Western Water Constructors, Inc.
license no. 188068

Submittal Cover

Job no. 16-05

CONTRACT NAME:	Manteca WQCF Digester Improvements	**SUB #:**	287
SPEC SECTION:	16125 Electrical Heat Tracing	**REV #:**	1
SUBMITTAL TITLE:	Electrical Heat Tracing – O&M	**CODE:**	16125-03
FILE NAME:	287-R1_16125-03_Electrical Heat Tracing-OM	**DATE:**	2/28/2018

WWC REVIEW/COMMENTS: ☒ **NO EXCEPTIONS** ☐ **EXCEPTIONS / DEVIATIONS AS NOTED**

REVIEWED BY: ST **SIGNED:**

WWC HAS REVIEWED THIS SUBMITTAL FOR CONFORMANCE WITH THE PROJECT PLANS & SPECIFICATIONS.

OWNER REVIEW:

ITEM	DESCRIPTION	REVIEW STATUS				
		A	B	C	D	E
1	Electrical Heat Tracing – O&M	☐	☐	☐	☐	☐
2		☐	☐	☐	☐	☐
3		☐	☐	☐	☐	☐
4		☐	☐	☐	☐	☐
5		☐	☐	☐	☐	☐

LEGEND: **A =** No Exceptions Taken **B =** Make Correction Noted **C =** Correct & Resubmit
D = Rejected **E** = Accepted for Record

OWNER COMMENTS:

REVIEWER'S NAME: _____

REVIEWER'S SIGNATURE: _____ **DATE:** _____

707 Aviation Blvd
Santa Rosa, CA 95403

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general engineering contractors

p 707.540.9640
f 707.540.9641

EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM TCM2-1-SSR15A/2R-240-I-xP3-H1-1-1

2. MANUFACTURER Thermon

3. EQUIPMENT IDENTIFICATION NUMBER(S) DCS-PNL-07-850
(maps equipment number)

4. LOCATION OF EQUIPMENT ALUM LINES

5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) NA

6. NAMEPLATE DATA - Horsepower NA
Amperage 30amp
Voltage 208 volt
Service Factor (S.F.)
Speed
ENC Type Fiberglass, Nema 4x
Capacity
Other NA

7. MANUFACTURER'S LOCAL REPRESENTATIVE

Name Qcon

Address 4070 Nelson Eve # F Concord CA 94520

Telephone
Number 925-682 -2020

8. MAINTENANCE REQUIREMENTS None

9. LUBRICANT LIST none

10. SPARE PARTS (recommendations) None

11. COMMENTS None

EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM TCM2-1-SSR15A/2R-240-I-xP3-H1-1-1

2. MANUFACTURER Thermon

3. EQUIPMENT IDENTIFICATION NUMBER(S) FOG-PNL-07-751
(maps equipment number)

4. LOCATION OF EQUIPMENT 6" FOG Lines

5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) NA

6. NAMEPLATE DATA - Horsepower NA
Amperage 30amp
Voltage 208 volt
Service Factor (S.F.)
Speed
ENC Type Fiberglass, Nema 4x
Capacity
Other NA

7. MANUFACTURER'S LOCAL REPRESENTATIVE

Name Qcon

Address 4070 Nelson Eve # F Concord CA 94520

Telephone
Number 925-682 -2020

8. MAINTENANCE REQUIREMENTS None

9. LUBRICANT LIST none

10. SPARE PARTS (recommendations) None

11. COMMENTS None

EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM TCM2-1-SSR15A/2R-240-I-xP3-H1-1-1

2. MANUFACTURER Thermon

3. EQUIPMENT IDENTIFICATION NUMBER(S) FOG-PNL-07-752
(maps equipment number)

4. LOCATION OF EQUIPMENT 4" FOG Lines

5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) NA

6. NAMEPLATE DATA - Horsepower NA
Amperage 30amp
Voltage 208 volt
Service Factor (S.F.)
Speed
ENC Type Fiberglass, Nema 4x
Capacity
Other NA

7. MANUFACTURER'S LOCAL REPRESENTATIVE

Name Qcon

Address 4070 Nelson Eve # F Concord CA 94520

Telephone Number 925-682 -2020

8. MAINTENANCE REQUIREMENTS None

9. LUBRICANT LIST none

10. SPARE PARTS (recommendations) None

11. COMMENTS None

EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM TCM2-1-SSR15A/2R-240-I-xP3-H1-1-1

2. MANUFACTURER Thermon

3. EQUIPMENT IDENTIFICATION NUMBER(S) FOG-PNL-07-753
(maps equipment number)

4. LOCATION OF EQUIPMENT 2" FOG Lines

5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) NA

6. NAMEPLATE DATA - Horsepower NA
Amperage 30amp
Voltage 208 volt
Service Factor (S.F.)
Speed
ENC Type Fiberglass, Nema 4x
Capacity
Other NA

7. MANUFACTURER'S LOCAL REPRESENTATIVE

Name Qcon

Address 4070 Nelson Eve # F Concord CA 94520

Telephone
Number 925-682 -2020

8. MAINTENANCE REQUIREMENTS None

9. LUBRICANT LIST none

10. SPARE PARTS (recommendations) None

11. COMMENTS None

EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM TCM2-1-SSR15A/2R-240-I-xP3-H1-1-1

2. MANUFACTURER Thermon

3. EQUIPMENT IDENTIFICATION NUMBER(S) FOG-PNL-07-754
(maps equipment number)

4. LOCATION OF EQUIPMENT FOG TANK

5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) NA

6. NAMEPLATE DATA - Horsepower NA
Amperage 30amp
Voltage 208 volt
Service Factor (S.F.)
Speed
ENC Type Fiberglass, Nema 4x
Capacity
Other NA

7. MANUFACTURER'S LOCAL REPRESENTATIVE

Name Qcon

Address 4070 Nelson Eve # F Concord CA 94520

Telephone
Number 925-682 -2020

8. MAINTENANCE REQUIREMENTS None

9. LUBRICANT LIST none

10. SPARE PARTS (recommendations) None

11. COMMENTS None

EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM TCM2-1-SSR15A/2R-240-I-xP3-H1-1-1

2. MANUFACTURER Thermon

3. EQUIPMENT IDENTIFICATION NUMBER(S) FOG-PNL-07-758
(maps equipment number)

4. LOCATION OF EQUIPMENT 4" FOOD WASTE LINES

5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) NA

6. NAMEPLATE DATA - Horsepower NA
Amperage 30amp
Voltage 208 volt
Service Factor (S.F.)
Speed
ENC Type Fiberglass, Nema 4x
Capacity
Other NA

7. MANUFACTURER'S LOCAL REPRESENTATIVE

Name Qcon

Address 4070 Nelson Eve # F Concord CA 94520

Telephone
Number 925-682 -2020

8. MAINTENANCE REQUIREMENTS None

9. LUBRICANT LIST none

10. SPARE PARTS (recommendations) None

11. COMMENTS None

EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM TCM2-1-SSR15A/2R-240-I-xP3-H1-1-1

2. MANUFACTURER Thermon

3. EQUIPMENT IDENTIFICATION NUMBER(S) FOG-PNL-07-759
(maps equipment number)

4. LOCATION OF EQUIPMENT 2" FOOD WASTE LINES

5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) NA

6. NAMEPLATE DATA - Horsepower NA
Amperage 30amp
Voltage 208 volt
Service Factor (S.F.)
Speed
ENC Type Fiberglass, Nema 4x
Capacity
Other NA

7. MANUFACTURER'S LOCAL REPRESENTATIVE

Name Qcon

Address 4070 Nelson Eve # F Concord CA 94520

Telephone
Number 925-682 -2020

8. MAINTENANCE REQUIREMENTS None

9. LUBRICANT LIST none

10. SPARE PARTS (recommendations) None

11. COMMENTS None

Manteca WQCF

Digester Improvement Project

Electrical Heat Tracing

Owner's Manual

Prepared For : Western Water Constructors

Prepared By: Gary Johnson - Qcon, Concord Ca.

Manufacture : Thermon

Table Of Contents

Thermon Heat Tracing System for Tanks & Piping

Thermon Factory Representative: Qcon, Concord Ca. www.qcon.net

Submittal: City of Manteca WQCF Proj.
For: Western Water Constructors Inc
By: Gary Johnson - Qcon

PRODUCT SPECIFICATIONS

BSX™ SELF-REGULATING HEATING CABLE

APPLICATION

BSX self-regulating heating cables are designed to provide freeze protection or process temperature maintenance to metallic and nonmetallic piping, tanks and equipment. The heat output of BSX cable varies in response to the surrounding conditions along the entire length of a circuit. Whenever the heat loss of the insulated pipe, tank or equipment increases (as ambient temperature drops), the heat output of the cable increases. Conversely, when the heat loss decreases (as the ambient temperature rises or product flows), the cable reacts by reducing its heat output. BSX cables are approved for use in ordinary (nonclassified) areas and hazardous (classified) areas.

RATINGS

Available watt densities ..... 3, 5, 8, 10 w/ft @ 50°F
(10, 16, 26, 33 w/m @ 10°C)
Supply voltages ..... 110-120 or 208-277 Vac
Max. maintenance temperature ..... 150°F (65°C)
Max. continuous exposure temperature
Power-off ..... 185°F (85°C)
Minimum installation temperature ..... -60°F (-51°C)
Minimum bend radius
@ 5°F (-15°C) ..... 0.38" (10mm)
@ -76°F (-60°C) ..... 1.25" (32 mm)
T-rating [1]
3, 5, 8 w/ft (10, 16, 26 W/m) ..... T6 185°F (85°C)
10 w/ft (33 W/m) ..... T5 212°F (100°C)

Notes
1. T-rating per the National Electrical Code and Canadian Electrical Code.

CONSTRUCTION

1 Nickel-plated copper bus wires (16 AWG)

2 Radiation cross-linked semiconductive heating matrix

3 Radiation cross-linked dielectric insulation

4 Tinned copper braid

5 Polyolefin overjacket provides additional protection for cable and braid where exposure to aqueous inorganic chemicals is expected.

OPTIONS

6 FOJ Fluoropolymer overjacket over tinned copper braid provides additional protection to cable and braid where exposure to organic chemicals or corrosives is expected.

BASIC ACCESSORIES

Thermon offers system accessories designed specifically for rapid, trouble-free installation of Thermon heating cables.

All cables require a connection kit to comply with approval requirements. Information on accessories to complete a heater circuit installation can be found in the "Heating Cable Systems Accessories" product specification sheet (Form TEP0010).

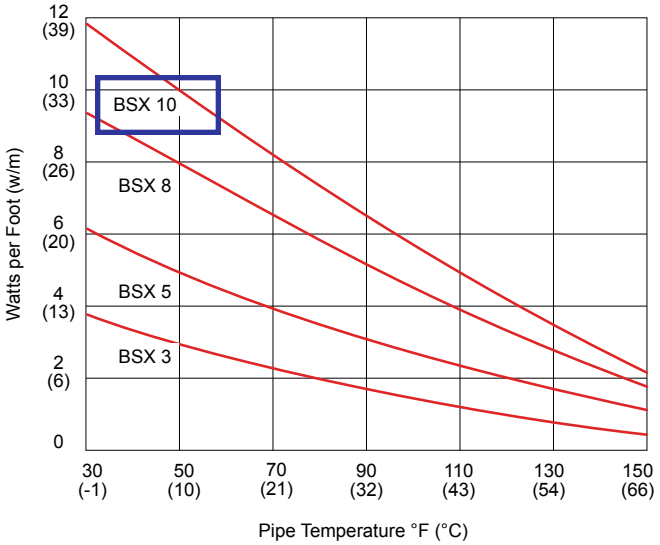
PRODUCT SPECIFICATIONS

BSX™ SELF-REGULATING HEATING CABLE

POWER OUTPUT CURVES [1]

The power outputs shown apply to cable installed on insulated metallic pipe (using the procedures outlined in IEEE 515) at the service voltages stated below. For use on other service voltages, contact Thermon.

Catalog Number 120 Vac Nominal	Catalog Number 240 Vac Nominal	Power Output at 50°F (10°C) w/ft (m)
BSX 3-1	BSX 3-2	3 (10)
BSX 5-1	BSX 5-2	5 (16)
BSX 8-1	BSX 8-2	8 (26)
BSX 10-1	BSX 10-2	10 (33)



CERTIFICATIONS/APPROVALS

FM Approvals
Ordinary Locations
Hazardous (Classified) Locations
- Class I, Division 2, Groups B, C and D
- Class II, Division 2, Groups F and G
- Class III, Divisions 1 and 2
- Class I, Zones 1 and 2, AEx e II

Underwriters Laboratories Inc.
Ordinary Locations
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- Class II, Division 2, Groups F and G
- Class III, Divisions 1 and 2

Canadian Standards Association
Ordinary Locations
Hazardous (Classified) Locations
- Class I, Divisions 1 & 2, Groups A, B, C and D
- Class II, Divisions 1 & 2, Groups E, F and G
- Ex e II

Notes

1. For more precise power output values as a function of pipe temperature, refer to CompuTrace®.
2. Based on the trip current characteristic of Type QOB or Type QO equipment protection devices. For devices with other trip current characteristics, contact Thermon.
3. The maximum circuit length is for one continuous length of cable, not the sum of segments of cable. Refer to CompuTrace® design software or contact Thermon for current loading of segments.

CIRCUIT BREAKER SIZING [2]

Maximum circuit lengths for various circuit breaker amperages are shown below. Breaker sizing should be based on the National Electrical Code, Canadian Electrical Code or any other applicable code. The National Electrical Code and Canadian Electrical Code require ground-fault protection of equipment for each branch circuit supplying electric heating equipment. Check local codes for ground-fault protection requirements.

120 Vac Service Voltage		Max. Circuit Length [3] vs. Breaker Size ft (m)		
Catalog Number	Start-Up Temperature °F (°C)	20A	30A	40A
BSX 3-1	50 (10)	360 (110)	360 (110)	360 (110)
	0 (-18)	325 (99)	360 (110)	360 (110)
	-20 (-29)	285 (87)	360 (110)	360 (110)
	-40 (-40)	260 (79)	360 (110)	360 (110)
BSX 5-1	50 (10)	240 (73)	300 (91)	300 (91)
	0 (-18)	205 (62)	300 (91)	300 (91)
	-20 (-29)	185 (56)	275 (84)	295 (90)
	-40 (-40)	165 (50)	250 (76)	265 (81)
BSX 8-1	50 (10)	190 (58)	240 (73)	240 (73)
	0 (-18)	150 (46)	225 (69)	240 (73)
	-20 (-29)	135 (41)	200 (61)	240 (73)
	-40 (-40)	120 (37)	180 (55)	215 (66)
BSX 10-1	50 (10)	160 (49)	200 (61)	200 (61)
	0 (-18)	110 (34)	170 (52)	200 (61)
	-20 (-29)	100 (30)	150 (46)	200 (61)
	-40 (-40)	90 (27)	135 (41)	180 (55)

240 Vac Service Voltage		Max. Circuit Length [3] vs. Breaker Size ft (m)		
Catalog Number	Start-Up Temperature °F (°C)	20A	30A	40A
BSX 3-2	50 (10)	725 (221)	725 (221)	725 (221)
	0 (-18)	650 (198)	725 (221)	725 (221)
	-20 (-29)	575 (175)	725 (221)	725 (221)
	-40 (-40)	515 (157)	725 (221)	725 (221)
BSX 5-2	50 (10)	480 (146)	600 (183)	600 (183)
	0 (-18)	395 (120)	590 (180)	600 (183)
	-20 (-29)	350 (107)	525 (160)	590 (180)
	-40 (-40)	315 (96)	475 (145)	530 (162)
BSX 8-2	50 (10)	385 (117)	480 (146)	480 (146)
	0 (-18)	285 (87)	425 (130)	480 (146)
	-20 (-29)	255 (78)	380 (122)	480 (146)
	-40 (-40)	230 (70)	345 (116)	430 (131)
BSX 10-2	50 (10)	280 (85)	400 (122)	400 (122)
	0 (-18)	225 (69)	340 (104)	400 (122)
	-20 (-29)	200 (61)	300 (91)	400 (122)
	-40 (-40)	180 (55)	275 (84)	365 (111)

Submittal: City of Manteca WQCF Proj.
For: Western Water Constructors Inc
By: Gary Johnson - Qcon

PRODUCT SPECIFICATIONS

HTSX™ SELF-REGULATING HEATING CABLE

APPLICATION

HTSX self-regulating heating cables are designed specifically for process temperature maintenance or freeze protection where high temperature exposure capability is required. HTSX withstands the temperature exposures associated with steam purging.

The heat output of HTSX cable varies in response to the surrounding temperature. Variations in the ambient temperature or heat lost through the thermal insulation are compensated for automatically along the entire length of a heat-traced pipe.

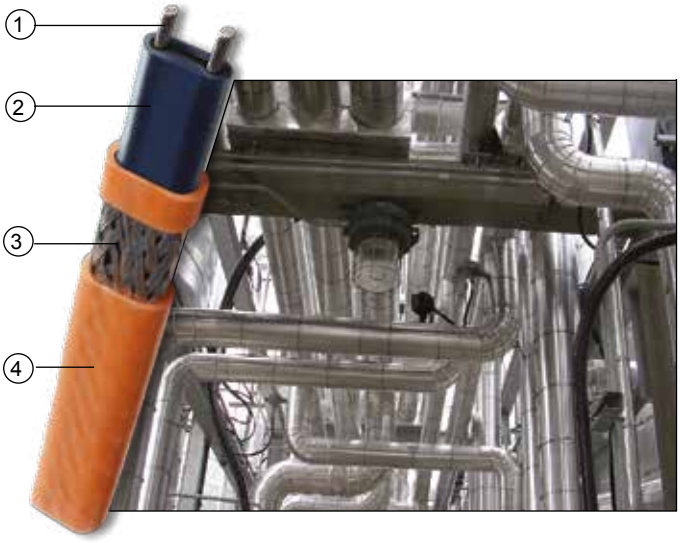
HTSX cables are approved for use in ordinary (nonclassified) areas and hazardous (classified) areas.

RATINGS

Available watt densities ... 3, 6, 9, 12, 15, 20 W/ft @ 50°F
(10, 20, 30, 39, 49, 66 W/m @ 10°C)
Supply voltages .....110-120 or 208-277 Vac
Max. maintenance temperature.....250°F (121°C)
Max. exposure temperature
Intermittent power-on .....420°F (215°C)
Intermittent power-off .....482°F (250°C)
Continuous power-off .....400°F (204°C)
Minimum installation temperature..... -76°F (-60°C)
Minimum bend radius
@ 5°F (-15°C) ..... 0.38" (10mm)
@ -76°F (-60°C) ..... 1.25" (32 mm)
T-rating [1] .....
3,6,9,12, 15-2 W/ft.....T3 392°F (200°C)
15-1 and 20-1 W/ft .....T2D 419°F (215°C)
20-2 W/ft .....T2C 446°F (230°C)
Based on stabilized design [2] .....T3 to T6

Notes

1. T-rating per the National Electrical Code and Canadian Electrical Code.
2. Thermon heating cables are approved for the listed T-ratings using the stabilized design method. This enables the cable to operate in hazardous areas without limiting thermostats. The T-rating may be determined using CompuTrace® Electric Heat Tracing Design Software or contact Thermon for design assistance.



CONSTRUCTION

1 Nickel-plated copper bus wires (16 AWG)

2 Semiconductive heating matrix and fluoropolymer dielectric insulation

3 Tinned copper braid

4 Fluoropolymer overjacket provides additional protection for cable and braid where exposure to chemicals or corrosives is expected.

BASIC ACCESSORIES

Thermon offers system accessories designed specifically for rapid, trouble-free installation of Thermon heating cables.

All cables require a connection kit to comply with approval requirements. Information on accessories to complete a heater circuit installation can be found in the "Heating Cable Systems Accessories" product specification sheet (Form TEP0010).

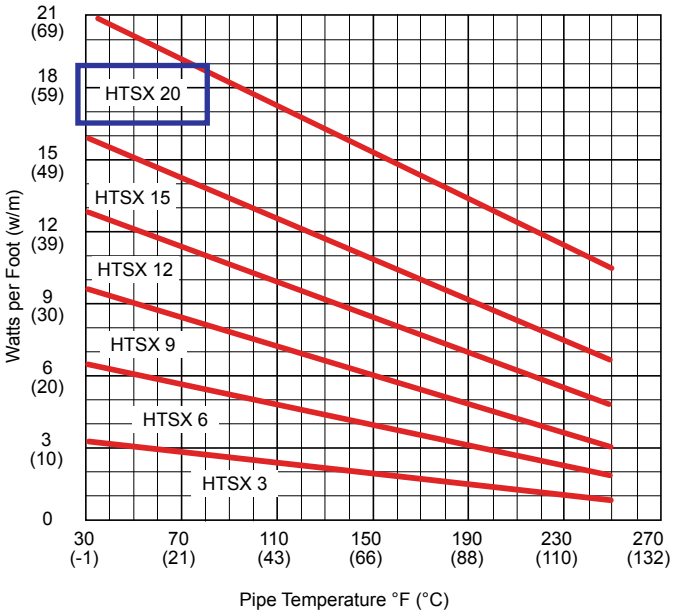
PRODUCT SPECIFICATIONS

HTSX™ SELF-REGULATING HEATING CABLE

POWER OUTPUT CURVES [1]

The power outputs shown apply to cable installed on insulated metallic pipe (using the procedures outlined in IEEE 515) at the service voltages stated below. For use on other service voltages, contact Thermon.

Catalog Number 120 Vac Nominal	Catalog Number 240 Vac Nominal	Power Output at 50°F (10°C) w/ft (m)
HTSX 3-1	HTSX 3-2	3 (10)
HTSX 6-1	HTSX 6-2	6 (20)
HTSX 9-1	HTSX 9-2	9 (30)
HTSX 12-1	HTSX 12-2	12 (39)
HTSX 15-1	HTSX 15-2	15 (49)
HTSX 20-1	HTSX 20-2	20 (66)



CERTIFICATIONS/APPROVALS

FM Approvals
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Class I, Division 2, Groups B, C and D
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Class II, Division 2, Groups F and G
Class III, Divisions 1 and 2

Canadian Standards Association
Ordinary Locations
Hazardous (Classified) Locations
Class I, Divisions 1 and 2, Groups A, B, C and D
Class II, Divisions 1 and 2, Groups E, F and G
Ex e II

Notes

1. For more precise power output values as a function of pipe temperature, refer to CompuTrace®.
2. Based on the trip current characteristic of Type QOB or Type QO equipment protection devices. For devices with other trip current characteristics, contact Thermon.
3. The maximum circuit length is for one continuous length of cable, not the sum of segments of cable. Refer to CompuTrace® design software or contact Thermon for current loading of segments.

CIRCUIT BREAKER SIZING [2]

Maximum circuit lengths for various circuit breaker amperages are shown below. Breaker sizing should be based on the National Electrical Code, Canadian Electrical Code or any other applicable code. The National Electrical Code and Canadian Electrical Code require ground-fault protection of equipment for each branch circuit supplying electric heating equipment. Check local codes for ground-fault protection requirements.

120 Vac Service Voltage		Max. Circuit Length [3] vs. Breaker Size ft (m)		
Catalog Number	Start-Up Temp °F (°C)	20A	30A	40A
HTSX 3-1	50 (10)	360 (109)	360 (109)	360 (109)
	0 (-18)	360 (109)	360 (109)	360 (109)
	-20 (-29)	360 (109)	360 (109)	360 (109)
	-40 (-40)	360 (109)	360 (109)	360 (109)
HTSX 6-1	50 (10)	235 (71)	250 (77)	250 (77)
	0 (-18)	235 (71)	250 (77)	250 (77)
	-20 (-29)	235 (71)	250 (77)	250 (77)
	-40 (-40)	235 (71)	250 (77)	250 (77)
HTSX 9-1	50 (10)	170 (52)	205 (62)	205 (62)
	0 (-18)	170 (52)	205 (62)	205 (62)
	-20 (-29)	170 (52)	205 (62)	205 (62)
	-40 (-40)	165 (50)	205 (62)	205 (62)
HTSX 12-1	50 (10)	135 (41)	175 (54)	175 (54)
	0 (-18)	135 (41)	175 (54)	175 (54)
	-20 (-29)	135 (41)	175 (54)	175 (54)
	-40 (-40)	125 (38)	175 (54)	175 (54)
HTSX 15-1	50 (10)	100 (30)	160 (48)	160 (49)
	0 (-18)	95 (29)	150 (46)	160 (49)
	-20 (-29)	90 (27)	145 (44)	160 (49)
	-40 (-40)	85 (26)	135 (41)	160 (49)
HTSX 20-1	50 (10)	85 (26)	130 (40)	140 (42)
	0 (-18)	80 (24)	120 (37)	140 (42)
	-20 (-29)	75 (23)	115 (35)	140 (42)
	-40 (-40)	70 (21)	110 (33)	140 (42)

240 Vac Service Voltage		Max. Circuit Length [3] vs. Breaker Size ft (m)		
Catalog Number	Start-Up Temp °F (°C)	20A	30A	40A
HTSX 3-2	50 (10)	710 (217)	710 (217)	710 (217)
	0 (-18)	700 (214)	710 (217)	710 (217)
	-20 (-29)	615 (187)	710 (217)	710 (217)
	-40 (-40)	530 (162)	710 (217)	710 (217)
HTSX 6-2	50 (10)	470 (143)	505 (154)	505 (154)
	0 (-18)	435 (132)	505 (154)	505 (154)
	-20 (-29)	390 (120)	505 (154)	505 (154)
	-40 (-40)	355 (108)	505 (154)	505 (154)
HTSX 9-2	50 (10)	340 (104)	410 (125)	410 (125)
	0 (-18)	310 (95)	410 (125)	410 (125)
	-20 (-29)	290 (88)	410 (125)	410 (125)
	-40 (-40)	265 (81)	410 (125)	410 (125)
HTSX 12-2	50 (10)	270 (82)	355 (109)	355 (109)
	0 (-18)	245 (74)	355 (109)	355 (109)
	-20 (-29)	230 (70)	355 (109)	355 (109)
	-40 (-40)	215 (65)	340 (104)	355 (109)
HTSX 15-2	50 (10)	200 (61)	315 (96)	315 (96)
	0 (-18)	175 (53)	275 (84)	315 (96)
	-20 (-29)	165 (51)	260 (79)	315 (96)
	-40 (-40)	155 (48)	245 (74)	315 (96)
HTSX 20-2	50 (10)	155 (48)	245 (75)	275 (84)
	0 (-18)	140 (42)	215 (65)	275 (84)
	-20 (-29)	130 (40)	205 (62)	275 (84)
	-40 (-40)	125 (38)	190 (59)	265 (80)

RTD-100
Temperature Sensor

Product Specifications

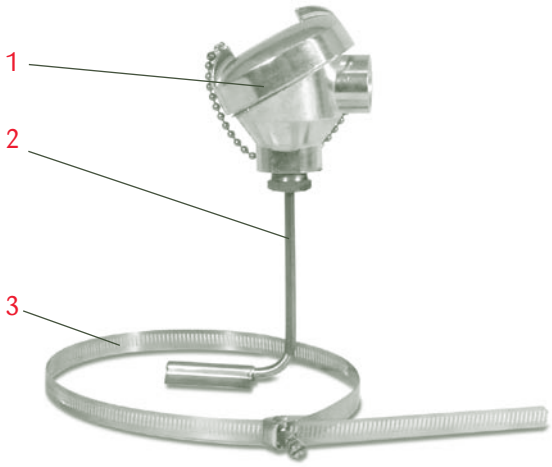
Application . . .

Electric Heat Tracing Control

The RTD-100 is designed for use as control input for freeze protection and temperature maintenance applications requiring pipewall or tankwall temperature sensing.

A cast-aluminum NEMA 4/7 enclosure and terminal block allows ease of wiring into a single unit that can be installed directly onto a heat traced pipe. The RTD-100 housing and mounting pad are stainless steel.

The RTD-100 is suitable for use in heat tracing applications where surface temperatures do not exceed 900°F (482°C).



Ratings/Specifications . . .

Electrical connection .....ceramic strip w/brass terminals
Enclosure rating.....NEMA 4/7
Enclosure hub size.....3/4" NPT female hub
RTD leads.....22 AWG fiberglass
RTD type.....3-wire platinum thin film
RTD resistance.....100 ohms at 32° (0°C)
RTD calibration
Per ASTM E1137, DIN standard 43760/BS1904/IEC 751
Temperature coefficient.....00385 Ohms/Ohms - °C
Maximum sensor temperature.....900°F (482°C)
Sensor housing material .....316 stainless steel

Note . . .

1. For additional options or enclosure materials contact Thermon.

Construction . . .

1 Junction Box With Terminal Strip
2 RTD Housing
3 Pipe Strap (purchased separately)
B4 = pipe dia. up to 4"
B10 = pipe dia. up to 10"
B21 = pipe dia. up to 21"

Certifications/Approvals . . .

Canadian Standards Association
The RTD-100 is CSA certified for use in North America.
Ordinary Locations
Hazardous (Classified) Locations
Class I, Division 2, Groups A, B, C and D
Class II, Division 2, Groups E, F and G

The RTD-100-D1 (pictured at left) is provided with a cast aluminum enclosure and is CSA certified for use in North America.
Ordinary Locations
Hazardous (Classified) Locations
Class I, Division 1, Groups B, C and D
Class II, Division 2, Groups E, F and G

ISO 9001 REGISTERED

THERMON . . . The Heat Tracing Specialists®
100 Thermon Dr. • PO Box 609 • San Marcos, TX 78667-0609
Phone: 512-396-5801 • Facsimile: 512-396-3627 • **800-820-HEAT**
www.thermon.com In Canada call **800-563-8461**

RTD-100

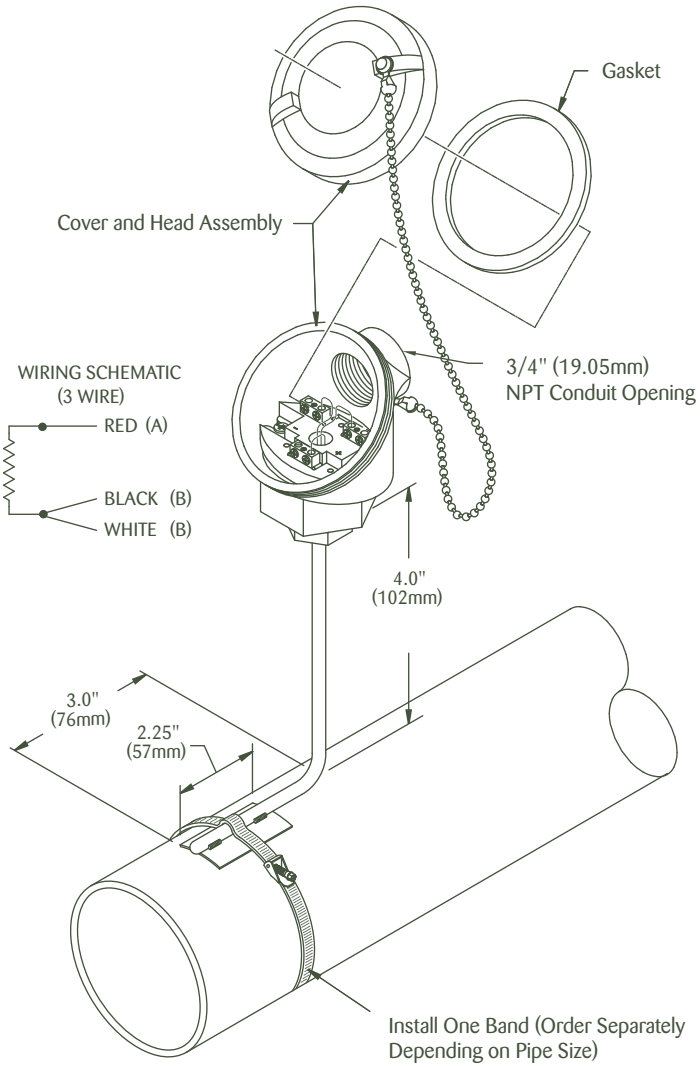
Temperature Sensor

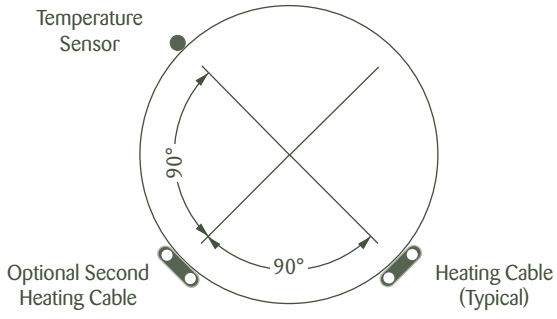
Product Specifications

The following installation procedures are suggested guidelines for the installation of a Thermon temperature sensor. They are not intended to preclude the use of other methods utilizing accepted engineering or field construction practices. Temperature sensors are used for freeze protection or temperature maintenance of piping, tanks and instrumentation.

Temperature Sensor Installation . . .

1. Upon receipt, check to make sure the proper type has been received.
2. Store in a dry place.
3. Ensure that temperature sensor/junction box combination is suitable for the area classification.
4. Mount the temperature sensor/junction box vertically upright and in a position that will prevent condensation from draining into the enclosure from the connected conduit. **Do not bend sensor or lead. Adequately support conduit leading to enclosure.**
5. The sensor should be placed at least 90° around the cirumference from the heating cable, or at least 2" (5 cm) from the cable. Mount the sensor in a location that is representative of the overall system temperature away from valves, pipe supports, nozzles, or other heat sinks. Fasten the temperature sensor securely to the pipe/vessel with banding (purchased seperately), being sure that the entire length of the sensor is in intimate contact with the pipe surface. The sensor may be covered with a parallel pass of metallic tape to enhance heat transfer (not shown).
6. **Power should always be disconnected and a lockout/tagout procedure performed prior to opening the box enclosure for maintenance.**
7. Any modification to the enclosure or deviation from these procedures may affect unit's rating or approvals. Contact factory if modifications are necessary.





Heating Cable vs. Sensor Location (Line Sensing Control)

PRODUCT SPECIFICATIONS

Systems Accessories

THERMON HEAT TRACING CABLES

Submittal: City of Manteca WQCF Proj.
For: Western Water Constructors Inc
By: Gary Johnson - Qcon

TERMINATOR™ NONMETALLIC POWER CONNECTION, SPLICE AND END-OF-CIRCUIT LIGHT KITS

Terminator nonmetallic accessories are approved for ordinary and Division 2 hazardous locations. The kits have a maximum pipe exposure temperature rating of 482°F (250°C) with a minimum installation temperature of -76°F (-60°C).

Terminator DP is designed to fabricate power connections, in-line/T-splice connections or for making end terminations. Electrical connections are made in terminal blocks utilizing nickel-plated copper terminals to ensure corrosion-free electrical integrity. The up front positioning of the terminal block permits easy access during assembly and for future routine maintenance.

The Terminator DP kit includes: Type 4X junction box with integral gasket, three- point DIN mount terminal block with nickel-plated copper terminals (600 V, 50 A), pipe-mounted fitting, stainless steel pipe attachment band for piping 10" or less. (PETK/SCTK termination kit required, order separately)

DP..... BSX, RSX, HTSX, KSX, VSX, HPT, FP
DP-M .....TEK, HTEK

Terminator DS/DE is designed to fabricate in-line splices or end terminations.

Terminator DE-B is designed to provide visual indication of an energized heating circuit.

Electrical connections are made using wire fasteners. Once the kit is assembled, a tool is required to remove the cover to gain access for maintenance or testing. (For applications requiring terminations to be made with terminal block connections, the Terminator DP or DL kit may be used.)

The Terminator DS/DE and DE-B kits include: Type 4X pipe-mounted fitting with locking splice cover, stainless steel pipe attachment band for piping 10" or less. (PETK/SCTK termination kit required, order separately)

DS/DE... BSX, RSX, HTSX, KSX, VSX, HPT, FP
DE-B..... BSX, RSX, HTSX, KSX, VSX, HPT, FP

Terminator DL is designed to provide visual indication of an energized heating circuit. The kit may be utilized as a power connection or an end termination kit. Electrical connections are made in terminal blocks utilizing nickel-plated copper terminals to ensure corrosion-free electrical integrity.

The Terminator DL kit includes: Type 4X junction box, yellow raised light, diode indicating lamp can be energized with up to 254 Vac without change in luminosity, three-point DIN mount terminal block with nickel-plated copper terminals, pipe-mounted fitting, stainless steel pipe attachment band for piping 10" or less. (PETK termination kit required, order separately)

DL..... BSX, RSX, HTSX, KSX, VSX, HPT, FP

TRACEPLUS™ NONMETALLIC POWER CONNECTION, SPLICE AND END-OF-CIRCUIT LIGHT KITS

TracePlus nonmetallic accessories are approved for ordinary and Division 2 hazardous locations. The kits have a maximum pipe exposure temperature rating of 400°F (204°C) with a minimum installation temperature of -20°F (-29°C).

PCA is designed to fabricate power connections, in-line/T-splice connections or for making end terminations.

The PCA kit includes: Type 4X junction box, pipe-mounted expediter, 2 stainless steel pipe attachment bands for piping 10" or less. (PETK/SCTK termination kit required, order separately)

PCA-H .....BSX, HTSX, KSX, HPT, FP
PCA-V .....RSX, VSX

PCS is designed to fabricate accessible outside-the-insulation splices or end terminations.

The PCS kit includes: Type 4X pipe-mounted expediter with splice cover, 2 stainless steel pipe attachment bands for piping 10" or less. (SCTK termination kit required, order separately)

PCS-H .....BSX, HTSX, KSX, HPT, FP
PCS-V.....RSX, VSX

VIL-6 is designed to provide visual indication of an energized heating circuit. 120 Vac (option 1), 208 Vac (option 4), 240 Vac (option 2) or 277 Vac (option 3).

The VIL-6 kit includes: Type 4X junction box, pipe-mounted expediter, Amber light assembly, 2 stainless steel pipe attachment bands for piping 10" or less. (PETK termination kit required, order separately)

VIL-6-H .....BSX, HTSX, KSX, HPT, FP
VIL-6-V .....RSX, VSX

PRODUCT SPECIFICATIONS

Systems Accessories

THERMON HEAT TRACING CABLES

METALLIC POWER CONNECTION, SPLICE AND END-OF-CIRCUIT LIGHT KITS

Thermon metallic accessories utilize epoxy-coated aluminum junction boxes and expediters and are approved for ordinary and Division 2 hazardous locations. The kits have a maximum pipe exposure temperature rating of 482°F (250°C) with a minimum installation temperature of -60°F (-51°C).

ECA-1 is designed for connecting one or two heating cables to power or for splicing two cables together.

The ECA-1 kit includes: epoxy-coated Type 4X/7 junction box, pipe-mounted expediter, 2 stainless steel pipe attachment bands for piping 4" or less, heater cable grommet, 2 power connection boots, RTV adhesive, wire fasteners and grounding lug.

ECA-1-SR.....BSX, RSX, HTSX, KSX, VSX
ECA-1-ZN.....FP, HPT

ECT-2 is designed for connecting three heating cables to power or for splicing three cables together.

The ECT-2 kit includes: epoxy-coated Type 4X/7 junction box, pipe-mounted expediter, third cable entry assembly, 2 stainless steel pipe attachment bands for piping 4" or less, heater cable grommets, 3 power connection boots, RTV adhesive, wire fasteners and grounding lug.

ECT-2-SR.....BSX, RSX, HTSX, KSX, VSX
ECT-2-ZN.....FP, HPT

VIL-4C is designed to provide visual indication of an energized heating circuit. 120 Vac (option 1), 208 Vac (option 4), 240 Vac (option 2) or 277 Vac (option 3).

The VIL-4C kit includes: pipe-mounted expediter, amber light assembly in Type 4X box, 2 stainless steel pipe attachment bands for piping 4" or less, heater cable grommet, power connection boot, RTV adhesive, 2 ring terminals and grounding splice lug.

VIL-4C-SR.....BSX, RSX, HTSX, KSX, VSX
VIL-4C-ZN.....FP, HPT

CABLE END TERMINATION KITS, ATTACHMENT TAPES AND MISCELLANEOUS ITEMS

PETK circuit fabrication kit includes a power boot, end cap, RTV adhesive.

SCTK splice connection/termination kit includes a power boot, wirenuts, RTV adhesive.

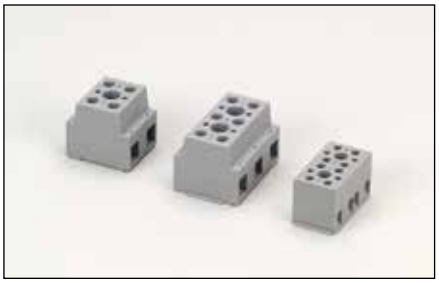
PETK-1D / SCTK-1D.....BSX, RSX, VSX
PETK-2D / SCTK-2D.....KSX, HTSX
PETK-3D / SCTK-3D.....FP, HPT

ET-6C, ET-7C, ET-8C end termination kits are designed to properly terminate the end (away from power) of a heat tracing circuit. Each kit includes a rubber end cap, RTV adhesive and caution label.

ET-6C.....BSX, RSX, VSX
ET-7C.....HPT (BN)
ET-8C.....HTSX, KSX, FP & HPT (OJ)

TBX-3LC, TBX-4LC power connection boots are used to prepare heating cable for connection to power. Kit includes rubber boot and RTV adhesive.

TBX-3LC.....BSX, RSX, VSX
TBX-4LC.....HTSX, KSX, FP & HPT



TB-2F, TB-3F, TB-4F floating terminal blocks for use inside metallic (ECA, ECT) and non-metallic (PCA, PCS) junction boxes.

TB-2F 2-point-rated 65A @ 600 Vac, 22 - 6 AWG

TB-3F 3-point-rated 65A @ 600 Vac, 22 - 6 AWG

TB-4F 4-point-rated 30A @ 250 Vac, 26 - 10 AWG

CL vinyl-based peel and stick caution labels are intended for direct exposure to industrial environments. Electrically heated pipelines and vessels are to be clearly identified at frequent intervals. Caution labels should be placed at 10'-20' (3-6 m) intervals or as required by code or specification.

B-4, B-10, B-21 stainless steel attachment bands for securing Thermon connection kits to pipes. Each connection kit includes two bands.

B-4 for pipes up to 4” (100 mm) diameter

B-10 for pipes up to 10” (250 mm) diameter

B-21 for pipes up to 21” (530 mm) diameter

FT-1L, FT-1H fixing tapes for attaching heating cable to piping every 12" (30 cm) or as required by code or specification.

AL-20L, AL-20H, AL-30L, AL-30H aluminum tape for continuous (longitudinal) covering.

Catalog #	Temp. Max.	Min. Install	Dimensions
FT-1L	200°F	40°F	1/2" x 108'
FT-1H	500°F	-40°F	1/2" x 108'
AL-20L	150°F	40°F	2" x 150'
AL-20H	300°F	20°F	2" x 180'
AL-30L	150°F	40°F	3" x 150'
AL-30H	300°F	20°F	3" x 180'

City of Manteca WQCF Proj.

TraceNet™ TCM2

CONTROL AND MONITORING SYSTEM SPECIFICATION GUIDE

TraceNet™ TCM2
CONTROL AND MONITORING SYSTEM

APPLICATION OVERVIEW

Control and monitoring systems play an essential role in heat tracing applications which range from freeze protecting water lines to maintaining critical process temperatures. While mechanical thermostats have been used successfully for many heat tracing applications, a more complete control and monitoring solution is necessary for most industrial heat tracing applications. Advancements in technology have made modern control and monitoring units both cost effective and reliable. Thermon electronic control and monitoring systems ensure accurate temperature measurements, conserve energy and extend system life.

A versatile electric heat tracing control and monitoring network is key to reducing operating cost in plants. Research has shown that the following features are a prerequisite within many industrial heat tracing applications:

- Monitor electric heat trace circuit operating and ground/earth leakage currents
- Selectable control method (On/Off, On/Off With Soft Start, Proportional, Ambient Proportional) on a per circuit basis
- Programmable alarm set points, with alarm acknowledgment and reset capability
- Programmable trip set-points for each circuit
- Temperature sensor status indication
- Communication to host computer via RS485 serial communication.
- “Push to Test” ground/earth leakage test feature on a per circuit basis
- Ground/earth leakage interruption capability

TCM2 PANEL CERTIFICATIONS/APPROVALS [1]

TraceNet TCM2 control and monitoring systems are approved/certified for installation and operation in Ordinary and Hazardous locations.

Ordinary Locations -40°C < Ta < +40°C

Hazardous Locations (Classified)[2]
CL I, Div 2, Gp BCD T4; -40°C < Ta < +40°C

Note:

1. For equipment in explosive atmospheres, to avoid elctrostatic discharge, clean the viewing window with a damp cloth only. If the equipment is not installed and operated within the specifications and limitations indicated by Thermon, then the protection provided by the equipment may be voided.
2. Refer to installation/operating instructions for maximum ambient temperature rating relative to the allowable current carrying ampere ratings.

TRACENET TCM2 SYSTEM SPECIFICATIONS

Environmental:
Hazardous Locations,
- Indoor and Outdoor - Solid State Relays

Ordinary Locations,
- Indoor and Outdoor - Power Distribution and Mechanical Relays and/or Solid State Relays

Operating Ambient Range: -40°F (-40°C) to 104°F (40°C)

Enclosures: Type 4, 4X, IP54 *

TraceNet Module Supply Voltage: 100-240 Vac, 50/60 Hz

Heat Tracing Voltages: 100-600 Vac

User Interface: 3” (76mm) x 1” (25mm) OLED 4 line, 20 character display

Standard Number of Circuits: Two within one control panel

Temperature Sensors per Circuit: Up to two 100 Ω Platinum, 3-wire RTD's

Current Switching Devices:
Solid State Relay:
Refer to Table 1

Mechanical Relay:
Per design requirements

Control Methods:
Process Sensing:
On/Off, On/Off With Soft Start, Proportional

Ambient Sensing:
On/Off, On/Off With Soft Start, Ambient Proportional (APC and APCM)

Control Temperature Range: -200°F (-129°C) to 1112°F (600°C)

Alarm Settings (per circuit)**:**
Low/High Temperature
Low/High Current
High Ground/Earth Leakage Current
RTD and Circuit Faults

Secondary Alarm Settings (with trip option):
High Temperature, High Heater Current,
Ground / Earth Leakage Current

Network Communications:
RS-485
Ethernet/Wireless (requires optional communication module)

Auxiliary Internal Output Power: 9 Watts at 24 Vdc

Alarm Outputs:
Three dry contacts rated 24 Vdc 200 mA max

* Additional panel types are available. Contact Thermon for details.

TraceNet™ TCM2
CONTROL AND MONITORING MODULE

TCM2 CONTROL AND MONITORING MODULE

The TCM2 is a temperature control and monitoring module developed specifically for heat tracing applications. The module provides control and monitoring capabilities via digital information display for one or two heat tracing circuits with input from up to two RTDs per circuit.

TCM2 RATINGS/SPECIFICATIONS

Control and monitoring capacity....Two heat tracing circuits
Module supply voltage.....100 to 240 Vac
Power consumption.....95 VA max
Controlled output voltage.....2x24 Vdc, 100 mA or
2x12 Vdc, 100 mA (user selectable)
Exterior operating ambient.....-40°F to 104°F
(-40°C to 40°C)
Storage ambient.....-40°F to 176°F
(-40°C to 80°C)
Power clamp function.....programmable from 20% to 100%
Temperature input.....up to two, 3-wire platinum
100 Ohm RTDs per circuit
Temperature control range.....-200°F to 1112°F
(-129°C to 600°C)
Control band.....programmable in increments of 1 degree
Module dimensions (HxWxD).....4.65 x 4.7 x 3.25 inch
(118 x 119 x 83 mm)
High operating current alarm/trip.....1 to 300 Amps[1]
Low operating current alarm.....0 to 30 Amps[1]
Ground/earth leakage alarm/trip.....30 to 250 mA
Alarm outputs.....three 24 Vdc, rated to 100 mA max
Self-test frequency.....programmable from 2 to 99 hours
Communication.....Modbus ASCII/RTU via RS485[2]
Communication rate.....up to 57600 Baud
Auxiliary power output.....9 W @ 24 Vdc

TCM2 CERTIFICATIONS/APPROVALS

When housed in a Type 4/4X (IP54) enclosure and equipped with solid-state relays[3] , the TCM2 module is approved for use in ordinary and hazardous (classified) areas.

Ordinary Locations -40°C < Ta < +40°C

Hazardous Locations (Classified)[4]
CL I, Div 2, Gp BCD T4; -40°C < Ta < +40°C

Notes
1. For higher amperage ratings, contact factory.
2. Ethernet or wireless communication via optional accessory modules.
3. Mechanical relay options are approved for ordinary location installations.
4. When used within Thermon TraceNet TCM2 control panels.

TCM2 PRODUCT FEATURES

A TCM2 control and monitoring module offers the following features:

Reduces Man-hours: With the simplified, 4-button user interface, operators can quickly program the TCM2. The new TCM2 wiring harness allows maintenance personnel to swiftly install, remove, and conduct troubleshooting of the system.

Improved Control Methods: The TCM2 utilizes multiple control methods, similar to the Thermon TCM18 (On/Off, Soft-Start, Proportional) and features the upgraded Ambient Proportional Control (APC and APCM) that employs the energy saving method of Ambient Proportional Control with the higher current capacity of the mechanical relay.

Upgraded Communications: The TCM2 can network with any Thermon Controller to TraceNet™ Command or any plant DCS system via RS-485 in either MODBUS ASCII or RTU. In the panel, the TCM2 can employ a converter to offer MODBUS TCP/IP Ethernet.

TCM2 CONTROL METHODS

Heat tracing circuits are typically controlled with the TCM2 via zero-crossing solid state relays or mechanical relays, which will allow any of four modes of operation:

- On-Off Control - The TCM2 delivers heat to hold the heated object above the programmed maintain temperature and within the programmed control band. It uses minimal switching to maximize the life of mechanical relays.
- On-Off Control with Soft Start - The TCM2, upon turn-on, ramps from zero power to 100 % power over a period of 3 minutes. This reduces the effects of high in-rush current on a cold power start. It then continues in the On-Off Control mode.
- Proportional - The TCM2, upon reaching the maintenance temperature, begins to reduce power until a level is attained that results in holding the maintenance temperature at a steady level with minimal control overshoot.
- Ambient Proportional Control (APC or APCM) - The TCM2 senses the ambient temperature and applies 100% power at the minimum ambient set point. Then it linearly reduces power to a level of 20%, and turns off at the temperature at which heating is no longer required. With mechanical relays the APC becomes APCM, allowing a 20, 25, or 33 minute cycle time to be selected.

TCM2 CURRENT RATING

The ambient operating conditions, enclosure size, number of circuits, and the relay heat sink style all affect the current ratings. Table1 below provides current ratings for typical design configurations. Note that the 40°F (4°C) ambient ratings are used for freeze protection applications where the heater circuits would be de-energized above 40°F (4°C).

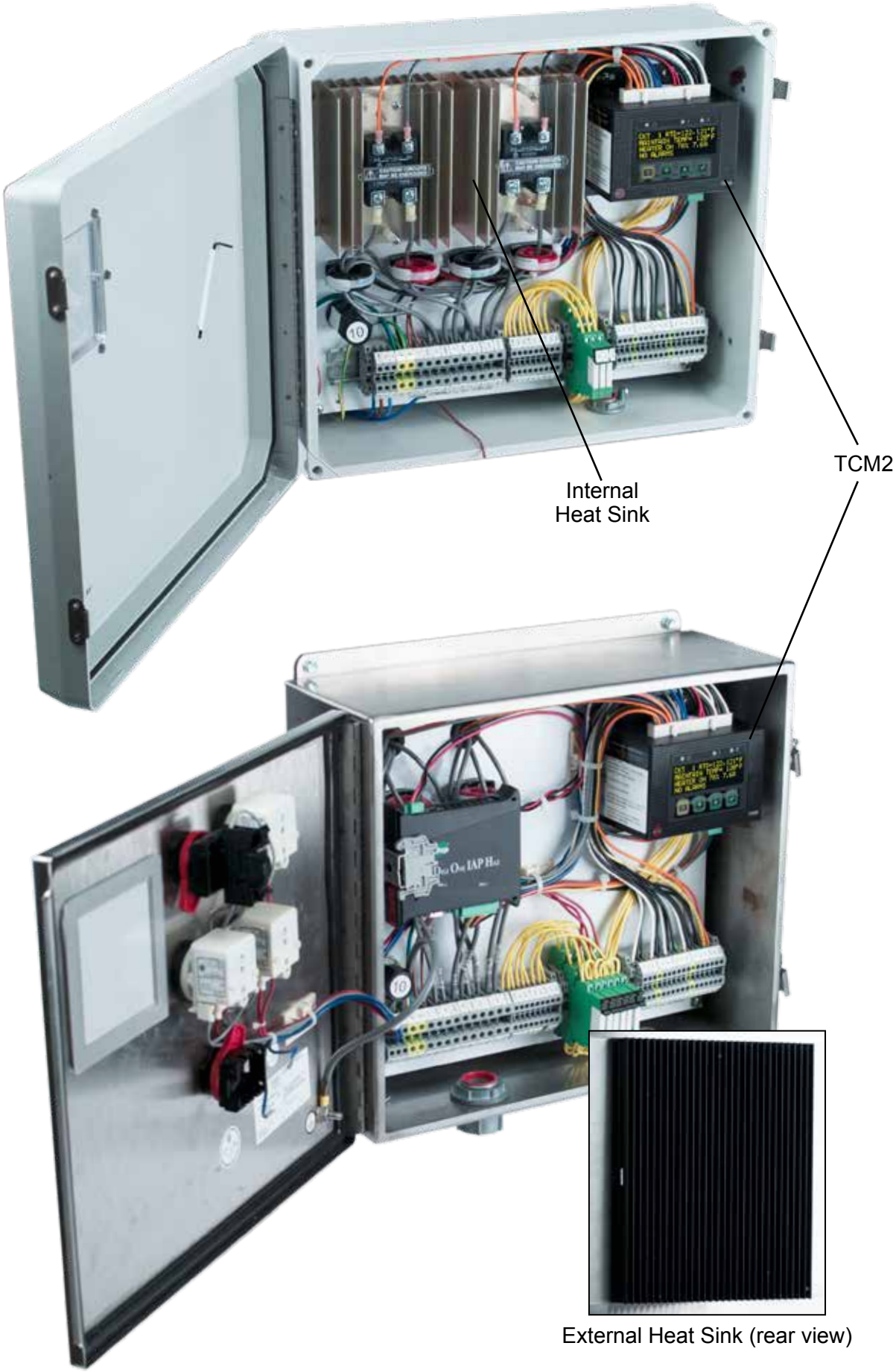
TABLE1: MAXIMUM HEATER CURRENT THROUGH EACH SOLID STATE RELAY SWITCH

Enclosure Option	Module Type	SSR30A (single pole relay)(4)		SSR15A (double pole relay) (4)		SSR30B (single pole relay) (4)		SSR15B (double pole relay) (4)		SSR50C(1) Up to 3 single pole Relays(3)		SSR30B/2R (single pole relay) (4)	
		40°F (4°C)	104°F (40°C)	40°F (4°C)	104°F (40°C)	40°F (4°C)	104°F (40°C)	40°F (4°C)	104°F (40°C)	40°F (4°C)	104°F (40°C)	40°F (4°C)	104°F (40°C)
P2 SS2	TCM2-1	30	19	22	9	30	30	24	15	---	---	30	25
P3 SS3	TCM2-1	30	24	24	12	30	30	24	15	---	---	30	30
	TCM2-2	30	12	19	6	30	30	24	14.75	---	---	---	---
SS3	TCM2-1	---	---	---	---	46(1,2)	46(1,2)	---	---	---	---	---	---
SS4	TCM2-1	30	24	24	12	30	30	24	15	60(2)/50(2)	60(2)/50(2)	30	28
	TCM2-2	30	24	24	12	30	30	24	15	60(2)/50(2)	60(2)/50(2)	---	---

The following notes apply to the table above.

(1) Relays in separate enclosure from control module.
(2) Amperage values over 30 only apply to higher amperage relays such as HD60125.
(3) 60 Amps applicable w/only 1 or 2 relays.
(4) A double-pole relay or 2 single-pole relays per circuit are required for 208VAC and 240VAC Heat Trace to break both power legs.

Typical Thermon **TraceNet**™ **TCM2** Systems



TRACENET COMMAND

The TCM2 communicates via Modbus RTU or ASCII protocol through its RS485 port at programmable rates up to 57600 Baud to the Thermon TraceNet Command electric tracing circuit monitoring software. TraceNet Command provides centralized electric tracing information such as:

- Heat tracing circuit status
- Temperatures, heater operating and earth/ground current alarm/trip events
- Event history
- Data trending
- Maintenance and troubleshooting guidance

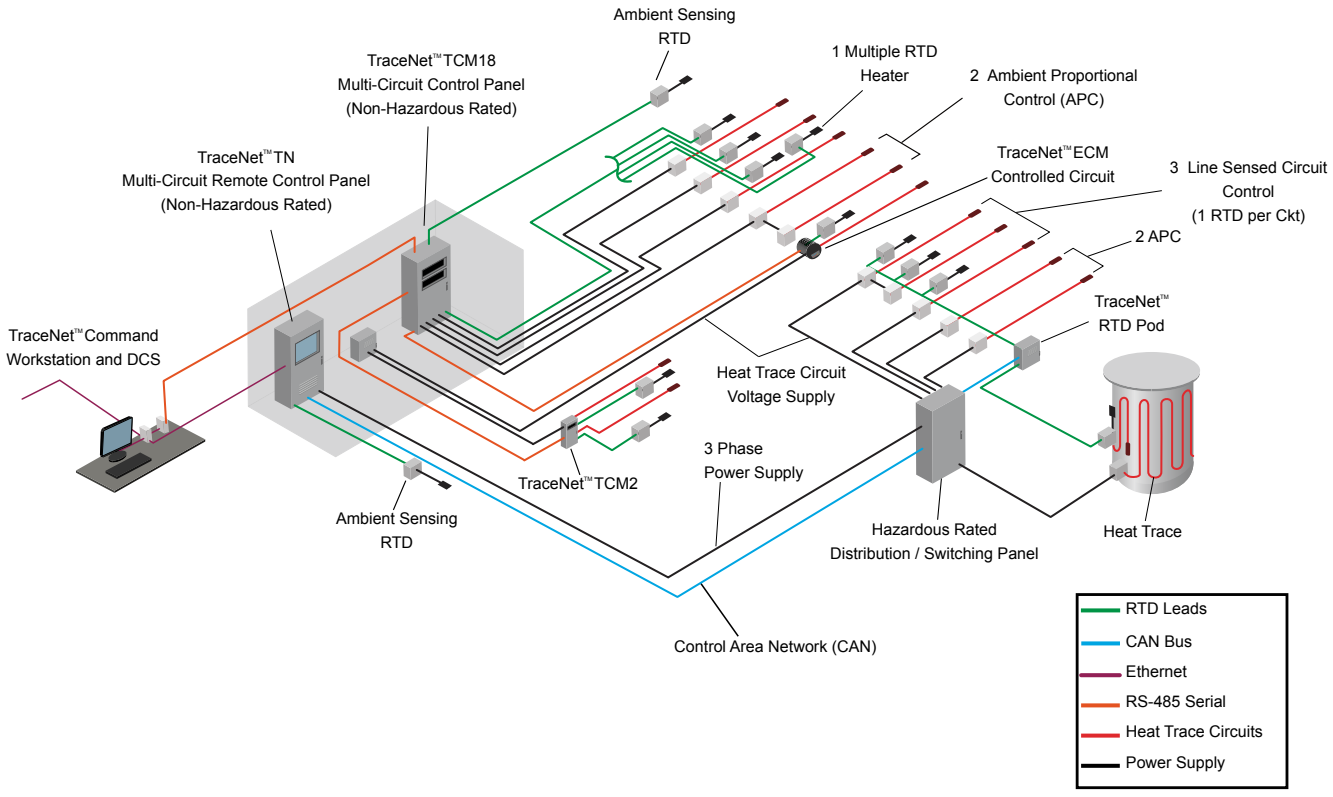
TraceNet Command additionally provides the operator the ability to:

- Change set points as well as alarm and trip values
- Reconfigure system control parameters
- Provide heat tracing management reports
- Load shed circuits on a priority level basis

DCS COMMUNICATIONS

The TCM2 can also communicate via Modbus RTU or ASCII protocol through its RS485 ports at programmable rates up to 57600 Baud to the plant DCS. The same operating data and control capabilities that are available through TraceNet Command are also accessible in the plant control room at the DCS.

Centralized/Distributed Control and Monitoring Systems



PRODUCT REFERENCE LEGEND

TCM2 - 2 - SSR30B/2R - 240 - I - 1P2 - H1 - 1 - 3 - P/N

TraceNet TC Series

Number of Heat Trace Circuits

1 = 1 Circuit

2 = 2 Circuits

Heat Sink/Relay Options

SSR30A/xR = x Single Pole Solid State Relay(s) With Type A Heat Sink

SSR30B/xR = x Single Pole Solid State Relay(s) With Type B Heat Sink

SSR15A/xR = x Double Pole Solid State Relay(s) With Type A Heat Sink

SSR15B/xR = x Double Pole Solid State Relay(s) With Type B Heat Sink

SSR30B/xR = x Single Pole Solid State Relay(s) With Type B Heat Sink

SSR58C/xR = x Single Pole Solid State Relay(s) With Type C Heat Sink

M301/xR = x Single Pole Mechanical Relay(s) Ordinary Locations Only

M302/xR = x Double Pole Mechanical Relay(s) Ordinary Locations Only

x = number of circuits (1 or 2)

Voltage Option

120 = 100-240 Vac Controller, 120 Vac Trace Heater

240 = 100-240 Vac Controller, 208-240 Vac Trace Heater

277 = 100-240 Vac Controller, 277 Vac Trace Heater

600 = 100-240 Vac Controller, 480-600 Vac Trace Heater

User Interface

I = Internal

E = External (Future)

Quantity and Enclosure Type

xP2 = x Fiberglass, Type 4X (IP54), 12x14x6 inch (305x356x152 mm)

xSS2 = x Stainless Steel, Type 4X (IP54), 12x14x6 inch (305x356x152 mm)

xP3 = x Fiberglass, Type 4X (IP54), 16x14x6 inch (406x356x152 mm)

xSS3 = x Stainless Steel, Type 4X (IP54), 16x14x6 inch (406x356x152 mm)

xSS4 = x Stainless Steel, Type 4X (IP54), 36x30x16 inch (914x762x406 mm)

Note: For heat trace circuit voltages above 277 Vac, dual enclosures are required ("x" above will be 2).

Location

O = Ordinary Locations

H1 = Classified Locations (Divisions)

H2 = Ex Explosive Atmospheres (Zones)

Communications

1 = RS485

2 = RS485/Ethernet

Alarm Outputs

1 = Standard

2 = Standard and Trip

3 = Standard, Trip, and System

Thermon Part Number

INDUSTRIAL PROCESS HEATING SOLUTIONS

THERMON
100 Thermon Dr. • PO Box 609 • San Marcos, TX 78667-0609
Phone: 512-396-5801 • Facsimile: 512-396-3627 • 1-800-820-HEAT

For the Thermon office nearest you
visit us at . . . **www.thermon.com**

Form TEP0174-0117

PRODUCT SPECIFICATIONS

Terminator™

HEATING CABLE TERMINATION KITS

Submittal: City of Manteca WQCF Proj.
For: Western Water Constructors Inc
By: Gary Johnson - Qcon

APPLICATION

Power Connection, In-Line/T-Splice, End Termination Lighted Power Connection/End Termination. Terminator nonmetallic termination kits are designed specifically for rapid, trouble-free installation of Thermon self-regulating, power-limiting, and series polymer insulated heating cables. The integral design of these nonmetallic kits combines the pipe-mounted fitting, heating cable grommet and cable strain relief into a single assembly. Screws for securing the covers of the kits have been eliminated to simplify cover installation while providing additional security (a tool is required to remove the cover after installation).

Terminator kits are approved for use in ordinary (nonclassified) areas and hazardous (classified) areas.

PETK Circuit fabrication kits are required for use with all Thermon Parallel Heating Cables Connection Kits. Kits for termination of SX cables include a power connection boot, end cap, RTV adhesive and a caution label. Kits for termination of HPT and FP cables also include tape strip and a distinct grommet.

SCTK Splice connection termination kits are required when preparing outside-the-insulation splices with all Thermon Parallel Heating Cables Connection Kits. Kits for terminations of SX cables include 2 splice connection boots, assorted wire nuts and RTV adhesive. Kits for termination of HPT and FP cables also include a distinct grommet.

RATINGS

Enclosure rating.....NEMA 4X, IP66
Maximum pipe exposure temperature.....482°F (250°C)
Minimum installation temperature..... -76°F (-60°C)
Oper. ambient temp.[2].... -76°F (-60°C) to +131°F (+55°C)
Maximum voltage rating .....600 Vac

Note

1. Electrostatic charge resistant glass reinforced polymer standard on ZP, ZL, ZS/ZE kits.
2. DE-B and ZE-B operating ambient temperature is -76°F (-60°C) to +113°F (45°C) with T6 T-rating. Higher ambients are possible, contact Thermon for corresponding T-rating.

PRODUCT REFERENCE LEGEND

"D" Kits Division 2 and Zone 2 Areas
"Z" Kits Zone 1 Areas

Kits for BSX, RSX, HTSX, KSX, TSX, VSX, HPT & FP Cables
DP or ZP = Power Connection Kit
DL or ZL = Lighted Power Connection/End Termination Kit
DS/DE or ZS/ZE = In-Line Splice or End Termination Kit
DE-B or ZE-B = LED End of Circuit Light Kit

Kits for TEK and HTEK Cables
DP-M or ZP-M = Power Connection Kit

Terminator Beacon

Terminator DP

CONSTRUCTION

1 Junction box, glass-reinforced polymer [1] with DIN rail mounted terminal blocks
2 Pipe-mount expediter, glass-reinforced polymer [1]
3 Stainless steel pipe attachment band
4 Splice cap, glass-reinforced polymer [1]

CERTIFICATIONS/APPROVALS

Terminator kits have the following approvals when used in conjunction with Thermon heating cables:

FM Approvals
Ordinary Locations
Hazardous (Classified) Locations
Class I, Division 2, Groups A, B, C and D
Class II, Division 2, Groups F and G
Class III, Divisions 1 and 2
Class I, Zone 2, Group IIC
Class I, Zone 1, AEx e II (ZP, ZL, ZS/ZE, ZE-B only)

Underwriters Laboratories Inc.
Ordinary Locations
Hazardous (Classified) Locations
Class I, Division 2, Groups A, B, C and D
Class II, Division 2, Groups F and G
Class III, Divisions 1 and 2
Class I, Zone 2, Group IIC
Class I, Zone 1, AEx e II (ZP, ZL, ZS/ZE, ZE-B only)

Canadian Standards Association
Ordinary Locations
Hazardous (Classified) Locations
Class I, Division 2, Groups A, B, C and D
Class II, Division 2, Groups F and G
Ex e II (ZP, ZL, ZS/ZE, ZE-B only)

II 2 G Ex eb IIC T4-T6 FM 10ATEX0058X II 2 D Ex tb IIIC T135°C-T85°C (ZP, ZL, ZS/ZE, ZE-B only)

International Electrotechnical Commission
IEC Certification Scheme for Explosive Atmospheres
FMG 10.0022X (ZP, ZL, ZS/ZE, ZE-B only)

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PRODUCT SPECIFICATIONS

Terminator™

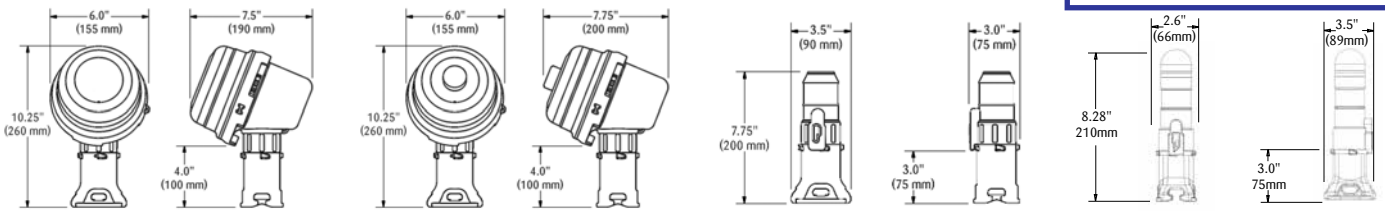
HEATING CABLE TERMINATION KITS

Terminator DP and ZP are designed to fabricate power connections, in-line/T-splice connections or for making end terminations. Electrical connections are made in terminal blocks utilizing nickel-plated copper terminals to ensure corrosion-free electrical integrity.

Terminator DL and ZL are designed to provide visual indication of an energized heating circuit. The kit may be utilized as a power connection or an end termination kit. Electrical connections are made in terminal blocks utilizing nickel-plated copper terminals to ensure corrosion-free electrical integrity.

Terminator DS/DE and ZS/ZE are designed to fabricate accessible outside-the-insulation in line splices or end terminations of Thermon Heating Cables. Electrical connections are made using wire fasteners. (For applications requiring terminations to be made with terminal block connections, the Terminator DP or ZP kit may be used.)

Terminator DE-B and ZE-B are designed to provide visual indication of an energized heating circuit. The DE-B and ZE-B utilize a high intensity green LED assembly for superior day or night visibility. Electrical connections are made using wire fasteners. (For applications requiring terminations to be made with terminal block connections, the Terminator DL or ZL kit may be used.)



	DP, ZP	DP-M ZP-M	DL, ZL	DS/DE ZS/ZE	DE-B, ZE-B
Enclosure Ratings	NEMA 4X, IP66	NEMA 4X, IP66	NEMA 4X, IP66	NEMA 4X, IP66	NEMA 4X, IP66
Max. Pipe Exposure Temperature	482°F (250°C)	482°F (250°C)	482°F (250°C)	482°F (250°C)	482°F (250°C)
Min. Installation Temperature	-76°F (-60°C)	-76°F (-60°C)	-76°F (-60°C)	-76°F (-60°C)	-76°F (-60°C)
Operating Ambient Temperature	-76°F to +131°F (-60°C to +55°C)	-76°F to +131°F (-60°C to +55°C)	-76°F to +131°F (-60°C to +55°C)	-76°F to +131°F (-60°C to +55°C)	-76°F to +113°F2 (-60°C to +45°C)2
Electrical Connection	Terminal Blocks[3]	Terminal Blocks[4]	Terminal Blocks[6]	Wire Fasteners	Wire Fasteners
Number of Power Connections	1 to 3 Cables	1 Cable	1 Cable[7]	n/a	n/a
Number of In-Line/T-Splices	2 to 3 Cables	2 Cables	n/a	2 Cables	n/a
Number of End Terminations	1 Cable (DP) 1 to 2 Cables (ZP)	1 Cable	1 Cable	1 to 2 Cables	1 Cable
Maximum Conductor Size[1]	6 AWG (16 mm²)	4 AWG (25 mm²)	6 AWG (16 mm²)	n/a	n/a
Maximum Voltage Rating	600 Vac	600 Vac	600 Vac	600 Vac	600 Vac
Maximum Rated Current [1]	50 Amps	85 Amps	50 Amps	n/a	n/a
T-rating, Ta[2] = 104°F (40°C)	T4 @ 46 Amps T6 @ 22 Amps	T4 @ 11.5 W/ft[5] T6 @ 5.2 W/ft[5]	T4 @ 46 Amps T6 @ 22 Amps	T4 @ 46 Amps T6 @ 22 Amps	T6
Indicating Lamp Service Life Rating	n/a	n/a	100,000 Hours	n/a	100,000 Hours
Indicating Lamp Operating Voltage Range	n/a	n/a	12 to 270 Vac[8]	n/a	100 to 277 Vac

Notes

1. Alternate terminal block configurations are available, contact factory.
2. Higher ambient temperatures are possible. Consult Thermon for corresponding T-rating.
3. Terminator DP kit includes three terminal blocks (L1, L2 and G). Terminator ZP kit includes four line terminal blocks (two jumpered pairs, L1 and L2) and two ground terminal blocks (G).
4. Terminator DP-M kit includes four terminal blocks (L1, L2, L3 and G). Terminator ZP-M kit includes three line terminal blocks (L1, L2 and L3) and one ground terminal block (G).
5. T-Rating based on individual cable power output.
6. Terminator DL kit includes three terminal blocks (L1, L2 and G). Terminator ZL kit includes four line terminal blocks (two jumpered pairs, L1 and L2) and one ground terminal block (G).
7. Terminator DL kit allows up to 3 cables to be connected to power; additional TBX boots may be ordered separately.
8. Higher voltages (up to 500 Vac) are available, contact Thermon.

Terminator™ DE-B Beacon

LED End of Circuit Light Kit

INSTALLATION PROCEDURES

THERMON®

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Terminator™ DE-B Beacon

Receiving, Storing and Handling . . .

1. Inspect materials for damage incurred during shipping.
2. Report damages to the carrier for settlement.
3. Identify parts against the packing list to ensure the proper type and quantity has been received.
4. Store in a dry location.

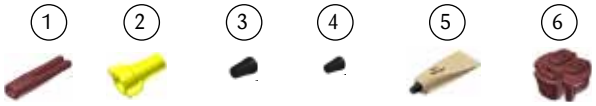
Kit Contents . . .

Item	Quantity	Description
1	1	Expediter Assembly Grommet Compressor Grommet Support Base with O-Ring
2	1	Light Module Cover
3	1	Banding Guide
4	1	Banding (fits 10" pipe and below)
5	1	LED Light Module

Order Separately . . .

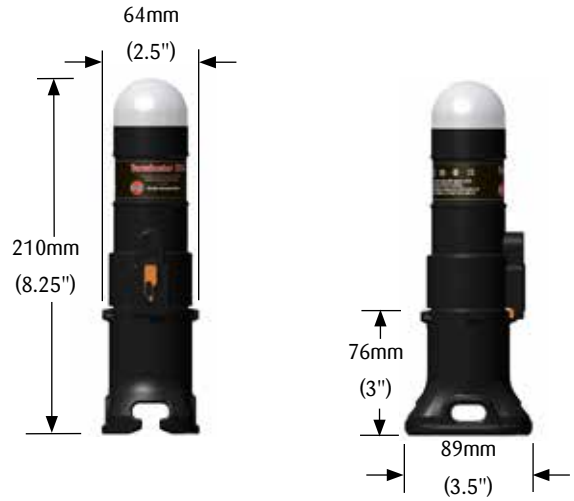
SCTK Connection Termination Kits (per cable)

SCTK-1D	for BSX, RSX, VSX
SCTK-2D	for KSX, HTSX
SCTK-3D	for FP, HPT



Item	Quantity	Description
1	2	Connection Boots
2	2	Large Wire Nut
3	2	Medium Wire Nuts
4	2	Small Wire Nuts
5	1	RTV Tube
6	1	GRW-G Grommet (SCTK-3D only)

Dimensions . . .



Installation Precautions . . .

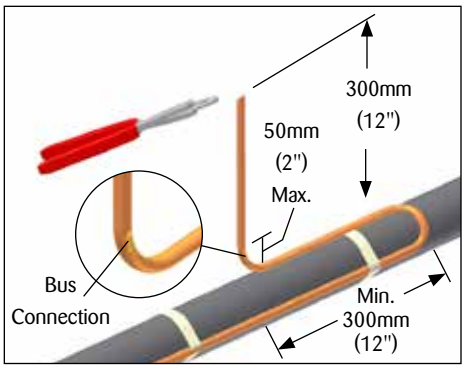
- To minimize the potential for arcing and fire caused by product damage or improper installation use ground-fault protection. The National Electrical Code (NEC) and Canadian Electrical Code (CEC) require ground-fault protection of equipment for each branch circuit supplying electric heat tracing.
- Installation must comply with Thermon requirements and be installed in accordance with the NEC, CEC, or any other applicable national and local codes.
- Component approvals and performance ratings are based on the use of Thermon specified parts only. User supplied power connection fittings must be listed or certified for intended use.
- De-energize all power sources before opening enclosure.
- Keep ends of heating cable and kit components dry before and during installation.
- Individuals installing these products are responsible for complying with all applicable safety and health guidelines. Proper personal protective equipment, or PPE, should be utilized during installation. Contact Thermon if you have any additional questions.

Certifications/Approvals . . .

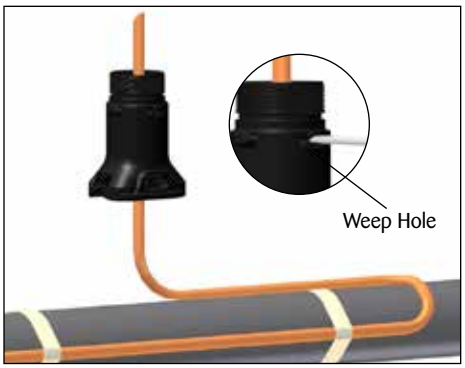
FM Approved
IP66/Type 4X -60°C ≤ Ta ≤ +45°C
Ordinary & Hazardous Locations
Class I, Division 2, Groups A, B, C, & D, Zone 2 IIC T6
Class II, Division 2, Groups F & G, Class III

Tools Required . . .

Terminator™ DE-B Beacon

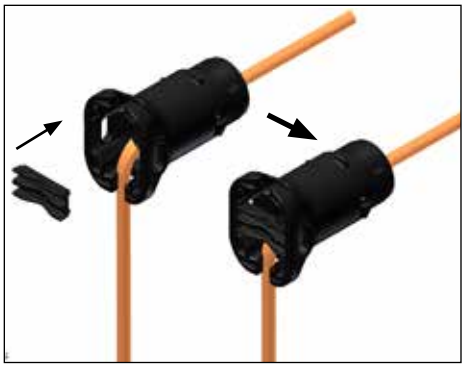


1. Locate bus connection (HPT and FP only) and cable as shown. Cut end of cable at angle to aid in piercing grommet. Leave additional cable for expansion loop.



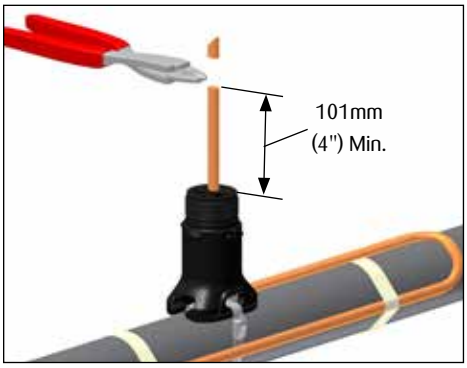
2. Insert cable into expediter. If mounted on bottom of pipe, punch out weep hole.

3. Slide expediter toward pipe and route cable through support base entry.

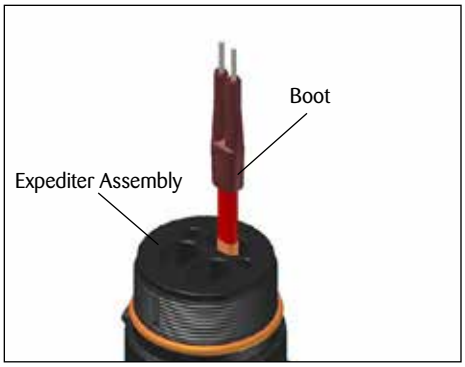


4. Insert banding guide into expediter and snap into place.

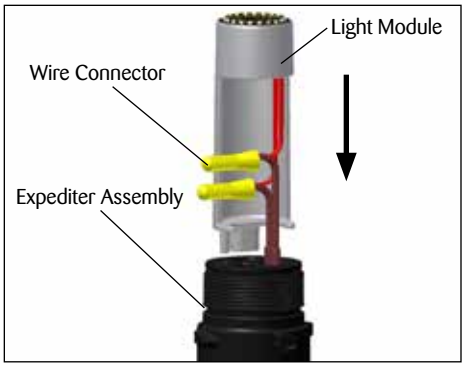
5. Mount expediter to pipe using pipe band. Do not band over cable.



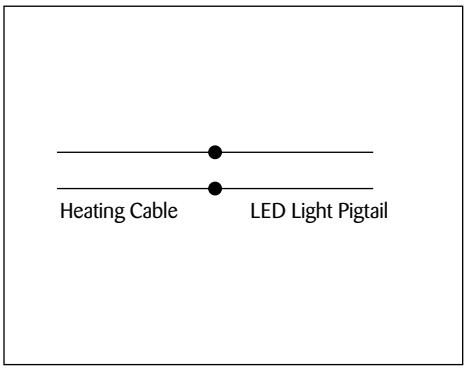
6. Cut off end of cable.



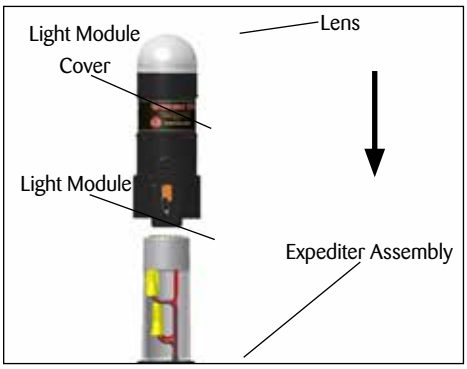
7. Terminate cable with appropriate SCTK termination kit. Refer to SCTK installation instructions. Push excess cable back through expediter. Remove braid pigtail. Tape cable expansion loop to pipe.



8. Connect bus wires using small wire nuts (for BSX, HTSX and KSX) or medium wire nuts (for RSX, VSX, HPT and FP). See wiring schematic for connections.

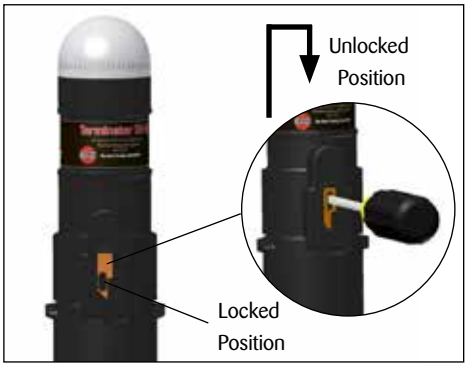


Wiring Schematic for LED Light



9. Slide the light module cover over light module.

10. Engage threads. Rotate light module cover clockwise and tighten cap securely. Make sure latch mechanism is in the locked position.



11. To remove cap, de-energize circuit, lift latch mechanism, and unscrew cap.

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Terminator™ DP

Power Connection Kit

INSTALLATION PROCEDURES

For Power Connection, In-Line Splice Connection,
T-Splice Connection, or End Termination Applications

THERMON®

The Heat Tracing Specialists®

Terminator™ DP

INSTALLATION PROCEDURES

Receiving, Storing and Handling . . .

1. Inspect materials for damage incurred during shipping.
2. Report damages to the carrier for settlement.
3. Identify parts against the packing list to ensure the proper type and quantity has been received.

Kit Contents . . .

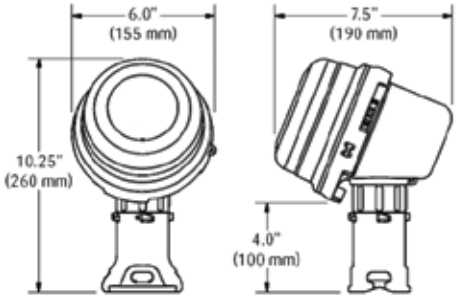
Item	Quantity	Description
1	1	Expediter Assembly Support Cap with O-Ring Threaded Grommet Compressor Grommet Support Base with O-Ring
2	1	Junction Box Lid
3	1	Junction Box Base with O-Ring
4	1	Nut
5	1	Banding
6	1	Banding Guide
7	1	Terminal Blocks with DIN Rail (22-8 AWG, 600 Vac, 50 Amp)
8	1	Junction Box Cord

Certifications/Approvals . . .

IP66/Type 4X -60°C ≤ Ta ≤ +55°C
Ordinary & Hazardous Locations
Class I, Division 2, Groups A, B, C, & D, Zone 2 IIC
Class II, Division 2, Groups F & G, Class III
Listed Heat Tracing Cable System 137M

Tools Required . . .

Dimensions . . .



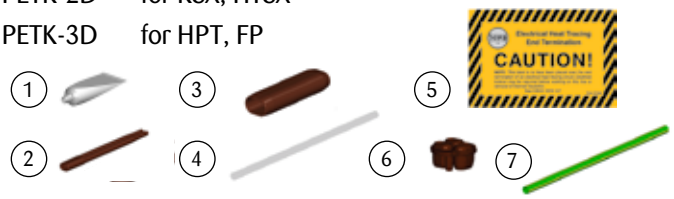
Installation Precautions . . .

- To minimize the potential for arcing and fire caused by product damage or improper installation use ground-fault protection. The National Electrical Code (NEC) and Canadian Electrical Code (CEC) require ground-fault protection of equipment for each branch circuit supplying electric heat tracing.
- Installation must comply with Thermon requirements and be installed in accordance with the NEC, CEC, or any other applicable national and local codes.
- Component approvals and performance ratings are based on the use of Thermon specified parts only. User supplied power connection fittings must be listed or certified for intended use.
- De-energize all power sources before opening enclosure.
- Keep ends of heating cable and kit components dry before and during installation.
- Individuals installing these products are responsible for complying with all applicable safety and health guidelines. Proper personal protective equipment, or PPE, should be utilized during installation. Contact Thermon if you have any additional questions.

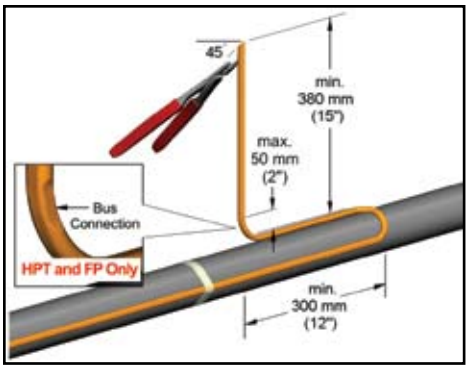
Order Separately . . .

PETK Power and End Termination Kits (per cable)

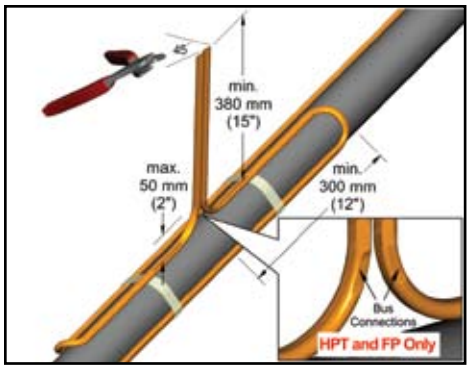
PETK-1D for BSX, RSX, VSX
PETK-2D for KSX, HTSX
PETK-3D for HPT, FP



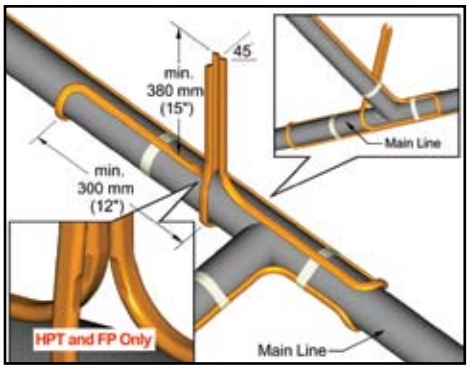
Item	Quantity	Description
1	1	RTV Tube
2	1	Power Connection Boot
3	1	End Cap
4	1	Tape Strip Teflon 6" (PETK-3D only)
5	1	End Termination Caution Label
6	1	GRW-G Grommet (PETK-3D only)
7	1	Ground Sleeve



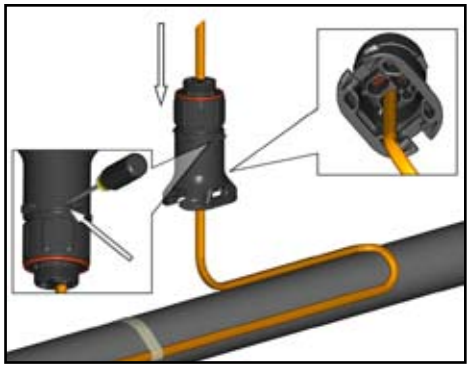
1a. For one, two or three cables. Locate bus connection (HPT and FP only) and cable as shown. Cut end of cable at angle to aid in piercing grommet. Leave additional cable for expansion loop.



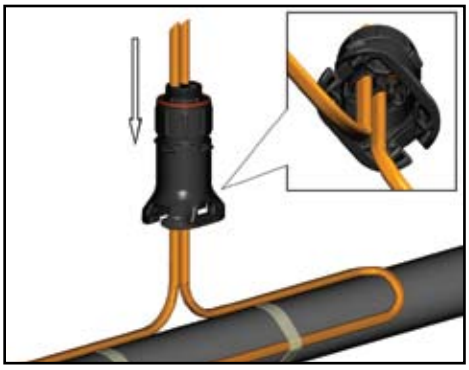
1b. Two cables.



1c. Three cables.

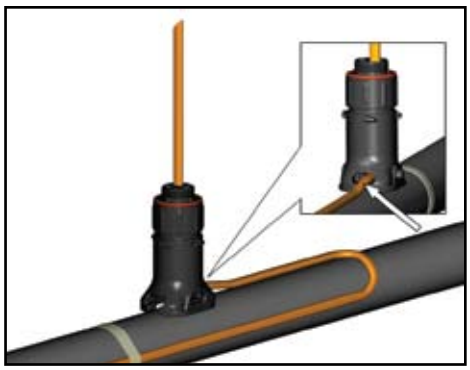


2a. For one, two or three cables. Insert cable into expediter. If mounted on bottom of pipe, punch out weep hole.



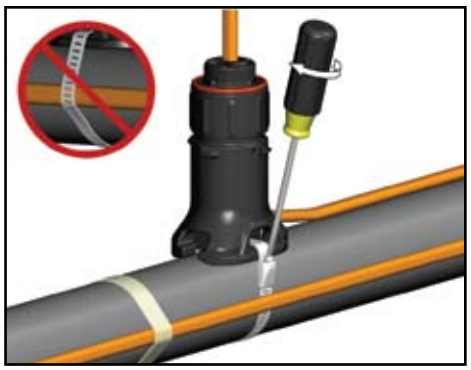
2b. Two cables.

2c. Three cables.

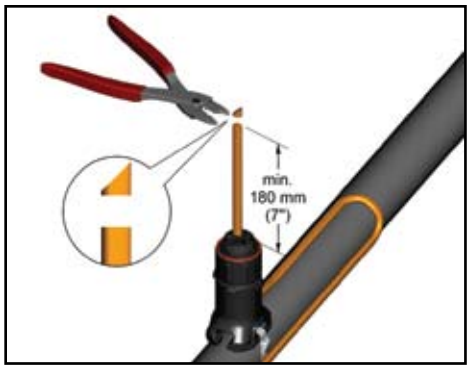


3. Slide expediter toward pipe and route cable through support base entry.

4. Insert banding guide into expediter and snap into place.

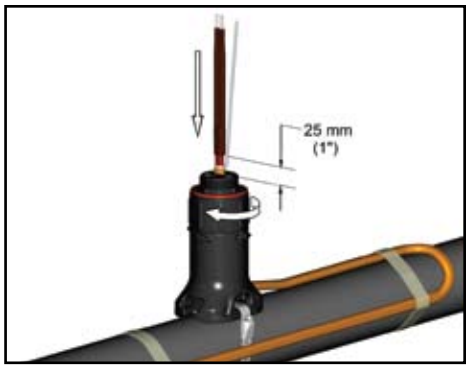


5. Mount expediter to pipe using pipe band. Do not band over cable.



6. Cut off end of cable.

7. Terminate cable with appropriate PETK termination kit. Refer to PETK installation instructions.

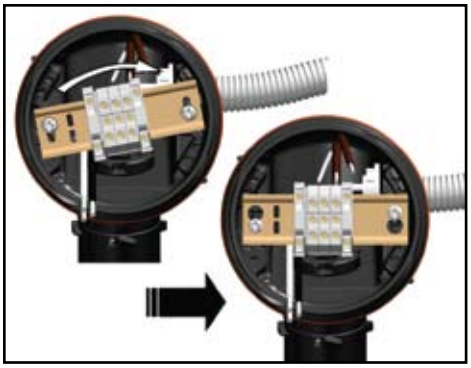


8. Push excess cable back through expediter. Tighten cap securely. Tape cable expansion loop to pipe.

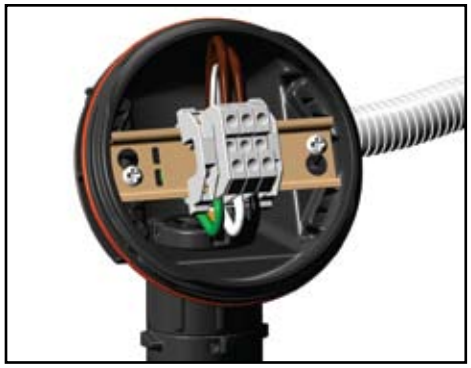
9. For power connection applications: Use dimple molded into side of junction box base to locate center of hole, drill for user supplied power connection fittings per manufacturer's recommendations.

10. Mount junction box base on expediter. Make sure to align slots to properly orient junction box base. Tighten nut securely.

11. For power connection applications: Install power connection fittings (user supplied) and pull in power and ground wires.

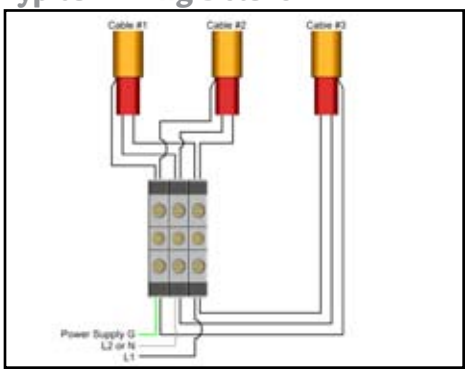


12. Install quick mount terminal blocks.

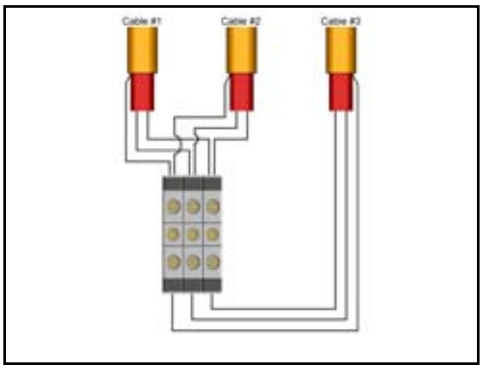


13. Complete system wiring. Refer to typical wiring details.

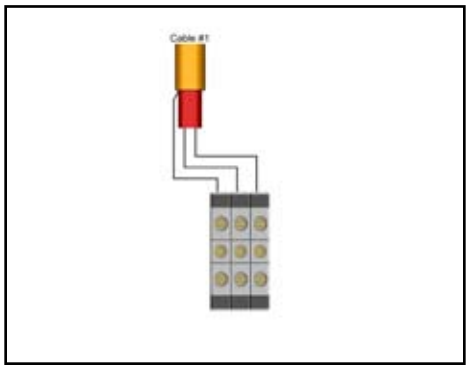
Typical Wiring Details



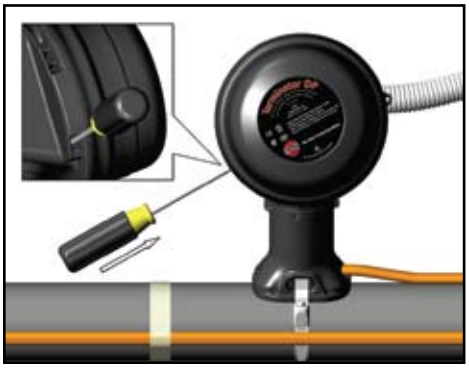
Power Connection (1 to 3 Cables). For 3 cable power connections, additional terminal blocks will be required when using 10mm² (#8 AWG) power supply wiring.



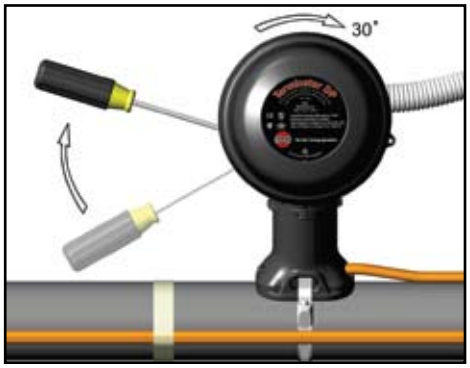
In-Line Splice and T-Splice



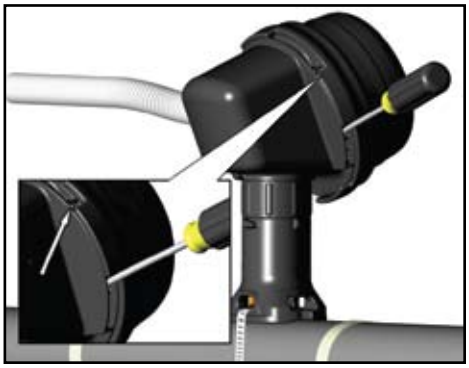
End Termination (1 Cable Only)



13. Install junction box lid and twist hand tight. Insert screwdriver into ratchet slots located on side of junction box base.



14. Use screwdriver to ratchet on junction box lid. Lid will rotate 30 degrees.



15. Lid latch mechanism fully engaged. To remove lid, repeat steps 13 and 14 but in the opposite direction.

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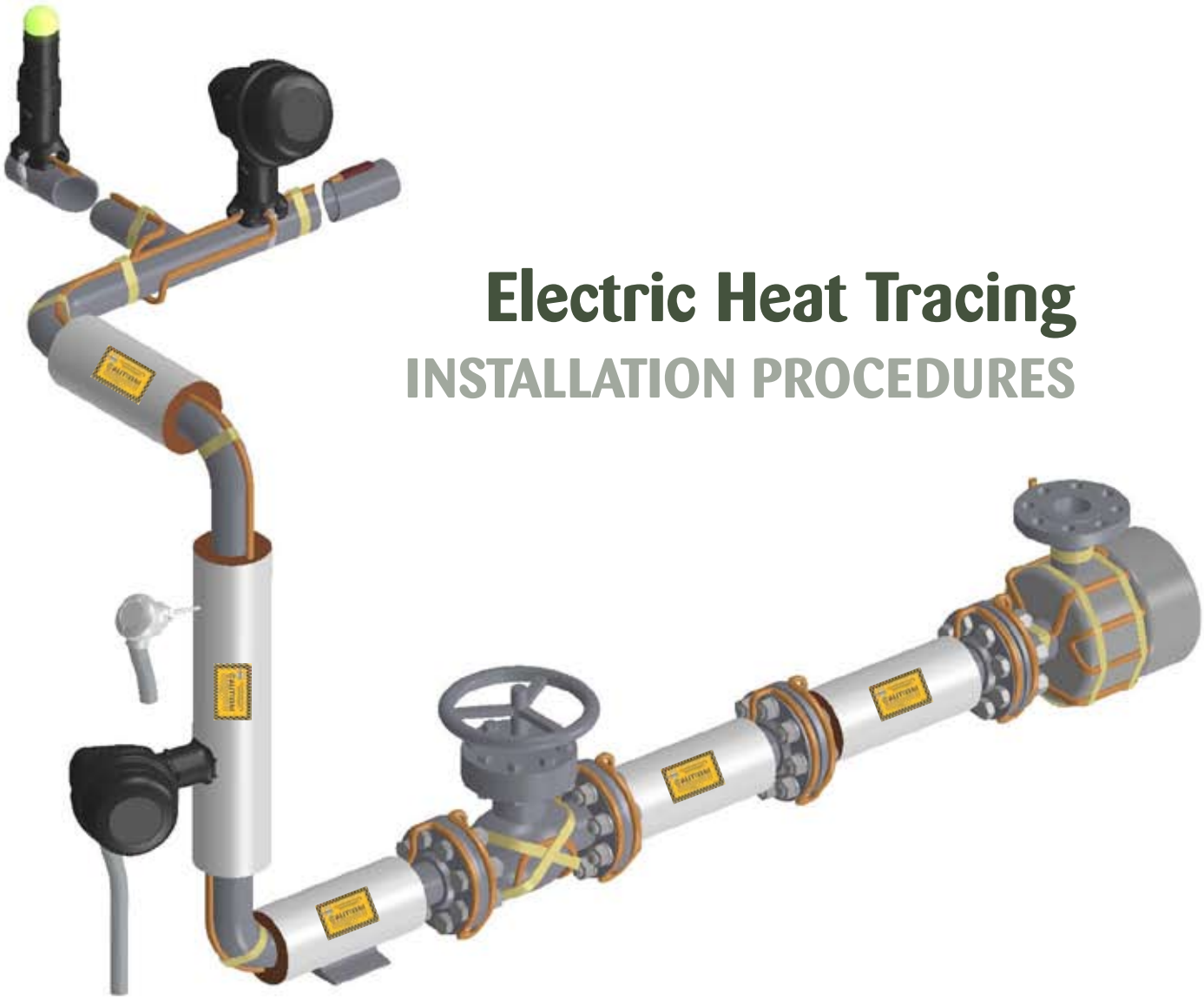
Phone: 512-396-5801 • Facsimile: 512-396-3627 • **1-800-820-HEAT**
www.thermon.com In Canada call **1-800-563-8461**

Specifications and information are subject to change without notice. Form No. 50840-0411

Submittal: City of Manteca WQCF Proj.
For: Western Water Constructors Inc
By: Gary Johnson - Qcon



Electric Heat Tracing

INSTALLATION PROCEDURES

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Electric Heat Tracing

The following installation procedures are suggested guidelines for the installation of a Thermon electric heat tracing system[1]. Individuals installing these products are responsible for complying with all applicable safety and health guidelines. Proper personal protective equipment, or PPE, should be utilized during installation. Contact Thermon if you have any additional questions.

Applications . . .

1. Electric heat tracing cables are used for freeze protection or temperature maintenance of piping, tanks and instrumentation. This set of instructions covers typical piping applications. For installation details on tanks and instrumentation, refer to the Installation Guides on our website www.thermon.com.
2. Heat tracing cables may be installed in ordinary (nonclassified) and hazardous (classified) locations depending on the specific cable options and approvals[2].

The National Electric Code and Canadian Electrical Code require ground-fault protection be provided for electric heat tracing .

Types of Heating Cables . . .

Self-Regulating Heating Cables:

BSX™ Self-Regulating Heating Cable (refer to Form TEP0067)
RSX™ Self-Regulating Heating Cable (refer to Form TEP0004)
KSX™ Self-Regulating Heating Cable (refer to Form TEP0072)
HTSX™ Self-Regulating Heating Cable (refer to Form TEP0074)
VSX™ Self-Regulating Heating Cable (refer to Form TEP0008)

Power-Limiting Heating Cable:

HPT™ Power-Limiting Heating Cable
(refer to Form TEP0011)

Parallel Constant Watt Heating Cable:

FP Parallel Constant Watt Heating Cable
(refer to Form TEP0016)

Series Constant Watt Heating Cables:

TEK™ Series Constant Watt Heating Cable
(refer to Form TEP0021)
HTEK™ Series Constant Watt Heating Cable
(refer to Form TEP0022)

Notes . . .

1. Illustration depicts a typical self-regulating heating circuit.
2. Ground-fault equipment protection is required for all heat tracing circuits.
3. Temperature control is recommended for all freeze protection and temperature maintenance heat tracing applications.
4. All heat-traced lines must be thermally insulated.
5. Refer to Thermon form number PN50273 for installation instructions for MIQ mineral insulated heating cables.

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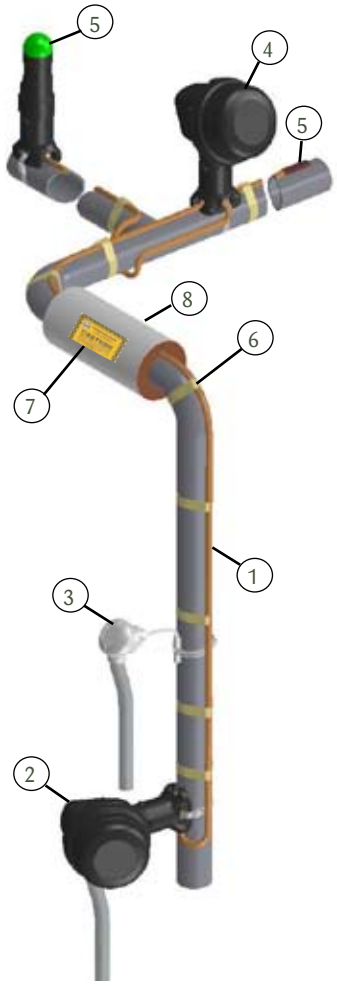
Complete Electric Heat Tracing System . . .

A complete electric heat tracing system will typically include the following components[1]:

1. Electric heat tracing cable[2] (self-regulating, power-limiting, parallel constant watt or series constant watt).
2. Power connection kit.
3. RTD sensor or control thermostat[3].
4. In-line/T-splice kit (permits two or three cables to be spliced together).
5. Cable end termination.
6. Attachment tape (use on 12" intervals or as required by code or specification).
7. "Electric Heat Tracing" label (peel-and-stick label attaches to insulation vapor barrier on 10' intervals or as required by code or specification).
8. Thermal insulation[4] and vapor barrier (by others).

The absence of any of these items can cause a system to malfunction or represent a safety hazard.

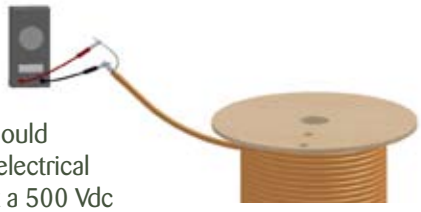
Illustration A: Typical Heat Tracing Installation



Electric Heat Tracing

Upon Receiving, Cable . . .

1. Upon receiving heating cable, check to make sure the proper type and output have been received. All flexible cables have the catalog number, voltage rating and watt output printed on the jacket.
2. Visually inspect cable for any damage incurred during shipment. The heating cable should be tested to ensure electrical integrity with at least a 500 Vdc megger between the heating cable bus wires and the heating cable metallic braid. IEEE 515 recommends that the test voltage for polymer insulated heating cables be 2500 Vdc. Minimum resistance should be 20 megohms. Connect the positive lead of the megger to the cable bus wires and the negative lead to the metallic braid. **(Record 1 on Cable Testing Report.)**



3. Store in dry location.

Before Installing Cable . . .

1. Be sure all piping and equipment to be traced is completely installed and pressure tested.
2. Surface areas where heat tracing is to be installed must be reasonably clean. Remove dirt, rust and scale with a wire brush and oil and grease films with a suitable solvent.

Initial Installation . . .

1. Locate the cable on the lower quadrant of the pipe at the 4 or 8 o'clock position. If accessibility is a problem the cable may be installed at the 10 or 2 o'clock position. Temperature sensor should be located at least 90° from all heating cables. Refer to Illustration B for Heating Cable vs. Sensor Location.
2. Begin temporary installation at the proposed end-of-circuit location and lay out heating circuit on the pipe, allowing extra cable for the power connection and for any splice locations[3]. Refer to Illustration C for temporary installation.
3. Make heating cable allowances for valves, flanges, elbows and supports as per the applicable drawings and table on pages 3 and 4 of these installation procedures.

Illustration B: Heating Cable vs. Sensor Location

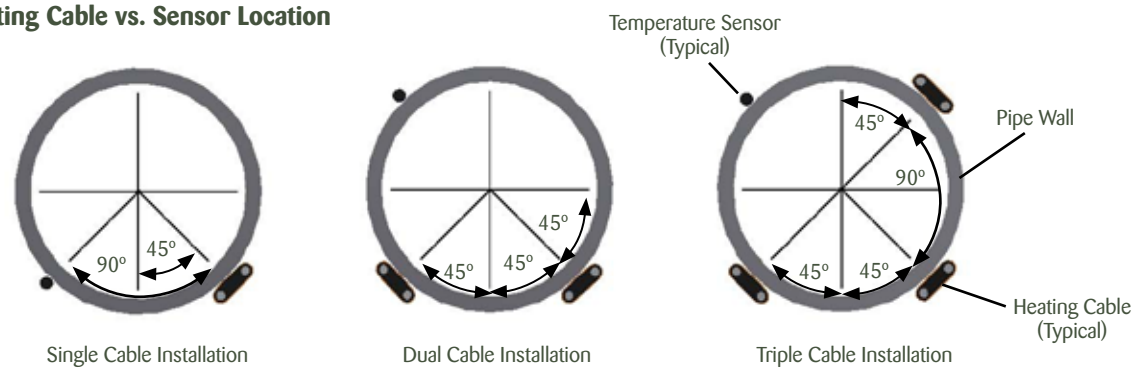
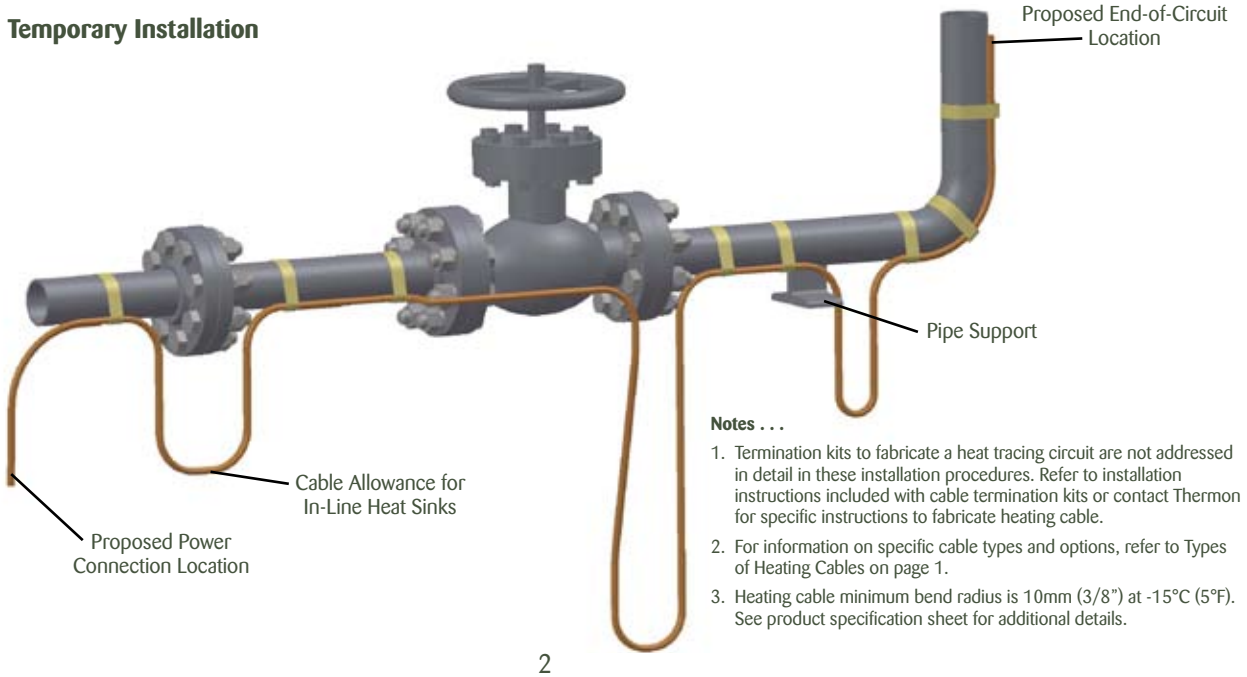


Illustration C: Temporary Installation



Notes . . .

1. Termination kits to fabricate a heat tracing circuit are not addressed in detail in these installation procedures. Refer to installation instructions included with cable termination kits or contact Thermon for specific instructions to fabricate heating cable.
2. For information on specific cable types and options, refer to Types of Heating Cables on page 1.
3. Heating cable minimum bend radius is 10mm (3/8") at -15°C (5°F). See product specification sheet for additional details.

Electric Heat Tracing

Installation on Elbows, Supports and Flanges . . .

1. Install heating cable in accordance with Illustrations D, E and F below. Secure heating cable to piping using attachment tape.
2. Elbows: Locate the cable on the outside radius of an elbow to provide sufficient heat to compensate for the added piping material. Secure the cable to the pipe on each side of the elbow with attachment tape.
3. Pipe Supports: Insulated pipe supports require no additional heating cable. For uninsulated supports, allow two times the length of the pipe support plus an additional 15" (40 cm) of heating cable.
4. Flanges: Allow cable to be looped around pipe on each side of and adjacent to the flange. Heating cable must maintain contact with flange when bending around pipe flanges to compensate for additional heat loss.
5. Refer to the product specifications sheet for minimum bend radius for the specific cable type. Do not exceed bend radius when completing installation.

Illustration D: Pipe Elbow

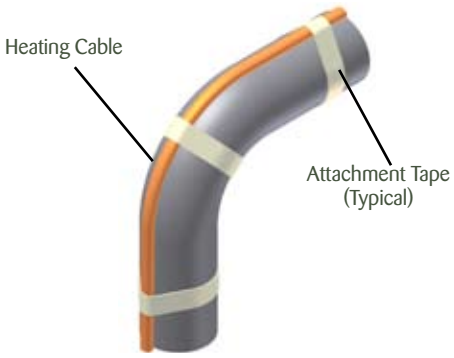
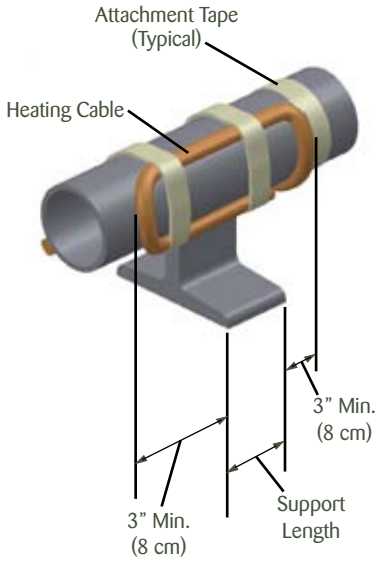
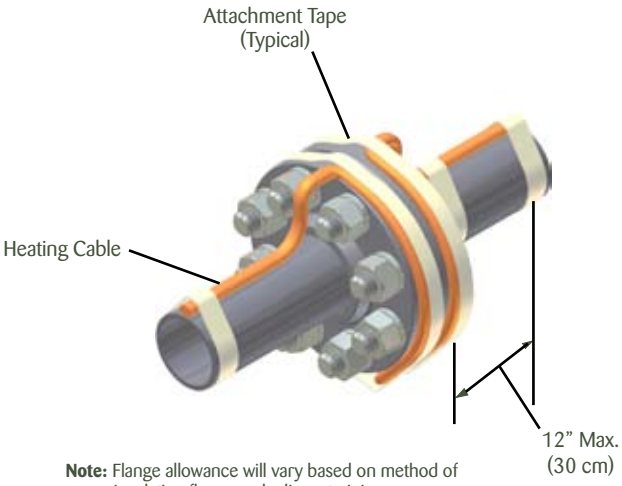


Illustration E: Pipe Support



Circuit Layout on Support

Illustration F: Pipe Flange



Note: Flange allowance will vary based on method of insulating flange and adjacent piping.

Electric Heat Tracing

Installation on Valves and Pumps . . .

1. Install heating cable in accordance with Illustrations G and H below. Secure heating cable to piping using attachment tape.
2. Additional cable is required to provide extra heat at valves, pumps and miscellaneous equipment to offset the increased heat loss associated with these items. Refer to Table 1 for estimated cable requirements for installation on typical valves and pumps. Allowances shown in Table 1 are for 150 pound valves. More cable is required for higher rated valves. Refer to heat trace isometric drawing for project specific allowances.
3. Install heating cable on valves and pumps utilizing a looping technique (this allows the valve or pump to be removed if required). Crossing constant watt heating cable over itself should be avoided.
4. Refer to the product specifications sheet for minimum bend radius for the specific cable type. Do not exceed bend radius when completing installation.

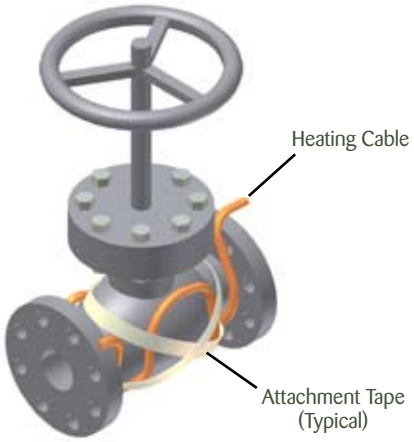
Table 1: Valve and Pump Allowances[1]

Pipe Size	Valve Allowance			Pump Allowance		Flange Allowance
	Screwed or Welded	Flanged	Butterfly	Screwed	Flanged	
½"	6"	1'	0	1'	2'	1' 3"
¾"	9"	1' 6"	0	1' 6"	3'	1' 6"
1"	1'	2'	1'	2'	4'	1' 6"
1¼"	1' 6"	2'	1'	3'	4' 6"	2' 0"
1½"	1' 6"	2' 6"	1' 6"	3'	5'	2' 0"
2"	2'	2' 6"	2'	4'	5' 6"	2' 3"
3"	2' 6"	3' 6"	2' 6"	5'	7'	2' 3"
4"	4'	5'	3'	8'	10'	2' 9"
6"	7'	8'	3' 6"	14'	16'	3' 3"
8"	9' 6"	11'	4'	19'	22'	3' 9"
10"	12' 6"	14'	4'	25'	28'	4' 3"
12"	15'	16' 6"	5'	30'	33'	5' 0"
14"	18'	19' 6"	5' 6"	36'	39'	5' 6"
16"	21' 6"	23'	6'	43'	46'	6' 0"
18"	25' 6"	27'	6' 6"	51'	54'	6' 6"
20"	28' 6"	30'	7'	57'	60'	7' 3"
24"	34'	36'	8'	68'	72'	8' 3"
30"	40'	42'	10'	80'	84'	10' 0"

Note . . .

1. The valve allowance given is the total amount of additional cable to be installed on the valve. If multiple tracers are used, total valve allowance may be divided among the individual tracers. The total valve allowance may be alternated among tracers for multiple valves in a heat trace circuit. Allowances are for 150 pound valves. More cable is required for higher rated valves. Refer to heat trace isometric drawing for project specific allowances.

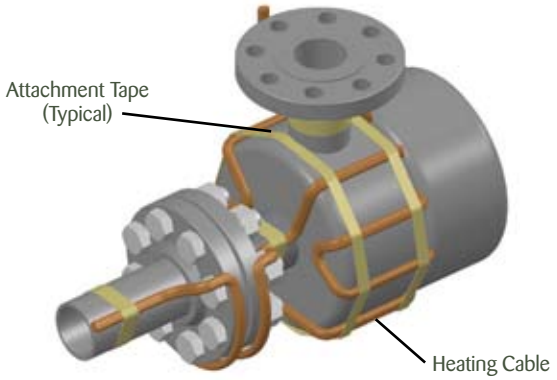
Illustration G: Typical Valve Detail



Heating Cable Serpentined on Valve

Circuit Layout on Valve

Illustration H: Typical Pump Detail



Heating Cable Serpentined on Pump

Circuit Layout on Pump

Electric Heat Tracing

Completing the Installation . . .

1. Begin final cable attachment by securing the end-of-circuit termination kit and working back toward the power supply. Refer to Illustration I.
   - Flexible heating cables are to be installed using attachment tape. Circumferential bands of tape should be installed at 12" (30 cm) intervals to keep the cable in proper contact with the pipe. Refer to Table 2 below to calculate the number of rolls of attachment tape required based on the pipe diameter[1].
   - If applicable, refer to installation details provided with the project drawings or contact Thermon for additional information regarding installation.
2. In addition to the circumferential tape requirements, a continuous covering of aluminum foil tape may be required when:
   - Spray or foam[2] thermal insulation is applied.
   - Heat tracing nonmetallic piping.
3. Complete splice connections (if required) in accordance with the installation instructions provided with the splice kit.
4. Before making power connections, The heating cable should be tested to ensure electrical integrity with at least a 500 Vdc megger between the heating cable bus wires and the heating cable metallic braid. IEEE 515 recommends that the test voltage for polymer insulated heating cables be 2500 Vdc. Minimum resistance should be 20 megohms. **(Record 2 on Cable Testing Report.)**
5. Install power connection kit in accordance to the detailed installation instructions provided with the kit.
6. Secure temperature sensor (if required) to pipe utilizing attachment tape. Locate temperature sensor as shown on page 6.

Notes . . .

1. Table 2 assumes circumferential bands every 12" (30 cm) along the length of the process piping.
2. Verify exposure temperature of heating cable versus curing temperature of insulation.

Illustration I: Final Cable Attachment

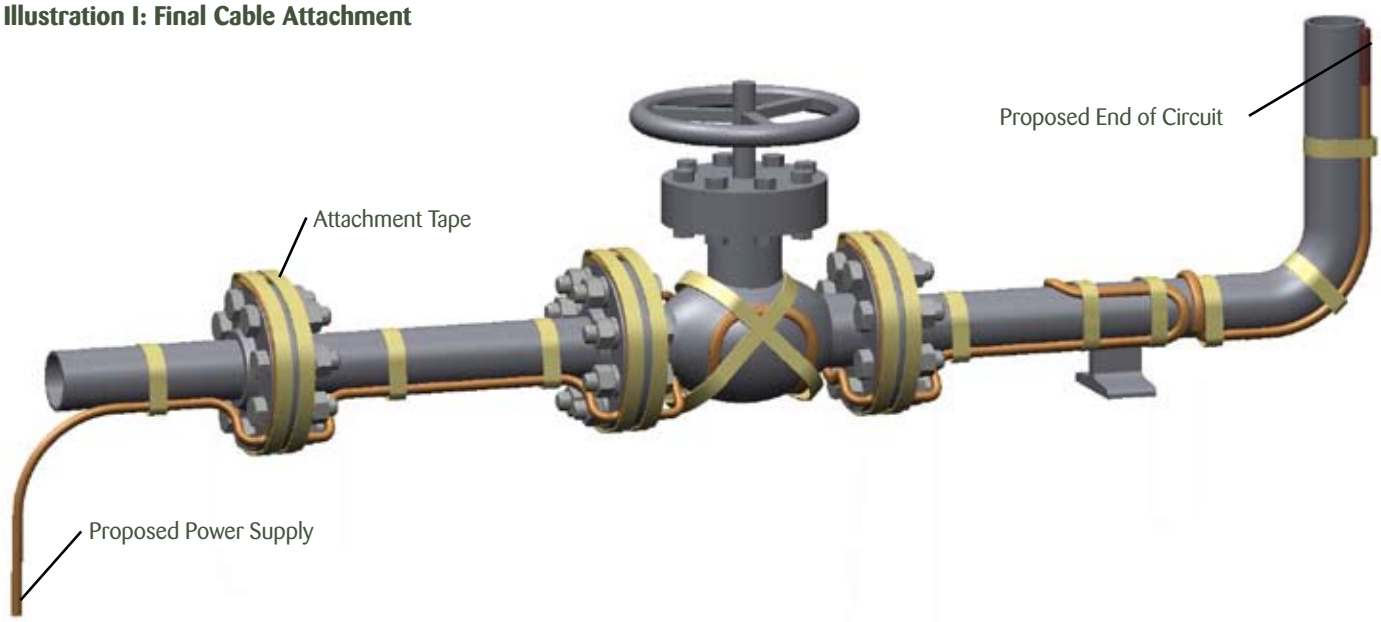


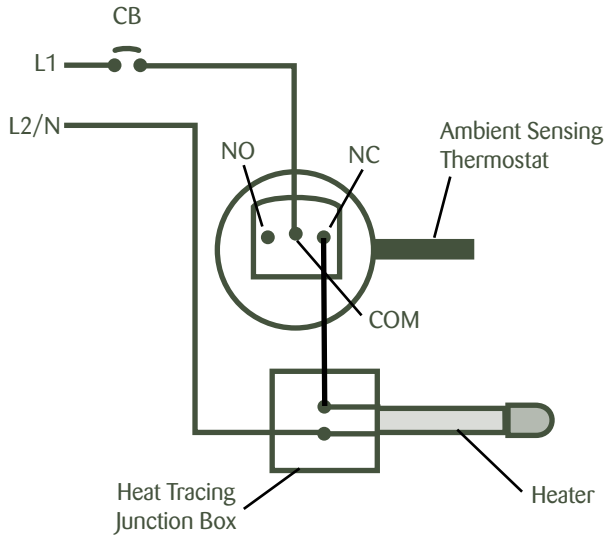
Table 2: Attachment Tape (Value Represents Approximate Linear Pipe Length Allowance Per Roll)

Tape Length	Pipe Diameter in Inches															
	½"-1"	1¼"	1½"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"
36 yd	130'	115'	110'	95'	75'	65'	50'	40'	35'	30'	26'	23'	21'	19'	16'	13'
60 yd	215'	195'	180'	160'	125'	105'	80'	65'	55'	50'	43'	38'	35'	31'	27'	22'

Electric Heat Tracing

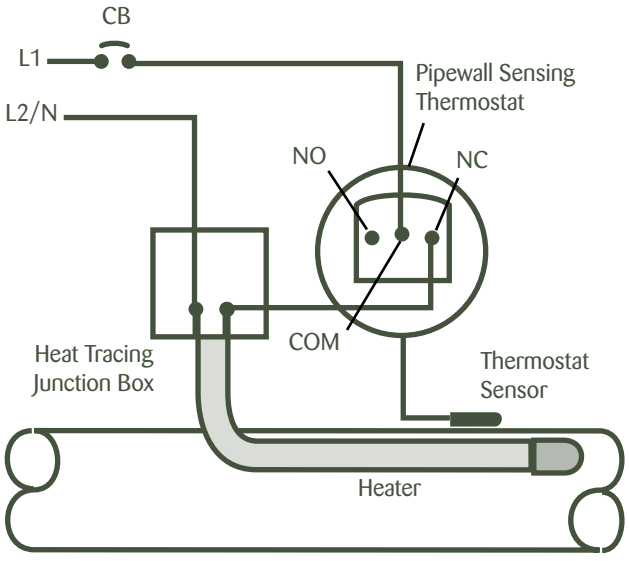
Final Connections . . .

1. Follow the circuit fabrication instructions for the specific cable type. Power connection and end-of-circuit termination kits are designed for each type of cable; substitutions should not be made.
2. For ambient controlled power, the heating circuit should be connected directly to the switched power feed wiring.



(SPDT Thermostat Shown)

3. For pipewall sensing thermostatic control, the heating circuit is to be connected in series with the control contacts as shown below. The pipewall sensing thermostat may require more than one support point.



(SPDT Thermostat Shown)

Thermal Insulation . . .

1. **The need for properly installed and well-maintained thermal insulation cannot be overemphasized.** Without insulation, heat losses are generally too high to be offset by a conventional heat tracing system.
2. In addition to piping and in-line equipment such as pumps and valves, all heat sinks must be properly insulated. This includes pipe supports, hangers, flanges and, in most cases, valve bonnets.
3. Regardless of the type or thickness of insulation used, a protective barrier should be installed. This protects the insulation from moisture intrusion, physical damage and helps ensure the proper performance of the heat tracing system. Seal around all penetrations through the thermal insulation.
4. After the installation of the thermal insulation and weather barrier but BEFORE ENERGIZING THE HEATING CIRCUIT, the megohmmeter test should be repeated. This should call attention to any damage to the heating cable that may have occurred during the insulation installation. **(Record 3 on Cable Testing Report)**
5. Apply caution labels to insulation weather barrier at required intervals along pipe

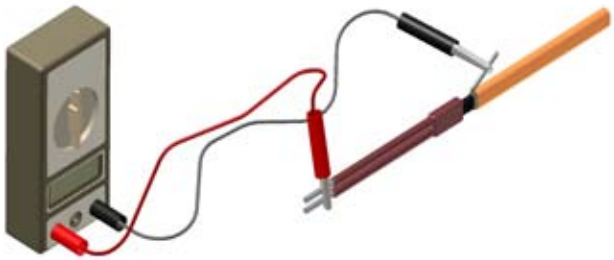
Final Inspection and Documentation . . .

1. It is recommended that the circuit be temporarily energized so that the volts, amps, pipe temperature and ambient temperature may be recorded. This information may be of value for future reference and should be maintained for the historical operating data log **(Record 4 on Cable Testing Report).**
2. Stabilized design can be used for self-regulating heating cables to assign a lower T-class through the use of the Thermon CompuTrace software or Thermon Engineering.
3. Stabilized design can be used for power-limiting and constant watt heating cables without a limiting device to determine the T-class through the use of the Thermon CompuTrace software or Thermon Engineering.
4. A sample historical operating data log form is included in the Electric Heat Tracing Maintenance and Troubleshooting Guide, Thermon Form TEP0066).

The National Electric Code and Canadian Electrical Code require ground-fault protection be provided for branch circuits supplying electric heat tracing.

Cable Testing Report

1. Refer to Thermon Installation Procedures, FORM PN 50207, for general installation procedures, requirements and guidelines.
2. Upon receiving heating cable, check the cable to make sure the proper type and output have been received. All flexible cables have the catalog number, voltage rating and watt output printed on the outer jacket.
3. Visually inspect cable for any damage incurred during shipment. The heating cable should be tested to ensure electrical integrity with at least a 500 Vdc megger between the heating cable bus wires and the heating cable metallic braid.
   IEEE 515 recommends that the test voltage for polymer insulated heating cables be 2500 Vdc. Minimum resistance should be 20 megohms. **(Record 1 on Cable Testing Report.)**

   A. Connect the positive lead of the megger to the cable bus wires.

   B. Connect the negative lead of the megger to the metallic braid.

   C. Energize the megger and record the reading. Readings between 20 megohms and infinity are acceptable. Readings below 20 megohms may mean the electrical insulation has been damaged. Recheck the heating cable for physical damage between the braid and the heating element; small cuts or scuffmarks on the outer jacket will not affect the megger reading unless there was actual penetration through the braid and dielectric insulation jacket.
4. Once the installation is complete, but prior to installation of thermal insulation, recheck the heating cable with at least a 500 Vdc megger between the heating cable bus wires and the heating cable metallic braid. IEEE 515 recommends that the test voltage for polymer insulated heating cables be 2500 Vdc should be 20 megohms. **(Record 2 on Cable Testing Report.)**
5. After the thermal insulation is installed, the megohmmeter test should be repeated. Minimum resistance should be 5 megohms. **(Record 3 on Cable Testing Report.)**
6. After the thermal insulation is installed and power supply is completed, record the panel and circuit breaker information. Ensure all junction boxes, temperature controllers, cable glands, etc. are properly secured. Set the temperature controller (if applicable) to the manual setting and apply rated voltage to the heat tracing circuit(s) for 5 minutes. Record the ambient temperature, measure and record the circuit(s) voltage and current. **(Record 4 on Cable Testing Report.)**

NOTE: To ensure the heating cable warranty is maintained through installation, the testing outlined on this sheet must be completed on the installed heating cables, and the test results recorded and mailed/faxed to:

Thermon Customer Service
100 Thermon Drive
San Marcos, Texas 78666
Fax: 512-754-2420

Cable Testing Report

make additional copies as required for each circuit.

Customer: _____ Contractor: _____

Address: _____ Address: _____

_____ _____

Phone No: _____ Phone No. _____

Project Reference: _____

Record 1: Prior to Installation

Cable Type: _____

Reel Length: _____

Reel Number: _____

Insulation Resistance M Ohms: _____

Tested By: _____ Date: _____

Witnessed By: _____ Date: _____

Record 2: After Installation of Heating Cable

Insulation Resistance M Ohms: _____

Heater Length: _____

Heater Number: _____

Tested By: _____ Date: _____

Witnessed By: _____ Date: _____

Record 3: After The Thermal Insulation Is Installed

Insulation Resistance M Ohms: _____

Tested By: _____ Date: _____

Witnessed By: _____ Date: _____

Record 4: Final Commissioning

Panel Number: _____

Breaker Number: _____

Volts: _____

Ambient Temperature (deg. F): _____

Pipe Temperature (deg. F): _____

Recorded Amps (After 5 Min.): _____

Tested By: _____ Date: _____

Witnessed By: _____ Date: _____

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For the Thermon office nearest you
visit us at . . .
www.thermon.com

ISO 9001 REGISTERED

 Form PN50207-1111

PETK

Power and End Termination Kit

INSTALLATION PROCEDURES

- ☐ **PETK-1D** **for BSX, RSX, VSX**
- ☐ **PETK-2D** **for KSX, HTSX**
- ☐ **PETK-3D** **for HPT, FP**

Order separately to be used in conjunction with Thermon connection kits

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PETK

Receiving, Storing and Handling . . .

1. Inspect materials for damage incurred during shipping.
2. Report damages to the carrier for settlement.
3. Identify parts against the packing list to ensure the proper type and quantity has been received.
4. Store in a dry location.

PETK Power and End Termination Kits (per cable)

PETK-1D	for BSX, RSX, VSX
PETK-2D	for KSX, HTSX
PETK-3D	for HPT, FP

Kit Contents . . .

Item	Quantity	Description
1	1	RTV Tube
2	1	Power Connection Boot
3	1	End Cap
4	1	Tape Strip (PETK-3D Only)
5	1	End Termination Caution Label
6	1	GRW-G Grommet (For PETK-3D Terminator kits only)

Installation Precautions . . .

- To minimize the potential for arcing and fire caused by product damage or improper installation use ground-fault protection. The National Electrical Code (NEC) and Canadian Electrical Code (CEC) require ground-fault protection of equipment for each branch circuit supplying electric heat tracing.
- Installation must comply with Thermon requirements and be installed in accordance with the NEC, CEC, or any other applicable national and local codes.
- Component approvals and performance ratings are based on the use of Thermon specified parts only.
- De-energize all power sources before opening enclosure.
- Keep ends of heating cable and kit components dry before and during installation.
- Individuals installing these products are responsible for complying with all applicable safety and health guidelines. Proper Personal Protective Equipment (PPE) should be utilized during installation. Contact Thermon if you have any additional questions.

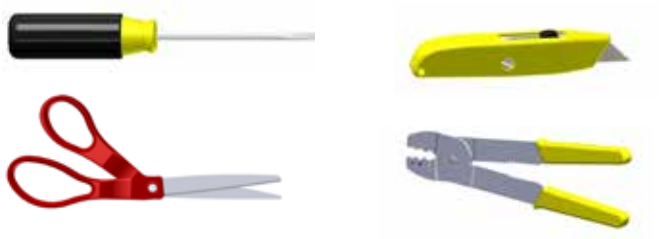
PETK Certifications/Approvals[1] . . .

FM Approved

Note:

1. These sets have been evaluated as components of Thermon's Approved connection kits, such that the area use ratings depend on the rating of the connection kits.

Tools Required . . .

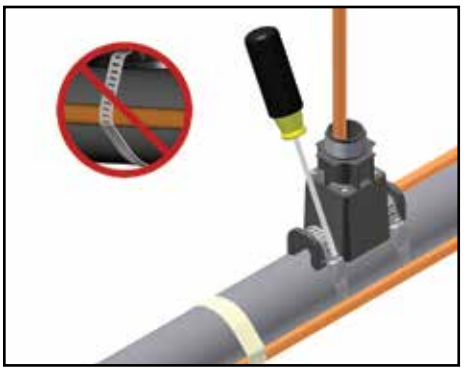


IMPORTANT!
Heating cable must be properly installed within expediter assembly and mounted to pipe prior to terminating with PETK kit.

See Terminator and/or TracePlus Installation Instructions for expediter mounting details.

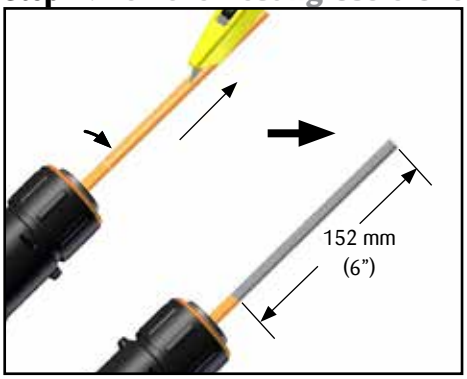
Terminator: Route cable through base entry and mount expediter to pipe using pipe band. Do not band over cable.

Note: For HPT and FP cable exchange grommet in Terminator with GRW-G provided in PETK-3D.



TracePlus: Route cable through base entry and mount expediter to pipe using pipe band. Do not band over cable.

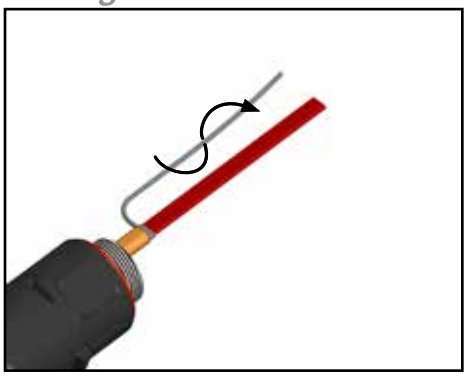
Step 1: Remove Heating Cable Overjacket and Separate Metallic Braid to Form Pigtail



1a. Cut and remove heating cable overjacket.

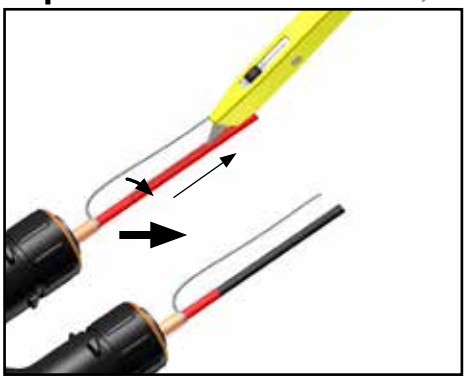
Do not cut metallic braid.

1b. Separate braid strands at edge of overjacket and pull cable through opening in braid.

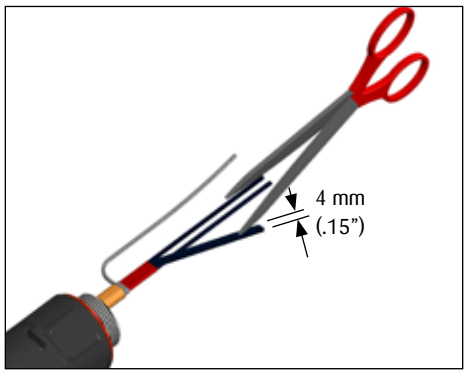


1c. Twist braid into a pigtail. Trim ends of braid.

Step 2: Matrix Removal for BSX, RSX, HTSX, KSX, and VSX Cables

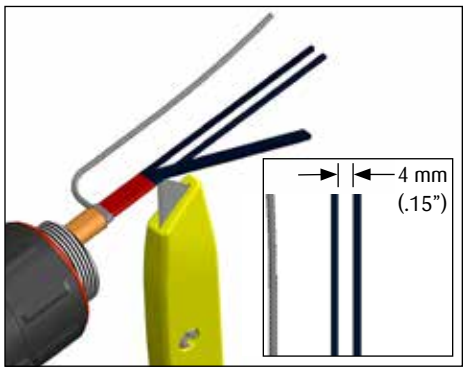


2a. Cut and remove primary insulation jacket (BSX and RSX cables only).



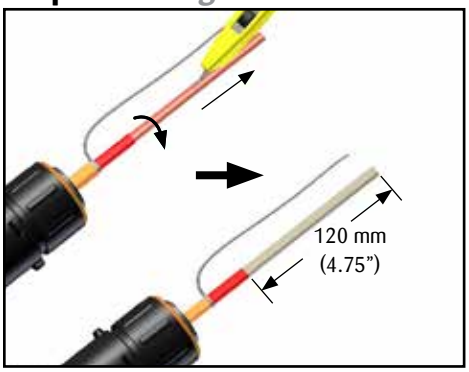
2b. Cut a 4mm strip of conductive matrix between the conductors.

Do not cut bus wire strands.



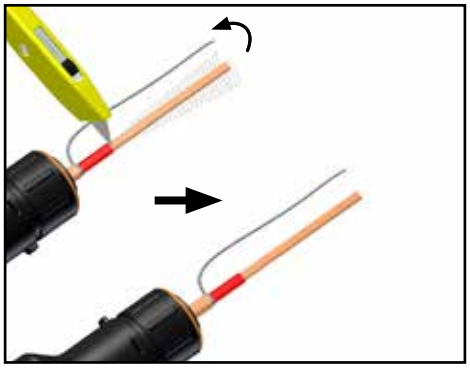
2c. Cut and remove the 4mm matrix strip.

Step 2: Heating Element Removal for HPT and FP Cables

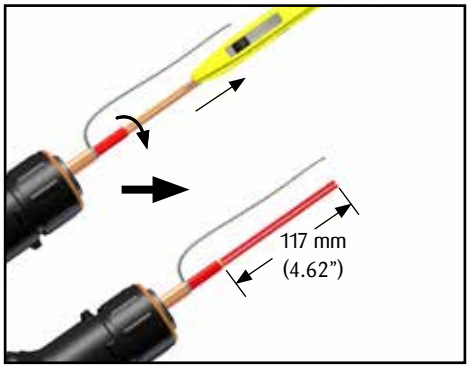


2a. Cut and remove primary insulation jacket.

NOTE: Bus connection must be no more than 50 mm (2") from pipe as addressed in connection kit instructions.



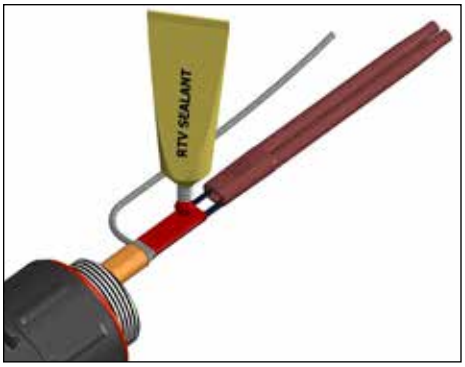
2b. Cut and remove fiberglass overlay and heating element. Push any remaining heating element wire under the primary insulation jacket.



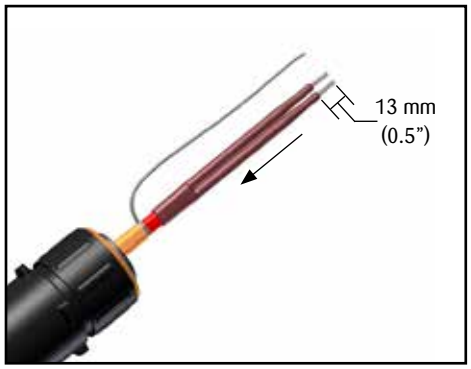
2c. Cut and remove pairing jacket.

Do not cut bus wire insulation.

Step 3: Install Power Boot on Heating Cables

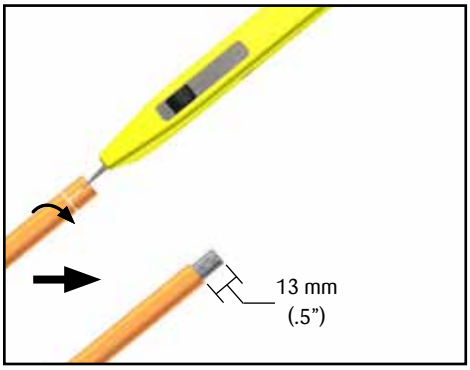


3a. Apply RTV sealant to cable to cover distance of at least 3mm and slide boot onto the end of the cable.

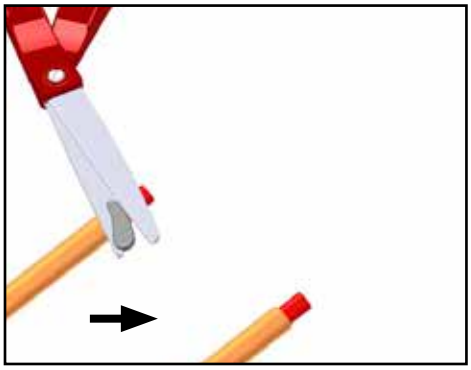


3b. Slide boot onto the end of the cable. Expose 13mm (0.5") of bus wire.

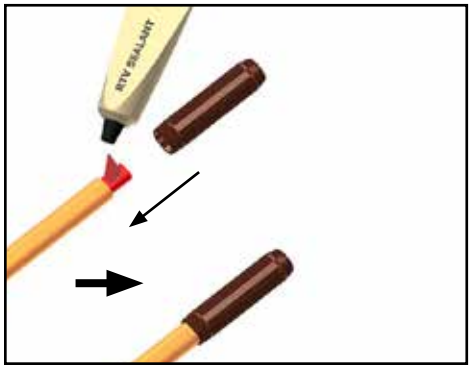
Step 4: End Termination for BSX, RSX, HTSX, KSX and VSX



4a. Cut and remove heating cable overjacket.

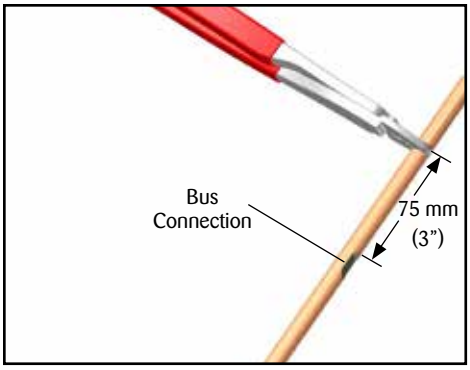


4b. Trim away exposed braid from cable.

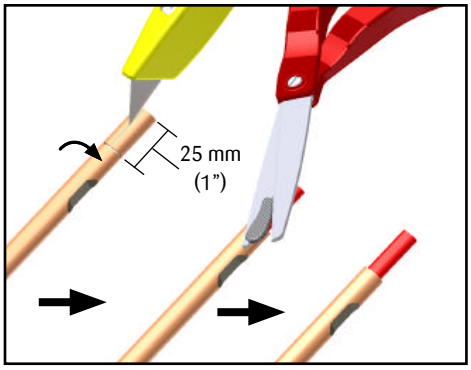


4c. Fill the end cap with RTV sealant and apply a circumferential bead to cable [minimum of 3 mm (0.12") wide]. Slide end cap onto end of cable.

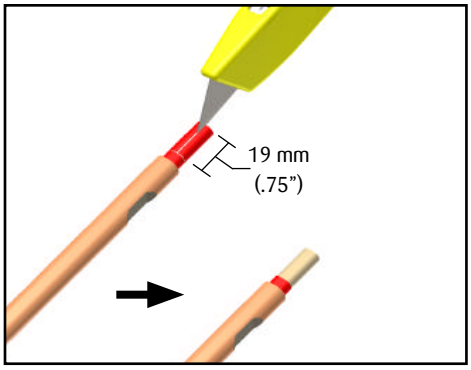
Step 4: End Termination for HPT and FP



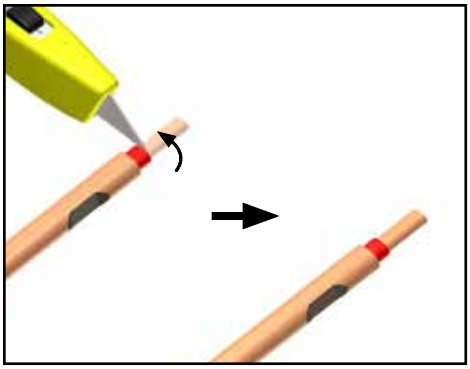
4a. Trim the cable 75mm (3") from the bus connection.



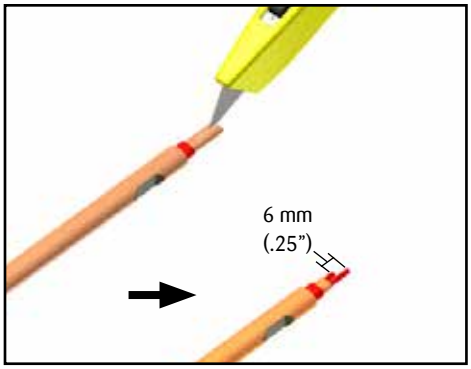
4b. Cut and remove overjacket and trim away exposed braid from cable.



4c. Cut and remove primary insulation jacket.

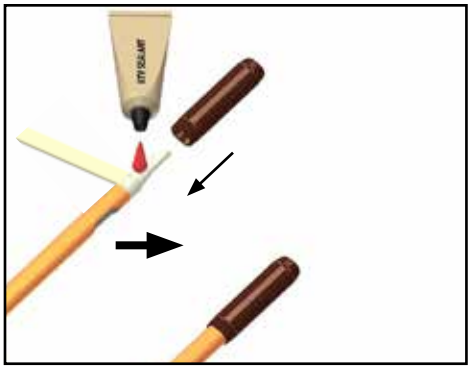


4d. Cut and remove fiberglass overlay and heating element. Push any remaining heating element wire under the primary insulation jacket.



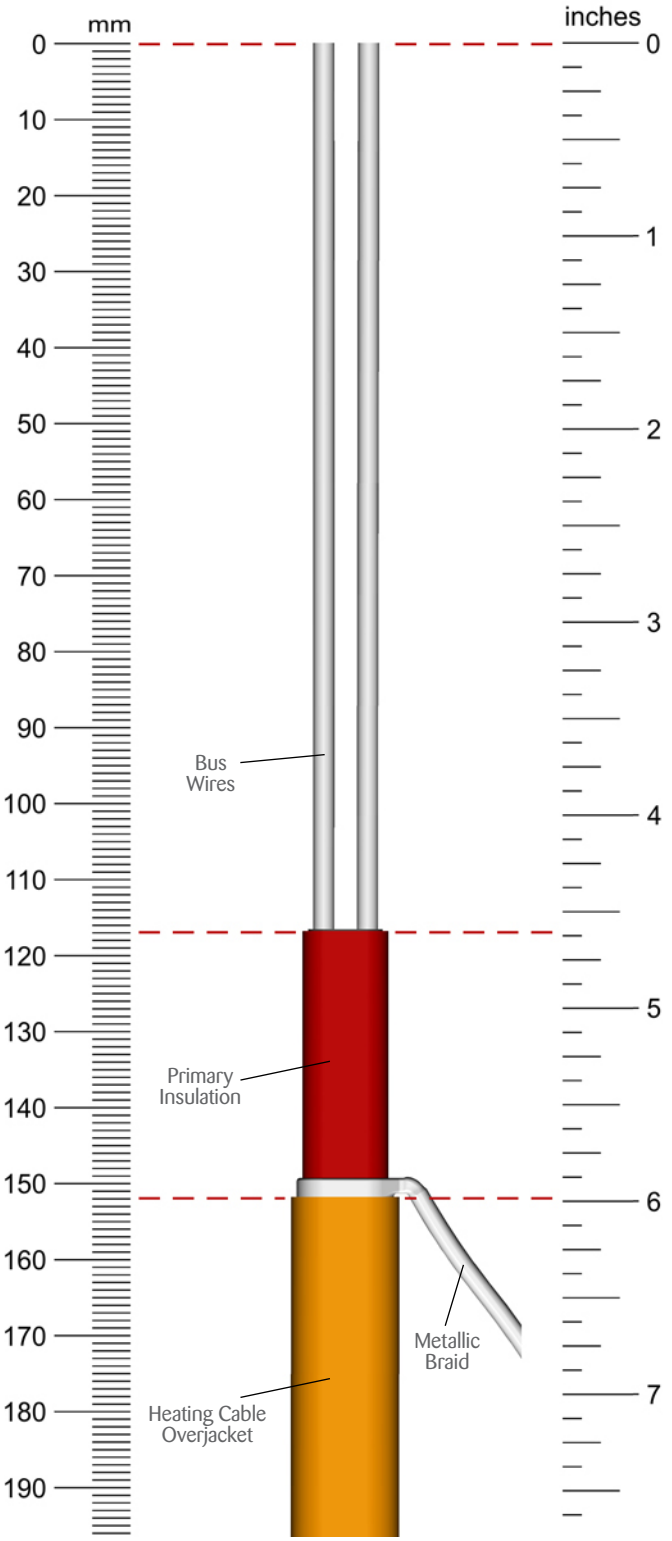
4e. Cut and remove pairing jacket. Stagger cut one of the bus wires.

Do not cut bus wire strands.

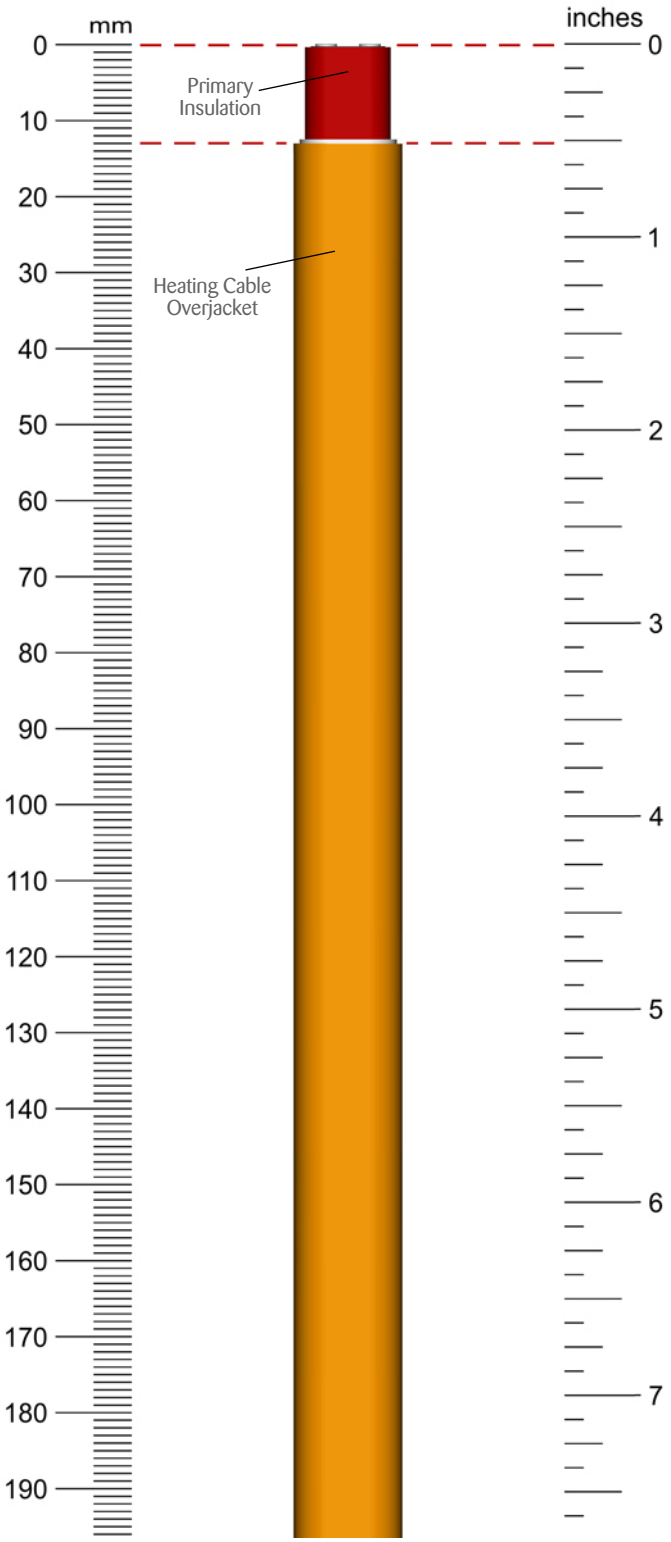


4f. Tape bus wires individually and then together. Continue taping to cover overjacket. Fill the end cap with RTV sealant and apply a circumferential bead to cable [minimum of 3 mm (0.12") wide]. Slide end cap onto end of cable.

Cable Take-off for BSX, RSX, HTSX, KSX and VSX



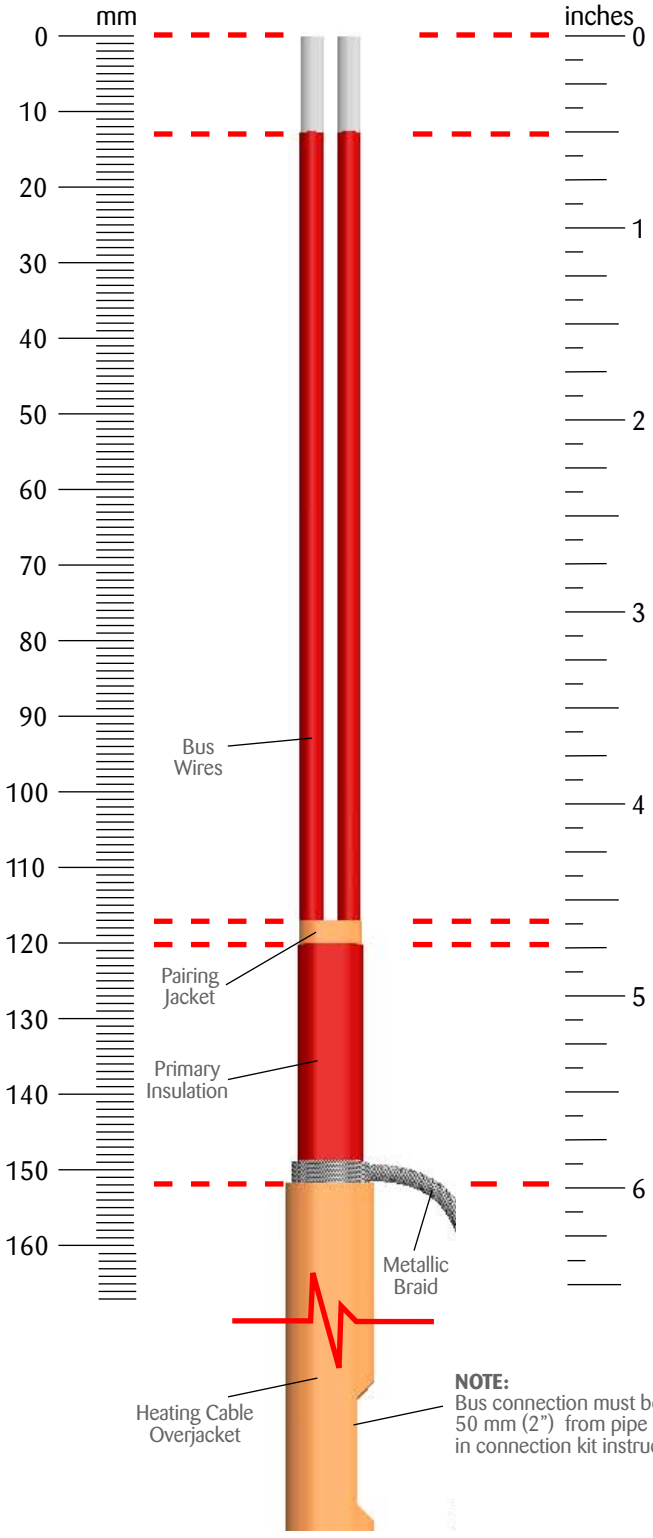
For Power Connecton Boot Termination



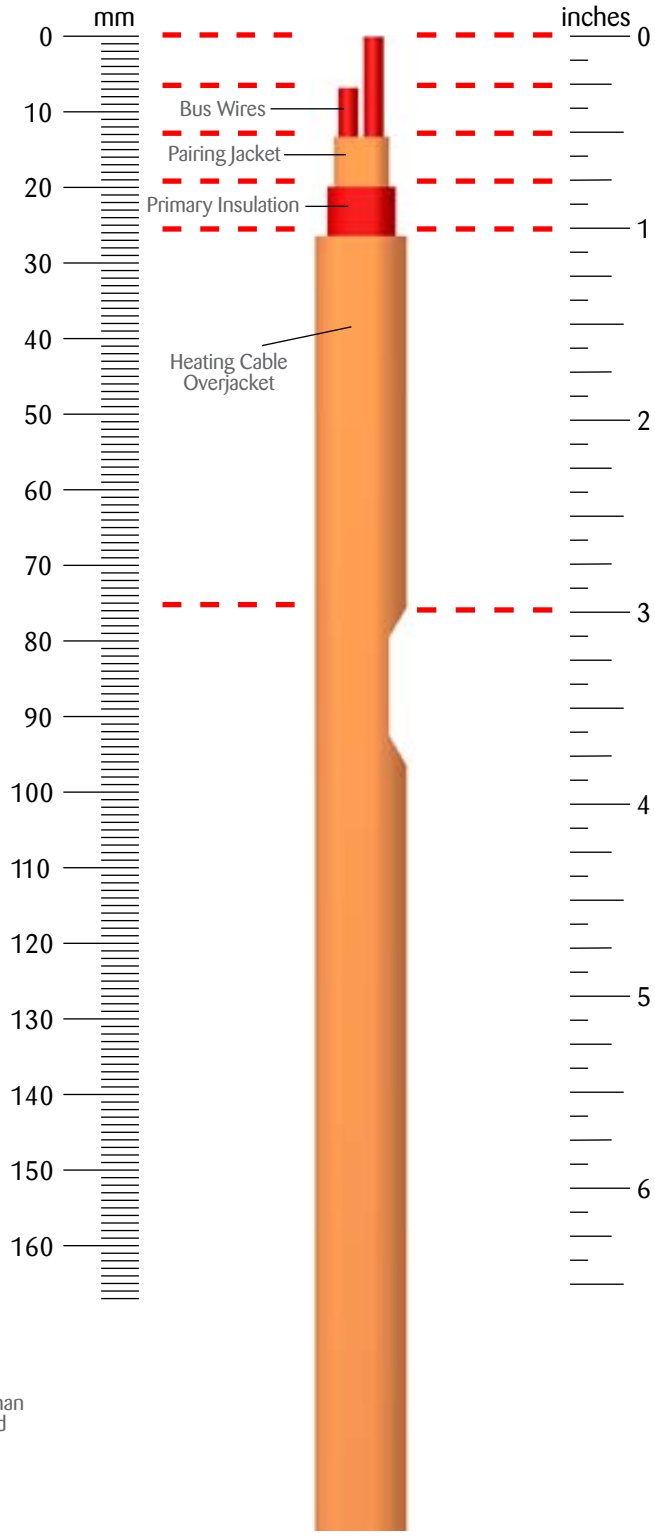
For End Cap Termination

NOTE:
Images may not be printed to scale.

Cable Take-off for HPT and FP Heating Cables



For Power Connection Boot Termination



For End Cap Termination

NOTE:
Images may not be printed to scale.

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TraceNet™ Control and Monitoring System

TCM2

Installation, Start-Up,

Operating and Maintenance Guide

Thermon Manufacturing Company

TCM2

Installation, Start-Up, Operating and Maintenance Guide

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Written and designed at Thermon Manufacturing Company,

100 Thermon Drive, San Marcos, TX 78667-0609, USA

Contents

1 Introduction

The following serves as a guide and overview of the installation, startup and operation of a TraceNet TCM2 heat tracing control and monitoring system. This guide shall be used in conjunction with the project specific control system drawings and any other standard installation instructions/guides provided. In the unlikely event that a conflict or uncertainty arises, contact the Thermon engineering support personnel assigned to this project to clarify.

All installation personnel should be properly trained and qualified to safely install, service and program this TraceNet heat tracing control panel as well as to operate the associated heat tracing system. Service shall only be performed by a certified technician. Equipment is located in enclosures whose doors can only be opened through use of a tool.

1.1 The Panel Location

A wide variety of TraceNet TCM2 system configurations are possible. The TCM2 control panels are designed to operate in ambients ranging from -40°F (-40°C) to 104°F (40°C) and higher. TraceNet TCM2 heat trace control and monitoring systems have been approved/certified for installation and operation in ORDINARY LOCATIONS and CLASS I, DIV 2, GROUPS B, C, D, T4 HAZARDOUS LOCATIONS ONLY, Installation Category II, at altitudes up to 2000 m, and in locations where the Mains supply voltage can fluctuate up to 10%. The actual markings provided on the panel will detail the specific location requirements for each design. The module may be used in pollution degree 2 or better.

1.2 Initial Inspection and Handling

Upon receiving the TraceNet TCM2 control panel, it is important to confirm that the contents of the shipping containers agree with the shipping documents and with the purchase order. Also, it is important to check the shipped container exterior and packing materials for any possible freight damage. Where damage is observed, take photos and notify the carrier as well as your nearest Thermon engineering support center before proceeding further.

After carefully removing the panel from its shipping container, move the panel to its selected location, either by utilizing the pallet base and the securement strapping provided (using a lift truck/fork lift in the case of large panels), or by lifting and mounting to a wall/rack for smaller panels. Where lifting eyes are provided on the panel, they should be used when handling.

Where the panel has external heat sinks to dissipate the heat generated by solid state relay switching, it is recommended that a minimum of 6” (150 mm) of

clearance be allowed between heat sinks and walls or other panels to minimize heat buildup at the heat sinks.

Where heat sinks are present on adjacent panels, allow 12” (300 mm) clearance between heat sinks for sufficient natural air movement.

Warning: Heat Sink Temperatures May Exceed 60°C

Adequate door clearance for service work entry and conduit panel entries should be anticipated when establishing the exact panel location. The panel should be positioned such that the operator can easily access any disconnecting breakers or fuses. When the panel is located outdoors, the panel should be located at a sufficient height to avoid potential standing water.

Once the panel has been properly located, refer to the project specific installation details for the recommended floor mounting as well as wall mounting details.

Once bolted in place, the panel is ready for final configuration, wiring, and site required assembly. Note that the TCM2 control and monitoring module is normally shipped in special packaging to minimize any undue impact stress during shipment. It should be removed from its packaging being attentive to any shipping damage that may have occurred during its transit.

WHEN USED IN A HAZARDOUS LOCATION THE FOLLOWING WILL APPLY.

WARNING – EXPLOSION HAZARD – DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS

AVERTISSEMENT – RISQUE D’EXPLOSION – AVANT DE DÉCONNECTER L’EQUIPEMENT, COUPER LE COURANT OU S’ASSURER QUE L’EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX

WARNING – EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2

AVERTISSEMENT – RISQUE D’EXPLOSION – LA SUBSTITUTION DE COMPASANTS PEUT RENDRE CE MATÉRIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2

1.3 The TCM2

The TCM2 is a microprocessor-based temperature control and monitoring module developed specifically for heat tracing. Designed for use exclusively in Thermon manufactured control systems, the TCM2 module provides a complete control solution for up to two heat tracing circuits.

Each TCM2 module is supplied with all necessary connection hardware. Substitutions may impair protections provided by the equipment.

Figure 1.1: TCM2 Control Module

1.4 Features

Features of the TCM2 module include the following

- Bright Four-Line OLED Display
- Resettable Minimum and Maximum Temperature Values
- Alarm Functions
  - High and Low Temperature
  - High and Low Current
  - High Ground/Earth Leakage Current
  - Circuit Fault
  - Damaged Temperature Sensor
- 3-phase Current Monitoring[1]
- Trip Functions
  - High Temperature
  - High Current
  - High Ground/Earth Leakage Current

The TCM2's four-line display, tri-color status LEDs and four-button interface offer the operator intuitive access to the heat tracing system operating parameters including heat trace status, all set-points, temperature data, operational control

[1] Factory configurable option. See **Section 7.5** for more information

parameters and communication settings. Tri-color LEDs on the front of the TCM2 module indicate module status including power, system health, alarm and trip status on a per-circuit basis.

The TCM2 module is provided with three 24 VDC digital outputs: TRIP, ALARM and SYS. TRIP and ALARM are configurable to be normally on or normally off.

The TCM2 is also equipped with an isolated RS-485 port capable of ModBus ASCII or RTU communications. Over a shielded two-wire twisted-pair physical layer, the TCM2 communicates with Thermon's TraceNet Command system as well as distributed control systems (DCS) at data rates up to 57600 baud. Ethernet connectivity is available with the factory addition of a serial to Ethernet converter.

The TCM2 contains an internal 3.15 Amp, 250 V~ fuse that is designed to be serviced only at the factory.

The TCM2 module can be utilized in a variety of TraceNet control and monitoring systems. Specific wiring and equipment arrangement details are provided in drawings included within the TCM2 Series panel at the time of shipment. The TCM2 module is also backward compatible and may be used as an upgrade within legacy HeatChek TC Series Systems formerly utilizing a TC202a, TC201a or TC101a control and monitoring module.

The TCM2 module is intended for installation exclusively in Thermon designed TCM2 panels. The Mains feed to the TCM2 module shall be current limited, either by a breaker or a fuse, with a current rating no higher than 15 A. The panel is designed such that the temperature internal to the enclosure does not exceed the maximum operating temperature of the TCM2 module. All wiring to the unit must conform to local electrical codes.

2 Specifications

TCM2 control panels are available in a variety of configurations. The table below serves as general specification information for these control panels.

Table 2.1: TCM2 Panel Specifications

Parameter	Description
Heat Trace Mains Supply	100 to 600 V~, 50/60 Hz (See **Table 2.2** for Control Module supply information)
Control Points	Up to 2 Heat Tracing Circuits
Heat Trace Current	See **Table 2.3**: Maximum Heater Current Through Each Solid State Relay
Temperature Inputs	Up to Two per Control Point; Platinum RTDs 100 Ω @ 32 °F (0 °C)
Temperature Control Range	-200 °F to 1112 °F (-129 °C to 600 °C)
Alarm Contact Relays	24 VDC, 200 mA
Communication	RS-485 , ModBus ASCII or RTU, up to 57600 Baud
Control Methods	On/Off MEC, On/Off SSR, Proportional, Ambient or APCM
Display	4 Line, 20 Character, OLED
Relative Humidity	0 to 90% Non-Condensing
Exterior Panel Operating Temperature	-40 °F to 104 °F (-40 °C to 40 °C)
Interior Operating Temperature	-40 °F to 140 °F (-40 °C to 60 °C)
Storage Temperature	-40 °F to 140 °F (-40 °C to 60 °C)
Dimensions (W x H x D)	See **Table 2.4**

The table below serves as general specification information for the TCM2 control module.

Table 2.2: TCM2 Module Specifications

Parameter	Description
Mains Supply	100 to 240 V~, 50/60 Hz, Overvoltage Category II
Max. Input Current	740 mA
Power Consumption	95 VA max
Control Points	Up to 2 Heat Tracing Circuits
Temperature Inputs	Up to Two per Control Point; Platinum RTD's 100 Ω @ 32 °F (0 °C)
Temperature Control Range	-200 °F to 1112 °F (-129 °C to 600 °C)
Communication	RS-485, ModBus ASCII or RTU, up to 57600 Baud
Accessory Power Output	9 W @ 24 VDC
Digital Alarm Outputs	3 x 24 VDC, 100 mA
Control Outputs	2 x 24 VDC, 100 mA or 2 x 12 VDC, 100 mA (user selectable)
Control Methods	On/Off MEC, On/Off SSR, Proportional, Ambient or APCM
Display	4 Line, 20 Character, OLED
Operating Temperature	-40 °F to 140 °F (-40 °C to 60 °C)
Storage Temperature	-40 °F to 176 °F (-40 °C to 80 °C)
Dimensions (W x H x D)	4.7" x 4.65" x 3.25" (119mm x 118mm x 83mm) Module should be mounted as seen in **Figure 2.1** and include a minimum 2" (50 mm) clearance above the module and 1.5" (38 mm) clearance below the module.

Figure 2.1: TCM2 Module Dimensions

Table 2.3: Maximum Heater Current Through Each Solid State Relay

Enclosure Option	Module Type	SSR30A (single pole relay)		SSR15A (double pole relay)		SSR30B (single pole relay)		SSR15B (double pole relay)		SSR50C Up to 3 single pole relays[1,2,3]		SSR30B/2R (single pole relay)	
		40°F (4°C)	104°F (40°C)	40°F (4°C)	104°F (40°C)	40°F (4°C)	104°F (40°C)	40°F (4°C)	104°F (40°C)	40°F (4°C)	104°F (40°C)	40°F (4°C)	104°F (40°C)
P2, SS2	TCM2-1	30	19	22	9	30	30	24	15	--	--	30	25
P3, SS3	TCM2-1	30	24	24	12	30	30	24	15	--	--	30	30
	TCM2-2	30	12	19	6	30	30	24	14.75	--	--	--	--
SS3	TCM2-1	--	--	--	--	46[1,2]	46[1,2]	--	--	--	--	--	--
	TCM2-2	--	--	--	--	46[1,2]	46[1,2]	--	--	--	--	--	--
SS4	TCM2-1	30	24	24	12	30	30	24	15	50/60	60/50	30	28
	TCM2-2	30	24	24	12	30	30	24	15	60/50	60/50	--	--

Note: For TCM2-x, the x denotes relay count. Double-pole relay or 2 single-pole relays required for 208VAC or 240VAC to break both legs.

[1] Relays in separate enclosure from control module.
[2] Amperage values over 30 only apply to higher amperage relays such as Crydom HD60125.
[3] 60 A allowed only when using 1 or 2 relays.

Table 2.4: TCM2 System Enclosure Options

Enclosure Option	Material	Type	Dimensions (inches)	Dimensions (mm)
P2	Fiberglass	4X (IP54)	12 x 14 x 6	305 x 356 x 152
SS2	Stainless Steel	4X (IP54)	12 x 14 x 6	305 x 356 x 152
P3	Fiberglass	4X (IP54)	16 x 14 x 6	406 x 356 x 152
SS3	Stainless Steel	4X (IP54)	16 x 14 x 6	406 x 356 x 152
SS4	Stainless Steel	4X (IP54)	36 x 30 x 16	914 x 762 x 406

3 Module Connections & Wiring

The TCM2 is intended for use exclusively in TraceNet TCM2 Control and Monitoring System panels. Refer to **Figures 3.1** and **3.2** for TCM2 Module connections.

Design considerations within panel:

- Control wiring is rated to 105°C
- GFI test loop wires should be passed through their corresponding GFI CT's
- Alarm digital outputs are intended to drive internal signal relays or lights and should not be directly connected to field wiring
- Care must be taken to avoid exceeding the temperature rating of the TCM2. Refer to **Table 2.3** for panel current ratings.

3.1 Bottom Side Connections

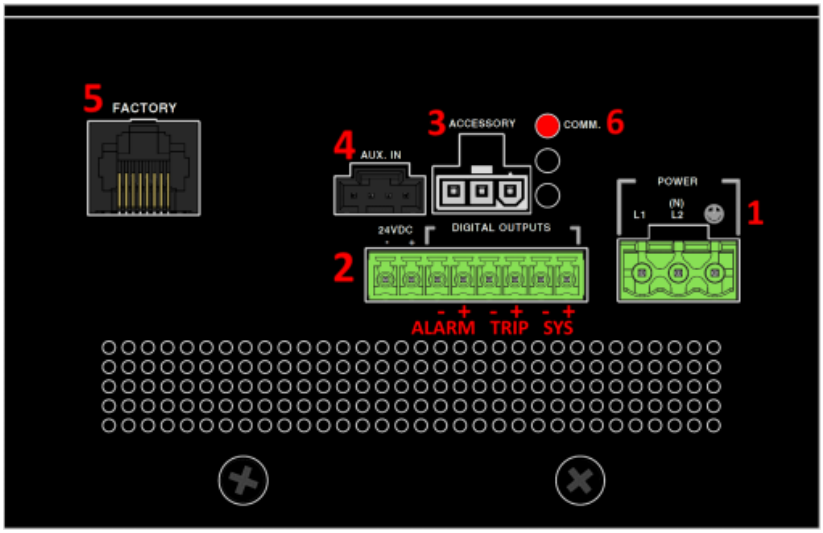

Figure 3.1: Bottom-Side Connections

1. POWER: Mains supply input accepts 100 – 240 V~, at 50/60 Hz. L1 is Line 1, L2 is Line 2 or Neutral, and the symbol ⏚ is the protective conductor/ground connection.
2. 24 VDC & DIGITAL OUTPUTS: A 24 VDC output is provided to power accessories such as a serial to Ethernet converter. The output supplies up to 9 W and is over-current protected. The Digital outputs provide alarm functionality. Each 24 VDC output is current limited to 100 mA.

The positive legs of each output are electrically connected. The outputs may be used to drive indicators or audible alarms, etc., or may be used to drive relays to connect to field wiring. TRIP and ALARM are configurable to be normally on or normally off. The TRIP output activates if either circuit trips for any reason. This requires a manual reset either at the module or by the remote communication. The ALARM output activates if either circuit experiences any type of alarm. The output deactivates when acknowledged or when the alarm condition is no longer present. The SYS alarm is hard wired to be normally on and to activate in the event of a CPU fault. *Note: These are open collector digital outputs not dry contact relays. They should not be connected directly in parallel or series.* **Digital outputs should not be directly connected to field wiring.**

3. ACCESSORY: Reserved for future developments and for entering factory test mode when connected to the isolated RS-485 (Right Pin > D-; Middle Pin > S; Left Pin > D+).
4. AUX IN: Provides connection for optional factory-installed externally mounted interface buttons (See **Appendix B** for wiring diagram).
5. FACTORY: This port is for factory programming only.
6. COMM LED: Indicates traffic on the isolated data highway RS-485.

3.2 Top Side Connections

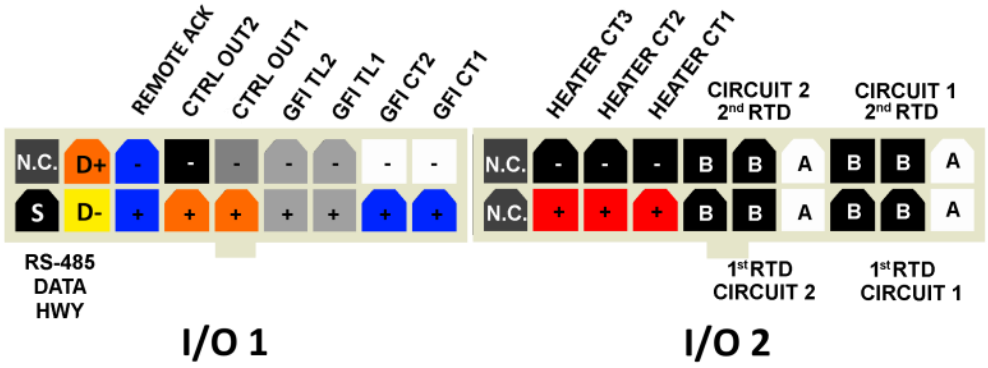

Figure 3.2: Top-Side Connections.

- RTD field wiring should be shielded and the shield grounded at one end. Ground connections are provided in the panel for this purpose.
- HEATER CT1, 2 and 3: In normal 2 circuit configuration, HEATER CT1 is used for Circuit 1, HEATER CT2 is used for Circuit 2 and HEATER CT3 is not used. When operating as a single-circuit 3-phase controller all three CTs are used, one on each leg of the 3-Phase heater outputs (See **Section 7.5**).
- GFI CT1 & 2: These are connection points for the ground/earth fault CTs.
- GFITL1 & 2: These are connections for the ground/earth fault interrupt test loop. These wires should be routed through each corresponding ground/earth fault CT. These wires are used to pass a small amount of

current (about 50 mA~) through the GFI CT to verify functionality on command or at a user configurable interval.

- CTRL OUT 1 & 2: These output signals control the power SSRs or mechanical relays which energize the heat trace. Signal voltage defaults to 12 VDC but can be changed to 24 VDC in the Factory Menu. Each output is current limited to 100 mA.
- REMOTE ACK: This isolated input allows acknowledgement of alarms without opening the panel. It may be connected to a pushbutton switch or to the contacts of a relay driven by a remote signal. The positive side provides an isolated 5 VDC signal. When switched, the negative side drives the diode of an opto-coupler to signal to the TCM2 acknowledgement of the alarm or trip.
- RS-485 DATA HWY: D+ & D- are the differential bus lines for communications. S is the common leg and is often connected to the shield in a 2-wire twisted pair cable. Though this configuration is common, ideally, S is connected to another wire within the cable and the shield is grounded on one side only. See **Section 8** for more information.

4 Field and Panel Wiring

For a successful installation of a TraceNet TCM series heat tracing control and monitoring system, a number of equally critical parts of the system must be installed properly. Areas requiring close attention are the heat trace and insulation, the RTD temperature sensor installation, the distribution of the field RTD and power wiring, and the installation and routing of wiring inside the TraceNet TCM panel.

The heat tracing system installation shall be in accordance with the electrical area classification requirements and as well shall conform to the latest requirements as detailed in applicable heat tracing standards, the local Electrical Code and plant standard practices. Where conflicts arise, contact the project engineer for resolution. If the equipment is used in a manner not specified in this Guide, protections provided by the equipment may be impaired.

4.1 Heat Trace and Insulation Installation

All heat trace circuits and insulation shall be installed in accordance with project installation details provided. In addition, refer to the Electric Heat Tracing Maintenance and Troubleshooting Guide (Thermon Form No. 20745) for general procedures and installation tips.

4.2 RTD Installation and Wiring

RTD control sensors should generally be installed on the process lines or in ambient (where ambient sensing is applied) in a location that is most representative of the entire heat trace circuit. In general, it is recommended that the sensors not be located at heat sinks such as pipe supports, pumps, and valves as the control system response needs to be based on the majority of the process line. The RTD control sensor location on the process piping should follow the installation guidelines detailed in **Figure 4.1**.

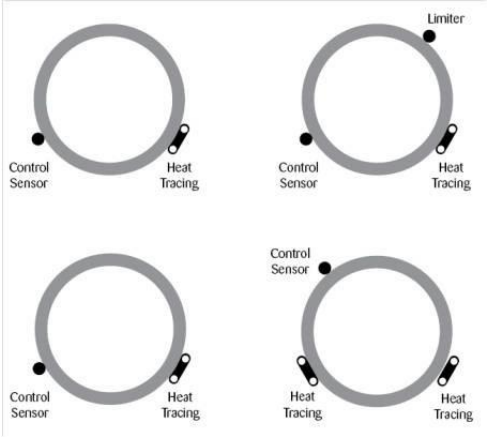

Figure 4.1: RTD Sensor Location

Where RTD sensors are installed on the process piping, follow the guidelines above. In special cases where the limiting temperature sensor is to be installed on the heater itself, it is important to recognize that an offset should be anticipated in the trip set-point to allow for sensor reading error and overshoot.

As a general rule, field RTD wiring and power wiring should not be routed in the same conduit or proximity in a tray as the temperature signals can become distorted and result in improper readings.

4.3 Power Distribution Wiring and Breakers

All field power wiring materials used shall be suitable for the intended service and shall be rated for insulation service temperatures up to and exceeding 221°F (105°C) unless higher values are otherwise noted in project specifications. Power supply wiring from the power transformers to the power distribution panel and distribution wiring to the heat trace circuits shall be rated for the heat trace use voltage or higher and shall be of a sufficiently large wire size to minimize voltage drop. Heat trace circuit breakers should be selected based on the type of heat trace used, the service voltage, and the circuit current draw characteristics. It is especially important when using self-regulating trace heaters to make sure that the circuit breaker response curve type is coordinated with the startup characteristic of the trace heater in a cold start condition. TCM2 controller circuit breakers should have current ratings no higher than 15 A. In addition to the controller circuit breaker, every heat trace circuit shall be provided with a circuit breaker as a means for disconnection. All circuit breakers shall be easily identifiable and accessible. All distribution wiring connections should be tightened using a torque indicating screw driver to the levels indicated in Table 4.1.

Table 4.1: Recommended Torque Values

Location of Terminals	Torque Values (Typical)*	
Distribution Equipment	13.2 to 15.9 in. lbs.	1.49 to 1.80 N-m

* Required torque values may vary depending on individual system designs and size of terminals. Refer to project documentation for additional information.

Protective earth/ground connection is required. Ground/earth with minimum 12 AWG conductors to a known and proven plant ground or by grounding rods.

4.4 TraceNet Panel Wiring

TraceNet TCM Series panels are configured and prewired into an integrated heat trace control and monitoring panel. Clean terminal strips are provided to facilitate the field wiring into the panels. Refer to the project specific panel drawings when installing the field wiring within the panel. Anticipated field wiring is conventionally shown by dashed lines. All field power wiring materials used shall be suitable for the intended service and shall be rated for insulation service temperatures of at least 221°F (105°C) unless higher values are otherwise noted in project specifications. All TraceNet component terminal block connections should be tightened using a torque indicating screw driver to the levels indicated in **Table 4.1**.

4.5 Serial Communication Wiring

TraceNet TCM Series panels may be linked together for communications with an RS-485 communication cable at distances up to 4000 ft (1200 m)[1]. In addition, a 120 Ohm termination module should be used at each end of the RS-485 network. The recommended communication cables for use in the RS-485 network are as given in **Table 4.2**.

[1] Max length depends on site conditions and baud rate

Table 4.2: Recommended RS-485 Cable Type

Cable Type	Recommended
120 ohm, -20°C to +60°C (-4°F to +140°F) 22AWG FHDPE insulation PVC outer jacket	Belden 3107A or equal
120 ohm, -30°C to +80°C (-22°F to +176°F) 24AWG PE insulation PVC outer jacket	Belden 9842 or equal
120 ohm, -70°C to +200°C (-94°F to +392°F) 24AWG Teflon FEP insulation Teflon FEP outer jacket	Belden 89842 or equal

Note: All these products are designated as 120 ohm impedance for balanced line communication uses.

5 Monitoring Heat Tracing Circuit Status

5.1 The Interface

Local interaction with the TCM2 panel takes place through the TCM2 module's simplified four-button membrane switch, four-line display and its three tri-color LEDs. See **Table 5.1** which follows for a complete explanation of the physical interface. Upon power up, the TCM2 will display the start-up screen message similar to that shown in Figure 5.1.

Figure 5.1: TCM2 User Interface at Start-Up

After this start-up message, the TCM2 will immediately begin normal operation and display the Circuit Screen. Once the Circuit Screen is shown, the TCM2 will control each enabled circuit according to its set-points. Figure 5.2 describes the information shown on a typical Circuit Screen in normal operation with two RTD's on Circuit 1 and no alarms. If any alarms are present, a corresponding alarm message will be displayed on the lowest line of the screen, the Alarm Line. If multiple alarm events occur on a circuit, the TCM2 will display one alarm message at a time until all have been cleared.

Figure 5.2: Typical Circuit Screen

Table 5.1: TCM2 Keypad and Indicators

Key/Indicator	Description		Function
	Power LED	Green: Red:	Power On System Fault
	Circuit 1 and Circuit 2 LED	Off: Green: Flashing Yellow: Solid Yellow: Flashing Red: Solid Red:	Heater OFF No Alarms & Heater ON One or more Unacknowledged ALARM Present One or more Acknowledged ALARM Present Unacknowledged TRIP or RTD fault Acknowledged TRIP or RTD Fault
	Main Menu		Enters Main Menu Returns to Circuit Screen from Main Menu Returns to Main Menu from Submenu
	Up and Down Arrow Keys		Navigation Value Changes
	Acknowledge/Accept Key		Acknowledge Alarms Reset Trips Enter Submenu Accept Change

5.2 Basic Navigation

At the Circuit Screen, alternate between circuits 1 and 2 using ▼ & ▲. Acknowledge Alarms and reset Trips using ✓. Press ⚙ to access the Main Menu of the TCM2.

Figure 5.3: Main Menu

The Main Menu gives the user access to all set-points and configuration options. Use ▼ & ▲ to navigate the Main Menu and ✓ to enter a submenu. For submenus with circuit specific settings, for example, MAINTAIN TEMP or RTD SETTINGS, use ▼ & ▲ to switch between circuits. In View Mode, where editing is prohibited, ✓ simply returns to the Main Menu. In Program Mode, ✓ selects a circuit for set-point editing.

Figure 5.4: Programming Maintain Temperature

Use ▼ & ▲ to change a value, then ✓ to accept the change and move on to the next set-point or setting, or press ⚙ to cancel the change and return to the Main Menu. To return to the Circuit Screen from the Main Menu, press ⚙. See **Table 6.1**, in **Part 6: Accessing Control Settings** for a list of Main Menu Options.

5.3 Alarms

In the event that the measured conditions of the heat trace circuit fall outside the user-defined parameters, the TCM2 will notify the user in four ways, the Alarm Line of the display, tri-color LEDs, digital outputs and through RS-485 communications. When an alarm condition first occurs, the corresponding tri-color LED will flash yellow, the common alarm digital output will annunciate and a message will appear on the Alarm Line of the corresponding Circuit Screen to inform the user of the type of alarm present. Pressing ✓ will acknowledge the alarm, deactivate the digital output, change the tri-color LED from flashing yellow to solid yellow and “ACK” will be displayed after the alarm message on the Alarm Line of the display. Alarms will automatically clear when the alarm condition is no longer present.

5.4 Trips

In the event that the measured conditions of the heat trace circuit go beyond the TRIP settings of the circuit, the circuit will trip, i.e. turn off. When a circuit trips, the circuit will be deactivated, the corresponding tri-color LED will flash red, the common TRIP digital output will annunciate and a corresponding message will be displayed on the Alarm Line of the display. A TRIP event is different from an ALARM event in that the heat trace circuit is deactivated and will remain deactivated until the circuit is manually reset by the user.

For Temperature TRIPS pressing  once will acknowledge the TRIP causing the circuit LED to stop flashing and stay solid red and the common TRIP digital output to deactivate. To reset a high temperature TRIP and reactivate the circuit,  must be pressed again.

For heater current and ground/earth fault TRIPs, pressing  will reset the TRIP, cause the common TRIP digital output to deactivate, the circuit LED to stop flashing red and the TCM2 will attempt to resume normal control.

If the conditions which caused the trip are still present, the circuit will TRIP again.

All alarms, trips and acknowledgements are transmitted via RS-485. Acknowledgements and resets can also be performed remotely from a TraceNet Command system or through a plant DCS systems via ModBus commands.

See **Appendix A** for ModBus Memory Map.

See **Table 5.2** for a comprehensive explanation of alarm messages.

Table 5.2: Alarm Messages

Message	Explanation
RTD FAULT ALARM	An RTD reading is out of range when the resistance exceeds 313 Ω or is less than 48 Ω. In either case, the RTD has been damaged or has been disconnected in service. NOTE: The TCM2 will continue to control off of a second undamaged RTD when available.
LOW TEMP ALARM	The measured temperature has fallen below a value equal to the LOW TEMPERATURE ALARM set-point.
HIGH TEMP ALARM	The measured temperature has risen above a value equal to the HIGH TEMPERATURE ALARM set-point but has not yet risen above a value equal to the HIGH TEMPERATURE TRIP/HIGH set-point.
HIGH TEMP TRIP (HIGH HIGH TEMP)	If HIGH TEMPERATURE TRIP is ON (OFF), this message will be displayed if the measured temperature rises above a value equal to the HIGH TEMPERATURE TRIP (HIGH) set-point.
HIGH GROUND CURR	The measured ground/earth leakage current has risen above the GROUND CURRENT ALARM set-point but not above the GROUND CURRENT TRIP/ALARM2 set-point.
GROUND CURR TRIP (HIGH HIGH GROUND)	If GROUND CURRENT TRIP is ON (OFF), this message will be displayed if the measured ground/earth leakage current rises above the GROUND CURRENT TRIP (HIGH) set-point.

Table 5.2: Alarm Messages (Continued)

Message	Explanation
LOW AMPS ALARM	The measured heater current has fallen lower than the LOW CURRENT ALARM set-point.
HIGH AMPS ALARM	The measured heater current rise is higher than the HIGH CURRENT ALARM set-point but not above the HIGH CURRENT TRIP/HIGH.
HIGH AMPS TRIP (HIGH HIGH AMPS)	If HIGH CURRENT TRIP is ON (OFF), this message will be displayed if the measured heater current is higher than the HIGH CURRENT TRIP (HIGH) set-point.
CKT FAULT ALARM	Indicates that a control relay was nonresponsive during a SELF-TEST or that heater current was detected when the circuit was off.

6 Accessing Control Settings

6.1 Password Protection

The TCM2 module features password protection for settings. The user has the option to set a four-digit numerical password which must be entered in order to authorize changes to any set-point or setting. Without the password, all setting and set-points may be viewed, alarms/trips may be acknowledged and circuits may be reset but no settings or set-points may be modified. When the correct password is entered, the TCM2 enters Program Mode where changes are authorized for 30 minutes. After the 30 minutes has passed, the password will again be required. The default password is 0000.

Figure 6.1: Enter Password to enter Program Mode

By default, password protection is disabled. The first line of the Main Menu displays whether the control module is in View Mode or Program Mode (See **Figure 6.1**). To enable the password, enter the Main Menu and select PASSWORD SETTINGS. Change PASSWORD from OFF to ON and enter a password using ▼ & ▲ to change each number and ✓ to select the number and confirm.

Figure 6.2: Enable/Disable Password or Change Password

6.2 Adjusting Set-points

To adjust the control parameters of the TCM2 module, be sure first, to enter Program Mode by entering the correct password or by disabling password protection as per the previous section. Then, using ▼ & ▲, navigate to the desired submenu and press ✓. **Table 6.1** shows a complete listing of all submenus as well as each set-point and setting contained within and their valid ranges. For set-points or settings which apply only to one circuit, for example MAINTAIN TEMP, the desired circuit must be selected upon entering the

submenu using ▼ & ▲ . Pressing ✔ , selects the circuit and advances the cursor to the first set-point or setting available for editing. Use ▼ & ▲ to change the value and ✔ to accept the new value and advance the cursor to the next set-point or setting available for editing. When finished editing within a submenu, use ⚙ to return to the Main Menu. When finished making changes, press ⚙ to return to the Circuit Screen from the Main Menu.

Table 6.1: Main Menu Options

Menu Option	Applies To	Set-Point/Settings Available	Range/Options	Precision
MAINTAIN TEMPERATURE	Individual Circuit	MAINTAIN TEMPERATURE	-129°C to 600°C; -200°F to 1112°F (LOW TEMP ALARM to HIGH TEMP ALARM) *see **Section 7.4** for Ambient setting	1°
		BANDWIDTH (Control Band)	1°C to 300°C; or 1°F to 300°F	1°
RTD SETTINGS	Individual Circuit	NUMBER OF RTDS	1 or 2	
		RTD FAULT POWER	0 – 100%	1 %
HIGH TEMP ALARMS	Individual Circuit	TRIP or HIGH (HIGH is a higher level alarm if HIGH TEMP TRIP is OFF)	HIGH TEMP ALARM to 1112°F or 600°C	1°
		ALARM	MAINTAIN TEMP+BANDWIDTH+1 to HIGH TEMPERATURE TRIP (HIGH)	1°
		HIGH TEMP SEEN	RESET = Y or N	1°
LOW TEMP ALARM	Individual Circuit	LOW TEMP ALARM	-200°F or -200°C to MAINTAIN TEMP	1°
		LOW TEMP SEEN	RESET = Y or N	1°
GROUND CURRENT	Individual Circuit	GROUND CURRENT (real-time ground/earth fault current measurement)	0-225 mA	1 mA
		TRIP or HIGH (HIGH is a higher level alarm if GROUND CUR TRIP is OFF)	GROUND CURRENT ALARM to 225 mA	1 mA
		GROUND CURRENT ALARM	20 to GROUND CURRENT TRIP (HIGH)	1 mA
HEATER CURRENT	Individual Circuit	HEATER CURRENT (real-time heater current measurement)	0.0 A to 240.0 A	0.1 A
		HEATER POWER CLAMP (FOR ON/OFF SSR only)	0 – 100%	1 %
HIGH CURRENT ALARMS	Individual Circuit	TRIP or HIGH (HIGH is higher level alarm if HEATER CUR TRIP is OFF	HIGH CURRENT ALARM to 245.0 A	0.1 A
		ALARM	1.0 A to HIGH CURRENT TRIP (HIGH)	0.1 A

Table 6.1: Main Menu Options (Continued)

Menu Option	Applies To	Set-Point/Settings Available	Range/Options	Precision
LOW CURRENT ALARM	Individual Circuit	ALARM	0.0 A to HIGH CURRENT ALARM -1.0A	0.1 A
HEATER ENABLE	Individual Circuit	HEATER	ENABLED, FORCED ON or DISABLED	
		CONTROL (Control Method)	ON/OFF MEC, ON/OFF SSR, PROPORTIONAL, AMBIENT, AMBIENT APCM (See **Section 7.1** for Control Method)	
CONFIGURATION	Both Circuits	GROUND CUR TRIP	ON or OFF	
		HEATER CUR TRIP	ON or OFF	
		HIGH TEMP TRIP	ON or OFF	
		ALARM ON (Digital Outputs Activate On…)	ALL ALARMS or TEMP ONLY	
		ALARM OUTPUT NRM (Alarm Outputs Normally)	ON or OFF	
		RTD UNITS (Temperature Units)	°C or °F	
		APCM CYCLE TIME	20, 25 or 33 min	
		AUTO SELF TEST	OFF or every 2 – 99 hours	1 hour
		START UP DELAY	0-30 min	1 min
		SOFT START	1 – 8 min	1 min
		FIRST CIRCUIT NUMBER	0-99	1
		SCREEN SAVER	ON or OFF	
		LANGUAGE	English, Spanish, Russian	
		SELF TEST	▲ for Self-test, ▼ for Ground Test	

Table 6.1: Main Menu Options (Continued)

Menu Option	Applies To	Set-Point/Settings Available	Range/Options	Precision
DATA HIGHWAY	Controller	NETWORK ID	1-247	1
		MODBUS Protocol	ASCII 7, 2, NP or RTU 8, 1, NP	
		BAUD RATE	9600, 19200, 38400, 57600	
ENTER PASSWORD	Controller in View Mode	PASSWORD	0000 – 9999	
PASSWORD SETTINGS	Controller in Program Mode	PASSWORD	ON or OFF (enable or disable password protection)	
		NEW PASSWORD	0000-9999 (DEFAULT = OLD PASSWORD)	
		OTHER SETTINGS (See below)	Seen after New Password Entered	
OTHER SETTINGS	Controller	FIRMWARE version	Major.Minor version	
		HOURS IN USE	Time on from manufacture	
		CID (Chip Identifier)	Family# + Unique Identifier	

7 Heat Trace Control and Monitoring

7.1 Control Method

To provide the most flexible and application specific heat trace solution, the TCM2 is capable of controlling using several different algorithms or control methods. These include ON/OFF MEC, ON/OFF SSR, Proportional and Ambient Proportional Control (APC and APCM). Each circuit's control method is independently configurable.

ON/OFF MEC

The simplest form of control is ON/OFF MEC. This simply turns the heat trace on when the RTD reading falls below the Maintain Temp and turns it off when the RTD read is above the Maintain Temp plus the control band (bandwidth). This control method is intended for use in applications using mechanical relays to switch the heat trace.

ON/OFF SSR

ON/OFF SSR adds the Soft Start feature to ON/OFF control. This control method takes advantage of the Solid-State Relay's high switching life to decrease temperature overshoot. Under ON/OFF SSR control, the heat trace will turn on and off the same way it does in ON/OFF but will gradually increase the duty cycle by way of cycle-omission from 18% to 100%. The duration of this gradual increase, or Soft Start, can be adjusted in the Configuration submenu.

Proportional

In Proportional control, the heat trace is on at a 100% duty cycle below and up to the Maintain Temp and the duty cycle decreases linearly to 18% at the Maintain Temp plus the control band. This control method is ideal for process sensing applications but is not suitable for applications using mechanical relays.

Ambient & Ambient APCM

See **Section 7.4, The TCM2 in Ambient Sensing Applications** for full explanation of this control method.

7.2 Setting the Control Method

Before attempting to change settings and set-points, be sure the TCM2 is in Program Mode. To determine whether the control module is in View Mode or Program Mode, check the first line of the Main Menu. If in View Mode, first enter the password to enter Program Mode (see **Section 6.1 Password Protection** for more information).

Figure 7.1: Main Menu in Program Mode

Then enter the HEATER ENABLE submenu. Use ▼ & ▲ to move to the circuit in question and ✓ to select the circuit. This will move the cursor to the first option, HEATER, which allows enabling, disabling or forcing ON a circuit. Change the setting and press ✓ or just press ✓ to keep the current setting and move to the next option, CONTROL. This sets the Control Method for this circuit. See **Section 7.1** for a complete explanation of the CONTROL options. Use ▼ & ▲ to choose the desired Control Method and ✓ to accept the change and move the cursor back to the top of this submenu. From here another circuit may be selected or press ⚙ to return to the Main Menu.

7.3 The TCM2 in Process Sensing Applications

The control method which provides the most tightly controlled temperature and highest energy efficiency is Proportional control with 1 or 2 RTDs per heat trace circuit. When configured with two RTD sensors, the TCM2 will control off of the lowest reading and alarm off of the highest reading. Both RTD readings will be displayed on the Circuit Screen. In the case of process sensing control, one must be aware of the normal flow directions within the process piping and only group process piping having a common flow condition with the control sensors. A failure to do so can result in non-flowing areas cooling and freezing when the flowing portions have appropriately turned the heat trace circuit off.

7.4 The TCM2 in Ambient Sensing Applications

The TCM2 may also be configured for Ambient Proportional Control (APC). One or two RTD's may be used to sense ambient temperatures in the process area. Under the APC method, the HEATER 100% and HEATER OFF are shown in place of MAINTAIN TEMP and BANDWIDTH. HEATER 100% should be set to the lowest expected ambient temperature. HEATER OFF should be set to the temperature at which the heat is no longer required.

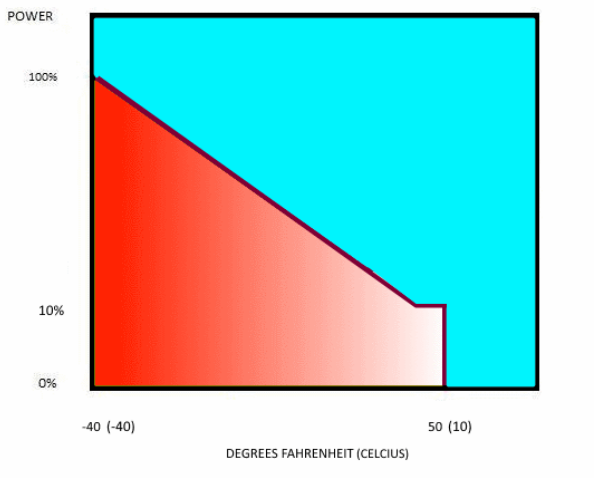

Figure 7.2: APC Power vs Temperature

As shown in Figure 7.2, at the lowest expected ambient temperature the heat trace will operate at 100% power and then ramp down to a 18% power level at HEATER OFF. If the ambient rises above this value, the heat trace will then turn off. So, for example, if the lowest expected ambient temperature around a given process unit is -40°F (-40°C), then one would set the circuit to operate using APC, and set HEATER 100% to -40°F (-40°C). HEATER OFF would be set to 50°F (10°C). A feature unique to the TCM2 among TraceNet controllers is the capability of using mechanical relays for ambient control. When using mechanical relays, the ambient algorithm changes the period over which duty cycle is adjusted. Instead of using cycle-omission over a period of about one second, the duty cycle period is set to a cycle time of 20, 25 or 33 minutes. This control method may also be used in applications where, under AMBIENT control, self-regulating cables operate in startup mode and can cause high current readings and alarms. In certain applications, it may be desirable to have ambient control but also to have one RTD sensor on the pipe for high temperature alarming. This is possible without further configuration. Just set the HIGH TEMP ALARM at the desired temperature. When using AMBIENT or AMBIENT APCM, LOW TEMP ALARM is disabled but the HIGH TEMP ALARM remains active. It is also possible to use a single RTD on both circuits by simply connecting both RTD inputs to the same RTD (i.e. connecting A to A, B to B and B to B).

APC control is not recommended where steam outs and high exposure temperature process conditions are expected and where the heat-trace due to its inherent characteristics cannot be operated during such events.

7.5 Single-Circuit 3-Phase

A new feature unique to the TCM2 among the TraceNet family of control and monitoring systems is the ability to directly monitor all three phases of a 3-phase system. In this single circuit 3-phase option, the TCM2 will monitor and display all three current readings on the Circuit Screen. Once configured for 3-phase operation there are no additional options to configure to begin normal operation. A high or low current condition on any phase or ground/earth fault condition will result in an alarm or trip as per the circuit settings and set-points. This is a factory configuration.

Figure 7.3: Circuit Screen in Single-Circuit 3-Phase Operation

8 The TCM2 Data Highway Communications

The TCM2 is provided with RS-485 communications. This allows for communication via Modbus ASCII or RTU protocols to a TraceNet Command System and/or to the facility's Distributed Control System (DCS). The TCM2 is also provided with an auxiliary 24 VDC power source which can an optional serial to Ethernet converter for applications where Ethernet is preferred. Through these communication links, all of the operating parameters which are programmable at the module can be accessible at the central PC workstation or DCS system console.

For communications linking information between the TCM2 and a PC workstation, refer to the TraceNet Command Operating Guide. Through the TraceNet Command System, the user has remote access to all the set-points and settings in the TCM2, including the ability to remotely view all parameters in real-time[1], acknowledge alarms and reset tripped circuits. The TCM2 Data Highway uses Modbus over RS-485, a world-wide standard in reliable industrial communications. Available with two user selectable protocol configurations and four common Baud rates, the TCM2 is ready to be integrated into the vast majority of current user systems including Thermon legacy HeatChek® control systems. **Appendix A** shows the memory map which should be used by DCS programmers to integrate the TCM2 into the plant's DCS. Current systems utilizing Thermon's TraceView or TraceView Network Explorer will require an upgrade to the new TraceNet Command system.

To access the TCM2 communications settings, enter the DATA HIGHWAY submenu (for help navigating to submenus see **Basic Navigation** in **Section 5** of this manual.)

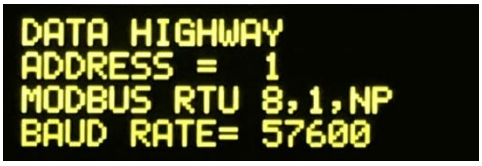

Figure 8.1: Data Highway

[1]Installations with high circuit counts may take longer to update circuit information

The DATA HIGHWAY submenu allows the user to set the Network ADDRESS of the TCM2 to a number between 1 and 247, the protocol configuration to either RTU 8, 1, NP or ASCII 7, 2, NP and the baud rate to either 9600 (if used on the same network as legacy Thermon HeatChek systems), 19200, 38400 or 57600.

For best results, a 120 Ω shielded twisted-pair cable is recommended. The Data Highway port on the TCM2 is isolated to 5 kVrms with protection against ESD to 15 kV. For shielding to be effective, the shield should be grounded on one side but not on both.

TCM2 panels can also be configured with reliable serial to Ethernet converters for easy IP connectivity.

9 System Start-Up

All heat trace circuits should be properly terminated and meggered prior to energizing the heat trace power distribution and control panels. In addition, all pipes should be insulated and weather sealed to achieve the expected heat up and temperature maintenance performance of the system.

9.1 Initial Start-Up Procedure

Heat trace circuits are on independent circuit breakers from the TCM2 controller. Any time that the TCM2 panel must be opened to gain access to the programming of the controller, the installer shall verify that all heat trace circuits are disconnected at the circuit breakers. This is done to provide protection from higher voltages while maintaining power so that the installer may program the controller.

If the equipment is used in a manner not specified in this Guide, protections provided by the equipment may be impaired.

9.2 Troubleshooting Tips

When starting up a newly installed heat trace and control and monitoring system, it is not uncommon to encounter numerous alarm and trip events. Data entry errors, unanticipated temperature overshoots due to system inertia or too tight control band settings, and incomplete installation details are just a few of the many contributing factors to this result. A table of Troubleshooting Tips is provided in **Appendix C** to assist during start-up.

10 Maintenance

Preventive maintenance consists of inspection, testing, checking connections and general cleaning of equipment at scheduled intervals. The maintenance recommendations that follow are intended to support and in some cases add to those procedures detailed in the facility's Planned Maintenance System (PMS). In case of conflicts, contact the project engineer for resolution. When carrying out the scheduled maintenance program, the following safety precautions should be observed.

10.1 Safety Precautions

The heat tracing can be powered by the project specified nominal voltages ranging from 100 to 600 VAC. It is important that only authorized trained personnel conduct these maintenance and service activities. Before conducting any maintenance or service procedure, exercise required lockout and tag out procedures at the appropriate circuit breakers. Additionally, test within the control panel to ensure that the specific heat tracing and control circuit of interest is fully de-energized and the equipment is grounded. See **Section 9.1** for more information.

If it becomes necessary to service or test live equipment, the following instructions must be followed:

Use one hand when servicing the equipment. Accidental death or severe injury may occur especially if a current path is created through the body from one hand to the other.

First, de-energize the equipment. To de-energize any capacitors connected into the circuits, temporarily ground the terminals where work is to be done.

Connect the multi-meter/instrument to the terminals of interest using a range higher than the expected. Make sure that personnel are not grounded whenever a need arises to adjust equipment or test circuit operation. Verify that all test equipment used is properly maintained and safe for the intended use.

Without touching the multi-meter/instrument, energize the equipment and read the values indicated on the multi-meter/instrument.

Remove the test leads after de-energizing the circuit of interest.

To avoid electrostatic discharge, clean the module only with a cloth dampened with water.

11 Notes

12 Appendix A: Memory Map

Table 12.1: Circuit Measurement and Status (Read Only)

Function Code(s)	Address	Description	Values
04	100	Alarm Acknowledge Circuit 1	See **Table 12.2**
04	101	Alarm Acknowledge Circuit 2	
04	102	Temp RTD1 Circuit 1	Temp = value x 10
04	103	Temp RTD1 Circuit 2	Temp = value x 10
04	104	Temp RTD2 Circuit 1	Temp = value x 10
04	105	Temp RTD2 Circuit 2	Temp = value x 10
04	106	Control Temp Circuit 1	Temp = value x 10
04	107	Control Temp Circuit 2	Temp = value x 10
04	108	Control RTD Circuit 1	
04	109	Control RTD Circuit 2	
04	110	Ground/Earth Current Circuit 1	
04	111	Ground/Earth Current Circuit 2	
04	112	Percent ON Circuit 1	
04	113	Percent ON Circuit 2	
04	114	Heater Current CT 1	
04	115	Heater Current CT 2	
04	116	Heater Current CT 3	
	117-119	No data	
04	120	Alarm Status Circuit 1	
04	121	Temp RTD1 Circuit 1	Temp = Value x 10
04	122	Temp RTD2 Circuit 1	Temp = Value x 10
04	123	Control Temp Circuit 1	Temp = Value x 10
04	124	Control RTD Circuit 1	RTD 1 or RTD 2
04	125	Ground/Earth Current Circuit 1	
04	126	Percent ON Circuit 1	
04	127	Heater Current CT 1	
04	128	Heater Current CT 2	
04	129	Heater Current CT 3	

Table 12.1: Circuit Measurement and Status (Read Only) Continued

Function Code(s)	Address	Description	Values
04	130	Alarm status Circuit 2	
04	131	Temp RTD1 Circuit 2	Temp = Value x 10
04	132	Temp RTD2 Circuit 2	Temp = Value x 10
04	133	Control Temp Circuit 2	Temp = Value x 10
04	134	Control RTD Circuit 2	RTD 1 or RTD 2
04	135	Ground/Earth Current Circuit 2	
04	136	Percent ON Circuit 2	
04	137	Heater Current CT 2	

Table 12.2: Alarm Status/Acknowledge

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
High Current Trip	Not Used	Circuit OFF	Ground/Earth Fault Trip	High Temp Trip RTD2	High Temp Trip RTD 1	RTD2 Fault	RTD1 Fault	High Current Alarm	Low Current Alarm	Circuit Fault	Ground/Earth Fault Alarm	High Temp Alarm RTD2	High Temp Alarm RTD 1	Low Temp Alarm RTD 2	Low Temp Alarm RTD 1

Table 12.3: Trips Enable/Disable Bits

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Heater Current Trip	Not Used	Not Used	Ground/Earth Current Trip	High Temp Trip RTD2	High Temp Trip RTD 1	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used

Table 12.4: Circuit Measurements/Status

Function Code(s)	Address	Description	Values
03	0	Alarm Acknowledge Circuit 1	See **Table 12.2**
03	1	Alarm Acknowledge Circuit 2	
03	2	Maintain Temp Circuit 1	
03	3	Maintain Temp Circuit 2	
03	4	Control Band Circuit 1	
03	5	Control Band Circuit 2	
03	6	High Temp Trip RTD 1 Circuit 1	
03	7	High Temp Trip RTD 1 Circuit 2	
03	8	High Temp Trip RTD 2 Circuit 1	
03	9	High Temp Trip RTD 2 Circuit 2	
03	10	High Temp Alarm RTD 1 Circuit 1	
03	11	High Temp Alarm RTD 1 Circuit 2	
03	12	High Temp Alarm RTD 2 Circuit 1	
03	13	High Temp Alarm RTD 2 Circuit 2	
03	14	Low Temp Alarm RTD 1 Circuit 1	
03	15	Low Temp Alarm RTD 1 Circuit 2	
03	16	Low Temp Alarm RTD 2 Circuit 1	
03	17	Low Temp Alarm RTD 2 Circuit 2	
03	18	High Ground/Earth Current Trip Circuit 1	
03	19	High Ground/Earth Current Trip Circuit 2	
03	20	High Ground/Earth Current Alarm Circuit 1	
03	21	High Ground/Earth Current Alarm Circuit 2	
03	22	High Current Trip Circuit 1	
03	23	High Current Trip Circuit 2	
03	24	High Current Alarm Circuit 1	
03	25	High Current Alarm Circuit 2	
03	26	Low Current Alarm Circuit 1	
03	27	Low Current Alarm Circuit 2	
03	28	Circuit 1 Status	See **Table 12.5**
03	29	Circuit 2 Status	
03	30	Control Method Circuit 1	0 = ON/OFF MEC 1 = ON/OFF SSR 2 = Proportional 3 = Ambient 4 = Ambient APCM
03	31	Control Method Circuit 2	
03	32	Number of RTD Circuit 1	
03	33	Number of RTD Circuit 2	
03	34	Power Clamp Circuit 1	
03	35	Power Clamp Circuit 2	

Figure 12.4: Circuit Measurements/Status (Continued)

Function Code(s)	Address Hex	Address Decimal	Description	Values
03	0x0024	36	RTD Fault Clamp Circuit 1	
03	0x0025	37	RTD Fault Clamp Circuit 2	
03	0x0026	38	Trips Enable/Disable Circuit 1	See **Table 12.3**
03	0x0027	39	Trips Enable/Disable Circuit 2	
03	0x0028	40	High Temp Seen RTD 1 Circuit 1	
03	0x0029	41	High Temp Seen RTD 1 Circuit 2	
03	0x002A	42	High Temp Seen RTD 2 Circuit 1	
03	0x002B	43	High Temp Seen RTD 2 Circuit 2	
03	0x002C	44	Low Temp Seen RTD 1 Circuit 1	
03	0x002D	45	Low Temp Seen RTD 1 Circuit 2	
03	0x002E	46	Low Temp Seen RTD 2 Circuit 1	
03	0x002F	47	Low Temp Seen RTD 2 Circuit 2	

Table 12.5: Circuit Status Bits

Bit	Description
3	Forced OFF
2	Forced ON
1	Tripped
0	Enabled

Table 12.6: Read Only Controller Data

Function Code(s)	Address	Description	Values
03	2008	Language	0 = English; 1 = Spanish; 2 = Russian;
03	2009	Password	0000 – 9999
03	2010	Password Enable	0 = Disabled; 1 = Enabled
03	2011	TCM2 Type	0 = 2-circuit (Default) 1 = 1-circuit, 1 CT; 2 = 1-Circuit, 2 CTs; 3 = 1-Circuit, 3 CTs
03	2012	Serial number low	
03	2013	Serial number med	
03	2014	Serial number high	
	2015	No Data Here	
03	2016	Circuit Offset	
	2017	No Data Here	
03	2018	Screen Saver	
	2019	Max Off Current	
03	2020-2021	No Data Here	
03	2022	Relay Output Voltage	0 = 12 V; 1 = 24 V
	2023	No Data Here	
	2024	Hours in Use	
03	2025	Start Up Delay	
	2026	Soft Start	
03	2027	Ground/Earth Fault Sensitivity	0 = Most Sensitive; 3 = Least Sensitive
	2028-2030	No Data Here	
03	2031	Single Temp Alarms	Should always = 0
03	2032	High Temp Alarm Delay	
	2033-2035	No Data Here	
03	2036	Alarm Relay Type	0 = Normally OFF; 1 = Normally ON
	2037	Alarm Relay Masking	
	2038	No Data Here	
03	2039	Firmware Version Number	
	2040-2043	No Data Here	
03	2044	Self-Test Hours	
	2045	Start self-Test	Non-zero Starts a self-test
03	2046	Units	0 = F; 1 = C

13 Appendix B: Additional Information

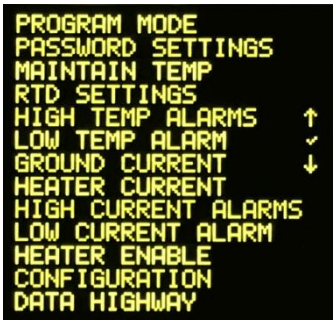

Figure 13.1: Program Mode Menu

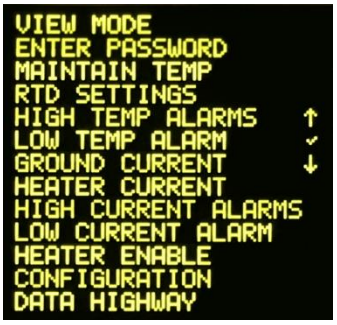

Figure 13.3: View Mode Menu

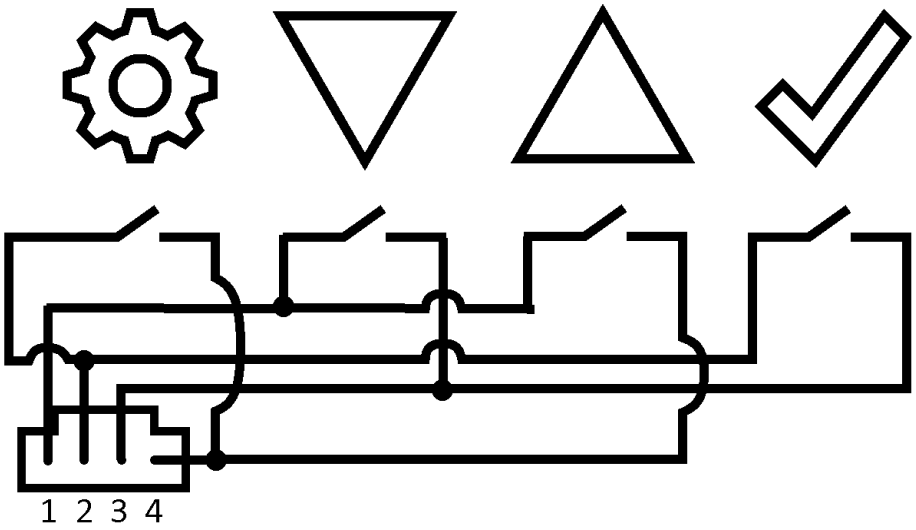

Figure 13.2: External Keypad Wiring Diagram

14 Appendix C: Troubleshooting Tips

Troubleshooting tips are provided here as a beginning point in correcting start-up issues and clearing out alarm and trip events.

High Temperature Reading/Alarm

The following summarizes some of the possible causes and solutions for heat tracing high temperature alarms.

Cause	Possible Solutions
Temperature of product in process line is above alarm set point or the expected reading due to events other than heat tracing such as high processing temperatures, steam-outs, etc.	Let process return to normal condition or adjust alarm set point (if approved by project engineer) to allow for this processing condition.
High alarm setting programmed or expected reading did not consider natural temperature overshoot associated with the control scheme.	Move control set point down to allow for overshoot or raise the high temperature alarm set point (if approved by project engineer). It may also be possible to decrease the control band on the control circuit or adjust the type of control from on-off to proportional.
Improperly located RTD sensor.	Is the RTD sensor installed next to a heated tank or a steam jacketed pump that might cause a higher than expected reading? Is the RTD sensor on the heater itself? Move the RTD sensor to location more representative of the majority of the piping. Is the sensor location representative for properly controlling under all flow scenarios? Review location of the RTD(s) with respect to the known process flow patterns which occur and change as appropriate.

Wrong insulation size, type, or thickness on all of the line being traced.	Measure circumference of insulation, divide by π, and compare to insulation diameter charts for proper over sizing. Check insulation type and thickness against design specification. Replace insulation or review system design for alternate operating possibilities.
Wrong insulation size, type, or thickness on part of the line being traced.	The insulation system should be as specified in the design for the entire circuit being traced. Having a lower heat loss on one part of the circuit and higher heat loss insulation on the other part of the circuit (perhaps where the RTD sensor is) will result in the better insulated line being too hot. Redo the insulation to assure uniformity and consistency.
Damaged RTD temperature sensor.	Disconnect RTD sensor and measure resistance. Compare to resistance tables for corresponding value of temperature. Compare to pipe or equipment temperature known by another probe or sensor. If different, the RTD sensor may need replacement.
Heat tracing over designed in heat output and or/ due to cable availability or natural design selections available. This can result in higher than expected temperatures due to overshoot (especially when used with on-off control mode). This can also occur in an ambient sensing control modes.	Review design as well as installation instructions. Check heat tracing for presence of proper current. Since replacing the circuit may not be a desirable option here, the first approach should be to adjust the control method which the TraceNet control system has been configured in.
Heat tracing circuits are miswired such that the RTD for circuit 1 is controlling circuit 2, etc.	Trace and recheck field and panel wiring. Use circuit "turn-on" and "turn-off" technique or disconnect RTD's one at a time to see if the proper RTD failure alarm occurs on the right circuit. Let process return to normal condition or adjust alarm set point (if approved by project engineer) to allow for this processing condition.

Low Temperature Reading/Alarm

The following summarizes some of the possible causes and solutions for heat tracing low temperature readings/alarms.

Cause	Possible Solutions
Temperature of product in process line is below the alarm set point or expected reading due to events other than heat tracing- low pumping temperatures, etc.	Let process operations return to normal conditions and then recheck for alarms. Alternately adjust alarm set point (with project engineers approval) to allow for this process condition.
Low temperature alarm programmed setting or expected reading did not consider natural temperature undershoot associated with control scheme.	Move control set point up to allow for natural undershoot or lower the low temperature alarm set point (when approved by project engineer).
Damaged, open, or wet thermal insulation does not allow the heat provided to hold the desired temperature.	Repair damage to insulation.
Wrong insulation size, type, or thickness on all of circuit being traced.	Measure circumference of insulation, divide by π, and compare to insulation diameter charts for proper over sizing. Check insulation type and thickness against design specification. Replace insulation or review system design for alternate operating possibilities which involve more heat output.
Wrong insulation size, type, or thickness on part of circuit being traced.	The insulation system should be as specified in the design for the entire circuit being traced. Having high heat loss on one part of the circuit and lower heat loss insulation on the other part of the circuit (perhaps where the sensor is) will result in the not so well insulated line being too cold. Redo the insulation to assure uniformity and consistency.

Improperly located RTD temperature sensor.	Is RTD sensor next to pipe support, equipment, or other heat sink? Move RTD sensor to location more representative of the majority of the piping.
Improperly installed RTD temperature sensor or RTD temperature probe.	Permanent RTD temperature sensors are most accurate when installed along the pipe or equipment with at least a foot of probe and sensor wire running along the pipe before exiting through the insulation. Permanent RTD sensors which enter the insulation at 90 degrees may be more sensitive to error associated with them depending on insulation installation or how well the sensor is physically attached. Adjust control set point to compensate for any accuracy offset. When using a 90 degree RTD probe for diagnostics, verify this measurement technique on a known pipe in the same general temperature range and insulation configuration.
Damaged RTD sensor.	Disconnect RTD sensor and measure resistance. Compare to resistance tables for corresponding value of temperature. Compare to pipe or equipment temperature known by another probe or sensor. If different, the RTD sensor may need replacement.
Heat tracing undersized, improperly installed or damaged.	Review design/installation. Check heat tracing for presence of proper current and also meg for dielectric resistance. Repair or replace heat tracing.
Heat tracing circuits are wired such that the RTD for circuit A is controlling circuit B, etc.	Trace and recheck field and panel wiring. Use circuit "turn-on" and "turn-off" technique or disconnect RTD's one at a time to see if the proper RTD failure alarm occurs on the right circuit.

Heat tracing does not heat. Breaker has been switched off due to maintenance activities or has possibly malfunctioned.	As soon as maintenance activities cease and after conferring with operations manager, switch breaker back ON. Note that some period of time will elapse before the temperature alarm goes away (pipes and equipment take time to heat up).

RTD Sensor Alarm

The following summarizes some of the possible causes and solutions for a heat tracing RTD sensor reading alarm.

Cause	Possible Solutions
RTD connections are wired improperly or have become loose.	Confirm wiring and connections are correct.
RTD has failed open or has extremely high resistance or RTD has failed shorted or has very low resistance.	Has lightning damaged the sensor? Maybe the piping has had some welding going on nearby? Maybe the RTD has gotten wet? Replace RTD.

Communications Alarm

The following summarizes some of the possible causes and solutions for heat tracing communications alarms.

Cause	Possible Solutions
Improperly set controller address, duplicate addresses or improper configuration firmware/software.	Change controller address or reconfigure firmware/software.
Loose or open connection in RS485 line.	Recheck for continuity in all communication lines.
Too many modules in network.	Check network limitations versus actual configuration.
Too long of an accumulated communication distance.	Consider the addition of a repeater.
Too many reflections of signal usually caused by improper terminations in network.	Add termination resistors as appropriate.

Circuit Fault Alarm

The following summarizes some of the possible causes and solutions for heat tracing circuit fault alarms.

Cause	Possible Solutions
Upon initial installation start-up, improper wiring of the relay or low current in heater.	Confirm correct wiring and presence of the heater. Where normal operating amperage is in range of 0 to 250mA, disabling the Self-Test function or adding multiple loops through the current sensing toroid may be required.
During daily operations; possibly indicates relay contact failure.	If relay has failed, replace.
Breaker off.	Turn on breaker after conferring with operations manager.

High Current Readings/Alarms

The following summarizes some of the possible causes and solutions for heat tracing high current readings or alarms.

Cause	Possible Solutions
Self-regulating heater or power limiting heater current may exceed set value during normal operation or start-up operations.	Increase high current alarm set point (if approved by project engineer). For startup operation current alarm nuisances, it may also be desirable to increase the delay time (before a current reading is done after turn on) set in the controller.
Self-regulating or power limiting heater may be operating at cooler than design pipe temperatures due to processing conditions and thus heaters may be drawing higher current values.	Increase high current alarm set point (if approved by project engineer).

Self-regulating or power limiting heater may be operating in its cold start regime.	When reading current on one of these type heaters, it is necessary to read the current at steady state. One may have to wait as long as 5 minutes for heater steady state values. After five minutes the current value will continue to drop as the pipe or equipment begins to warm.
Heater circuit may be longer than anticipated in the design stage.	Verify installed length (if possible) and if different review design. If length is different but performance-wise the "as built" design is acceptable, initiate "as built" drawing change and change controller high current setting.
Wrong heater wattage or heater resistance may be installed.	Check heater set tags or markings on heater cable against installation drawings. As an additional check, disconnect heater from power and measure DC resistance.
Heat tracing may be powered on wrong voltage.	Recheck heater supply voltage.
Current sensing circuitry may have encountered a problem.	Use a different current clamp type meter which is known to be accurate and do a comparative reading. Investigate current measurement circuitry further. Note that one should only read heater currents when the heater is 100% on.
Field heater wiring is improperly labeled and/or connected such that the heater and the circuit number are not matched.	Trace out the circuit wiring from the field back into the panel and subsequently to the controller. Wherever possible, turn the circuit "off" and "on" and watch for an appropriate response. If this is the problem, redo the wiring.

Short circuit in a series resistance circuit	Disconnect heater from power, meg between each of the conductors and ground for proper dielectric rating. If okay, measure resistance of circuit for agreement with design values.

Low Current Readings/Alarms

The following summarizes the possible causes and solutions for heat tracing low current readings/alarms.

Cause	Possible Solutions
Self-regulating or power limiting heater may be operating at higher than design pipe temperatures due to processing conditions and thus heaters may be drawing lower current values.	Decrease low current alarm set-point (if approved by project engineer).
Loss of a branch of the heat tracing circuit.	Measure total current and each branch current. Compare to design values. Check all connections.
Breaker off.	Turn breaker back on after conferring with operations manager.
Heat tracing cable may have been exposed to temperatures in excess of their maximum temperature ratings (excessive steam-out temperatures or upset process temperature events) and could have damaged the heater.	Replace heater.
Controller may be in error in reading current	Use a different current clamp type meter which is known to be accurate and do a comparative reading. If the current measuring circuitry is in error, investigate controls further. Note that one should only read heater currents when the heater is 100% on.

Heater circuit may be shorter than anticipated in the design stage.	Verify installed length (if possible) and if different review design. If length is different but performance-wise the "as built" design is acceptable, initiate "as built" drawing change and change controller low current setting. Check heater set tags or markings on heater cable against installation drawings. As an additional check, disconnect heater from power and measure DC resistance.
Wrong heater wattage or heater resistance may be installed.	Measure pipe temperature and measure steady-state heater current, voltage, and length. Compare to manufacturer's rated power curve. Replace heat tracing cable if necessary.
Heat tracing may be powered on wrong voltage.	Recheck heater supply voltage.
Current sensing circuitry may have encountered a problem.	Use a different current clamp type meter which is known to be accurate and do a comparative reading. Investigate current measurement circuitry further. Note that one should only read heater currents when the heater is 100% on.
Field heater wiring is improperly labeled and/or connected such that the heater and the circuit number are not matched.	Trace out the circuit wiring from the field back into the panel and subsequently to the controller. Wherever possible, turn the circuit "off" and "on" and watch for an appropriate response. If this is the problem, redo the wiring.
Open circuit in a series resistance circuit.	Disconnect heater from power, meg between each of the conductors and ground for proper dielectric rating. If okay, measure resistance of circuit for agreement with design values.

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High Ground/Earth Current Alarm

The following summarizes some of the possible causes and solutions for heat tracing high ground current alarm.

Cause	Possible Solutions
Heat tracing is damaged.	Disconnect heat tracing circuit and determine if alarm clears. If so, repair heat tracing.
Wiring to heat tracing had high leakage current.	Disconnect heat tracing and sequentially disconnect power wiring until the alarm ceases. Check last section removed for damage.
Improper wiring of current sense wires through torroid.	The current sensing toroid must have the outgoing heater current lead and the return current heater lead run through the toroid for a proper ground leakage measurement. Redo wire routing if only one wire has been run through the current sensing toroid.
Heat tracing power wires in a multiple circuit system improperly paired.	If the return current wire in the toroid is from a different circuit the two heater currents will not cancel and leave only leakage to be measured. Correct wiring.
Heat tracing circuit has higher than expected leakage due to circuit length or higher voltage.	Replace the EPD breaker with a higher ground/earth current trip device if available. Where a controller (with variable leakage trip functions) is doing the ground/earth leakage detection function, increase ground/earth leakage alarm set point (if approved by project engineer).

If issues remain after exercising all these possible causes and solutions for heat tracing alarms and trips, contact your nearest Thermon engineering center for assistance and/or for arranging for field service.

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Thermon PN80514 Revision 4

CompuTrace Version 5.6.4
5/30/2017 8:28:44 AM

Project		Identification		Operating Temperatures		
Job Name	Digester Improv	Record	1	Maintenance Temperature	90	°F
Job Facility	Manteca WWTP	Circuit		Pipe Maint Temperature	90	°F
Designer	Gary J- Qcon	Line\Pipe	6" FOG	Pipe Maint Temp Hi	n/a	°F
Project Number	6" FOG	Panel\Breaker Number		Operating Cable Temperature	138	°F
Job Number	na	Isometric Number		Operating Cable Temperature Hi	n/a	°F
				Max Cable Temperature	171	°F

Pipe & Insulation			Environment			Cable		
Design Heat Loss	5.1	W/ft	Min Ambient Temperature	25	°F	Cable Name	BSX 10-2	
Heat Loss w/o SF	4.5	W/ft	Startup Amb Temperature	39	°F	Design Cable Output	5.6	W/ft
Pipe Length	60	ft	Max Ambient Temperature	104	°F	Cable Output - End of Cable	5.4	W/ft
Pipe Size	6	in	Max Exposure Temperature	n/a	°F	Nominal Operating Power	1102	VA
Pipe Type	Stainless Steel		Max Product Temperature	n/a	°F	Circuit Length	176	feet
Insulation Thickness	2	in	Area Classification	Non-hazardous		Total Cable	176	feet
Insulation Size	6.0	in	T-Class	n/a		Nominal Operating Current	5.3	A
Insulation Type	Fiberglass		Autoignition Temperature	n/a	°F	Total Maximum Current	9.5	A
Insulation K Value	0.2255	BTU-in/hr-ft²-°F	Temperature Control	Pipe Sensing		Voltage	208	Vac
Insul Mean Temp	58	°F	Temperature Control Set Point	90	°F	Overvoltage	0	%
Jacket Emissivity	.12		Wind Speed	25	mph	Trace Ratio	1	
			Safety Factor	15	%	Power Points	1	
No. Valves	6	No. Supports 6	No. Flanges	0	No. Pumps 2	Spiral Pitch	n/a	in
Valve Allow	8.0 feet	Support Allow 2.4 feet	Flange Allow	0.98 feet	Pump Allow 16.00 feet	Circuit Breaker Size	30	

Remarks

* Current and power values include all passes and power points for each record. Three phase designs display the line amperage for all circuits

Catalog Number	Description	Quantity	Units	Unit Pricing	Extended Pricing
BSX 10-2-OJ	Self-regulating heater cable w/overjacket	176	feet		
Terminator DP	Non-metallic Power Connection Box	1	each		
(see catalog)	Pipe Sensing Temperature Controller/Control Point	1	each		
PETK-1D	Power and End Termination Kit	1	each		
FT-1L	Polyester Fiber Tape	2	roll(s)		
CL	Caution Labels	6	each		

CompuTrace Version 5.6.4
5/30/2017 8:24:56 AM

Project		Identification		Operating Temperatures		
Job Name	Digester Improv	Record	1	Maintenance Temperature	90	°F
Job Facility	Manteca WWTP	Circuit		Pipe Maint Temperature	90	°F
Designer	Gary J- Qcon	Line\Pipe	4" FOG	Pipe Maint Temp Hi	n/a	°F
Project Number	4" FOG	Panel\Breaker Number		Operating Cable Temperature	138	°F
Job Number	na	Isometric Number		Operating Cable Temperature Hi	n/a	°F
				Max Cable Temperature	172	°F

Pipe & Insulation			Environment			Cable		
Design Heat Loss	4.6	W/ft	Min Ambient Temperature	25	°F	Cable Name	BSX 10-2	
Heat Loss w/o SF	4.0	W/ft	Startup Amb Temperature	39	°F	Design Cable Output	5.6	W/ft
Pipe Length	150	ft	Max Ambient Temperature	104	°F	Cable Output - End of Cable	5.2	W/ft
Pipe Size	4	in	Max Exposure Temperature	n/a	°F	Nominal Operating Power	1664	VA
Pipe Type	Stainless Steel		Max Product Temperature	n/a	°F	Circuit Length	262	feet
Insulation Thickness	1.5	in	Area Classification	Non-hazardous		Total Cable	262	feet
Insulation Size	4.0	in	T-Class	n/a		Nominal Operating Current	8.0	A
Insulation Type	Fiberglass		Autoignition Temperature	n/a	°F	Total Maximum Current	14.2	A
Insulation K Value	0.2255	BTU-in/hr-ft²-°F	Temperature Control	Pipe Sensing		Voltage	208	Vac
Insul Mean Temp	58	°F	Temperature Control Set Point	90	°F	Overvoltage	0	%
Jacket Emissivity	.12		Wind Speed	25	mph	Trace Ratio	1	
			Safety Factor	15	%	Power Points	1	
No. Valves	10	No. Supports 15	No. Flanges	0	No. Pumps 1	Spiral Pitch	n/a	in
Valve Allow	5.0 feet	Support Allow 2.0 feet	Flange Allow	0.92 feet	Pump Allow 10.00 feet	Circuit Breaker Size	30	

Remarks

* Current and power values include all passes and power points for each record. Three phase designs display the line amperage for all circuits

Catalog Number	Description	Quantity	Units	Unit Pricing	Extended Pricing
BSX 10-2-OJ	Self-regulating heater cable w/overjacket	262	feet		
Terminator DP	Non-metallic Power Connection Box	1	each		
(see catalog)	Pipe Sensing Temperature Controller/Control Point	1	each		
PETK-1D	Power and End Termination Kit	1	each		
FT-1L	Polyester Fiber Tape	3	roll(s)		
CL	Caution Labels	15	each		

CompuTrace Version 5.6.4
5/30/2017 8:31:39 AM

Project		Identification		Operating Temperatures		
Job Name	Digester Improv	Record	1	Maintenance Temperature	90	°F
Job Facility	Manteca WWTP	Circuit		Pipe Maint Temperature	90	°F
Designer	Gary J- Qcon	Line\Pipe	2" FOG	Pipe Maint Temp Hi	n/a	°F
Project Number	2" FOG	Panel\Breaker Number		Operating Cable Temperature	129	°F
Job Number	na	Isometric Number		Operating Cable Temperature Hi	n/a	°F
				Max Cable Temperature	164	°F

Pipe & Insulation			Environment			Cable		
Design Heat Loss	2.8	W/ft	Min Ambient Temperature	25	°F	Cable Name	BSX 8-2	
Heat Loss w/o SF	2.4	W/ft	Startup Amb Temperature	39	°F	Design Cable Output	4.3	W/ft
Pipe Length	140	ft	Max Ambient Temperature	104	°F	Cable Output - End of Cable	4.1	W/ft
Pipe Size	2	in	Max Exposure Temperature	n/a	°F	Nominal Operating Power	1040	VA
Pipe Type	Stainless Steel		Max Product Temperature	n/a	°F	Circuit Length	209	feet
Insulation Thickness	1.5	in	Area Classification	Non-hazardous		Total Cable	209	feet
Insulation Size	2.0	in	T-Class	n/a		Nominal Operating Current	5.0	A
Insulation Type	Fiberglass		Autoignition Temperature	n/a	°F	Total Maximum Current	9.3	A
Insulation K Value	0.2255	BTU-in/hr-ft²-°F	Temperature Control	Pipe Sensing		Voltage	208	Vac
Insul Mean Temp	58	°F	Temperature Control Set Point	90	°F	Overvoltage	0	%
Jacket Emissivity	.12		Wind Speed	25	mph	Trace Ratio	1	
			Safety Factor	15	%	Power Points	1	
No. Valves	10	No. Supports 14	No. Flanges	0	No. Pumps 1	Spiral Pitch	n/a	in
Valve Allow	2.0 feet	Support Allow 1.6 feet	Flange Allow	0.69 feet	Pump Allow 4.00 feet	Circuit Breaker Size	30	

Remarks

* Current and power values include all passes and power points for each record. Three phase designs display the line amperage for all circuits

Catalog Number	Description	Quantity	Units	Unit Pricing	Extended Pricing
BSX 8-2-OJ	Self-regulating heater cable w/overjacket	209	feet		
Terminator DP	Non-metallic Power Connection Box	1	each		
(see catalog)	Pipe Sensing Temperature Controller/Control Point	1	each		
PETK-1D	Power and End Termination Kit	1	each		
FT-1L	Polyester Fiber Tape	2	roll(s)		
CL	Caution Labels	14	each		

CompuTrace VT 1.3.32
Circuit Report & BOM
5/24/2017 5:32:53 PM

Project			Identification			Operating Temperatures		
Job Name	Digester Improv.		Record	1		Maintenance Temperature	80	°F
Project No.	PE Alum Tank		Circuit No.			Vessel Outer Wall Temp	91	°F
Project Ref.	FOG Tank		Vessel			Film Temperature	N/A	°F
Designer	Gary J- Qcon		Panel/Breaker No.			Heater Temperature	132	°F
Job No.	DCS-TNK-07-805		Isometric No.			Max. Heater Temperature	N/A	°F

Vessel & Insulation			Product & Environment				Heater Performance Data	
Design Heat Loss	887.	Watts	Min. Ambient Temperature	25	°F	Number of Heaters	N/A	
Safety Factor	15	%	Startup Ambient Temperature	40	°F	Heater Type	BSX 10-2	
Heat Sink Factor	1.158		Max. Ambient Temperature	104	°F	Voltage	208	VAC
Vessel Orientation	Vertical		Wind Speed	20	mph	Total Applied Power/Heat	998	Watts
Vessel Support	Concrete Pad		Max. Exposure Temperature	50	°F	Start Up Current	10.59	Amps
Vessel Top	Flat		Max. Product Temperature	150	°F	Operating Current	4.8	Amps
Vessel Bottom	Flat/Concrete		Area Classification	Non-hazardous (Ordinary)		Number of Circuits	1	
Vessel Diameter	6.	ft	Autoignition Temperature	N/A	°F	Design Cable Output	4.6	Watts/ft
Vessel Height	7.5	ft	Product Name	Sodium Hydroxide (50%)		U3	N/A	BTU/hr-ft²-°F
Vessel Width	N/A	ft	Product Density	94.86	lb/ft³	Circuit Length	195	ft
Wall Material	HDPE		Product Specific Heat	.77	Btu/lb°F	Circuit Breaker Size	30	Amps
Wall Thickness	.5	in	Product Thermal Conductivity	.38	BTU/hr-ft-°F			
Insulation Type	MF (ASTM C612)		Product Viscosity	48.58	cP			
Insulation Thickness	2	in	Product Coeff. Cubical Expansion	.0003				
Insulation Coverage	Full Insulation		Product Heat of Fusion/Vaporization					
Insulation K Value	.019	BTU/hr-ft-°F	Normal Product Level	7.5	ft			
Mean Insulation Temp.	48	°F	Minimum Product Level	3.75	ft			
Jacket Emissivity	Aluminum (.12)		Additional Load	200	Watts			

Catalog Number	Description	Quantity	Units	Unit/Extended Pricing
BSX 10-2	Electric heat tracing cable	195	ft	
AL-30L	Aluminum tape	2	Roll	
(see catalog for controllers)	Temperature controller	1	Each	
(see cat. for power connection kits)	Power connection kit	1	Each	
(see cat. for end termination kits)	End termination kit	1	Each	

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Project		Identification		Operating Temperatures		
Job Name	Digester Improv.	Record	1	Maintenance Temperature	90	°F
Project No.	SST FOG Tank	Circuit No.		Vessel Outer Wall Temp	116	°F
Project Ref.	FOG Tank	Vessel		Film Temperature	N/A	°F
Designer	Gary J- Qcon	Panel/Breaker No.		Heater Temperature	230	°F
Job No.	TNK 07-700	Isometric No.		Max. Heater Temperature	N/A	°F

Vessel & Insulation			Product & Environment			Heater Performance Data		
Design Heat Loss	3592.	Watts	Min. Ambient Temperature	25	°F	Number of Heaters	N/A	
Safety Factor	15	%	Startup Ambient Temperature	50	°F	Heater Type	HTSX 20-2	
Heat Sink Factor	1.056		Max. Ambient Temperature	104	°F	Voltage	240	VAC
Vessel Orientation	Vertical		Wind Speed	20	mph	Total Applied Power/Heat	3,945	Watts
Vessel Support	Concrete Pad		Max. Exposure Temperature	200	°F	Start Up Current	20.97	Amps
Vessel Top	Flat		Max. Product Temperature	150	°F	Operating Current	16.44	Amps
Vessel Bottom	Flat/Concrete		Area Classification	Non-hazardous (Ordinary)		Number of Circuits	1	
Vessel Diameter	19.	ft	Autoignition Temperature	N/A	°F	Design Cable Output	20.7	Watts/ft
Vessel Height	12.	ft	Product Name	Oil: SAE 90		U3	N/A	BTU/hr-ft²-°F
Vessel Width	N/A	ft	Product Density	56.14	lb/ft³	Circuit Length	183	ft
Wall Material	Stainless Steel		Product Specific Heat	.45	Btu/lb°F	Circuit Breaker Size	30	Amps
Wall Thickness	.2	in	Product Thermal Conductivity	.07	BTU/hr-ft-°F			
Insulation Type	MF (ASTM C612)		Product Viscosity	273.14	cP			
Insulation Thickness	2	in	Product Coeff. Cubical Expansion	.0004				
Insulation Coverage	Full Insulation		Product Heat of Fusion/Vaporization					
Insulation K Value	.019	BTU/hr-ft-°F	Normal Product Level	12.	ft			
Mean Insulation Temp.	53	°F	Minimum Product Level	6.	ft			
Jacket Emissivity	Aluminum (.12)		Additional Load	.	Watts			

Catalog Number	Description	Quantity	Units	Unit/Extended Pricing
HTSX 20-2	Electric heat tracing cable	183	ft	
AL-30H	Aluminum tape	2	Roll	
(see catalog for controllers)	Temperature controller	1	Each	
(see cat. for power connection kits)	Power connection kit	1	Each	
(see cat. for end termination kits)	End termination kit	1	Each	

Controller Global Settings Table	Setting
Data Highway Address (1 to 247)	NA
First Circuit Number (1 to 99)	NA
Control Type (On-Off, On-Off w/SoftStart, or Proportional)	On-Off
STD Alarm Relay Action (Norm Open or Norm Close)	Norm Open
Pipe Sense or Ambient Sense 1 RTD	Pipe Sense
Self Test Interval (0=Off or 2-99 hours)	Off
Temperature Units (°F or °C)	F

POWER DISTRIBUTION PANEL NUMBER:

Ambient Temperature (°F):

	Design Information						Controller Settings													Start-up Data after heater on 15 minutes			
Control Point (CKT)	Heater Circuit #	Circuit Breaker #	Controller S/N	Maintain Temp °F	Maximum Operating Temp °F	Megger Reading Minimum 20 Megohms at 2500 vdc Pass or Fail	Circuit Status (Enabled or Disabled)	Maintain Temp °F	RTD Sensor Fault (Turn Circuit On or Off)	Control Band °F	High Temp Alarm °F	High Temp. Trip (On or Off)	Low Temp. Alarm °F	High Current Alarm A	High Current Trip (On or Off)	Low Current Alarm A	Ground Current Alarm mA	Ground Current Trip (On or Off)	Max Power at Maintain Temp %	Visual Inspection of Connection Kits	Temp °F	Heater Current A	Ground Leakage Current mA	Time after Heater Turn On min
1																							
2																							
3																							
4																							
5																							
6																							

	Installation Comments	Date	REVIEWED &	APPROVED		Manteca WQCF Digester Improvement Start-Up and Final Commissioning Form TCM2 Controller Settings		