

## Ensures Efficient Heating and Transport of Liquids and Gases

The miniature heated polymeric tubing assemblies from Watlow® provide a flexible heat-up and transport system for moving fluids inside of tubing with an inside diameter as narrow as 1/32 in. (0.8 mm). 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 temperature needs contact your Watlow representative.

Watlow's innovative design places the heating element and sensor in direct 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 allows tubing to flex and move in a dynamic system enabling 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 designed with the ability to incorporate optional thermocouple, thermistor or RTD temperature sensors into the thermal package. Users can select power leads to exit from one or both ends of the assembly. Typical standard Teflon® tubing is available in 1/32, 1/16, 1/8 or 3/16 in. (0.8, 1.6, 3.2, 4.8 mm) inside diameters. Ask 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

#### 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

- Maintain close control of heater and fluid temperatures

#### Low voltage design

- Promotes safety

#### Miniature inside diameters as small as 1/32 in. (0.8 mm)

- Transports and heats fluids in the smallest spaces

#### Convenient retrofit

- Allows flexible tubing to be routed around system components of existing control system

#### UL® recognition

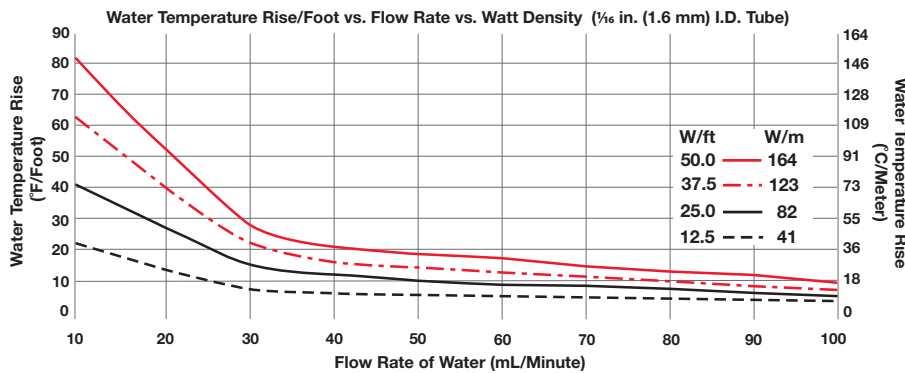
- Available on qualified designs by request

## Typical Applications

- **Clinical:** 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**

## Technical Data

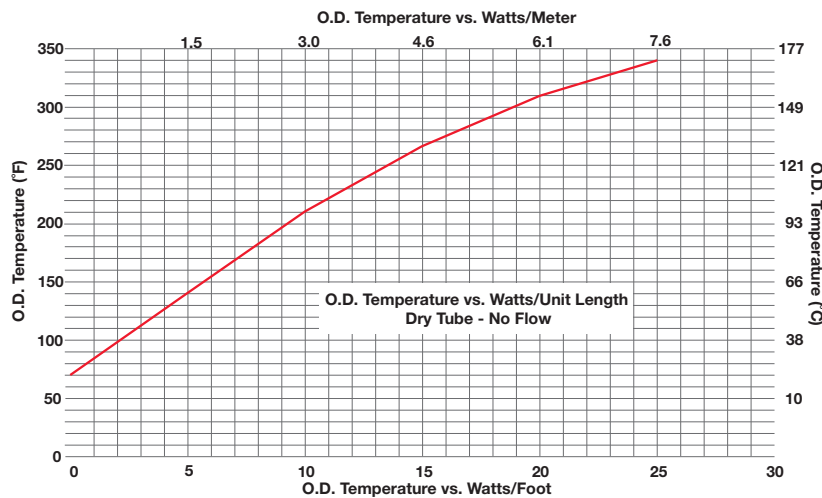
### Water Temperature Rise/Length Versus Flow Rate Versus Watt Density



W/ft	Water Temperature Rise °F/Foot			
	Flow Rate (mL/minute)			
	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

W/m	Water Temperature Rise °C/Meter			
	Flow Rate (mL/minute)			
	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 °F	O.D. Temperature (°C) (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)

## Details Required for Application Support/Product Requirements

- **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 available 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

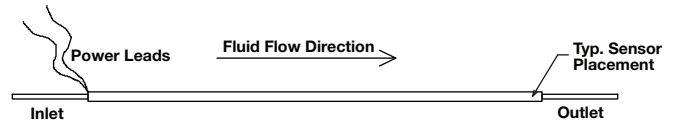
**Note:** Min. recommended flexing radius

- 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®  
1 1/2 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)

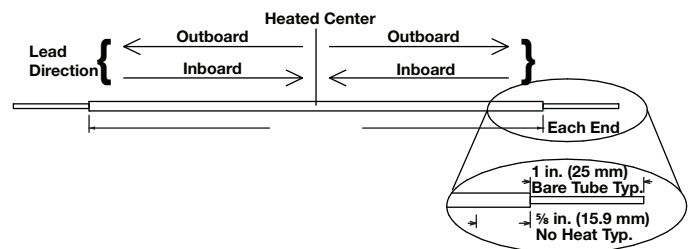
- **Heater Leads**
  - One at each end
  - Both at one end
  - Standard lead insulation (UL® Style 1180 CSA white Teflon®)
  - Other insulation (specify)
- **Heater Lead Length**
  - Standard 12 in. (305 mm) w/customer end stripped/tinned 1/2 in. (13 mm)
  - Other (specify)
- **Heater Lead Exit Direction**
  - 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)

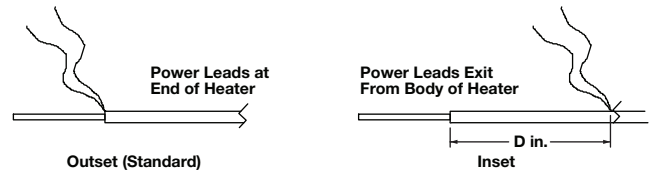
### Typical FREEFLEX Layout



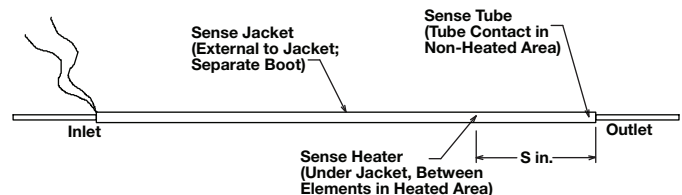
### Lead Orientation



### Lead Location



### Sensor Location/Mounting Description



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