Tubular and Process Assemblies

Quick Ship

On stock chart units:
- *Three to five working days on most heaters*
- *10 working days on special voltages and/or wattages*
- *15 working days on special element lengths*

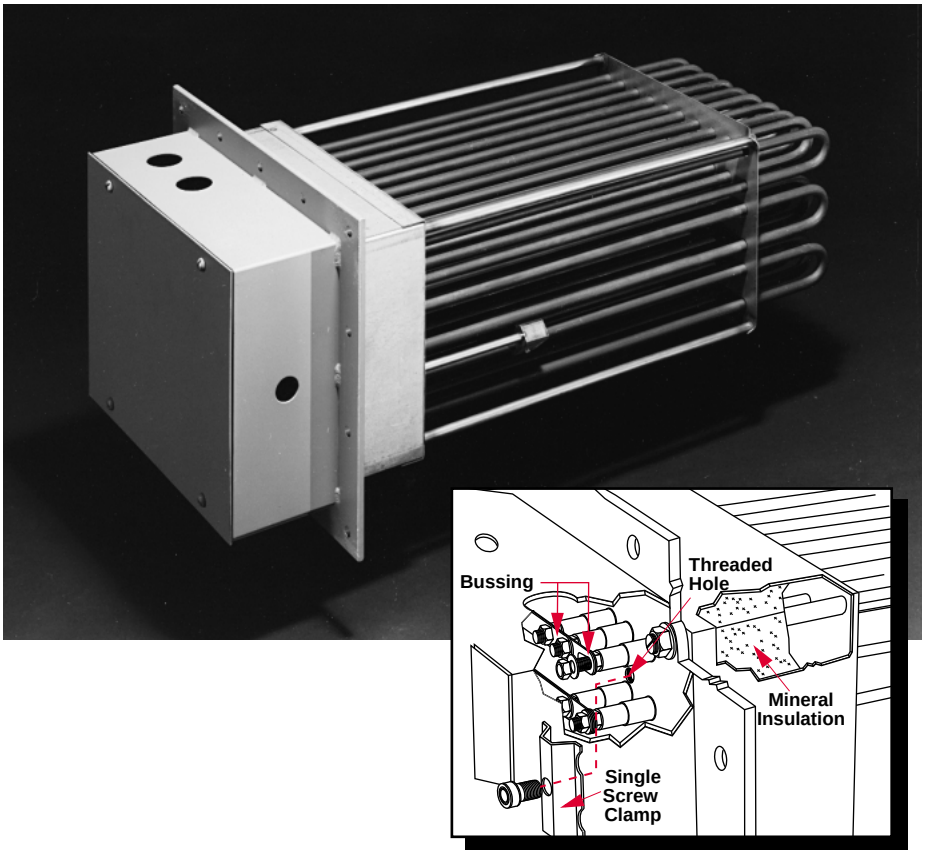
Duct Heaters

Constructed of sturdy 0.430 inch (11 mm) diameter WATROD heating elements mounted to a ¼ inch (6 mm) thick steel flange, duct heaters are easily adapted to many non-pressurized, air-heating systems.

They are easily installed in applications requiring a wide range of temperature vs. air flow combinations.

Watlow duct heaters offer advantages over gas or oil fired and open coil electric units with:

- Installation flexibility—no flues or fuel lines.
- 100 percent energy efficient—no energy loss up the flue.
- Universal availability of electricity.
- Resistance coil in Incoloy® sheath is protected from corrosive environments.



Performance Capabilities

- Watt densities to 40 W/in² (6.2 W/cm²)
- Recommended process temperatures from -20 to 1200°F (-7 to 650°C)
- Wattages to 2.2 megawatts
- Voltages to 600V~(ac)

Features and Benefits

- **Long life Incoloy® sheath** resists corrosion/oxidation while protecting resistance coils against contamination.
- **MgO insulation filled elements**, compacted to rock hard density maximize dielectric strength, heat transfer and life.
- **Field replaceable heating elements** permit easy service and reduce downtime. Element change-out is made simple by a single screw clamp.
- **3½ inches (90 mm) thick mineral insulation** keeps wiring cooler and reduces heat loss.
- **Vented general purpose (NEMA 1) terminal enclosure** ensures cooler terminations.
- **A ¼ inch (6 mm) inside diameter thermowell** accepts an optional Type J or K thermocouple for accurate sheath temperature sensing.
- **Rigid stainless steel supports** prevent element sagging or deformation in various mounting positions.
- **A ¼ inch (6 mm) thick steel flange**, with ⅜ inch (10 mm) diameter mounting holes, easily bolts to the duct wall.
- **WATROD hairpins are repressed (recompacted)** after bending to assure MgO density that eliminates hot spots and electrical insulation voids.
- **Stock heaters feature 6, 12, 18, 24, 30, 36, 42, 48, 54, and 60 elements** to meet a wide variety of kW demands.
- **One or three phase voltages** to meet local power supplies.
- **Maximum 48 amps per circuit** complies with National Electrical Code (NEC).
- **Duct heaters with general purpose enclosures meet UL® and CSA component recognition** to 480 and 600V~(ac) maximum respectively—UL® and CSA file numbers are E52951 and 31388.

Incoloy® is a registered trademark of Special Metals Corporation.

UL® is a registered trademark of Underwriter's Laboratories, Inc.

Duct Heaters

Applications

- Drying ovens
- Autoclaves
- Furnaces
- Load banks
- Heat treating
- Reheating
- HVAC
- Paint drying

Choosing a Duct Heater

The following English and metric graphs, shown on **pages 413 to 414**, will help you to select the correct duct heater. These graphs include: *Watt Density vs. Air Temperature/Velocity, Watt Density vs. Sheath Temperature and Pressure Drop vs. Air Velocity*.

These graphs, with the quick formulas on this page, along with information specific to your application, will determine the correct duct heater specifications. However, if engineering assistance is needed, contact your Watlow representative.

Required Application Information

- Desired outlet air temperature
- Inlet air temperature
- Delta T—the temperature difference between inlet and desired outlet temperature
- Air volume (CFM/CMM) measured at both inlet temperature and pressure
- Air velocity in feet per minute (FPM); meters per minute (MPM) which equals:

English

$$FPM = \frac{\text{CFM measured at standard conditions}}{\text{Duct cross section area at heater in ft}^2}$$

Metric

$$MPM = \frac{\text{CMM measured at normal conditions}}{\text{Duct cross section area at heater in m}^2}$$

- Minimum duct heater wattage (kW). This can be determined by:

English

$$kW = \frac{\text{CFM x Delta T (°F) x 1.1(safety factor)}}{3000}$$

Metric

$$kW = \frac{\text{CMM x Delta T (°C) x 1.1(safety factor)}}{48}$$

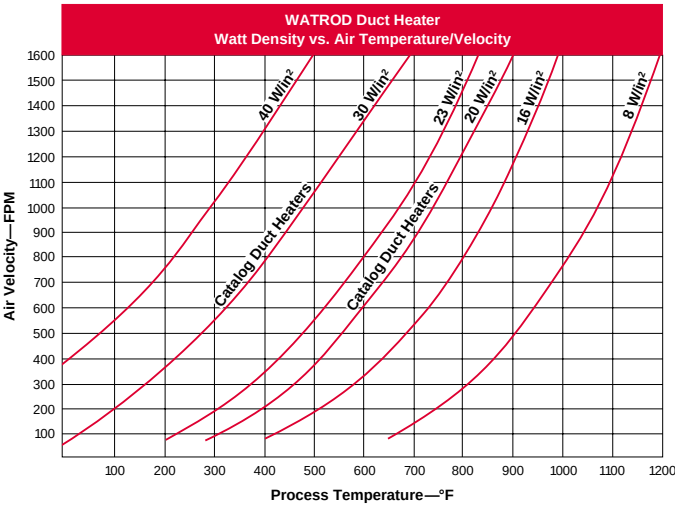
Note: The duct heater, or combination of duct heaters, used for the process should be equal to or exceed the minimum wattage calculation.

Tubular and Process Assemblies

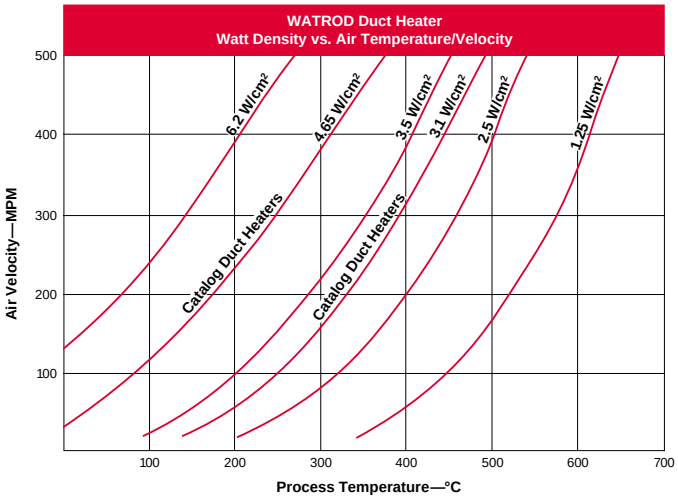
Duct Heaters

Watt Density vs. Air Temperature/Velocity

To decide watt density requirements, first determine the desired outlet air temperature and velocity in feet per minute. Then follow the lines on the graph for velocity and process temperature to the watt density curve's intersecting point. This shows the recommended watt density based on a maximum sheath temperature of 1400°F (760°C). **For longer heater life, lower watt densities should be chosen.**



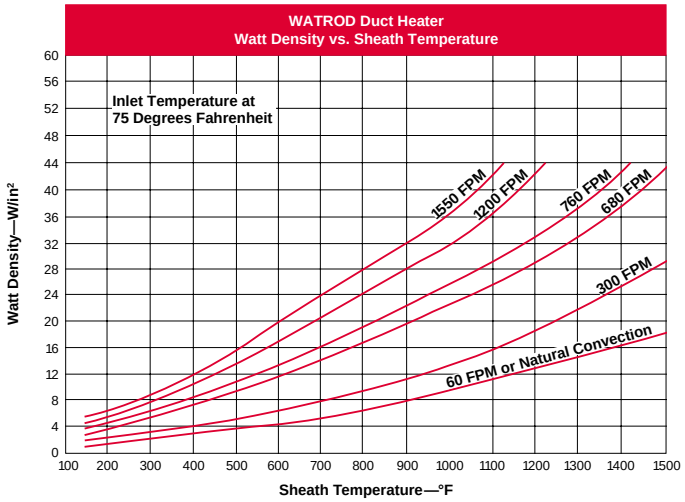
Estimated Sheath Temperature = 1400°F

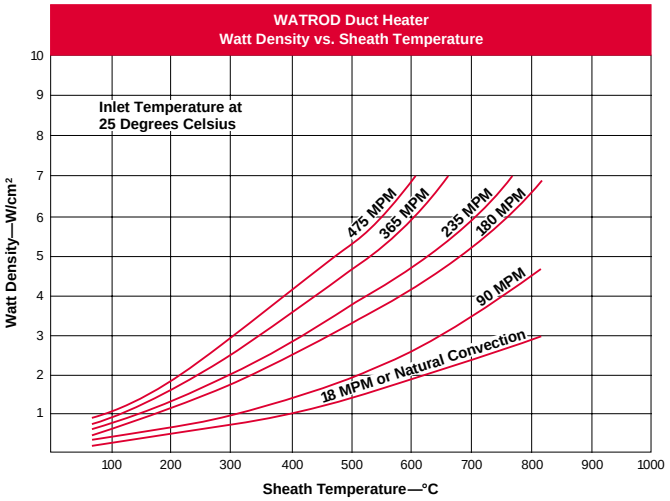


Estimated Sheath Temperature = 760°C

Watt Density vs. Sheath Temperature

The *Watt Density vs. Sheath Temperature* graph shows the air velocity (FPM or MPM) required to operate a WATROD duct heater at specific watt densities or sheath temperatures. Also depicted is the appropriate watt density vs. sheath temperature at a specified air flow.



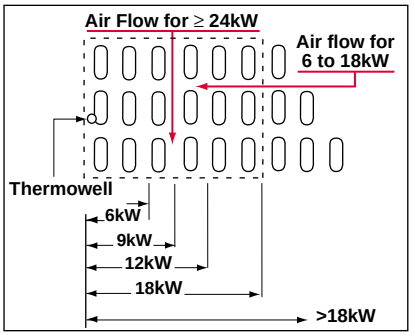


Duct Heaters

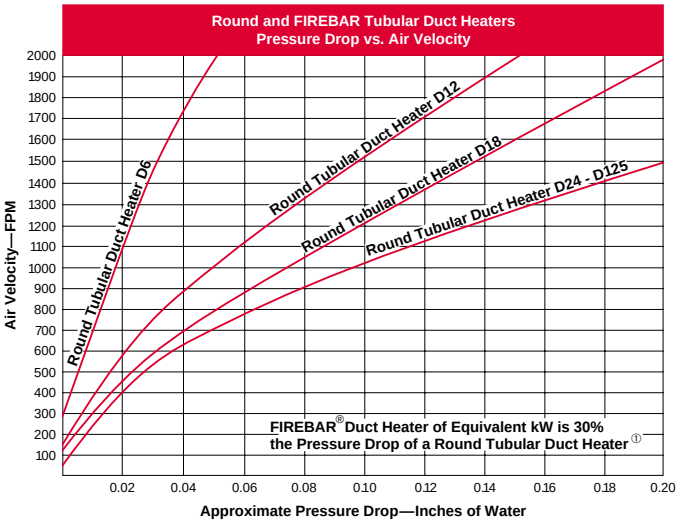
Pressure Drop vs. Air Velocity

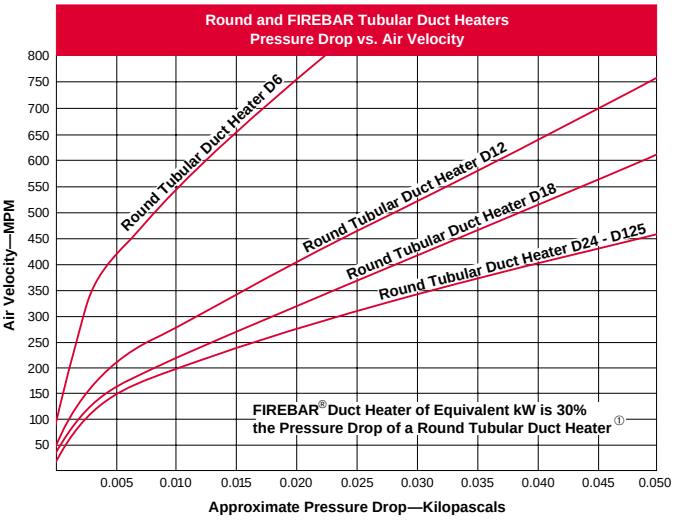
The rate at which pressure drops through the duct heater is critical for properly sizing blowers and pumps. *The Pressure Drop vs. Air Velocity* graph gives recommended maximum velocities in feet per minute and meters per minute according to the air velocity and duct heater size.

To determine the pressure drop through the duct heater, follow the air velocity (FPM or MPM) over to the appropriate curve which identifies the duct heater size. Then, take the intersecting point down to the approximate pressure drop value.



Note: Viewing from the element ends—the recommended air flow direction through element bundle changes at > 18kW.





① FIREBAR® flat tubular element duct heaters can be custom designed and built when they enhance your application output or performance. Although duct heaters are not normally constructed with FIREBAR elements, we show the pressure drop reduction using FIREBAR as a distinct advantage.

Options

Sheath Material

Watlow duct heaters can be made with element sheath materials other than Incoloy®.

Consult your Watlow representative for details and availability.

Wattages/Voltages

To meet specific application needs, voltage and wattage combinations outside stock product parameters are available.

For more information about this option, consult your Watlow representative.

Tubular and Process Assemblies

Duct Heaters

Options

Continued

Terminal Enclosures

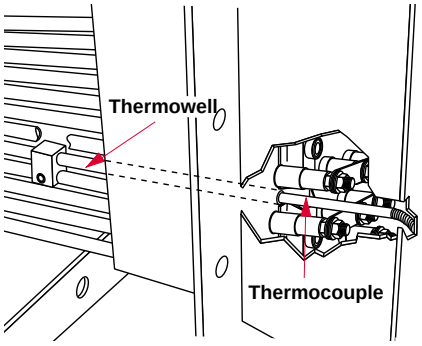
In addition to the standard, general purpose (NEMA 1) terminal enclosure, Watlow offers the following optional terminal enclosures to meet specific application requirements:

- Moisture resistant (NEMA 4)
- Stainless steel corrosion resistant (NEMA 4X—consult factory)
- Explosion resistant (NEMA 7—consult factory)
- Dust resistant (NEMA 12)

Thermocouples

Type J or **K** thermocouples, inserted in the thermowell, accurately sense element sheath temperature for over-temperature conditions.

To sense process temperature, sensing element should be located down stream from the duct heater. This will eliminate incorrect sensing caused by radiant heat.



Duct heater thermowell holds thermocouple for sensing sheath temperature.

Thermocouples are supplied with 120 inch (3050 mm) leads (longer lead lengths available). Unless otherwise specified, thermocouples are supplied with temperature ranges detailed on the *Thermocouple Types* chart.

Using a thermocouple requires an appropriate temperature and power control. These must be purchased separately. Watlow offers a wide variety of temperature and power controls to meet virtually all applications. Temperature controls can be configured to accept process variable inputs, too. Consult your Watlow representative for details.

To order a thermocouple, add the appropriate suffix letter to the duct heater's base code number, as indicated on the Build-a-Code chart on **page 418**.

Thermocouple Types

ASTM Type	Conductor Characteristics Positive	Conductor Characteristics Negative	Recommended ① Temperature Range °F	Recommended ① Temperature Range (°C)
J	Iron (Magnetic)	Constantan (Non-magnetic)	0 to 1000	(-20 to 540)
K	Chromel® (Non-magnetic)	Alumel® (Magnetic)	0 to 2000	(-20 to 1100)

① **Type J** and **Type K** thermocouples are rated 32 to 1382°F and 32 to 2282°F (0-750°C and 0-1250°C), respectively. Watlow does not recommend exceeding temperature ranges shown on this chart for the tubular product line.

Application Hints

- Mount duct heaters horizontally to lower enclosure temperatures and promote unit life.
- Orient heating elements as per the air flow illustration on **page 414**.
- Promote heater life by keeping sheath temperature below the 1400°F (760°C) maximum.
- Measure process temperature in the outlet stream, away from the heater.
- Maintain wiring integrity by keeping enclosure temperature below 400°F (205°C).
- Thermal cycling can cause terminations to loosen. Periodically check and tighten all electrical connections.
- Size power feeder wires in accordance with NEC and other applicable codes.
- Protect employees against electrical shock by properly grounding the unit per NEC specifications.

Alumel® and Chromel® are registered trademarks of Hoskins Manufacturing Company.

Tubular and Process Assemblies

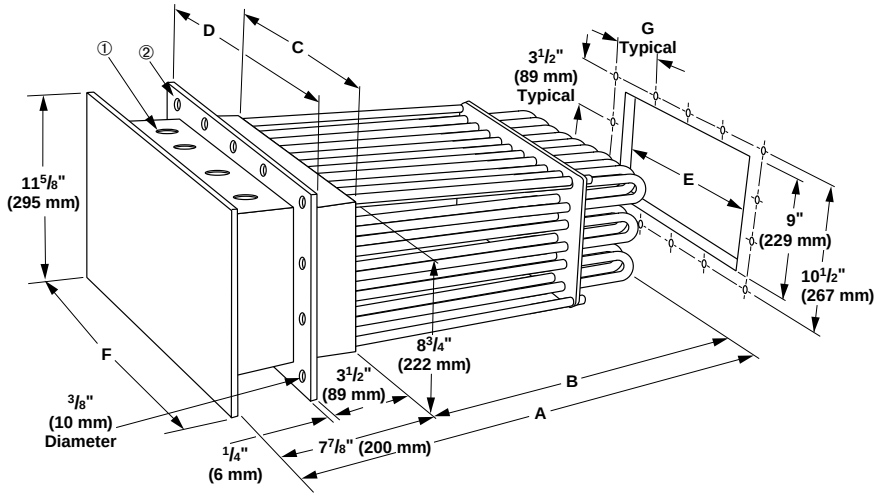
Duct Heaters

① Stock heaters with six and 12 elements have one 1 inch NPT conduit opening.

Stock heaters with 18, 24, 30 and 42 elements have two 1 inch NPT conduit openings.

Stock heaters with 36, 48, 54 and 60 elements have two 1 inch NPT and two 1¼ inch NPT conduit openings.

② All flanges are 12 inches wide.



Duct Heater Dimensions

Dimension Reference No.	Number of Elements	A Dimension in	A Dimension (mm)	B Dimension in	B Dimension (mm)	C Dimension in	C Dimension (mm)	D Dimension in	D Dimension mm	E Dimension in	E Dimension (mm)	F Dimension in	F Dimension (mm)	G Dimension in	G Dimension (mm)
1	6	27⅞	(708)	20	(508)	2¾	(70)	6½	(165)	3	(76)	5 ¾	(146)	2½	(64)
2	12	27⅞	(708)	20	(508)	4¾	(121)	8 ½	(215)	5	(127)	7 ¾	(197)	3½	(89)
3	18	27⅞	(708)	20	(508)	6¾	(171)	10½	(267)	7	(178)	9 ¾	(248)	3½	(76)
4	24	27⅞	(708)	20	(508)	8¾	(222)	12½	(318)	9	(229)	11 ¾	(298)	2¾	(70)
5	30	27⅞	(708)	20	(508)	10¾	(273)	14½	(368)	11	(279)	13 ¾	(349)	3¼	(83)
6	36	27⅞	(708)	20	(508)	12¾	(324)	16½	(419)	13	(330)	15 ¾	(400)	3¾	(95)
7	42	27⅞	(708)	20	(508)	14¾	(375)	18½	(470)	15	(381)	17 ¾	(451)	4¼	(108)
8	48	27⅞	(708)	20	(508)	16¾	(425)	20½	(521)	17	(432)	19 ¾	(502)	4¾	(121)
9	54	27⅞	(708)	20	(508)	18¾	(476)	22½	(572)	19	(483)	21 ¾	(552)	5¼	(133)
10	60	27⅞	(708)	20	(508)	20¾	(527)	24½	(622)	21	(533)	23 ¾	(603)	5¾	(146)
11	60	32⅞	(835)	25	(635)	20¾	(527)	24½	(622)	21	(533)	23 ¾	(603)	5¾	(146)
12	60	40⅜	(1026)	32½	(826)	20¾	(527)	24½	(622)	21	(533)	23 ¾	(603)	5¾	(146)
13	60	49⅜	(1254)	41½	(1054)	20¾	(527)	24½	(622)	21	(533)	23 ¾	(603)	5¾	(146)

20 W/in² (3.1 W/cm²)

kW	Dimension Reference No.	Number of Elements	Code No. 240V~(ac) 1-Phase	# of Circ.	240V~(ac) 3-Phase	# of Circ.	480V~(ac) 1-Phase	# of Circ.	480V~(ac) 3-Phase	# of Circ.	Est. Ship. Weight lbs	(kg)
6	1	6	**D6S10**	1	**D6S3**	1	**D6S11**	1	**D6S5**	1	50	(23)
12	2	12	**D12S10**	1	**D12S3**	1	**D12S11**	1	**D12S5**	1	55	(25)
18	3	18	**D18S10**	2	**D18S3**	1	**D18S11**	1	**D18S5**	1	65	(30)
24	4	24	**D24S10**	2	**D24S3**	2	**D24S11**	1	**D24S5**	1	95	(43)
30	5	30			**D30S3**	2	**D30S11**	2	**D30S5**	1	120	(55)
36	6	36			**D36S3**	2	**D36S11**	2	**D36S5**	1	135	(62)
42	7	42			**D42S3**	2	**D42S11**	2	**D42S5**	2	155	(71)
48	8	48			**D48S3**	4	**D48S11**	2	**D48S5**	2	195	(89)
54	9	54			**D54S3**	3	**D54S11**	3	**D54S5**	2	205	(93)
60	10	60			**D60S3**	4	**D60S11**	4	**D60S5**	2	235	(107)
75	11	60			**D75S3**②	4	**D75S11**	4	**D75S5**	2	260	(118)
100	12	60							**D100S5**②	4	290	(132)
125	13	60							**D125S5**②	4	310	(141)

All duct heaters are Assembly Stock unless otherwise noted.

② Standard

Availability

Assembly Stock: Three to five working days

Standard: 10 working days

Truck Shipment only

Tubular and Process Assemblies

Duct Heaters

30 W/in² (4.7 W/cm²)

kW	Dimension Reference No.	Number of Elements	Code No. 240V~(ac) 1-Phase	# of Circ.	240V~(ac) 3-Phase	# of Circ.	480V~(ac) 1-Phase	# of Circ.	480V~(ac) 3-Phase	# of Circ.	Est. Ship. Weight lbs	(kg)
9	1	6	D6SX10	1	D6SX3	1	D6SX11	1	D6SX5	1	50	(23)
18	2	12	D12SX10	2	D12SX3	1	D12SX11	1	D12SX5	1	55	(25)
27	3	18	D18SX10	3	D18SX3	2	D18SX11	2	D18SX5	1	65	(30)
36	4	24	D24SX10	4	D24SX3	2	D24SX11	2	D24SX5	1	95	(43)
45	5	30			D30SX3	5	D30SX11	2	D30SX5	2	120	(55)
54	6	36			D36SX3	3	D36SX11	3	D36SX5	2	135	(62)
63	7	42			D42SX3	7	D42SX11	3	D42SX5	2	155	(71)
72	8	48			D48SX3	4	D48SX11	4	D48SX5	2	195	(89)
81	9	54			D54SX3	6	D54SX11	6	D54SX5	3	205	(93)
90	10	60			D60SX3	5	D60SX11	4	D60SX5	4	235	(107)
115	11	60			D75SX3②	10	D75SX11	5	D75SX5	4	260	(118)
150	12	60							D100SX5②	4	290	(132)
190	13	60							D125SX5②	5	310	(141)

Replacement Elements

Replaceable heating elements provide easy field service and reduce downtime. Element change-out is made simple by a single screw clamp.

To order replacement elements, specify the **replacement element code number** (from the table) that corresponds to the original Watlow duct heater code number. Then specify **quantity.**

All duct heaters are Assembly Stock unless otherwise noted.
Availability
Assembly Stock: Three to five working days
Standard: 10 working days
Truck Shipment only

Replacement Elements

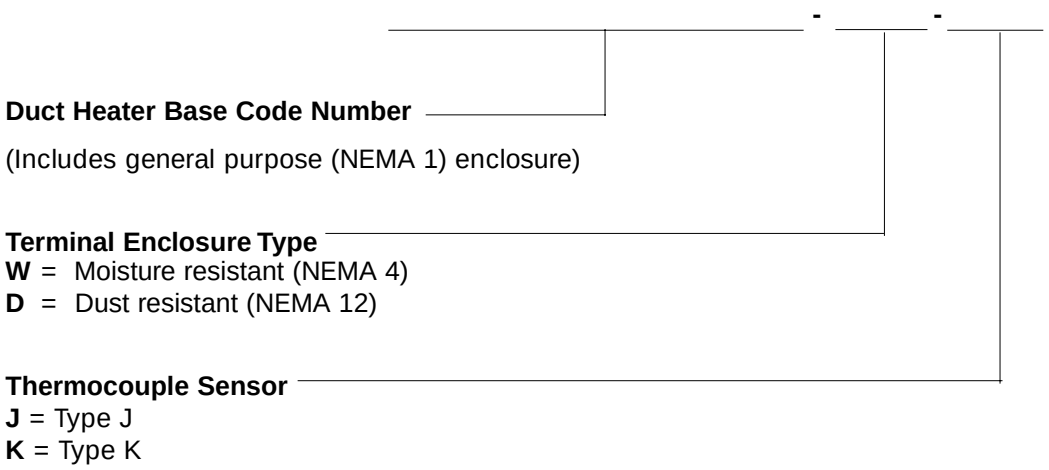
Original Duct Heater Code Numbers	Replacement Element Volts	Watts	A Dimension in	(mm)	Replacement Element Code No.	Availability	Est. Net Weight lbs	(kg)
20 W/in² (3.1 W/cm²)								
D6S3 to D60S3	240	1000	27⅞	(708)	D6240	Stock	1.0	(0.5)
D6S5 to D60S5	480	1000	27⅞	(708)	D6480	Stock	1.0	(0.5)
D75S3	240	1250	32⅞	(835)	D75240	Standard	1.0	(0.5)
D75S5	480	1250	32⅞	(835)	D75480	Stock	1.0	(0.5)
D100S5	480	1667	40⅜	(1026)	D100480	Stock	1.4	(0.7)
D125S5	480	2083	49⅜	(1254)	D125480	Stock	1.7	(0.8)
30 W/in² (4.7 W/cm²)								
D6SX3 to D60SX3	240	1500	27⅞	(708)	D6X240	Stock	1.0	(0.5)
D6SX5 to D60SX5	480	1500	27⅞	(708)	D6X480	Stock	1.0	(0.5)
D75SX3	240	1917	32⅞	(835)	D75X240	Standard	1.0	(0.5)
D75SX5	480	1917	32⅞	(835)	D75X480	Stock	1.0	(0.5)
D100SX5	480	2500	40⅜	(1026)	D100X480	Stock	1.4	(0.7)
D125SX5	480	3167	49⅜	(1254)	D125X480	Stock	1.7	(0.8)

② Standard

F.O.B.: Hannibal, Missouri

Duct Heaters

Build-a-Code



How to Order

To order stock duct heaters, please specify:

- Watlow code number
- Volts/watts
- Phase
- Options
- Quantity

If our stock units do not meet your application needs, Watlow can provide a made-to-order unit. For **made-to-order** units please consult your Watlow representative and provide the following information:

- Application (inlet and outlet air temperature, CFM/CMM, duct size and mounting orientation)
- Volts/watts
- Phase
- Number of circuits
- Watt density
- Number of heating elements
- Sheath material
- Element ('B' dimension) length
- Mounting flange material and mounting hole layout
- Insulation thickness and material
- Terminal enclosure type
- Options
- Quantity

Availability

Assembly Stock: Three to five working days

Modified Stock①: Five to seven working days

Standard: 10 working days

Made-to-Order: Five to seven weeks

Replacement Elements Only

Stock: Same day shipment

Standard: 10 working days

Made-to-Order: Four weeks

Options, complexity and quantity may affect availability and lead times. Consult factory.

① Stock or Assembly Stock units with catalog options.