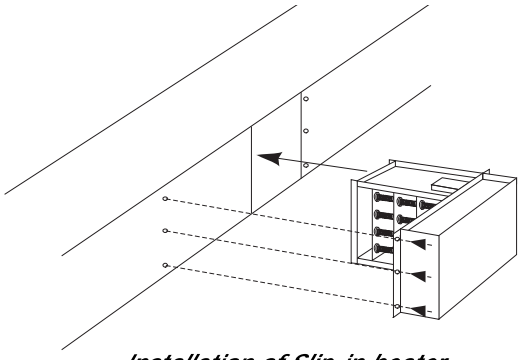
Minimum recommended distance for safety and service



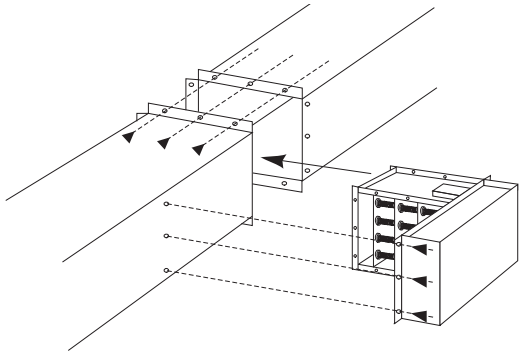
Installation clearances

STEP 2 - (continued)

Heater Installation

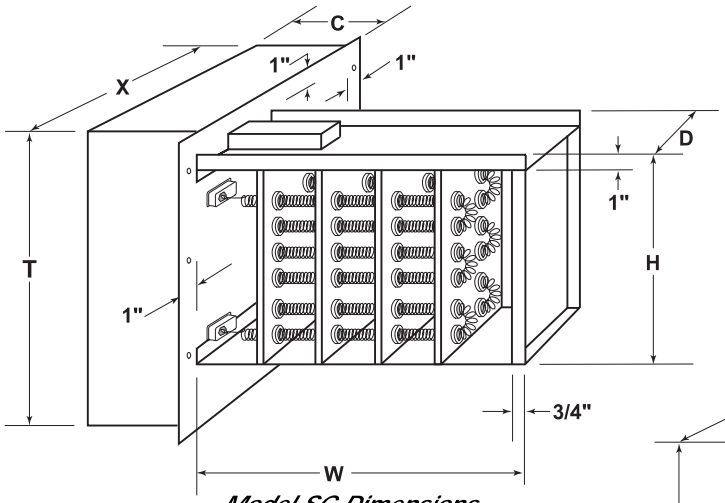


Installation of Slip-in heater



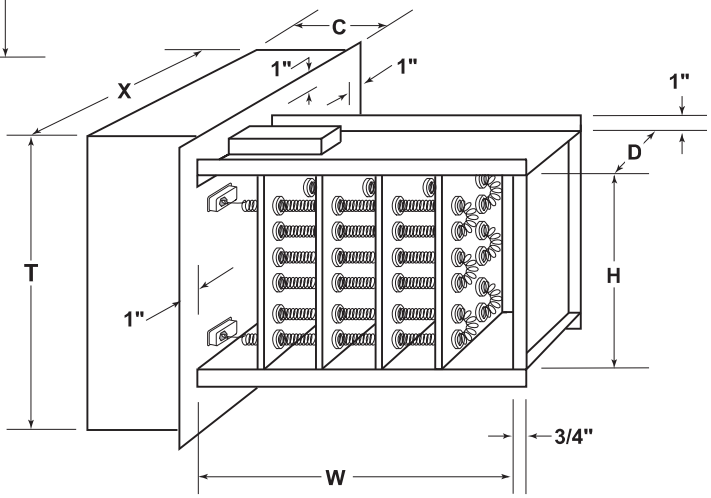
Installation of flanged heater

Details of the Thermolec Mechanical construction

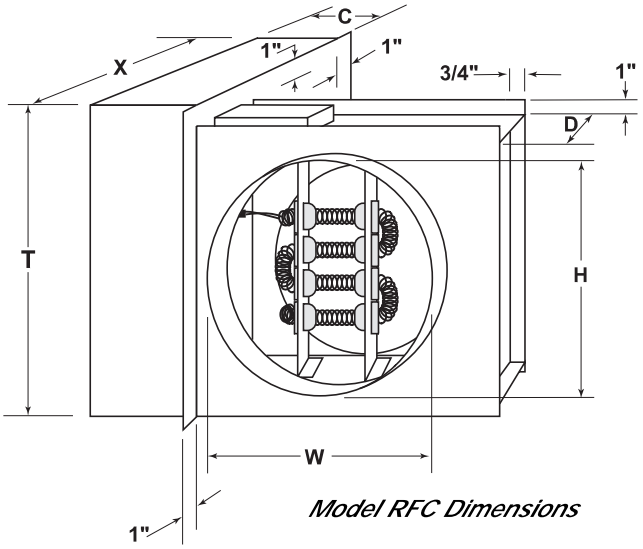


Model SC Dimensions

Detailed dimensions:



Model FC Dimensions

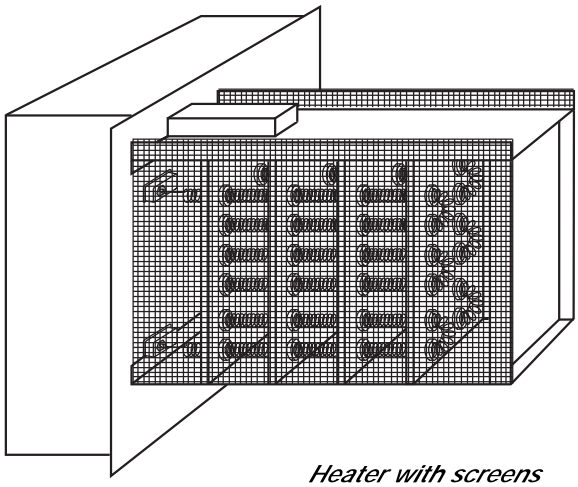


Model RFC Dimensions

Conversion to metric
1” = 25.4 mm
3/4” = 19.05 mm

STEP 2 - (continued)

Protective screens

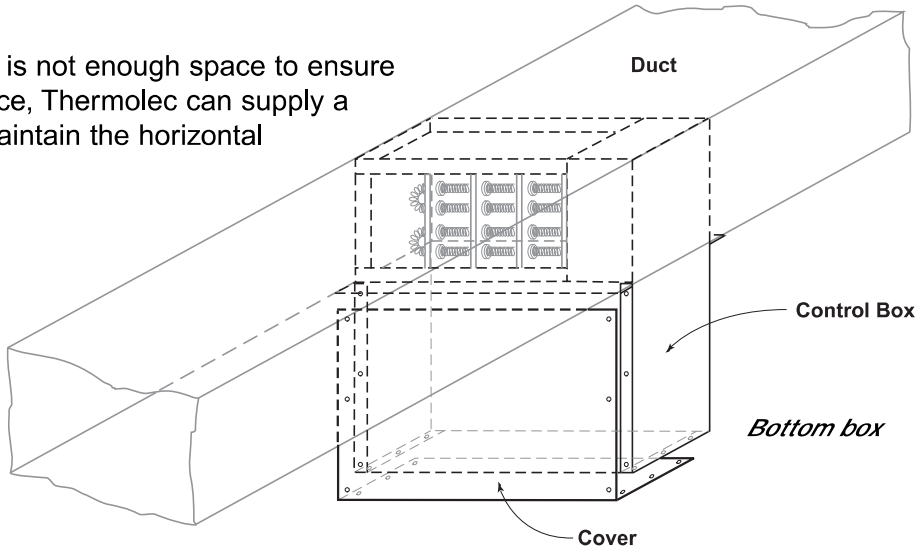


Heater with screens

Screens on both sides of the heater prevent any accidental contact by personnel or tools with electrically de-energized but still "live" coil elements.

Bottom control box

In special conditions, where there is not enough space to ensure proper installation and maintenance, Thermolec can supply a bottom control box designed to maintain the horizontal orientation of open coil elements.



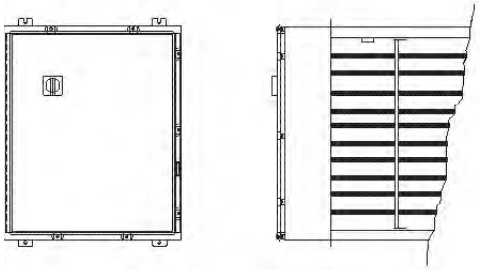
Dust-tight control box

Dust-tight Control Box

A dust-tight control box can be supplied by Thermolec when local codes require it. The control box has all the openings sealed and the cover is gasketed. When SCRs or fuses are installed in a gasketed control box, since there is no opening allowed for proper cooling, the box has to be oversized.

STEP 2 - (continued)

Nema 4 or Weatherproof control Box

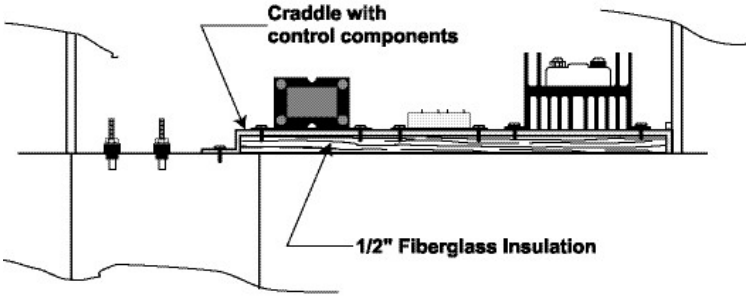


NEMA 4 or Weatherproof oversized control panel

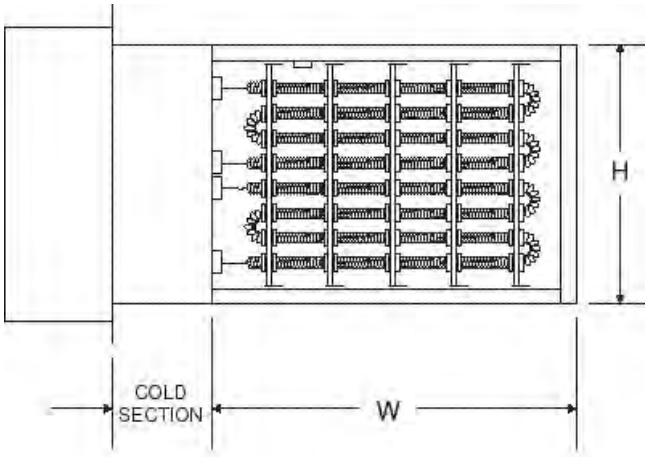
In locations subject to frequent washdowns (i.e. mines, food processing plants), the electric heaters must be supplied with a NEMA 4 control box. The terminal box is all welded, painted steel, with a hinged, gasketed cover and hold-down clamps. When required, the terminal box could be made in stainless steel (specify Nema 4X). The electrical contractor must install water-tight connectors for power supply and control wires.

Insulated Terminal Box

When there is a risk of condensation because of a high contrast between the duct temperature and the control box temperature, Thermolec recommends an insulated control box.



Insulated Terminal Box



Recessed Terminal Box

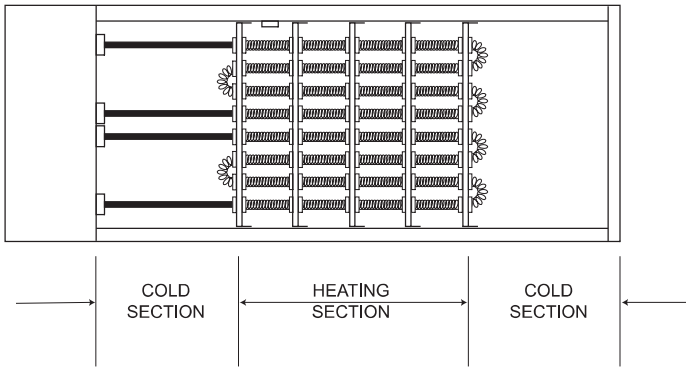
Recess Terminal Box

When heaters are installed in insulated ducts with more than 1” insulation or are inserted through an accoustic plenum, specify a recessed terminal box and indicate dimension of cold section.

STEP 2 - (continued)

Special Heaters

Thermolec manufactures heaters with special specifications to meet the needs of any OEM manufacturer.



Special Heater with no-heat sections

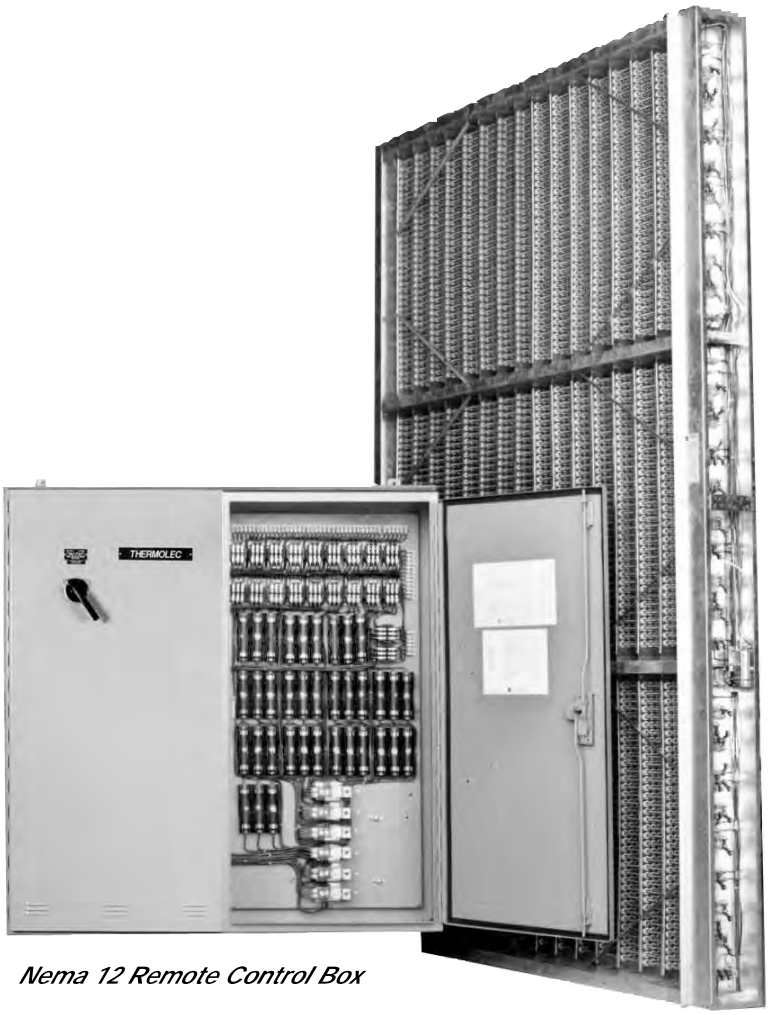
Stainless Steel Process Heater

Process Heaters

Thermolec manufactures process heaters for drying, curing, baking, etc...

Heater with remote control panel

Thermolec electric duct heaters are available in any size from 6" x 6" up to 144" x 96" and up to 1000 KW in one section.
Shown across is a 750 KW open coil heater with it's Nema 12 remote control panel.



Nema 12 Remote Control Box

STEP 3 - DETERMINE METHOD OF CONTROL AND SELECT CONTROL COMPONENTS

Temperature Control Modes and Staging

In selecting temperature controls the specification writer will generally wish to consider both control accuracy and cost.
To provide an acceptably close match of heater output to the system's varying demand for heat it is usually necessary to divide the total KW capacity into separately controlled increments or "control stages". Each stage accounts for part of the total temperature rise ΔT through the heater.
This temperature rise per stage (ΔT / stage) determines how accurately the temperature in the system can be controlled. For selection purposes Thermolec distinguishes FINE, MEDIUM, and COARSE control, which we arbitrarily define:

Temperature rise per control stage, ˚F	Temperature control accuracy
5 or less	FINE (SCR)
6 to 20	MEDIUM
over 21	COARSE

When a heater is controlled by an SCR, it can be considered as having an infinite number of stages and the accuracy is equivalent to FINE.
For a given accuracy and energy efficiency requirement, the number of control stages to be specified depends on the total design temperature rise through the heater.
The following table shows the Thermolec recommendations for control.

Recommended Number of Control ON/OFF stages or SCR Proportional Control							
Heating Load		ΔT = 6°C 10°F	ΔT = 11°C 20°F	ΔT = 17°C 30°F	ΔT = 22°C 40°F	ΔT = 28°C 50°F	ΔT > 28°C 50°F
Temperature Control Options	Coarse	--	1 stage ON / OFF	2 stages ON / OFF	2 stages ON / OFF	2 stages ON / OFF	SCR
	Medium	1 stage ON / OFF	SCR	SCR	SCR	SCR	
	Fine	SCR	SCR	SCR	SCR	SCR	

Caution: It should be reminded that a coarse control puts an additional stress on the contactors since they have to cycle more often.

STEP 3 - (continued)

ON - OFF Control Mode

Air temperature is controlled by switching on and off selected control stages of the heater or, on single stage heaters, the entire heater. The ON / OFF mode is practical up to two control stages.
It is recommended for most COARSE control accuracy applications and is satisfactory up to a maximum of 25 ˚F ΔT temperature rise per stage.

CONTROL STAGES

A control stage is a "portion of the total KW capacity of a heater, wired to respond separately to temperature control". Contrary to a common misunderstanding, the number of control stages to be specified for an ON / OFF control system does **not** depend on total KW capacity nor on total amps of a heater.

With ON - OFF control, the temperature rise per control stage (ΔT/stage) determines the inherent temperature control accuracy of the duct heater. Therefore the correct number of control stages is a function of the total temperature rise of the heater and of the desired control accuracy.
For example, a 200 KW heater, handling 120,000 CFM for a design temperature rise of 5 ˚F will give FINE control accuracy with only one control stage. The temperature controller for this heater will be a 1 stage ON - OFF thermostat (if, for any reason, it is not desirable to switch 200 KW in a single step, several "power stages" can be used with automatic time delay).

On the other hand, with a 10 KW heater, handling 600 CFM for a design temperature rise of 50 ˚F, FINE temperature control requires FULL SCR control.

POWER STAGES

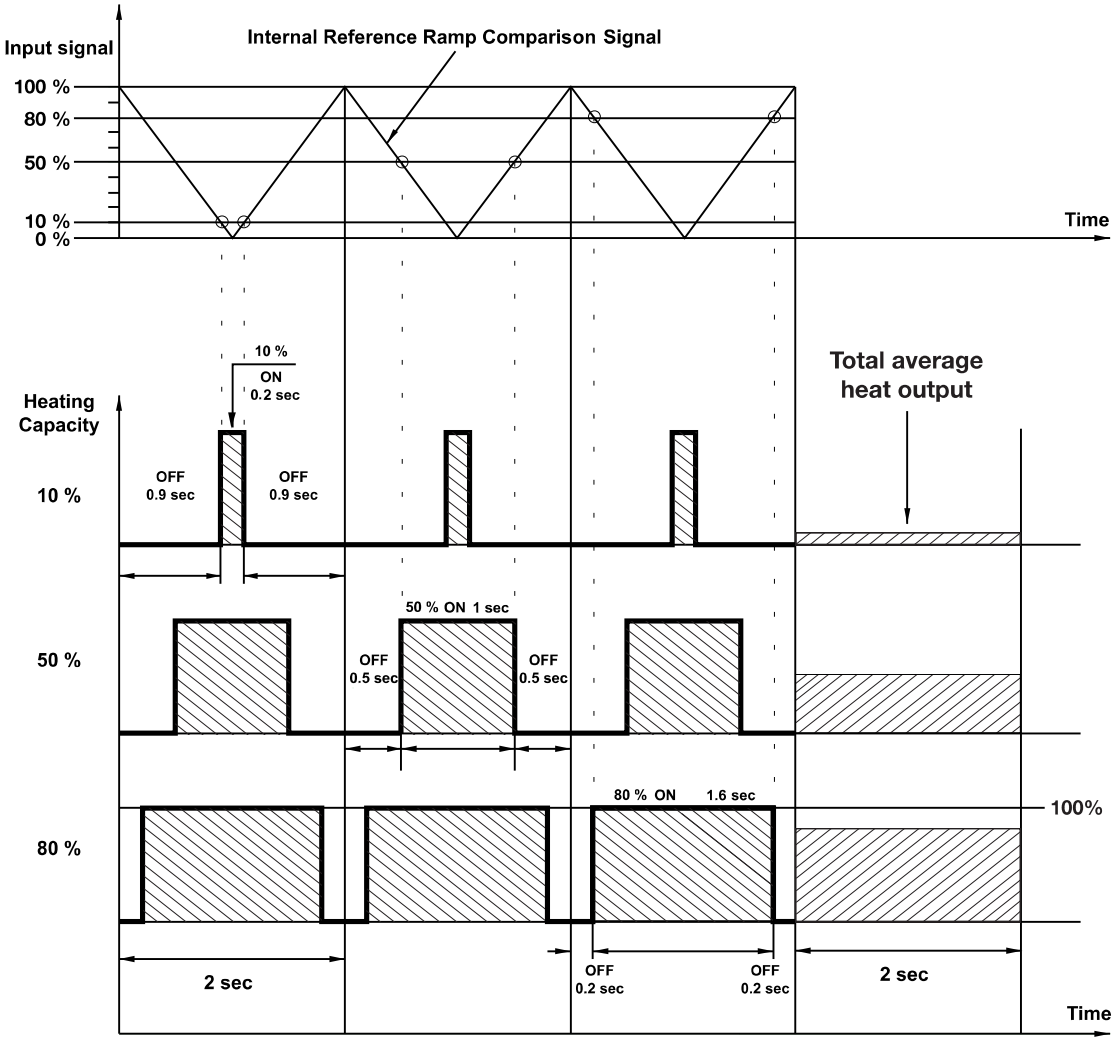
A power stage is a part of a control stage, wired for delayed switching ON. The need for and the capacity of power stages is determined, not by temperature control requirements, but by local codes and conditions governing the increments of capacity that may be brought on line at any moment without causing excessive voltage drop. When required, Thermolec will break down high amperage control stages into several power stages.

MODULATING CONTROL MODE

This method is also referred to as **"proportional"**. The heater is electronically controlled to deliver anywhere from zero to 100% of it's capacity, precisely and smoothly matching the heat demand of the system. This is achieved by means of an SCR controller connected to a proportioning thermostat which may be either a duct type for a Fresh Air make-up or a room type for zone heating.

The word proportional refers to the portion of a time period in which a heating element is turned ON and OFF (e.g. 10% ON and 90% OFF meaning 10% of the heating capacity).
According to the thermostat demand, the heater is pulsed in different proportion of ON time and OFF time to match the heating demand. The longer the element is turned ON, the more heat it is generating and vice versa. The heat produced during the ON period continues to dissipate during the OFF period, thus creating an average temperature output matching the thermostat set-point.

STEP 3 - (continued)



Pulse Width Modulation Diagram

In the above example:

10%	=	12 cycles ON, 108 cycles OFF	0.2 seconds of heating on 2 seconds
50%	=	60 cycles ON, 60 cycles OFF	1 second of heating on 2 seconds
80%	=	96 cycles ON, 24 cycles OFF	1.6 second of heating on 2 seconds
100%	=	120 cycles ON	2 seconds of heating on 2 seconds,

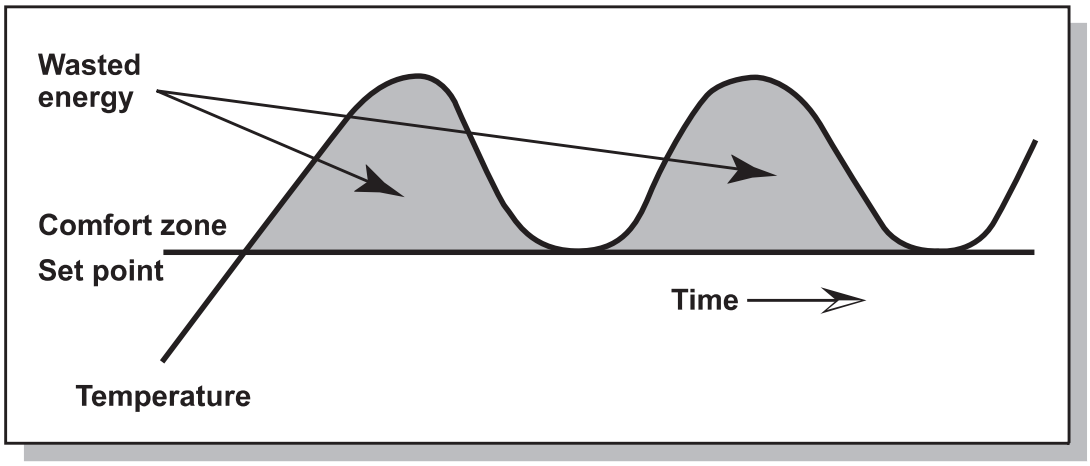
Principle of the Pulse Width Modulation (PWM)
The input signal is compared with an internally generated reference signal (triangle wave) that has a time base of 2 seconds (2 x 60 cycles or 120 cycles), and the controller activates the SCR output in a range of 0 to 100%. On this graphic, every time the horizontal line corresponding to the input (in the above example, 10%, 50% and 80%), crosses the reference signal, the heating elements are switched ON or OFF. The total heat output is an average between the ON and OFF periods, and for low heat demand, the heater is not "dimmed" but switched ON for very shorts periods.

STEP 3 - (continued)

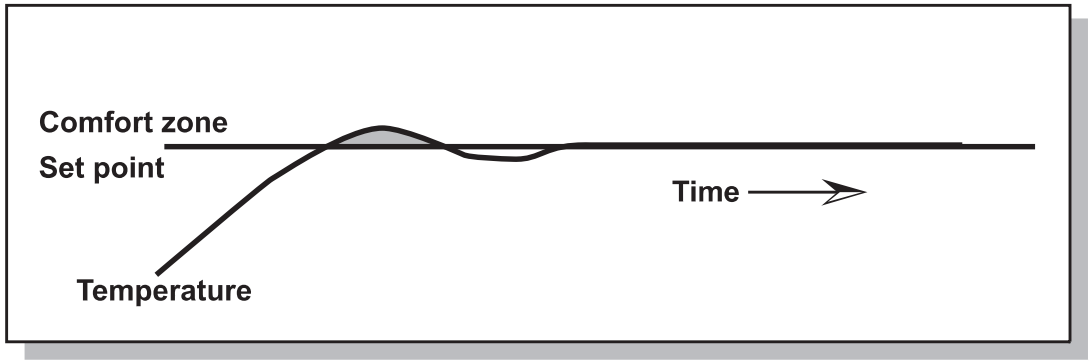
Comparison between ON/OFF and proportional control

Due to it's high differential, ON/OFF control mode wastes a lot of energy. The graphic below shows how the ON/OFF method creates high "overshoot" above the temperature set point while the electronic proportional method keeps the temperature close to the set point. The shaded areas correspond to wasted energy. A proportional control can thus maintain an accurate room or discharge temperature without the typical variations of the ON/OFF method. This represents an energy saving of approximately 15%.

Heating Cycle of ON / OFF Control Mode



Heating Cycle with Proportional Control (SCR)

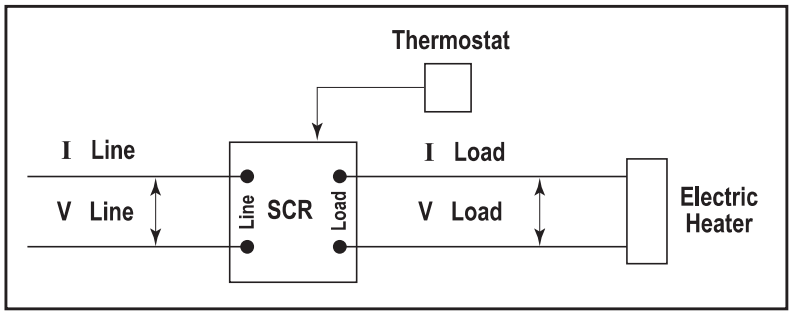


STEP 3 - (continued)

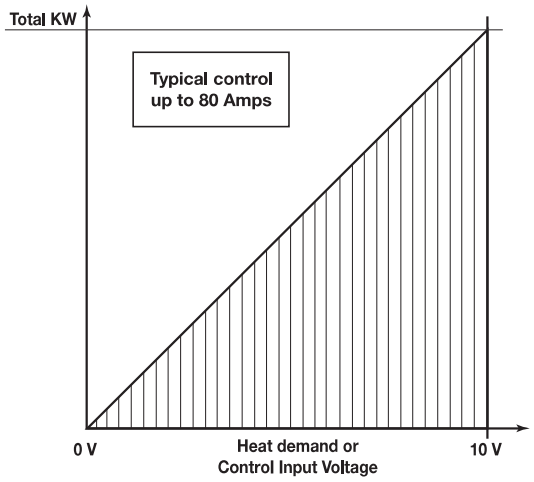
Thermolec strongly recommends the use of SCR proportioning controls for the best results in energy efficiency and maximum comfort.
When the output of the entire heater is being modulated in this manner, the control system is defined as **"FULL SCR".**
When one control stage only is controlled by a SCR while the balance of the heater stages are handled by ON - OFF control, the system is defined as **"HYBRID or VERNIER".**

FULL SCR

SCR is the abbreviation of Silicon Controlled Rectifier, also called current valve because of its ability to modulate the current supplied to, and consequently the capacity of, the heater. The example below sketches how a typical SCR modulates the heat output of a 15 KW / 600 V / 1 PH, electric heater.
As long as the temperature controller demands less than full heat, the SCR will switch the heater on and off repetitively on a very short cycle or period, typically 2 seconds. The net heat output is the product of the KW capacity of the heater multiplied by the ratio of the "ON" to "ON+OFF" or "period" time.
This ratio is determined by an electronic logic in the SCR according to a signal from a proportioning thermostat. Enough heat is stored in the electric elements so that there is an almost constant operating temperature corresponding to the demand.
FULL SCR control is recommended where FINE temperature control is required.



Full SCR Control Electric Diagram



Full SCR Load Diagram

Note: All Thermolec controllers are equipped with a zero-cross thyristor switching system that virtually eliminates all Electro-magnetic interference (EMI) and radio frequency interference (RFI).
The Light Emitting Diode (LED) on the controller indicates when the heating element is on.

STEP 3 - (continued)

HYBRID or VERNIER CONTROL - Principles

Where FINE control accuracy is required and the heater capacity is too high to be handled economically by "FULL SCR", (80 Amps max.), Thermolec recommends a combination of a smaller SCR and a step controller, both being controlled by the same input signal. In this system, the "SCR" is the modulating heating stage. The other heating stages are controlled by the Thermolec electronic step controller. **D46 (the Sequential mode).**

The SCR stage automatically fills the gaps between the step controlled stages, thus providing fully proportional control over the entire heater range.

In applications where the heated air is delivered to the space without proper mixing and stratification is a problem, it is preferable to use the sequential mode and specify "FULL FACE" staging (each stage covers the entire duct face area) when the heater capacity is below 12 KW/sq.ft. Otherwise the binary mode (more economical) is recommended above 12 KW/sq.ft.

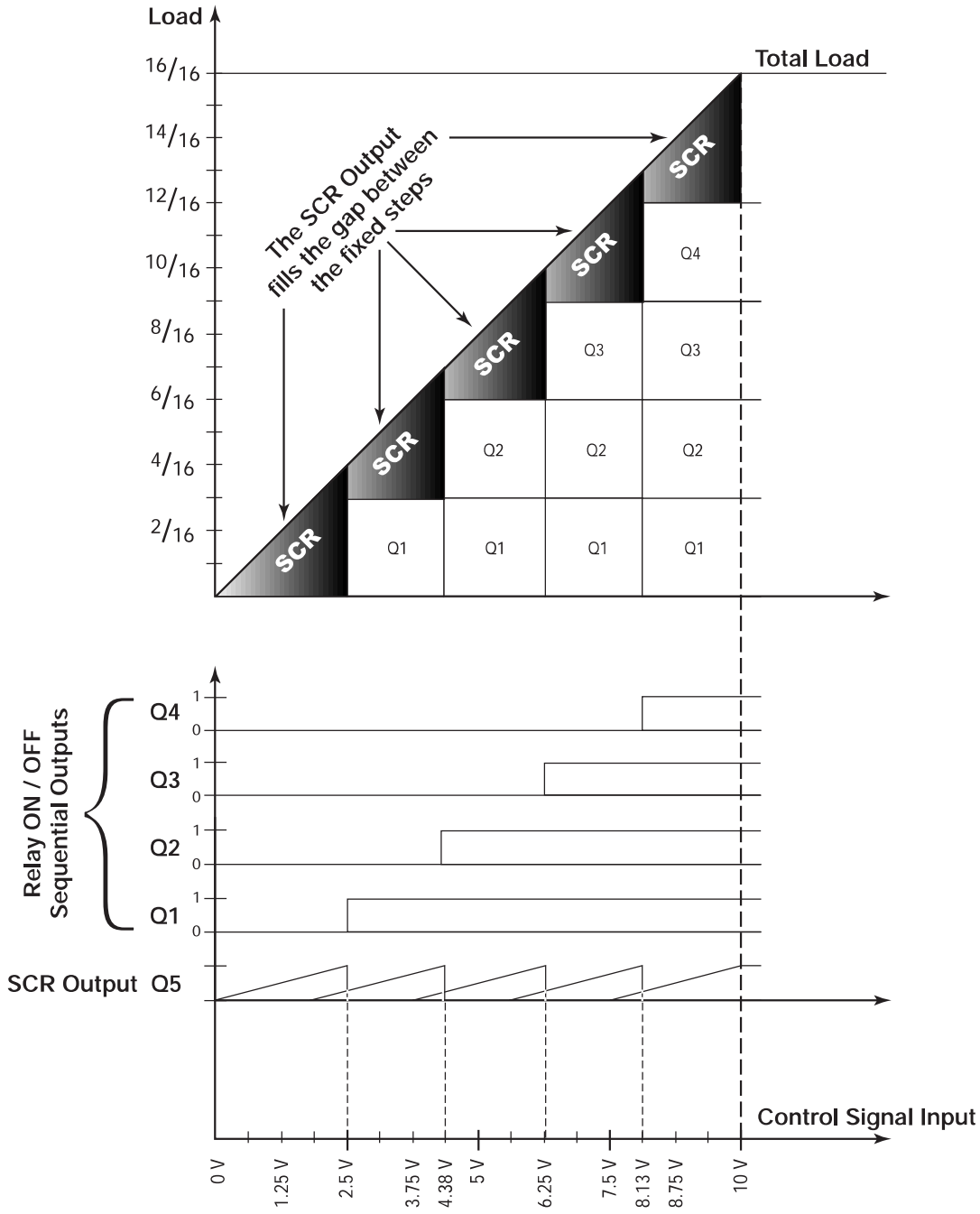
TYPICAL DIVISION OF STEPS - Hybrid control				
	Sequential mode	Sequential staging for a 160 KW heater.		
SCR Step	2/6	SCR Step	2/6	53.33 KW
Step 1	1/6	Step 1	1/6	26.66 KW
Step 2	1/6	Step 2	1/6	26.66 KW
Step 3	1/6	Step 3	1/6	26.66 KW
Step 4	1/6	Step 4	1/6	26.66 KW

Input voltage	KW output	Fixed steps “ON” and SCR
from 0 to 3.3 V	0 to 53.33 KW	The variable SCR step covers the heat demand
from 3.3 to 4.99 V	53.33 to 79.99 KW	step 1 + SCR (26.66 fixed + 53.33 SCR)
from 4.99 to 6.65 V	79.99 to 106.66 KW	step 1 + step 2 + SCR (53.33 fixed + 53.33 SCR)
from 6.65 to 7.81 V	106.66 to 133.32 KW	step 1 + step 2 + step 3 + SCR (79.99 fixed + 53.33 SCR)
from 7.81 to 10 V	133.32 to 160 KW	step 1 + step 2 + step 3 + step 4 + SCR (106.66 fixed + 53.33 SCR)

STEP 3 - (continued)

Since the SCR step is kept relatively small (53.3 Kw), it is still cost effective compared to a full SCR 160 KW.

In the following graphic, the sequential loads are switched ON and OFF to match the heat demand. Lay a straightedge vertically at any position of the control input voltage and find exactly which stages are ON or OFF. The SCR not only fill the gaps but overlaps the gaps between the fixed steps at all times.



Hybrid Sequential Load Diagram

STEP 3 - (continued)

Summary of Temperature Control

1- Electric ON / OFF thermostats are available up to three stages for room or duct control and up to four stages for duct control only. Three and four stage thermostats are not recommended for FINE or MEDIUM temperature control because of their large differentials. However, they are suitable for COARSE control.

2- P.E. Switches with a pneumatic thermostat are recommended for up to four stages only and can be used for FINE as well as MEDIUM or COARSE control.

3- FULL SCRs are compatible with electronic or pneumatic signal. They are recommended where FINE temperature control and energy conservation is required. As a general guideline, it is economical to use Full SCR on heaters up to 70 Amps total load. Between 70 and 120 Amps, the cost is slightly more expensive and beyond 120 Amps Hybrid controllers are the best choice.

4- Hybrid controllers are compatible with electronic or pneumatic signal. They are recommended where FINE temperature control is required and where the heater capacity is too large to be controlled economically by a FULL SCR (over 120 Amps).

5- Thermolec is engaged in a countinuous effort of product development, hence, the following information is presented as a general overview of existing products and can be modified without further notice.

Notes:

a- Although ON/OFF stages can offer some economy, in most multi-stage (2 stages and over) applications up to 40 KW, SCR proportional control can be obtained at almost the same price. Please see selection of most economical KW / voltage combination on page 7.

b- In order to manage the energy resources properly and provide the best comfort, **Thermolec recommends specifying a proportional control at all times.**

ON/OFF Room Thermostats

24 volts wall thermostat, ON-OFF type with built-in thermometer and adjustable heat anticipator.

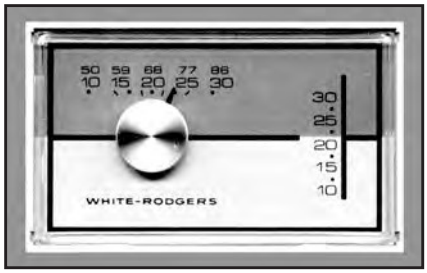
1 stage

T86 Honeywell

2 stages

T874 Honeywell

1 and 2 stages



1F30W-301 (1 stage) and 1F37-408 (2 stages) - White-Rodgers

STEP 3 - (continued)

Modulating Room Thermostats

RT

RT
The Thermolec RT electronic modulating room thermostat is a thermistor proportional type that is compatible with all Thermolec electronic controls. ABS casing. Thermistor based, proportional control, two wire type, with built-in adjustable set point.
Standard range: 10 to 30 ˚C, (50 to 86 ˚F).

RARS

RARS Remote (set point) **Adjuster + Room Sensor**
Similar to an RT but divided into a two controls: a room sensor without adjustment and a remote adjuster. Two wire sensor to be installed in the room (RS) in conjunction with a remote set point adjuster (RA) installed at customer is convenience.
Standard range: 10 to 30 ˚C, (50 to 86 ˚F).

ON/OFF Duct thermostats

T678A Honeywell

Bulb thermostat
(Capillary type) with 5' capillary tube to be installed in the duct.
Designed for pilot duty service.
Available in 1 or 2 stages ON-OFF.
Standard range: -15 to + 35 ˚C (5 to 95 ˚F).

1687-9 White-Rodgers

Bulb thermostat

(Capillary type) with 8' capillary tube to be installed in the duct.
Designed for pilot duty service.
Available in 1 stage ON-OFF.
Standard range: -34 to + 32 ˚C (-30 to 90 ˚F).

STEP 3 - (continued)

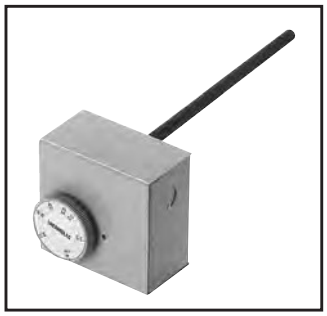
Modulating Duct Thermostats

DT - ABS Casing

DT

The Thermolec DT electronic modulating duct thermostat is a thermistor proportional type that is compatible with all Thermolec electronic controls. ABS casing for temperatures up to 65 ˚C. Metal casing for temperatures over 65 ˚C, two wire type, with built-in adjustable set point.

Model #	Range ˚C	˚F.
DT-1815	-18 - +15	0 - 59
DT-037	0 - 37	32 - 99
DT-1040	10 - 40	50 - 104
DT-3265	32 - 65	90 - 149
DT-6590	65 - 90	149 - 194
DT-80155	80 - 155	176 - 311

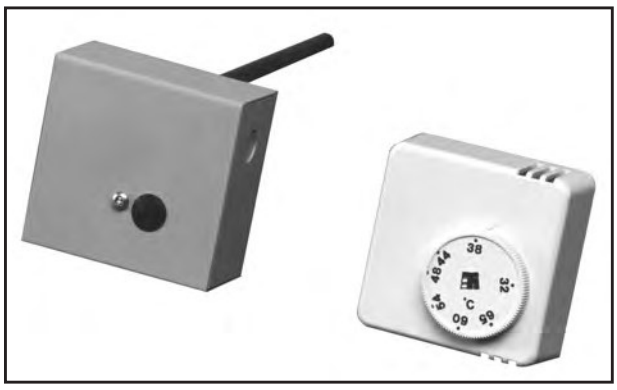


DT - Metal casing

RADS - ABS casing

RADS Remote (set point) Adjuster + Duct Sensor

Two wire sensor to be installed in the air duct (**DS**) in conjunction with a remote set point adjuster (**RA**) installed at customer's convenience.



RADS - Metal casing

Model #	Range ˚C	˚F.
RADS-1815	-18 - +15	0 - 59
RADS-037	0 - 37	32 - 99
RADS-1040	10 - 40	50 - 104
RADS-3265	32 - 65	90 - 149
RADS-6590	65 - 90	149 - 194
RADS-80155	80 - 155	176 - 311

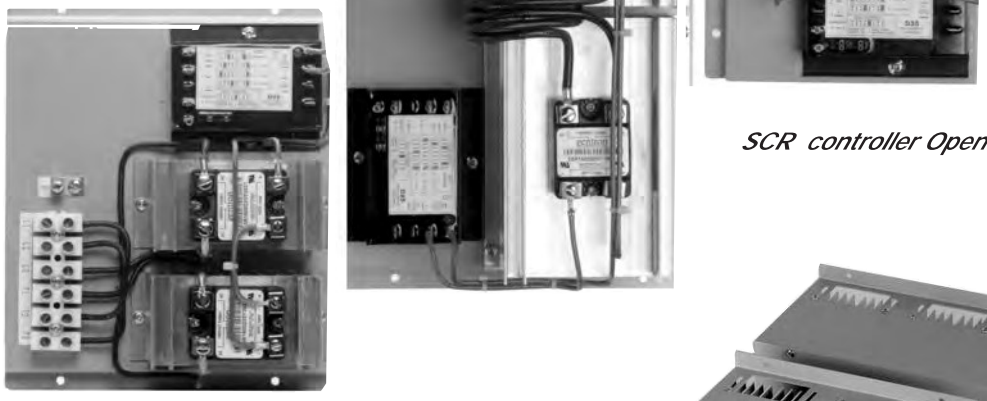
STEP 3 - (continued)

SCR Controller

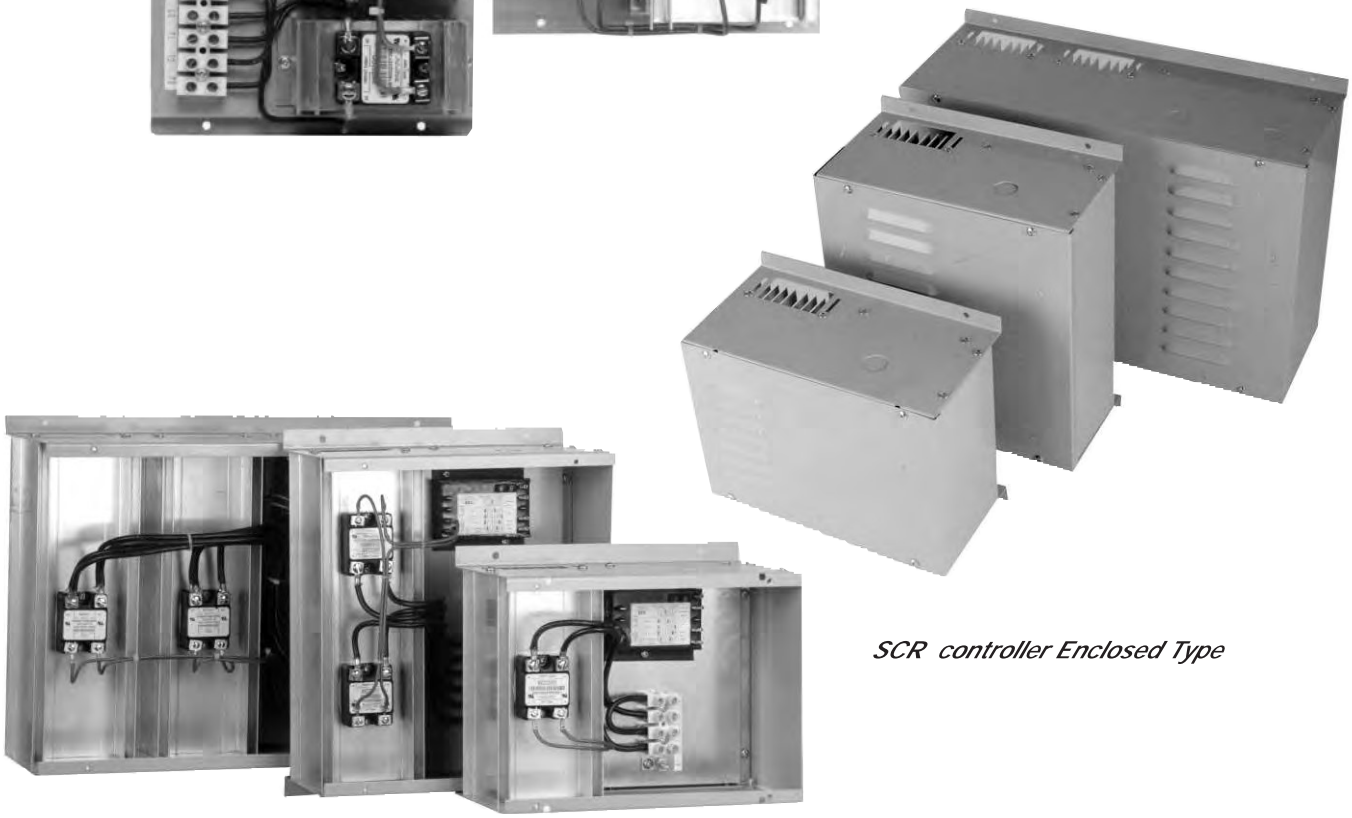
The SCR is a time proportioning type controller that modulates the heater and supplies the exact amount of power to match the heat demand.

Input: Thermistor thermostat (RT or DT),
0 - 10 VDC, 4 - 20 mA, 0 - 135 Ohms.

Output: Single or three phases load,
20, 30, 40 and 80 Amps @ 600 V. max



SCR controller Open Type



SCR controller Enclosed Type

Warranty

1- Thermolec Ltd. guarantees their heater resistance elements and other built-in components against any defect in workmanship and material for a period of one year, effective date of shipment from it's factory.
Any claim under this guarantee will be considered only if the product has been installed and operated in accordance with Thermolec's instructions.

2- Thermolec's responsibility will be limited in any case to the replacement or repair, at its factory or in the field, by its own personnel or through others, at its option, of such heaters or parts thereof that shall prove to be defective within one year from shipment.

3- Misuse of this product, or repairs made by others without Thermolec's authorization, will void this warranty.

4- Thermolec shall not be held responsible for damage or delays and shall not be held liable for any charges resulting from the removal or replacement of the allegedly defective heater.

5- Thermolec shall not be held responsible for any incidental or consequential damage or delays due to workmanship or material. No additional charge will be accepted for repair, replacement or modification if prior written authorization was not obtained from Thermolec.

6- Any control device or accessory, supplied with the heater, to be mounted or connected remotely, will only be guaranteed by the manufacturer per conditions stated in clause 5.

SPECIFICATION FOR OPEN COIL HEATERS

Long Form

Supply where indicated in these specifications, or where shown on drawings, CSA (NRTL/C) approved open coil duct heaters as manufactured by THERMOLEC.

☛ 1- CONSTRUCTION:

- Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA.
- Coils shall be made of high grade Nickel-Chrome alloy and shall be insulated by floating ceramic bushings from the galvanized steel frame.
- Coil terminal pins shall be in stainless steel, mechanically secured and insulated from the frame by means of non-rotating ceramic bushing.
- Coil support bushing shall be made of ceramic and shall be held in the frame by a lock which will keep it floating and stress-free.

☛ 2- SAFETY CONTROLS:

- Heaters shall be equipped with fail-safe automatic reset disc-type thermal cut-out(s) located in the top frame component above the heating elements.
- In addition to the automatic reset cut-out, heaters of 30KW and less, rated for voltages below 300 volts shall be equipped with a fail-safe manual reset disc-type thermal cut-out, semi-recessed in the terminal box, facing the heating element hairpin as required by CSA.
- The sensing element of the cut-out shall be stream mounted, shall be shielded from mechanical damage and shall face the center portion of the heating section so as to make the heater non-sensitive to air flow direction.
- Cut-outs shall de-energize the heater in case of insufficient air flow.
- For maintenance and safety purposes, the heater shall be equipped with a built-in disconnect to switch the power off at the heater location (option X1) and protective screens on both sides (option MS).
- Load fuses shall be supplied as recommended by NEC (National Electrical Code).
- When heaters are used in VAV systems, they should be modulating type ***"THERMO-V"*** equipped with an electronic air flow sensor as described in item #8.

☛ 3- AIR FLOW:

- Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts without impairing safety.
- Heaters shall be CSA approved for zero clearance in horizontal ducts.

☛ 4- MOUNTING METHOD:

- Heaters shall be open coil model SC slip-in type or model FC flanged type, as shown on the plans or on the coil schedule.
- Slip-in heaters shall be suitable for insertion into the duct through an opening on its side and shall have a flange for securing it to the duct side.
- Flanged heaters shall be suitable for attaching to matching flanges on the duct.
- Mounting flanges on both models shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.

☛ 5- SIZE & CAPACITY:

- Heater size, volts, phases, kilowatt and number of control stages shall be as per heater schedule.

☛ 6- INTERNAL WIRING:

- All internal wiring shall terminate on clearly identified terminal blocks.
- A wiring diagram shall be installed on the control box cover.
- Prior to shipping, heaters shall withstand tests as required by CSA.

Long Form (continued)

☛ 7- STANDARD BUILT-IN CONTROLS:

All duct heaters shall be complete with the following built-in controls:

- High limit cut-outs, magnetic contactors as required, control transformer and air flow sensor as standard components.

Additional options can be chosen from the following list:

- Mercury contactors
- Unfused disconnect switch
- SCR proportional controller
- HRC Form 1 load fuses
- Hybrid controller with SCR and binary steps
- Pressure Electric switches
- Pneumatically controlled SCR
- Pilot lights to indicate staging, power supply on, overheating, no air flow, heating on

Note: it is also possible to order a separate CEMA-1 remote control panels (option M6)* with the above options.
* Remote mounting control panel must include HRC Form 1 load fuses in order to provide over-current protection for each duct heater power circuit.

☛ 8- HEATERS FOR VAV SYSTEMS:

- **Duct heaters for VAV systems will be electronic modulating type "THERMO-V", equipped with a proportional controller to modulate the total heater load according to the temperature control signal and a proportional electronic air flow sensor (non pressure dependent type) to modulate the heater capacity according to the available air flow:**
  Maximum heating with normal air flow
  Reduced heating with low air flow
  No heating with no air flow

Please refer to the Thermo-V flyer and specification at the end of this section.

☛ 9- SPECIAL CONSTRUCTION:

- Heaters could be equipped with a bottom terminal box, weatherproof shroud or any other feature selected from the option list (see section 2).

☛ 10- APPROVALS:

- Heaters data sheets, wiring diagrams and mechanical drawings shall be submitted to the consulting engineer for approval before manufacturing.

Short Form

- Supply where indicated in these specifications CSA (NRTL/C when required) approved duct heaters as manufactured by THERMOLEC.

- Coils shall be of High Grade Nickel-Chrome alloy and shall be insulated by floating ceramic bushings from the galvanized steel frame. Coil terminal pins shall be stainless steel insulated by means of non-rotating ceramic bushings.

- Heaters shall be model SC slip-in type, as shown on the plans or on the heater schedule. Heaters shall be suitable for insertion into the duct through an opening on its side and shall have a flange for securing it to the duct side. Mounting flanges shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.

- All duct heaters shall be equipped with fail-safe, automatic reset and manual reset disc-type thermal cut-outs, as required by CSA.

- Cut-outs shall be shielded from accidental impact, and shall de-energize the heater in case of insufficient air flow.

- Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts. Heaters shall be CSA approved for zero clearance in horizontal ducts.

- Duct heaters shall be equipped with magnetic contactors as required, 24 volts transformer, airflow sensor, …(room thermostat, duct thermostat, SCR control, load fuses, solid state relays, mercury contactors, pilot lights, protective screens, etc).

- For maintenance and safety purposes, the heater shall be equipped with a built-in disconnect to switch the power off at the heater location (option X1) and protective screens on both sides (option MS).

- Load fuses shall be supplied as required by local codes.

- **Duct heaters for VAV systems will be electronic modulating type "THERMO-V", equipped with a proportional controller to modulate the total heater load according to the temperature control signal and a proportional electronic air flow sensor (non pressure dependent type) to modulate the heater capacity according to the available air flow:**
  Maximum heating with normal air flow
  Reduced heating with low air flow
  No heating with no air flow

THERMOLEC THERMOLEC 0PEN COIL HEATERS SCHEDULE

ID	SYSTEM / TAGS / HEATER	TYPE	QTY	DUCT DIMENSIONS IN. ☑ MM ☐ WIDTH x HEIGHT		kW	VOLTS/ PHASES	STAGES	AIR FLOW CFM ☑ L/S ☐	ΔT TEMP F° ☑ C° ☐	CONT. VOLTS	OPTIONS
1												
2												
3												
4												
5												
6	*Examples :*											
7	RH - 1	SC	1	12	10	5	600/3	1	600	25	24	1 - 2 - 3 - 17
8	RH - 2	SC	1	48	36	60	600/3	1	2000	90	24	1 - 2 - 3 - 7 - 18

STANDARD BUILT-IN CONTROLS:

All duct heaters shall be complete with the following built-in controls:
High limit cut-outs, magnetic contactors as required, control transformer and air flow sensor as standard components.

➤ Required Options

1 ➤ Built-in disconnect switch
2 ➤ SCR proportional controller
3 ➤ Screens both sides
4 ➤ Pneumatically controlled SCR
5 ➤ Solid State Relay (TRIAC)
6 ➤ Hybrid controller (SCR + step controller)
7 ➤ Load fuses, HRC type
8 ➤ Mercury contactors
9 ➤ Pressure electric switch
10 ➤ Low watts density elements

11 ➤ Pilot lights
12 ➤ Full break contactors
13 ➤ Nema 4 control box
14 ➤ _____
15 ➤ _____
16 ➤ _____
17 ➤ Electronic room thermostat RT
18 ➤ Electronic duct thermostat DT
19 ➤ Remote adjustable duct sensor RADS
20 ➤ Remote adjustable room sensor RARS

SPECIFICATION FOR TUBULAR HEATERS

Long Form

Supply where indicated in these specifications CSA (NRTL/C) approved tubular duct heaters as manufactured by THERMOLEC.

☛ 1- CONSTRUCTION:

- Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA.
- Heating elements shall be tubular type made of heavy gauge Incoloy 800 filled with compacted magnesium oxide insulating powder.
- Above 277 Volts or 30KW, each tube shall be of "U" type and shall be removable through the control box without removing the heater from its ductwork.

☛ 2- SAFETY CONTROLS:

- Heaters shall be equipped with fail-safe automatic reset disc-type thermal cut-out(s) located in the top frame component above the heating elements.
- In addition to the automatic reset cut-out, heaters of 30 KW and less, rated for voltages below 300 volts shall be equipped with a fail-safe manual reset disc-type thermal cut-out, semi-recessed in the terminal box, facing the heating element hairpin as required by CSA.
- The sensing element of the cut-out shall be stream mounted, shall be shielded from mechanical damage and shall face the center portion of the heating section so as to make the heater non-sensitive to air flow direction.
- Cut-outs shall de-energize the heater in case of insufficient air flow.
- For maintenance and safety purposes, a built-in disconnect shall be supplied to switch the power off at the heater location.
- Load fuses shall be supplied as required by NEC (National Electrical Code).

☛ 3- AIR FLOW:

- Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts.

☛ 4- MOUNTING METHOD:

- Heaters shall be ST slip-in type or model FT flanged type, as shown on the plans or on the heater schedule.
- Slip-in heaters shall be suitable for insertion into the duct through an opening on its side and shall have a flange for securing it to the duct side.
- Flanged heaters shall be suitable for attaching to matching flanges on the duct.
- Mounting flanges on both models shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.

☛ 5- SIZE & CAPACITY:

- Heater size, volts, phase kilowatt and number of control stages shall be as per heater schedule.

Long Form (continued)

☛ 6- INTERNAL WIRING:

- All internal wiring shall terminate on clearly identified terminal blocks.
- A wiring diagram shall be installed on the control box cover.
- Prior to shipping, heaters shall withstand tests as required by CSA.

☛ 7- STANDARD BUILT-IN CONTROLS:

All duct heaters shall be complete with the following built-in controls:

- High limit cut-outs, magnetic contactors as required, control transformer and air flow sensor as standard components.

Additional options can be chosen from the following list:

- Mercury contactors
- Unfused disconnect switch
- SCR proportional controller
- HRC Form 1 load fuses
- Hybrid controller with SCR and binary steps
- Pressure Electric switches
- Pneumatically controlled SCR
- Pilot lights to indicate staging, control voltage on, power supply on, overheating, no air flow, heating on

☛ 8- SPECIAL CONSTRUCTION:

- Heaters could be equipped with a bottom terminal box, weatherproof shroud or any other feature selected from the option list (see section 2).

☛ 9- APPROVALS:

- Heaters data sheets, wiring diagrams and mechanical drawings shall be submitted to the consulting engineer for approval before manufacturing.

SPECIFICATION FOR TUBULAR HEATERS

Short Form

- Supply where indicated in these specifications CSA (NRTL/C when required) approved duct heaters as manufactured by THERMOLEC.

- Heating elements shall be tubular type made of heavy gauge Incoloy 800 filled with compacted magnesium oxide insulating powder.
  Above 277 Volts or 30KW, each tube shall be of "U" type and shall be removable through the control box without removing the heater from its ductwork.

- Heaters shall be ST slip-in type, as shown on the plans or on the heater schedule.
  Heaters shall be suitable for insertion into the duct through an opening on its side and shall have a flange for securing it to the duct side. Mounting flanges shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.

- All duct heaters shall be equipped with fail-safe disc-type thermal cut-outs, automatic reset and manual reset as required by CSA.

- Cut-outs shall be shielded from accidental impact, and shall de-energize the heater in case of insufficient air flow.

- Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts.

- Duct heaters shall be equipped with magnetic contactors as required, 24 volts transformer, airflow sensor, …(room thermostat, duct thermostat, SCR control, load fuses, solid state relays, mercury contactors, pilot lights, protective screens, etc).

- For maintenance and safety purposes, the heater shall be equipped with a built-in disconnect to switch the power off at the heater location.

- Load fuses shall be supplied as required by local codes.

THERMOLEC

THERMOLEC TUBULAR HEATERS SCHEDULE

ID	SYSTEM / TAGS / HEATER	TYPE	QTY	DUCT DIMENSIONS IN. ☑ MM ☐ WIDTH x HEIGHT		kW	VOLTS/ PHASES	STAGES	AIR FLOW CFM ☑ L/S ☐	ΔT TEMP F° ☑ C° ☐	CONT. VOLTS	OPTIONS
1												
2												
3												
4												
5												
6	***Examples :***											
7	RH - 1	ST	1	12	10	5	600/3	1	600	25	24	1 - 2 - 17
8	RH - 2	ST	1	48	36	60	600/3	1	2000	90	24	1 - 2 - 7 - 18

STANDARD BUILT-IN CONTROLS:

All duct heaters shall be complete with the following built-in controls:
High limit cut-outs, magnetic contactors as required, control transformer and PDS as standard components.

➤ Required Options

1 ➤ Built-in disconnect switch
2 ➤ SCR proportional controller
3 ➤ Screens both sides
4 ➤ Pneumatically controlled SCR
5 ➤ Solid State Relay (TRIAC)
6 ➤ Hybrid controller (SCR + step controller)
7 ➤ Load fuses, HRC type
8 ➤ Mercury contactors
9 ➤ Pressure electric switch
10 ➤ Low watts density elements

11 ➤ Pilot lights
12 ➤ Full break contactors
13 ➤ Nema 4 control box
14 ➤ _____
15 ➤ _____
16 ➤ _____
17 ➤ Electronic room thermostat RT
18 ➤ Electronic duct thermostat DT
19 ➤ Remote adjustable duct sensor RADS
20 ➤ Remote adjustable room sensor RARS

THERMO-V SPECIFICATION

Supply where indicated in these specifications, or where shown on drawings, CSA (NRTL/C) approved THERMO-V type heaters specially designed for VAV boxes and manufactured by THERMOLEC.

☛ 1- AIR FLOW:

- The proportional electronic air flow sensor shall be totally independent of the duct static pressure and shall adjust the heater capacity according to the available air flow:
  The heaters shall deliver maximum heating when needed with normal minimum air flow, reduce heating with lower than minimum air flow and stop heating with no air flow.

☛ 2- CONTROL AND INPUT SIGNAL:

- Heaters shall be equipped with a proportional controller to modulate the heater load according to the temperature control signal.
  The electronic controller shall be compatible with the following input signals:
  - Variable voltage signal 0-10 VDC
  - Pulse with modulation AC or DC

☛ 3- CONSTRUCTION:

- Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA.
- Coils shall be made of high grade Nickel-Chrome alloy and shall be insulated by floating ceramic bushings from the galvanized steel frame.
- Coil terminal pins shall be in stainless steel, mechanically secured and insulated from the frame by means of non-rotating ceramic bushing.
- Coil support bushing shall be made of ceramic and shall be held in the frame by a lock which will keep it floating and stress-free.
- Heaters shall be CSA approved for zero clearance in horizontal ducts.

☛ 4- SAFETY AND BUILT-IN CONTROLS:

- Heaters shall be equipped with fail-safe automatic reset disc thermal cut-out.
- In addition, heaters of 30KW and less, rated for voltages below 300 volts shall be equipped with a fail-safe disc type manual reset thermal cut-out as required by CSA.
- Cut-outs shall de-energize the heater in case of accidental over-heating.
- For maintenance and safety purposes, the heaters shall be equipped with a built-in disconnect to switch the power off at the heater location and protective screens on both sides.
- Load fuses shall be supplied as recommended by NEC (National Electrical Code).
- All duct heaters shall be complete with the following built-in controls : magnetic contactors as required, control transformer, proportional electronic controller and air flow sensor as standard components.

☛ 5- SIZE & CAPACITY:

- Heater size, volts, phase, kilowatts shall be as per the following schedule.

☛ 6- INTERNAL WIRING:

- All internal wiring shall terminate on clearly identified terminal blocks.
- A wiring diagram shall be installed on the control box cover.
- Prior to shipment, heaters shall withstand tests as required by CSA.

☛ 7- APPROVALS:

- Heaters data sheets, wiring diagrams and mechanical drawings shall be submitted to the consulting engineer for approval before manufacturing.

THERMOLEC

THERMO-V ELECTRIC HEATERS SCHEDULE

ID	SYSTEM / TAGS / HEATER	TYPE	QTY	DUCT DIMENSIONS IN. ☑ MM ☐ WIDTH	x HEIGHT	kW	VOLTS/ PHASES	STAGES	AIR FLOW CFM ☑ L/S ☐	ΔT TEMP F° ☑ C° ☐	CONT. VOLTS	OPTIONS
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13	***Example :***											
14	RH - 1	SC	1	12	10	5	600/3	1	600	25	24	1 - 2

STANDARD BUILT-IN CONTROLS:

All duct heaters shall be complete with the following built-in controls:
High limit cut-outs, magnetic contactors as required, control transformer, SCR proportional controller, built-in disconnect switch and air flow sensor as standard components

➤ Required Options

1 ➤ Screens both sides

2 ➤ Load fuses, HRC type

3 ➤ Pneumatically controlled SCR

4 ➤ _____

5 ➤ _____

6 ➤ _____