

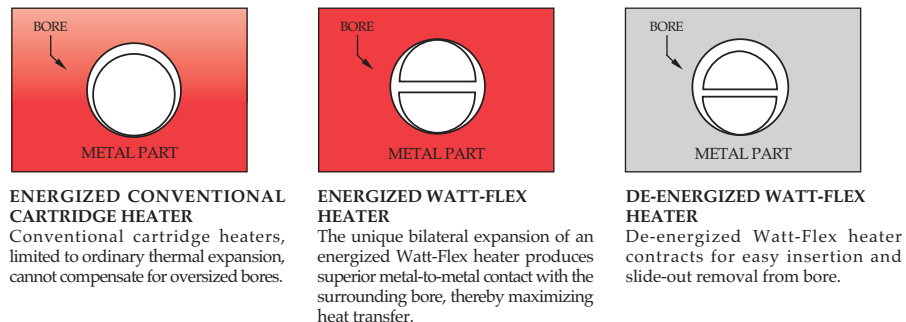
Watt-Flex®

The Revolutionary Split-Sheath Cartridge Heater
(Patented in the United States and Canada)

Maximized Heat Transfer

● The unique split-sheath design of the Watt-Flex® Cartridge Heater allows the independent, bilateral expansion of each half of the heater outward against the walls of the surrounding bore. Maximized metal-to-metal contact results in greatly improved heat transfer under normal fit conditions of .005" to .007". The thermal expansion of conventional cartridge heaters limits heater contact to only one side of the bore (Figure 1). The unique split-sheath expansion of Watt-Flex heaters assures superior heat transfer, more uniform process heat, greater efficiency, and reduced consumption of electricity.

Figure 1: Watt-Flex Expansion Comparison



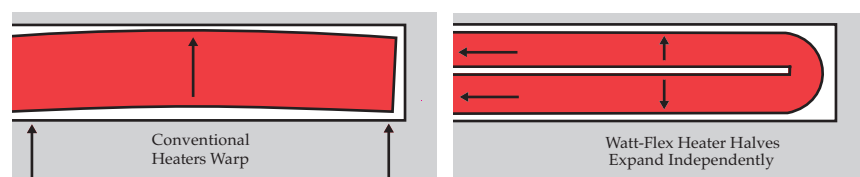
Use in Oversized Bores

● The fit of a cartridge heater is measured as the difference between the inside diameter (I.D.) of the bore and the outside diameter (O.D.) of the heater. The suggested fit for a Watt-Flex Cartridge Heater is .007" greater than the standard diameters shown on Page 4.

For example, the ideal bore diameter for a 1/2" diameter Watt-Flex heater would be 0.502" to 0.505". At the maximum tolerance dimension of the heater and the minimum bore diameter, the heater would have 0.005" fit, allowing ease of insertion and removal. Generally, smaller diameter heaters benefit from a bit tighter fit and fit can be slightly loosened for larger diameters.

The unique expanding action of Watt-Flex heaters eliminates the need for tight fits. This makes Watt-Flex heaters ideal for use in oversized bores. Superior bilateral expansion permits the use of Watt-Flex heaters in bores where conventional heaters could not be used effectively.

Figure 2: Thermal Expansion Comparison



Ease of Removability

● Dalton Electric will replace, free of charge, any Watt-Flex Cartridge Heater that cannot be withdrawn from the bore.

Dalton Electric's standard product warranty covers the removal of Watt-Flex heaters from bores, providing the bore fit is a minimum of .005" and there is no bore contamination to cause seizure. This warranty is possible because the split-sheath design of Watt-Flex heaters eliminates warping, the primary cause of bore seizure in heating applications.

As shown in Figure 2, temperature differentials exist from one side of conventional cylindrically sheathed cartridge heaters to the other. These differentials occur because only one side of the heater comes in contact with the bore. The resulting deflection within a close-fitting bore often makes the heater bind during removal. With the Watt-Flex heater's split-sheath design, each half of the heater contracts independently when de-energized to provide ease of removability.

Higher Watt Densities and Temperatures

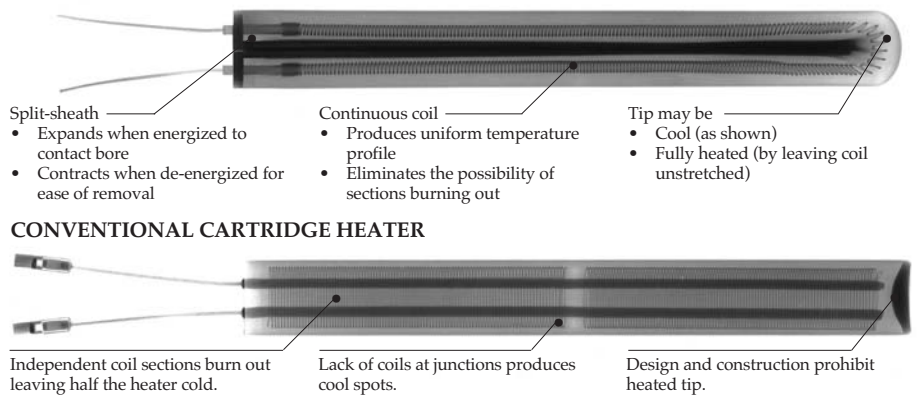
Longer Life

● The Watt-Flex Cartridge Heater is essentially a tubular heater bent back on itself and swaged into a cylindrical format. Unlike conventional heaters, Watt-Flex heaters have no ceramic core which can crack during swaging, therefore, they can be compacted to a much greater density. This process increases both heat transfer ability and insulative value of the dielectric.

The greater insulation value accommodates significantly higher watt-densities. In fact, Watt-Flex heaters produce up to 50% higher warrantable watt-densities than conventional heaters and can operate at much higher temperatures.

● The life of a cartridge heater is directly related to its internal operating temperature. Denser and more uniform compaction of the dielectric provides greater heat transfer to the Watt-Flex sheath. This, combined with more efficient heat transfer to the surrounding metal through intimate contact with the wall of the bore, permits the Watt-Flex resistance coil to run substantially cooler than conventional cartridge heater coils. The result is up to five times longer life, decreased downtime, and lower operating costs.

Figure 3: Watt-Flex® SPLIT-SHEATH CARTRIDGE HEATER

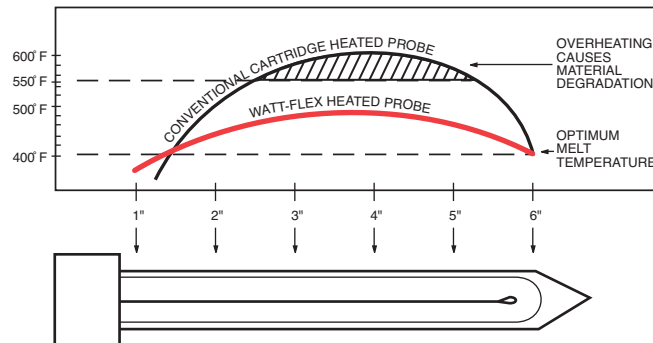


Uniform Temperature Profile

● Unlike conventional cartridge heaters, Watt-Flex heaters have a continuous heating coil for a more uniform temperature profile. Continuous coil construction eliminates the cold spots which can occur at core junctions in ceramic core heaters. (See Figure 3.) With Watt-Flex heaters there are no independent sections to burn out. Therefore, Watt-Flex heaters are either totally on or totally off. Figure 4 shows the superior temperature profile along the length of a torpedo probe heated by a Watt-Flex heater. Uniform sheath temperature is vital when molding heat-sensitive plastics where the temperature window between gate freeze-off and material degradation is very narrow.

By varying the watt-density, the temperature profile may be custom-matched to specific requirements. For example, certain applications, such as those requiring temperatures higher at the tip of a molding probe than along the sheath, can be accomplished with Watt-Flex heaters but not with conventional cartridge heaters.

Figure 4: Superior Temperature Distribution Based on Actual In-Mold Tests



Standard Watt-Flex Heater Dimensions

AVAILABLE DIAMETERS	NOMINAL DIAMETERS ¹	STANDARD COLD SECTION AT TERMINAL END	MINIMUM - MAXIMUM ² LENGTHS
1/4"	0.245"	5/16"	1 1/4" - 22"
3/8"	0.370"	3/8"	1 1/2" - 36"
1/2"	0.495"	5/8"	2" - 50"
5/8"	0.620"	5/8"	2 1/2" - 70"
11/16"	0.683"	5/8"	3 1/2" - 64"
3/4"	0.745"	5/8"	3 1/2" - 90"
1"	0.9925"	1"	10" - 60"
8.0 mm	7.875 mm	8.000 mm	38 mm - 660 mm
10.0 mm	9.875 mm	9.500 mm	38 mm - 915 mm
12.0 mm	11.875 mm	15.875 mm	50 mm - 1140 mm
12.5 mm	12.375 mm	15.875 mm	50 mm - 1140 mm
15.0 mm	14.875 mm	15.875 mm	65 mm - 1250 mm
16.0 mm	15.875 mm	15.875 mm	65 mm - 1775 mm
20.0 mm	19.875 mm	15.875 mm	100 mm - 1525 mm

1) Tolerance: $\pm .002"$ ($1/4"$ - $3/4"$); $\pm .0025"$ (1")
 $\pm .05$ mm (8 mm - 20 mm)

2) Tolerance: $\pm 3\%$ with $3/32"$ minimum
 $\pm 2\%$ above 20" (500 mm)

Hot Tip Option

Watt-Flex heaters can be constructed to generate full heat at the tip (Figure 5). When selected for injection molding gate probes, the hot tip feature minimizes undesirable gate freeze-off.

Figure 5: Watt-Flex Hot Tip Heater vs. Conventional Heater



Conventional cartridge heater construction prohibits a heated tip.



Only Watt-Flex heaters are designed with a continuous coil which delivers full heat to the tip.

Exclusive External Thermocouple Option

Watt-Flex heaters can be manufactured with a groove along the exterior of the cartridge to accommodate a needle-type thermocouple (Figure 6) for more accurate temperature sensing and control. Unlike cartridge heaters with internal thermocouples which measure the internal coil temperature, Watt-Flex heaters measure the temperature at the point of heat transfer from the heater to the host metal.

Another feature of this design is that the temperature can be monitored at any point along the heater, unlike internal thermocouples with fixed positions. And, the Watt-Flex design allows for independent replacement of the heater or the thermocouple, without having to discard an operational component as in conventional designs.

The maximum lengths for grooved heaters are 15" for 1/4" and 3/8" diameter heaters and 7" for 1/2" diameter heaters. Longer heaters, 1/2" diameter or larger, can be center grooved between the legs to a depth of 6". Thermocouples are Type J with a lead length of 48". A 0.040" needle diameter is used for 1/4" diameter heaters and all center grooves. A 0.062" needle diameter is used for side grooved 3/8" and 1/2" diameter heaters.

Figure 6: Watt-Flex Heater with Optional Thermocouple

