Raychem

Manual / Auto Control System (MACS)

Setup and Operation Manual

chemelex

CONTENTS

GENERAL DESCRIPTION

The Raychem Manual/Auto Control System uses an ambient sensing controller to provide an energy-efficient control system.

The ambient sensing controller feeds power to the heater circuits only when the sensed ambient temperature is below the controller's Heater On set value and above its Low Temp Cutout set value.

The temperature controller has been factory programmed and is ready for use. Refer to the following steps for proper initial setup and continuing operation of the Manual/Auto Control System (MACS):

SYSTEM SETUP

1. To familiarize yourself with the general configuration of the MACS, refer to one of the following drawings:
   - R50-050-A017 (120V incoming power)
   - R50-050-A009 (208/120V incoming power)
   - R50-050-A008 (240/120V incoming power)
   - R50-050-A013 (480/277V incoming power)
2. Refer to the project specific RIM System Control Panel drawing for proper wiring of the RIM heater sections and the RTD to the terminal blocks in the control panel.
3. For proper positioning of the Ambient Sensing RTD, refer to drawing R50-052-A020.

OPERATION MODES

1. Auto Mode Operation: When a given Control Zone's HOA switch is set to Auto Mode and the ambient temperature falls below the controller's Heater On set point, the Heater On light will illuminate and the heaters in that Control Zone will be energized. When the ambient temperature falls below the controller's Low Temp Cutout set point, the Low Temp Cutout light will illuminate and the given Control Zone's heaters will be de-energized. Once the sensed ambient temperature rises above the Low Temp Cutout set point the heaters will again be energized.
2. Hand Mode Operation: When a given Control Zone's HOA switch is set to Hand Mode (manual operation), heaters in that Control Zone will be energized without regard to sensed temperature.
3. Off Mode: When a given Control Zone's HOA switch is set to Off Mode, heaters in that Control Zone will be prevented from being energized without regard to sensed temperature.

FALL TESTING

Some time prior to the winter season, test each branch circuit for proper heater operation. First, confirm all branch circuit breakers are set to the off position and that the main power feed into the control panel is delivering the proper voltage. Next, set each Control Zone's 3-position HOA switch to Hand mode. Next, turn on each circuit breaker, one at a time, at 20 to 30 second intervals. Once all circuits are operational, leave them on for 10-15 minutes. If any circuit breaker trips, reset it for a second test. If the circuit breaker trips again, refer to the "RIM System Troubleshooting Guide". Once testing is complete, set the HOA switches to Off mode.

WINTER STARTUP

At the onset of snow accumulation on the roof surface (typically November/December), turn on the branch circuit breakers and set each Control Zone's 3-position HOA switch to Auto mode. Or, if a significant amount of snow has accumulated, the HOA switch may be set to Hand mode until the snow has been melted off the RIMpanels, then the HOA switches may be set to Auto mode.

UNUSUAL WINTER CONDITIONS

Most winters start with gradual snow accumulation on the roof in November/December and continued snow accumulation through March/April. Sometimes, however, the snow either melts or slides off roof areas, and those areas remain without snow until the next snowstorm. At the option of the owner or responsible party, individual heater circuits in those areas may be de-energized (via turning off branch circuit breakers), or entire heater Sections may be turned off (via Control Zone HOA switch set to Off mode). The owner or responsible party must then remember to reset branch circuit breakers or HOA switches back to the proper operational position.

SPRING SHUTDOWN

In the spring when snow has melted off the roof surface, the owner or responsible party should de-energize (turn off branch circuit breakers) the RIM System for the summer. As mentioned above, some roof sections (primarily south facing) can be de-energized before the balance of the roof sections (north facing and shaded areas).

AMBIENT TEMPERATURE SENSING WITH LOW TEMP CUTOUT FOR ROOF ICE MELT SYSTEMS

Heater On Set Value

When the ambient temperature falls below the Heater On set value (SEt 1), the Heater On Indication Light will illuminate, indicating that the heater circuits are energized (unless the ambient temperature falls below the Low Temp Cutout set value).

Adjusting Set Values

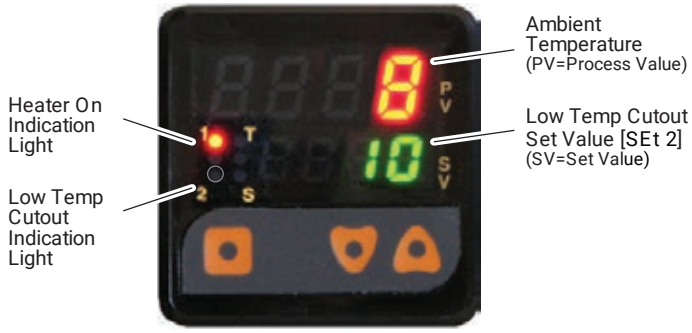
Two set values are available:
SEt 1 = Heater On
SEt 2 = Low Temp Cutout

To toggle between which set value is displayed, press the up arrow. To change the displayed set value, hold down the square button and press the up or down arrow (the longer the arrow button is held down, the faster the value will change).

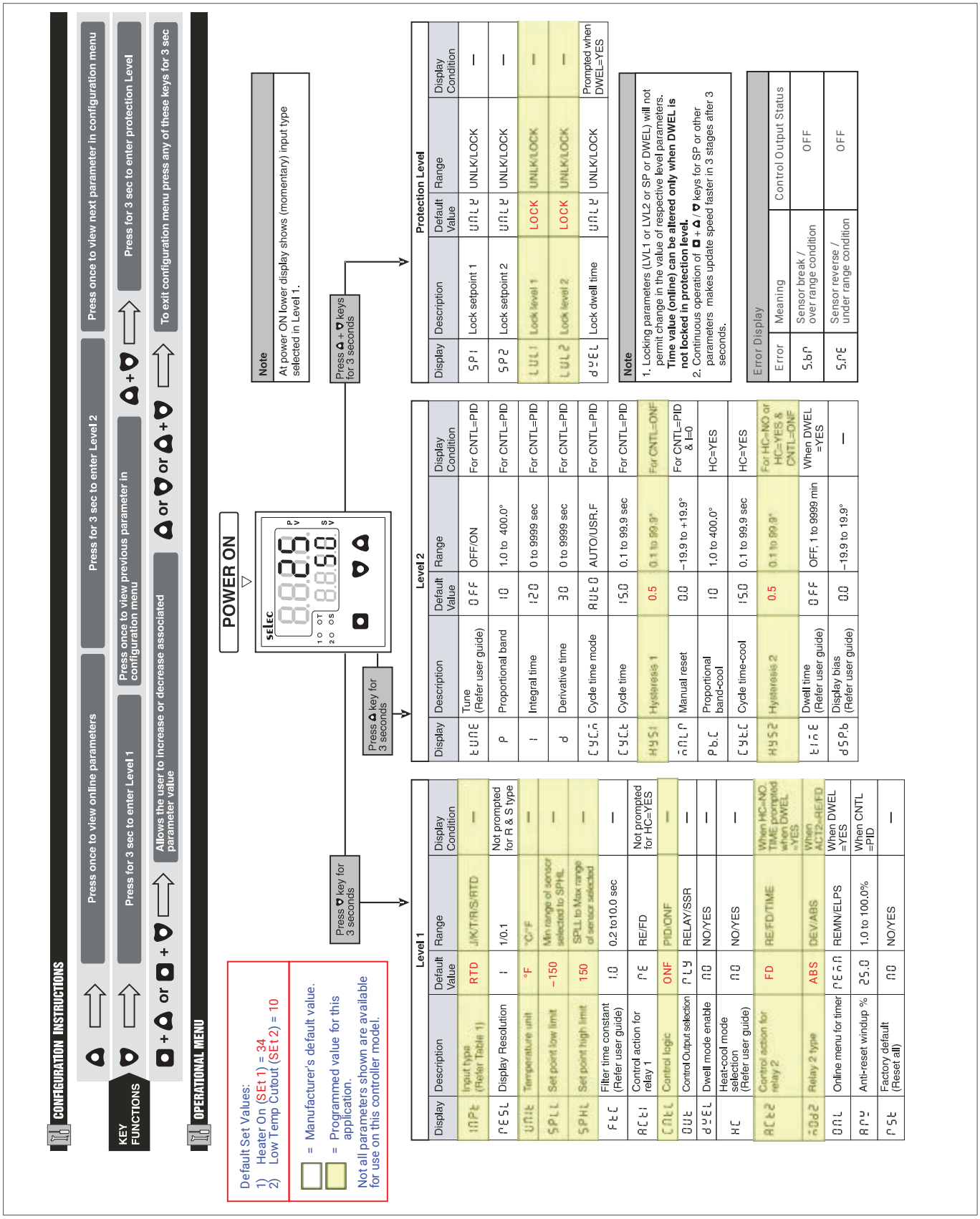
Low Temp Cutout Set Value

If the ambient temperature falls below the Low Temp Cutout set value (SEt 2), the Low Temp Cutout Indication Light will turn off, indicating that the heater circuits have been de-energized (the Heater On Indication Light remains on). The heater circuits will be re-energized when the ambient temperature rises above the Low Temp Cutout set value.

Note: Low Temp Cutout can be avoided by setting its value below the lowest expected ambient temperature (for example: –150).



PROGRAM VALUES - AMBIENT TEMPERATURE SENSING WITH LOW TEMP CUTOUT FOR ROOF ICE MELT APPLICATIONS



Level 1

Display	Description	Default Value	Range	Display Condition
inPt	Input type (Refer Table 1)	RTD	J/K/T/R/S/RTD	—
rESL	Display Resolution	1	1/0.1	Not prompted for R & S type
UnIt	Temperature unit	°F	°C/°F	—
SPLL	Set point low limit	−150	Min range of sensor selected to SPHL	—
SPHL	Set point high limit	150	SPLL to Max range of sensor selected	—
Ftc	Filter time constant (Refer user guide)	1.0	0.2 to10.0 sec	—
Act1	Control action for relay 1	rE	RE/FD	Not prompted for HC=YES
Cntl	Control logic	ONF	PID/ONF	—
Out	Control Output selection	rLY	RELAY/SSR	—
dwEL	Dwell mode enable	no	NO/YES	—
HC	Heat-cool mode selection (Refer user guide)	no	NO/YES	—
Act2	Control action for relay 2	FD	RE/FD/TIME	When HC=NO TIME prompted when DWEL =YES
rOd2	Relay 2 type	ABS	DEV/ABS	When ACT2=RE/FD
onL	Online menu for timer	rEmn	REMN/ELPS	When DWEL =YES
Aru	Anti-reset windup %	25.0	1.0 to 100.0%	When CNTL =PID
rSt	Factory default (Reset all)	no	NO/YES	—

Level 2

Display	Description	Default Value	Range	Display Condition
tUnE	Tune (Refer user guide)	OFF	OFF/ON	For CNTL=PID
P	Proportional band	10	1.0 to 400.0°	For CNTL=PID
I	Integral time	120	0 to 9999 sec	For CNTL=PID
d	Derivative time	30	0 to 9999 sec	For CNTL=PID
CYC.n	Cycle time mode	AUtO	AUTO/USR.F	For CNTL=PID
CYCt	Cycle time	15.0	0.1 to 99.9 sec	For CNTL=PID
HYS1	Hysteresis 1	0.5	0.1 to 99.9°	For CNTL=ONF
rnLn	Manual reset	0.0	−19.9 to +19.9°	For CNTL=PID & I=0
Pb.C	Proportional band-cool	10	1.0 to 400.0°	HC=YES
CYt.C	Cycle time-cool	15.0	0.1 to 99.9 sec	HC=YES
HYS2	Hysteresis 2	0.5	0.1 to 99.9°	For HC=NO or HC=YES & CNTL=ONF
tIME	Dwell time (Refer user guide)	OFF	OFF, 1 to 9999 min	When DWEL =YES
dSPb	Display bias (Refer user guide)	0.0	−19.9 to 19.9°	—

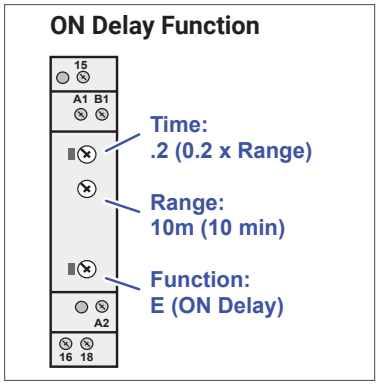
Protection Level

Display	Description	Default Value	Range	Display Condition
SP1	Lock setpoint 1	UnLU	UNLK/LOCK	—
SP2	Lock setpoint 2	UnLU	UNLK/LOCK	—
LUL1	Lock level 1	LOCK	UNLK/LOCK	—
LUL2	Lock level 2	LOCK	UNLK/LOCK	—
dwEL	Lock dwell time	UnLU	UNLK/LOCK	Prompted when DWEL=YES

Error Display

Error	Meaning	Control Output Status
S.br	Sensor break / over range condition	OFF
S.rE	Sensor reverse / under range condition	OFF

INTERVAL TIMER



This timer/ function may be used in the MACS panel to limit in-rush current

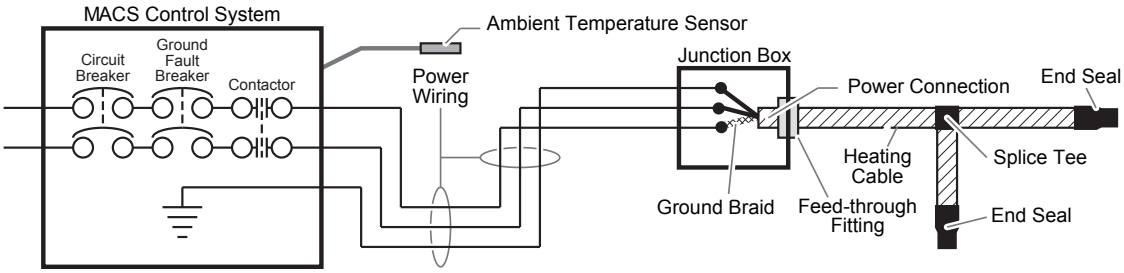
Function E (ON Delay) delays operation of a group of heaters for the timer's specified interval (to reduce overall inrush current). Two events can initiate this interval:

1. Control system's HOA switch is reset from Off or Auto mode to Hand mode.
2. Control system's HOA switch is set to Auto mode and ambient conditions cause temperature controller to call for heater power.

Interval can be field adjusted for local ambient conditions

Note: Refer to the project control panel wiring diagram and notes to determine the type of function the timer is used for, and the pre-set factory settings.

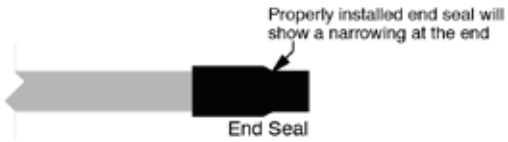
SYSTEM TROUBLESHOOTING GUIDE, MACS



General Wiring Layout Using MACS Control System

The RIM System must be installed and tested in accordance with manufacturer's installation and testing instructions

	Symptom	Possible Cause	Remedy
1	RIM System will not heat when ambient temperature is below Heater On set point.	a. Circuit breaker and /or ground fault projection device turned off or tripped.	a. Turn on / reset.
		b. Interconnect wiring has open circuit.	b. Check continuity of wiring and connections via voltage reading at junction box. Check all splices in condolet boxes.
		c. Contactor coil not powering.	c. Check for and reconnect any loose wires. Refer to control panel wiring diagram S-W-008 for proper wiring.
		d. Contactor defective or failed.	d. Coil is defective and contactor must be replaced.
		e. Temperature controller Heater On set-point too low.	e. Raise set-point (factory set at 34° F). Refer to Temperature Controller programming sheet.
2	Ambient temperature displayed on controller is higher than actual ambient temperature.	a. Ambient temperature controller sensor bulb is sensing a higher than ambient temperature (exposed to the solar gain or is near a heat source such as an exhaust fan).	a. Reposition sensor to a true ambient temperature location away from heat source. Refer to drawing R50-052-A024.
		b. Sensor extension wire gauge is too small.	b. Proper 300 Vac copper extension wire gauge size versus length: 16 guage up to 60 ft max, 14 gauge up to 120 ft max, 12 gauge up to 240 ft max 10 gauge up to 480 ft max

3	Part of a circuit with a line or tee splice is not heating.	a. Improperly installed heating cable splice kit.	a. Replace heating cable splice kit, carefully following installation instructions.
4	Selec TC544A Controller displays **S.br** message	a. One or both ambient temperature sensor lead wires not properly connected.	a. Check all wire connections between control panel terminal blocks and ambient temperature sensor factory lead wires. Refer to control panel wiring diagram for proper terminal block connections.
		b. Damaged or defective ambient temperature sensor.	b. Refer to RTD Troubleshooting page to evaluate ambient temperature sensor functionality.
5	Selec TC544A Controller displays **S.rE** message	a. Ambient temperature sensor lead wires reversed.	a. Confirm that jumper wire on temperature controller is connected between pins 7 and 8.
6	Circuit breaker or ground fault protection device continues tripping.	a. Short circuit in heating cable or wiring has occurred.	a. Disconnect the power wires from circuit breaker and perform insulation resistance test of the power wiring at the circuit breaker. Refer to Insulation Resistance Test document H59331 in the Raychem RIM System Installation and Operation Manual (pp 15-16). If the test passes, proceed to Step “b”. If the test fails at the power wiring, perform test on heating cable at local junction box by disconnecting power wires from heating cable (for multiple heater cable runs on same circuit, test each run separately). If the test passes for each heating cable run, test power wiring. If insulation test fails for power wiring, fix or replace wiring until wiring passes test. If the test fails for a run of heating cable, check for moisture in junction box, damage to the heating cable, or improper power connection, splice or end seal installation. Repair or replace heating cable and components using approved materials. Retest. 
		b. Ground fault protection device rating is too low (e.g., 5mA).	b. Replace with 30mA EPD (Equipment Protection Device) ground fault protection device.
		c. Defective ground fault protection device.	c. Replace ground fault protection device as required.

RTD SENSOR TROUBLESHOOTING

1. **Use an accurate measuring device (quality glass or digital thermometer) to measure the ambient or surface temperature at the exact location of the RTD.**

2. **Disconnect the RTD at the terminal blocks in the control panel and measure the resistance across the two wires.**

3. **Consult the RTD Sensor Resistance vs Temperature chart to see if the measured resistance value matches the value the chart indicates it should be at the measured temperature.**

3.1. If the two resistance values match or are very close, reconnect the RTD to the terminal blocks and check the controller readout. Otherwise go to step 3.2.

3.1.1. If the readout value matches or is very close to the measured temperature value then the system is working correctly.

3.1.2. If the readout value is significantly different from the measured temperature value, check connections and components inside the control panel (refer to the control panel wiring diagram).

3.1.3. If no obvious control panel wiring or component problem (such as a loose connection) shows up during the inspection, consult Chemelex

3.2. If the two resistance values are significantly different, then a wiring or connection problem exists somewhere between the control panel and the RTD, or in the RTD itself.

3.2.1. Locate the point where the RTD's factory leads are connected to the extension wire leads and disconnect them.

3.2.2.Measure the resistance across the RTD's two wires.

3.2.3. Consult the RTD Sensor Resistance vs Temperature chart to see if the measured resistance value matches the value the chart indicates it should be at the measured temperature.

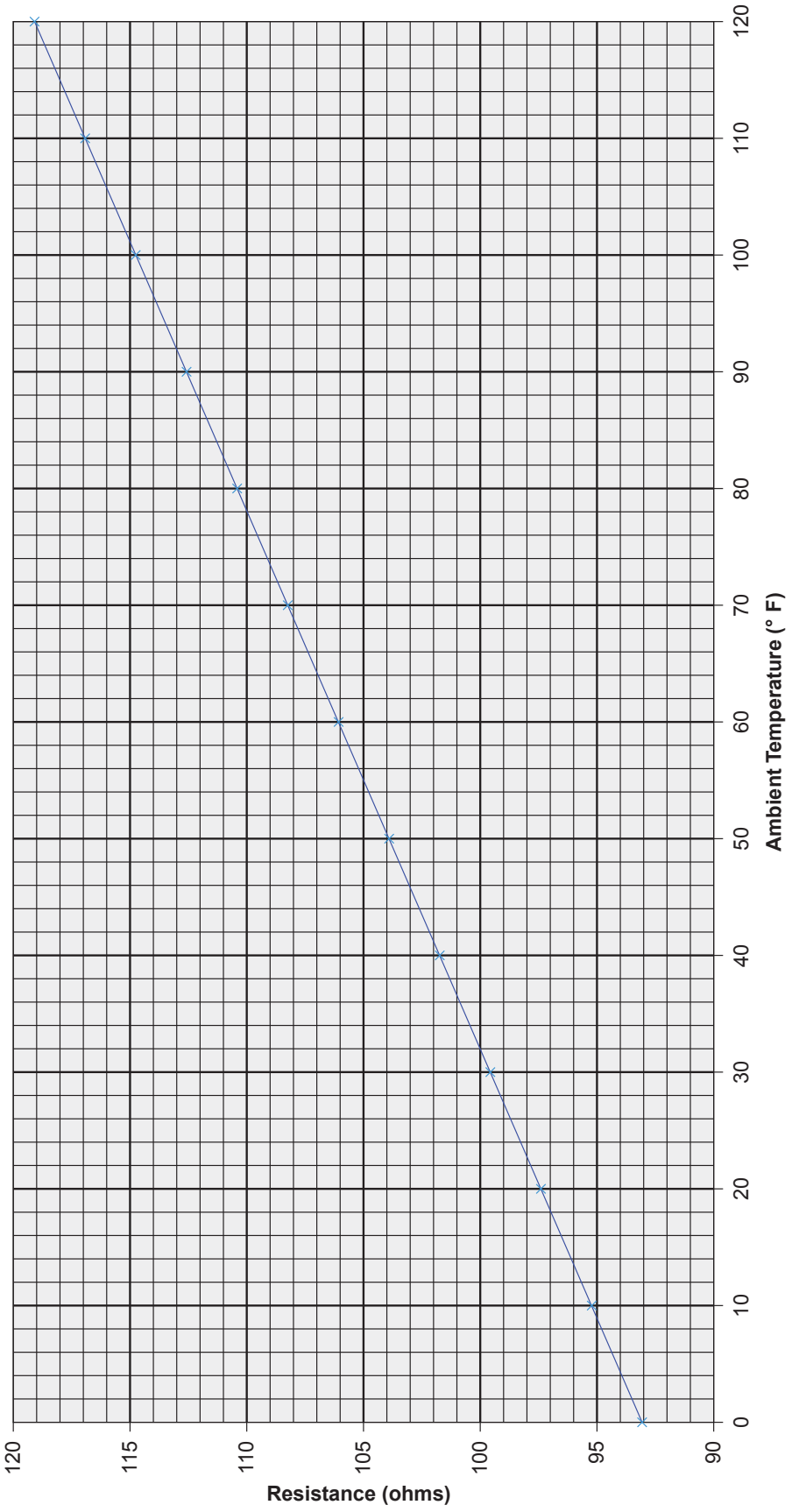
3.2.3.1. If the two resistance values match or are very close, then there is a wiring or connection problem somewhere between the control panel and the RTD. Consult Table 1, below, for proper wire gauge versus extension wire length. Also check that all wire connections are clean and secure.

3.2.3.2. If the two resistance values are significantly different, then the RTD must be replaced.

RTD extension Wire requirements
a. Copper extension wire, 300 Vac rated insulation:
16 gauge up to 60 ft max 14 gauge up to 120 ft max
12 gauge up to 240 ft max
10 gauge up to 480 ft max

Table 1

RTD SENSOR RESISTANCE VS TEMPERATURE



North America

Tel +1 800 545 6258
info@chemelex.com

chemelex
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Raychem Tracer Pyrotenax Nuheat

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