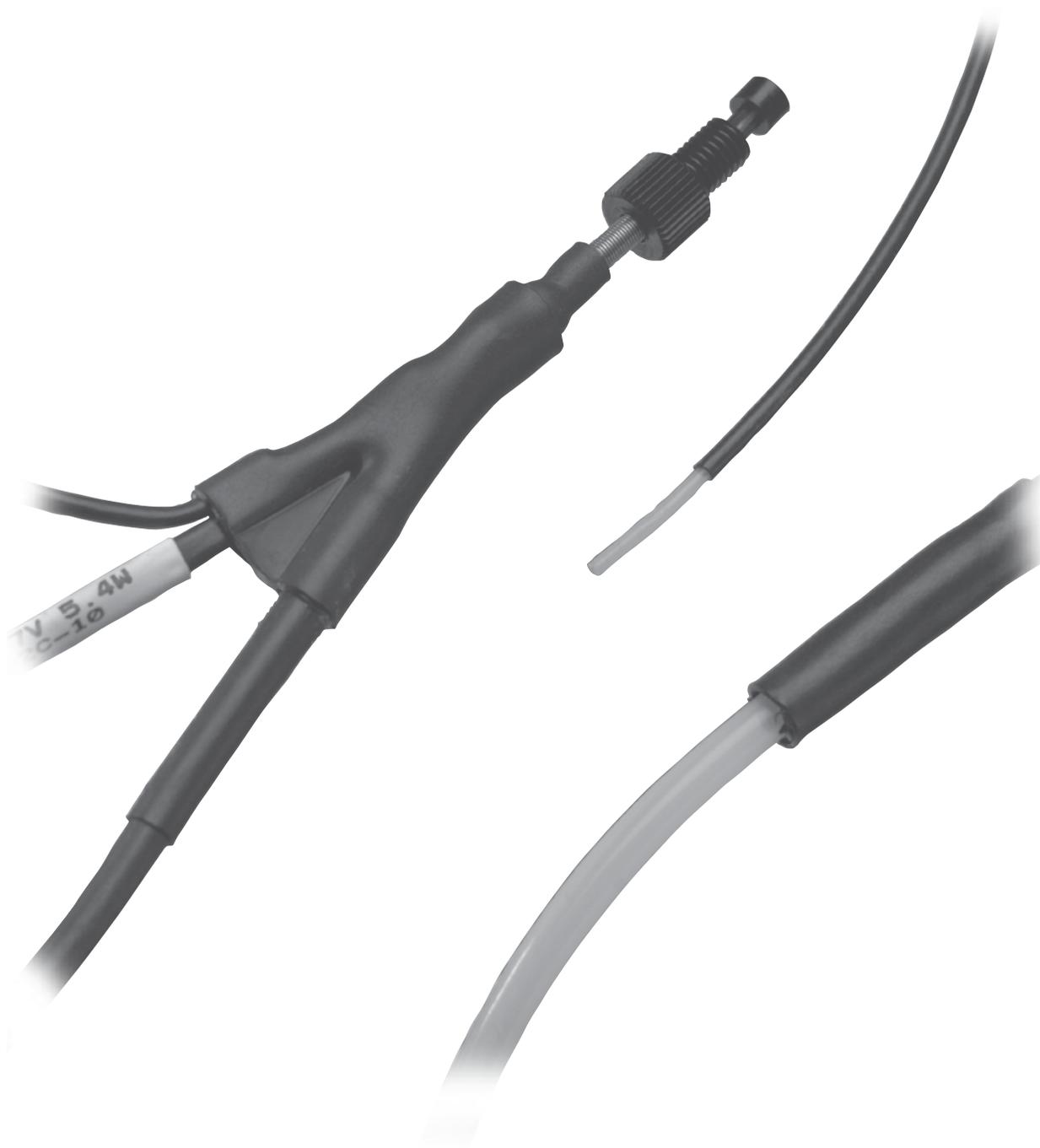


# Fluid Delivery Heaters

Fluid Delivery Heaters	Sheath Materials	Max. Operating Temperatures		Typical Max. Watt Densities		Page
		°F	°C	W/in <sup>2</sup>	W/cm <sup>2</sup>	
<b>FREEFLEX®</b>	Polymeric	212	100	10	1.5	<b>385</b>
<b>Syringe</b>	Polycarbonate laminate	185	85	2	0.3	<b>388</b>



Fluid Delivery Heaters



# Fluid Delivery Heaters

EXTENDED  
CAPABILITY

## Extended Capabilities For FREEFLEX® Heaters

Watlow's miniature heated polymeric tubing assemblies provide a flexible heat-up and transport system for moving fluids within diameters as small as  $\frac{1}{32}$  in. (0.8 mm). The FREEFLEX® heater heats fluids up to 212°F (100°C) and maintains temperature during transfer from a reservoir to a point of use. In some applications, the tubing can actually serve as the reservoir for limited volumes of fluid, helping to reduce start-up times. For higher temperatures, contact your Watlow representative.

Watlow's innovative design places the heating element and sensor directly in contact with the perimeter of the tubing to produce efficient, responsive heating and temperature control of the tube contents. The element is evenly wound to ensure reliable, close contact for uniform heating along a portion or the entire length of the line. A flexible, durable jacket covers the wound element to let the tubing flex and move in a dynamic system. This allows for fluid delivery to multiple locations from a single supply source. In stationary applications, the FREEFLEX heated tubing is conveniently routed through available space or around other system components. This saves space and provides an uncomplicated retrofit in existing systems.

The FREEFLEX heater's efficient heating element design can incorporate an optional thermocouple, thermistor or resistance temperature detector (RTD) temperature sensor into the thermal package. Users can select leads to exit from one or both ends of the assembly. Typical standard PTFE tubing is available in  $\frac{1}{32}$ ,  $\frac{1}{16}$ ,  $\frac{1}{8}$  or  $\frac{3}{16}$  in. (0.8, 1.6, 3.2, 4.8 mm) inside diameters. Contact your Watlow representative for other sizes and materials.

### Features and Benefits

#### Flexible heat-up and transport system

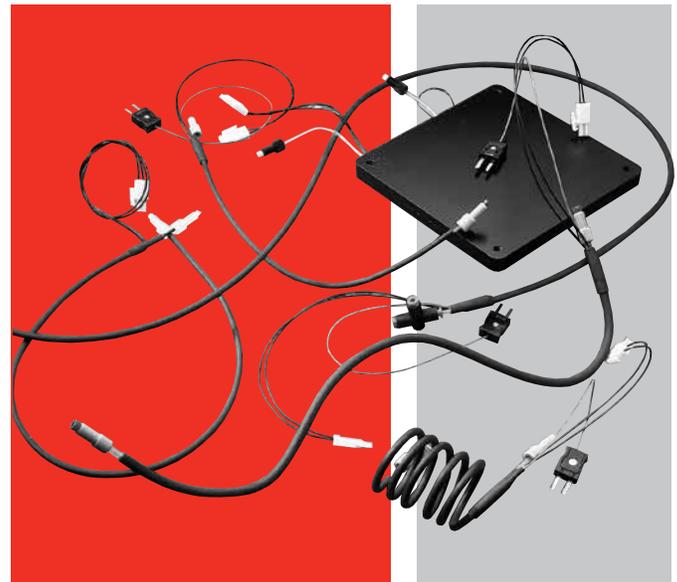
- Eliminates the need for heated reservoir systems in many applications

#### Direct contact between the heating element and tubing

- Provides fast, efficient, highly responsive heating

#### Available in three configurations

- FREEFLEX design allows tubing to flex, coil or bend around system components, enabling convenient retrofits
- Pre-formed design allows a longer tube length in a smaller volume
- Molded design provides a compact heating assembly for easy installation



#### Integral sensors

- Maintain close control of heater and fluid temperatures

#### Low voltage design

- Ensures safety

#### Miniature sizes as small as $\frac{1}{32}$ in. (0.8 mm) inside diameter

- Heats and transports fluids within tiny spaces

#### Convenient retrofit

- Allows for routing flexible tubing around system components and using existing control system

#### UL® recognition

- Available on qualified designs by request

#### Typical Applications

- **Medical:** automated clinical analyzers, tissue processing equipment
- **Analytical:** sample preheating for LC and HPLC systems, breathalyzers
- **Semiconductor processing:** wafer drying equipment, DI water heating
- **Printing:** ink jet printers, rapid prototyping systems, photo lithography
- **General process:** wax/paraffin processing and non-combustible gas heating
- **Water purification systems**
- **Precision cleaning equipment**
- **Aerospace**
- **Military**

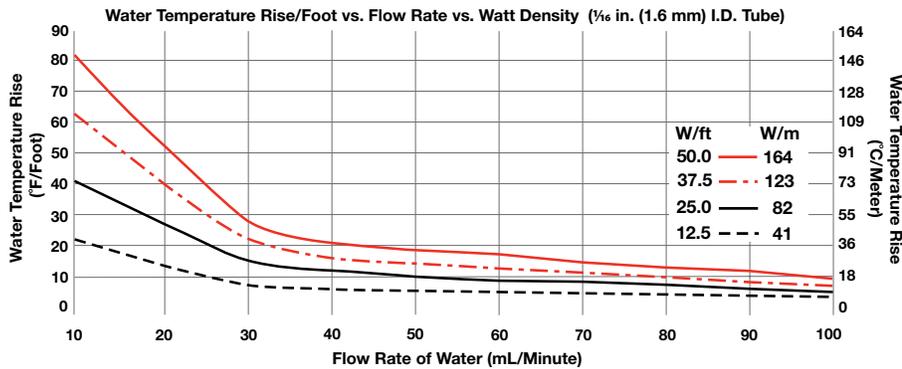
# Fluid Delivery Heaters

**EXTENDED  
CAPABILITY**

## Extended Capabilities For FREEFLEX Heaters

### Technical Data

### Water Temperature Rise/Length Versus Flow Rate Versus Watt Density



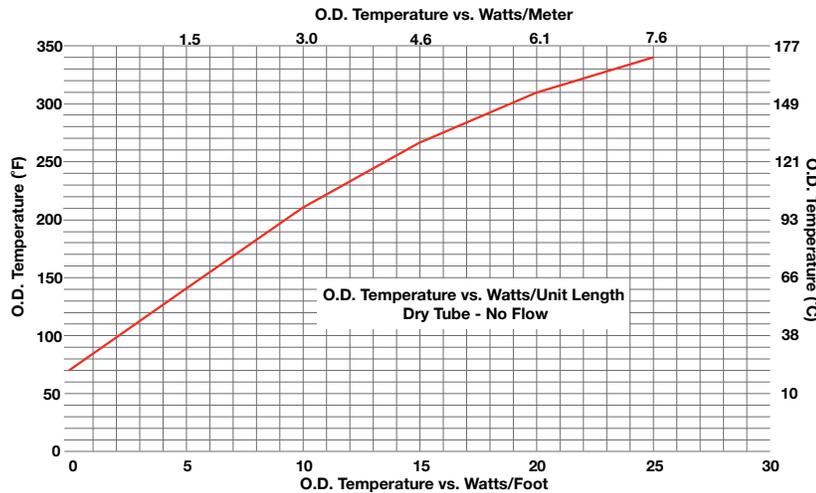
Water Temperature Rise °F/Foot

Flow Rate (mL/minute)	10	30	50	100
W/ft 50.0	82	29	19	10
37.5	64	22	14	7
25.0	41	16	10	5
12.5	22	8	5	3

Water Temperature Rise °C/Meter

Flow Rate (mL/minute)	10	30	50	100
W/m 164	149	52	35	18
123	116	40	26	13
82	75	29	18	9
41	40	15	9	5

### FREEFLEX Outside Diameter Temperature Versus Watts/Length



W/ft	W/m	O.D. Temperature °C	(°F) (Ambient)
0	0	70	(21)
5	1.5	140	(60)
10	3.0	210	(99)
15	4.6	265	(129)
20	6.1	310	(154)
25	7.6	340	(171)

# Fluid Delivery Heaters

## Extended Capabilities For FREEFLEX Heaters

### Typical Application Requirements

When requesting a quote please specify:

- **Fluid Type**
- **Inlet Temperature**
- **Outlet Temperature**
- **Flow Rate**
- **Voltage** - Typically less than 36V
- **Watts/ft** - See chart on previous page for typical values
- **Maximum Allowable Outside Surface Temperature**
- **Tube Size**
  - 1/32 in. (0.8 mm) I.D. x 1/16 in. (1.6 mm) O.D.
  - 1/16 in. (1.6 mm) I.D. x 1/8 in. (3.2 mm) O.D.
  - 1/8 in. (3.2 mm) I.D. x 3/16 in. (4.8 mm) O.D.
  - 3/16 in. (4.8 mm) I.D. x 1/4 in. (6 mm) O.D.
  - Other (specify size)
- **Tube Material**
  - PTFE standard
  - Silicone rubber
  - Others upon request
- **Tube Length** - 12 to 120 in. (305 to 3048 mm) typical
  - Total
  - Heated
  - Unheated (specify)
- **Tube Fittings**
  - No fittings (1 in. [25 mm] bare tubing each end)
  - Other (specify)
- **Tube Flexing**
  - Static (to route around components in system)
  - Dynamic (subject to more continuous flexing)
  - Occasional, frequent or continuous

**Note:** Min. recommended flexing radius

- 1/32 in. (0.8 mm) I.D. x 1/16 in. (1.6 mm) O.D. PTFE 1 in. (25 mm)
- 1/16 in. (1.6 mm) I.D. x 1/8 in. (3.2 mm) O.D. PTFE 1 1/2 in. (38 mm)
- 1/8 in. (3.2 mm) I.D. x 3/16 in. (4.8 mm) O.D. PTFE 2 in. (51 mm)
- 3/16 in. (4.8 mm) I.D. x 1/4 in. (6 mm) O.D. PTFE 3 in. (76 mm)

### Heater Leads

- One at each end
- Both at one end
- Standard lead insulation (UL® Style 1180 CSA white PTFE)
- Other insulation (specify)

### Heater Lead Length

- Standard 12 in. (305 mm) w/customer end stripped/tinned 1/2 in. (13 mm)
- Other (specify)

### Heater Lead Exit Direction

- Inboard/outboard

### Temperature Sensor

- Thermocouple (#30 AWG PFA - Type J)
- Thermistor (specify) 10KΩ at 72°F (25°C) standard
- Other temperature sensors size/types (specify)
- Sense heater element or tube temperature

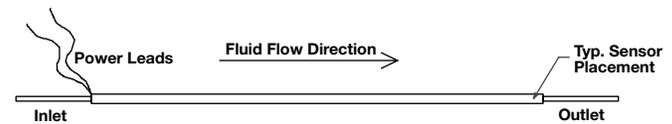
### Sensor Lead Exit Direction

- Inboard/outboard

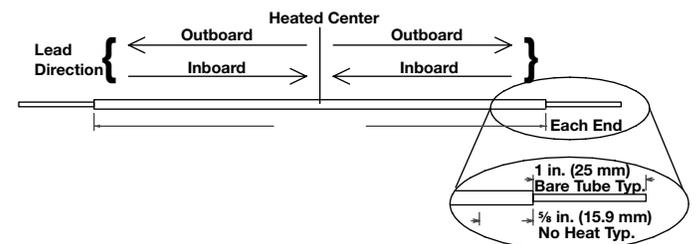
### Temperature Sensor Lead Length

- 12 in. (305 mm)
- Other (specify)

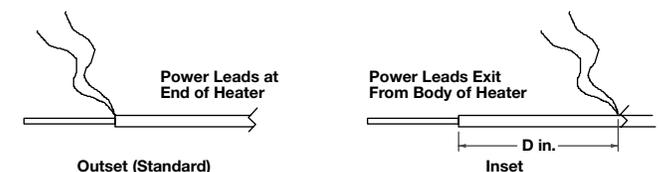
### Typical FREEFLEX Layout



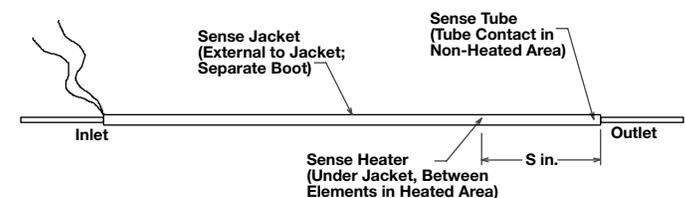
### Lead Orientation



### Lead Location



### Sensor Location/Mounting Description



## Extended Capabilities for Syringe Heaters

The Watlow syringe heater was developed to match the unique needs of medical injection applications. It produces consistent results by reducing temperature and viscosity variations. Fluid and drug delivery that maintain precise liquid temperatures and reduce fluid viscosity maximize patient comfort and reduce risk. Body temperature injections are more easily introduced, particularly for patients in a frail or distressed condition.

The Watlow syringe heater is available in two configuration types with an optional, repeatable temperature sensing controller. The silicone/wire configuration accommodates varying syringe size needs. The translucent, high-tech laminate construction of the polycarbonate/foil design enables fluid levels and air bubbles to be easily viewed and monitored. Both heater forms are designed to “snap” on to the syringe with one hand and hold firmly during a procedure.

An overmold design houses the optional electronic controller and/or temperature sensor to allow trouble-free servicing and extend heater life. The overmold can be modified and color matched for seamless, integrated appearance.

### Features and Benefits

#### Long operational life

- Improves system reliability
- Reduces equipment down time and minimizes the need to reschedule procedures

#### Two heater configurations provide flexibility and adaptability

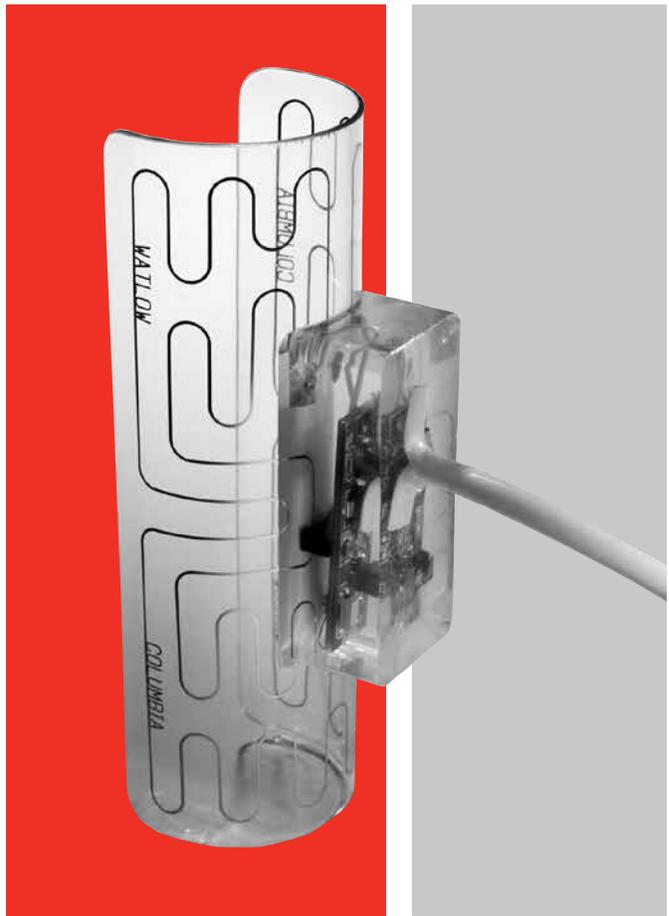
- Silicon wire enables maximum flexibility to accommodate various syringe sizes
- Polycarbonate/foil provides high tech appearance and functionality

#### Customizable to most OEM requirements

- Allows over-mold to be modified and color matched for a seamless, integrated appearance

#### Optional precise, repeatable temperature sensing control

- Maximizes patient comfort
- Minimizes patient risk
- Increases the consistency of test results by eliminating temperature and viscosity variations
- Carries a longer product life than bimetal thermostats



### Specifications

#### Silicone/Wire and Polycarbonate/Foil

- Length: 5 in. (127 mm) max.
- Formed heater diameter: formed to fit syringe. Typical diameter is 2 in. (50 mm) to 6 in. (150 mm)\*
- Voltage: dependent on application, over 48V may impact agency approvals
- Control accuracy: 5.4°F ( $\pm 3^{\circ}\text{C}$ )
- Max. operating surface temperature: 185°F (85°C)
- Approximate control pod dimensions: 1 x 1 x 2.75 in. (25 x 25 x 70 mm)\*
- Cord pull strength: Up to 89 N (20 lb<sub>F</sub>)\*

\* Dependent on design requirements.