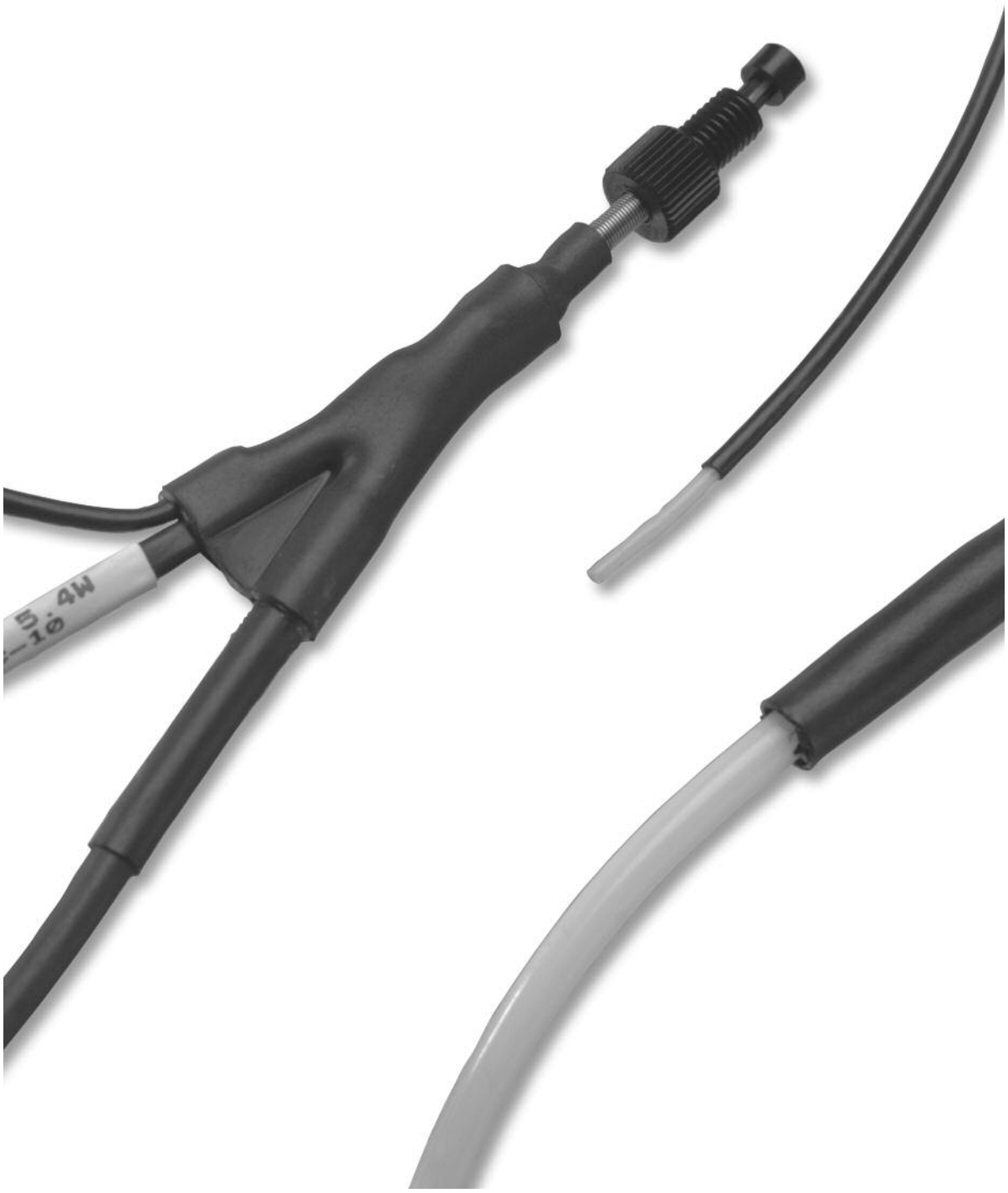
Fluid Delivery Heaters

Fluid Delivery Heaters	Sheath Materials	Max. Operating Temperatures °F	°C	Typical Max. Watt Densities W/in²	W/cm²	Page
FREEFLEX®	Polymeric	212	100	10	1.5	**421**
Syringe	Polycarbonate laminate	185	85	2	0.3	**424**



Fluid Delivery Heaters

EXTENDED CAPABILITY

Extended Capabilities For FREEFLEX® Heaters

The miniature heated polymeric tubing assemblies from Watlow® provide a flexible heat-up and transport system for moving fluids in tubing as small as 1/32 in. (0.8 mm) inside diameter. FREEFLEX® 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 and lets 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 for an uncomplicated retrofit in existing systems.

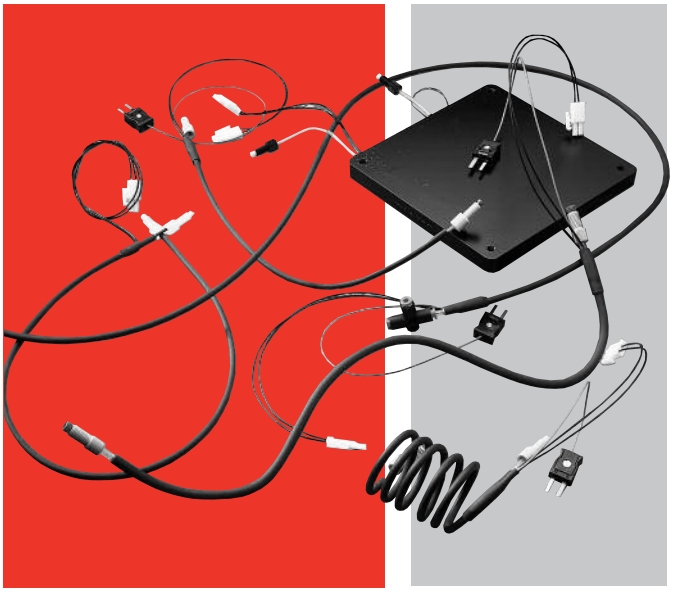
The superior construction employs an efficient heating element design with the ability to incorporate optional thermocouple, thermistor or RTD temperature sensors into the thermal package. Users can select leads to exit one or both ends of the assembly. Typical standard Teflon® tubing comes in 1/32, 1/16, 1/8 or 3/16 in. (0.8, 1.6, 3.2, 4.8 mm) inside diameters, although other sizes and materials are available.

Features and Benefits

Flexible heat-up and transport system
- Eliminates the need for heated reservoir systems in many applications

Heating element directly contacts tubing
- Provides fast, efficient more responsive heating

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



Integral sensors
- Maintains close control of heater and fluid temperatures

Low voltage design
- Promotes safety

Miniature sizes as small as 1/32 in. (0.8 mm) inside diameter
- Transports and heats fluids in even the smallest 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

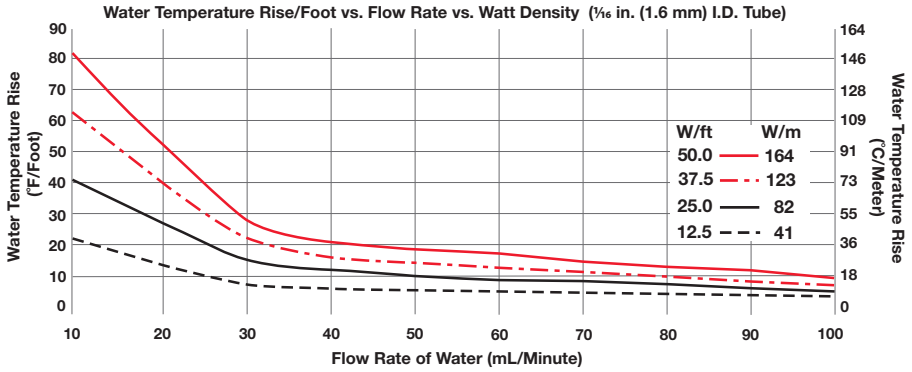
- **Medical:** automated clinical analyzers, tissue processing equipment
- **Analytical:** sample preheating for LC and HPLC systems, breathalyzers
- **Semiconductor processing:** wafer drying equipment, DI water heating
- **Printing:** Ink jet printers, rapid prototyping systems, photo lithography
-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

EXTENDED CAPABILITY

Extended Capabilities For FREEFLEX® Heaters

Technical Data

Water Temperature Rise/Length Versus Flow Rate Versus Watt Density



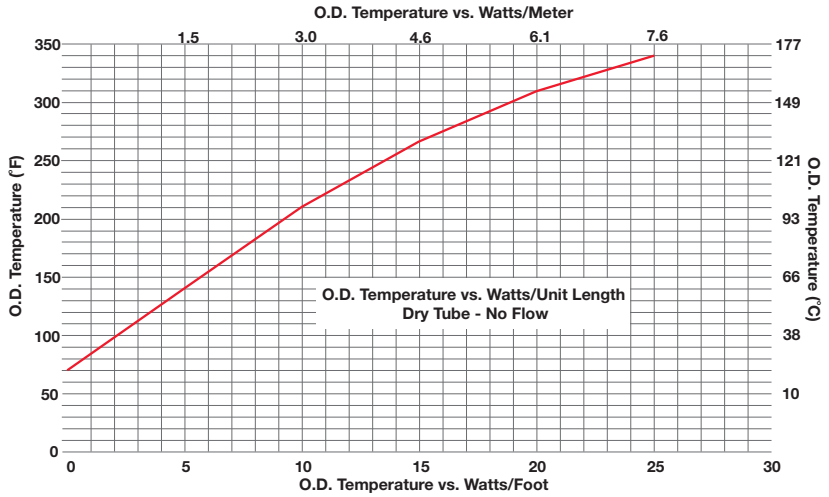
Water Temperature Rise °F/Foot

Flow Rate (mL/minute)				
W/ft	**10**	**30**	**50**	**100**
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)				
W/m	**10**	**30**	**50**	**100**
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	O.D. Temperature (°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)

EXTENDED CAPABILITY

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**
  - Teflon® (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. Teflon® 1 in. (25 mm)
- 1/16 in. (1.6 mm) I.D. x 1/8 in. (3.2 mm) O.D. Teflon® 1½ in. (38 mm)
- 1/8 in. (3.2 mm) I.D. x 3/16 in. (4.8 mm) O.D. Teflon® 2 in. (51 mm)
- 3/16 in. (4.8 mm) I.D. x 1/4 in. (6 mm) O.D. Teflon® 3 in. (76 mm)

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

Heater Lead Length

- Standard 12 in. (305 mm) w/customer end stripped/tinned ½ in. (13 mm)
- Other (specify)

Heater Lead Exit Direction

- Inboard/outboard

Temperature Sensor

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

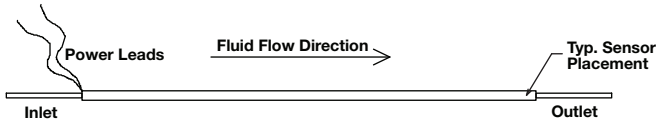
Sensor Lead Exit Direction

- Inboard/outboard

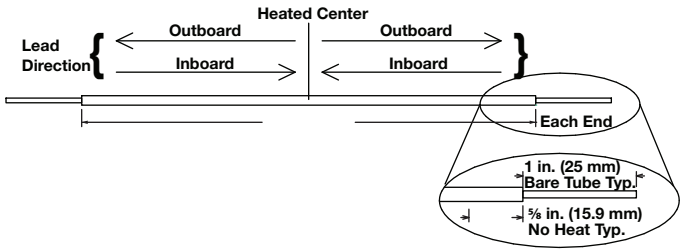
Temperature Sensor Lead Length

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

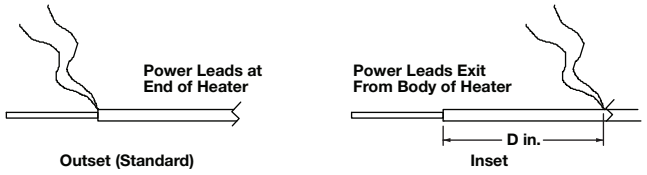
Typical FREEFLEX Layout



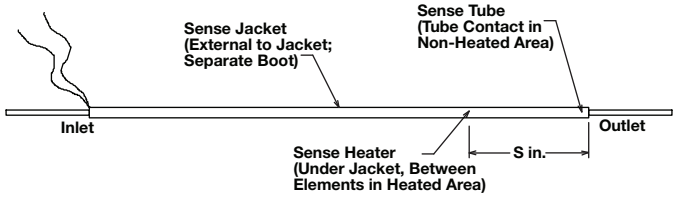
Lead Orientation



Lead Location



Sensor Location/Mounting Description



Fluid Delivery Heaters

EXTENDED CAPABILITY

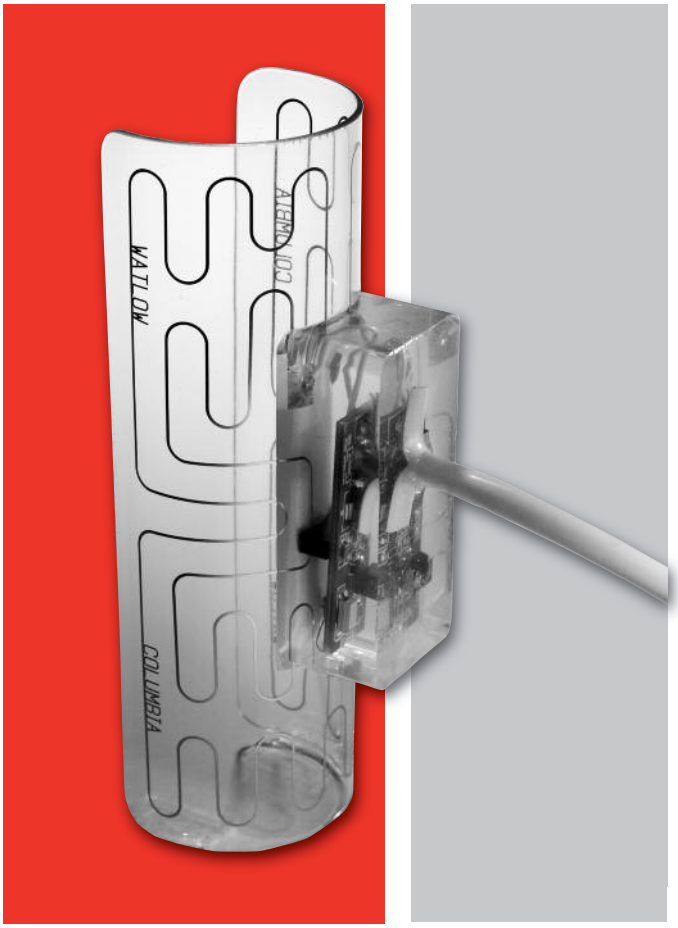
Extended Capabilities for Syringe Heaters

The syringe heater from Watlow produces consistent results by reducing temperature and viscosity variations. These heaters provide a heated fluid and drug delivery solution that maximizes patient comfort while reducing risk.

The versatile Watlow heater system was developed for the unique needs of medical injection applications. Heater configurations include silicone/wire or polycarbonate/foil configurations to deliver flexibility and convenience. Both heater forms are designed to "snap" on to the syringe with one hand and hold firmly during the procedure.

Constructed utilizing a clear polycarbonate laminate, this design allows technicians to view fluid levels and monitor for air bubbles. Smooth outer surfaces and a radius on all inside corners facilitate cleaning. The syringe heaters also house an overmold containing an electronic controller and/or sensor to deliver years of accurate, trouble free service and warm solutions to precise specifications. Redundant controller may also be incorporated if required.

Precise fluid temperatures greatly increase patients' comfort levels. Body temperature injections are more easily introduced to patients and have reduced viscosity. Heated contrast media minimizes patient risk and is particularly beneficial for patients in a frail or distressed condition.



Features and Benefits

Long operational life

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

Two heater configurations provide flexibility and adaptability

- Provides maximum flexibility to accommodate various syringe sizes (silicon wire)
- Provides high tech look and functionality (polycarbonate/foil)

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
- Improves product life versus 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 (±3°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 20 lbs*

* Dependent on design requirements.