Job: Cherry Creek Mall

Engineer: E&S

Contractor: HPE

Prepared By: A Deal Date: 12-11-14

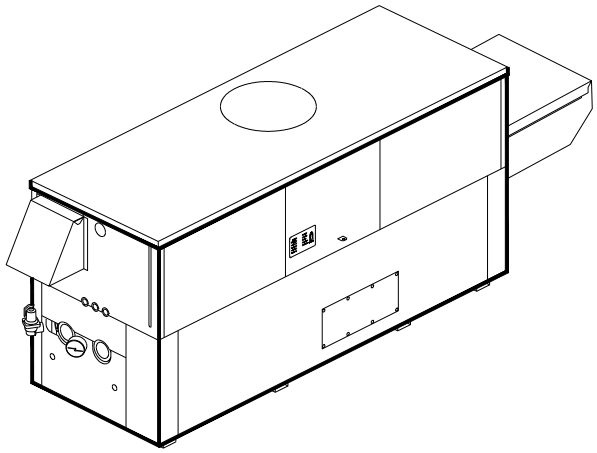
Model: H-2072BE Indoor/Outdoor: outdoor MBTUH Input: 2,070,000

Hi Delta™ - Type H

Hydronic Heating Boiler
Models 992BE-2342BE

87% Efficiency

- **100% Factory Fire Tested**
- **Efficiency: 87%**
- **Maximum Outlet Temperature: 230°F**
- **Minimum Non-Condensing Inlet Temperature: 120°F**
- **Thermal Shock Proof Heat Exchanger**
- **Limited Twenty-Year Thermal Shock Warranty**
- **Limited Ten-Year Closed-System Heat Exchanger Warranty**
- **Diagnostic Center with Fault History**
- **PolyTuf Powder Coated Cabinet**
- **No Combustible Floor Shield Required**
- **Fan-Assisted**
- **Patented Burner Security Blanket**



Heat Exchanger
- H Stamp
- Headers
  - ☐ Glass-Lined Cast Iron – Standard
  - ☒ Bronze – Option A-1
- ASME Inspected and Stamped 160 PSIG Working Pressure
- National Board Approved
- Fin Tubing
  - ☒ Copper – Standard
  - ☐ Cupro Nickel – Option A-3
- ASME Steel Tube Sheet
- Silicone High Temp. O-Rings
- ASME Pressure Relief Valve
  - ☐ 60 PSIG – Standard
  - ☒ 75 PSIG – Optional
- Temperature and Pressure Gauge
- Water Connections
  - ☒ Left – Standard
  - ☒ Right – Option A-6

Controls
- 120V, 60Hz, 1∅ Power Supply
- 120/24V 60Hz Transformer
- 100% Shut-Off/Lockout
- Hot Surface Ignition
- Remote Flame Sensor
- High Limit Control, Manual Reset
- On/Off Power Switch
- Manual Shut-Off, Front-Mounted
- Flow Switch
- Blocked Vent Pressure Switch
- Combustion Air Proving Switches
- Economaster Pump Time Delay
- Enable/Disable

Gas Train
- Manual Gas Shut-Off Valve(s)
- Gas Pressure Regulator
- Safety Shut-Off Valve
- Firing Control Valve
- Low Gas Pressure Switch, Manual
- Firing Mode
  - ☐ 3-Stage: Model 992BE
  - ☒ 4-Stage: Models 1262BE-2342BE
- Fuel
  - ☒ Natural Gas
  - ☐ Propane Gas
  - ☐ 4" WC Gas Supply Pressure G-20
- Design Certified ANSI Z21.13/ CSA 4.9

Construction
- Indoor/Outdoor Construction
- Enclosed Front Controls

Venting
- Vent Location
  - ☒ Top – Standard
  - ☐ Rear – Option D-14
- Vent Termination Cap
  - ☒ Outdoor D-11
  - ☐ Indoor, Horizontal D-15
  - ☐ Indoor, Vertical (by others)
- Combustion Air
  - ☐ In-Line Filter Kit (TruSeal only) D-17
  - ☐ Air Intake Elbow D-16
- Extractor – Optional
  - ☐ By others
  - ☒ Not required

Burner
- Ultra-Low NOx: Less than 30 PPM

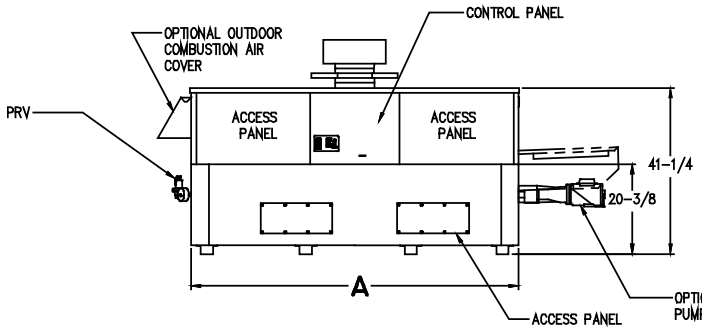
Temperature Controls
- ☒ B-36 TempTracker Digital Controller, 4-Stage
- ☐ Y-241 Electronic Sequencer, 4-Stage
- ☐ Y-281 Electronic Sequencer, 8-Stage

Options
- ☐ C-6 Ignition Module, Manual Reset
- ☐ D-21 TruSeal™ Direct Vent
- ☐ F-10 Low Water Cut-Off, Remote Probe
- ☒ I-1 High Limit Control, Auto Reset
- ☐ P-__ Pump: _____ HP, 120V, 1∅, 60Hz
  Water Hardness: _____ GPG
  ☐ Cast Iron ☐ Bronze
  ☐ Mounted ☐ Loose
  ☐ Front ☐ Rear
- ☒ P-26 Cold Water Start (See 2000.49)
- ☒ S-2 High Gas Pressure Switch, Manual
- ☐ X-1 SureRack™ Kit
- ☐ X-2 SureRack Add-on
- ☒ B-36 Boiler sequencer

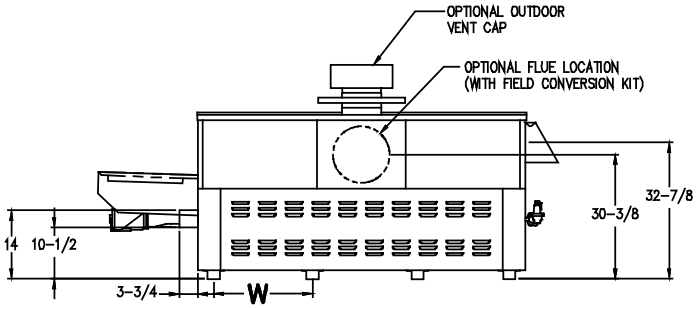
Regulatory Agency Requirements
- ☒ CSD-1

Hi Delta – Type H
Models 992BE-2342BE, 87% Efficiency

Model H-2072BE

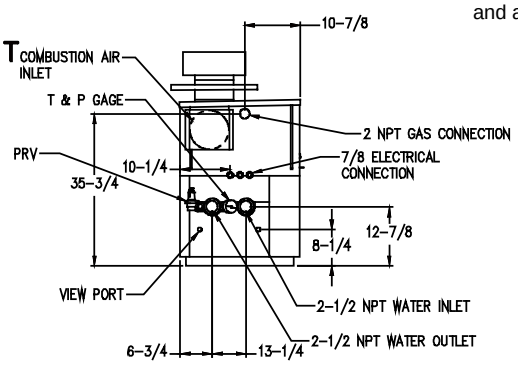


FRONT VIEW

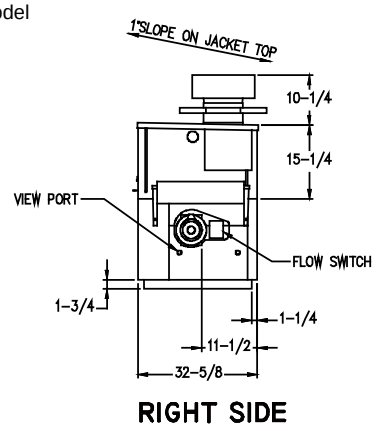


BACK VIEW

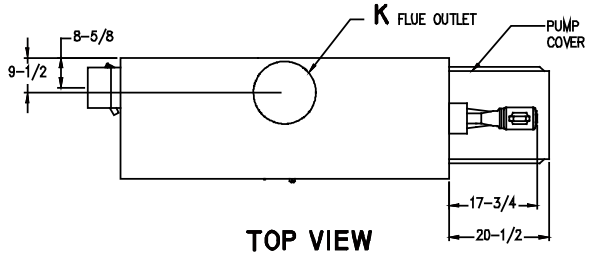
NOTE: Pump location varies based on model and application.



LEFT SIDE



RIGHT SIDE



TOP VIEW

RATES OF FLOW AND PRESSURE DROPS

Model	20°F ΔT		30°F ΔT		Min. Flow			Max. Flow		
	GPM	ΔP (ft)	GPM	ΔP (ft)	GPM	ΔP (ft)	ΔT	GPM	ΔP (ft)	ΔT
992BE	86	6.0	57	2.7	43	1.6	40	132	14.0	13
1262BE	110	10.7	73	4.9	55	2.8	40	132	15.5	17
1532BE	132	16.5	89	7.6	67	4.4	40	132	16.5	20
1802BE	N/A	N/A	104	11.6	78	6.5	40	132	18.0	24
2002BE	N/A	N/A	116	15.1	87	8.7	40	132	19.5	26
2072BE	N/A	N/A	120	16.2	90	9.3	40	132	19.5	27
2342BE	N/A	N/A	N/A	N/A	102	13.0	40	132	21.0	31

Basis is 30 GPM or 40°F ΔT for minimum flow, 132 GPM for maximum flow.

SPECIFICATIONS

Model	MBTUH Input	MBTUH Output	Firing Stages	A Width	H NPT	K	T	W	Amp. Draw*	Approx. Shipping Wt. (Lbs.)
992BE	990	861	3	57-1/8	2-1/2	10	10	16-13/16	<12	900
1262BE	1260	1096	4	68-1/2	2-1/2	12	10	20-9/16	<12	1010
1532BE	1530	1331	4	79-7/8	2-1/2	12	10	24-3/8	<12	1225
1802BE	1800	1566	4	91-1/8	2-1/2	14	10	28-1/8	<12	1350
2002BE	1999	1739	4	102-1/2	2-1/2	14	10	31-15/16	<12	1450
2072BE	2070	1801	4	102-1/2	2-1/2	14	10	31-15/16	<12	1450
2342BE	2340	2036	4	113-7/8	2-1/2	16	10	35-11/16	<12	1520

Dimensions are in inches.

* Without pump

NOTES: 1. Rates shown are for natural or propane gas, and elevations up to 5,000 feet. For installation above 5,000 feet, please contact manufacturer.
2. Required natural gas pressure is 7 - 14" WC. Required propane gas pressure is 11 - 14" WC.

Raypak, Inc. ▪ 2151 Eastman Avenue, Oxnard, CA 93030 ▪ (805) 278-5300 ▪ Fax (800) 872-9725 ▪ www.raypak.com
Raypak Canada Ltd. ▪ 2805 Slough St., Mississauga, Ontario, Canada L4T 1G2 ▪ (905) 677-7999 ▪ Fax (905) 677-8036 ▪ www.raypakcanada.com

Catalog No.: 2000.451D Effective: 1-1-07 Replaces: 10-5-05

Protect Your Boiler Investment

Prevent condensation with Raypak®

Cold Water Solutions

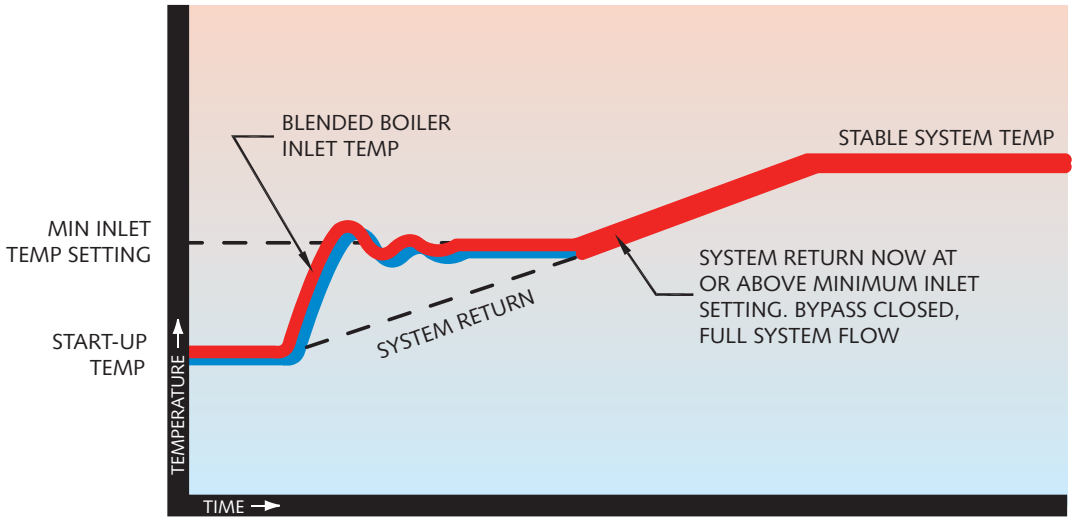
Raypak®

A Rheem® Company

COLD WATER START

It is commonly known that prolonged internal condensation will dramatically shorten the life of standard boilers and water heaters. While Raypak boilers and water heaters can operate without harmful condensation at lower inlet water temperatures than the competition, there are still applications that require reliable protection against harmful condensation caused by frequent, extended, cold water start-ups. Raypak's **Cold Water Start** protection system utilizes a proportional three-way valve to bypass water from the boiler outlet to the inlet during start-up, when the system return water temperature is below the minimum acceptable level.

Boiler Start-Up Cycle



Raypak's Cold Water Start system:

- Continuously monitors and adjusts inlet water temperature to prevent condensation
- Regulates minimum inlet water temperature during system start-up
- Shuts down boiler if the minimum inlet water temperature is not achieved
- Eliminates jobsite set-up with proprietary self-tuning controller and system-matched components
- Utilizes proportional three-way valve to achieve bypass
- Allows high-temperature system operation without cycling on high-limit
- Activates alarm if shutdown occurs (option)

APPLICATIONS

Commercial Hydronic Heating
- Office Buildings
- Factories/Warehouses
- Greenhouses

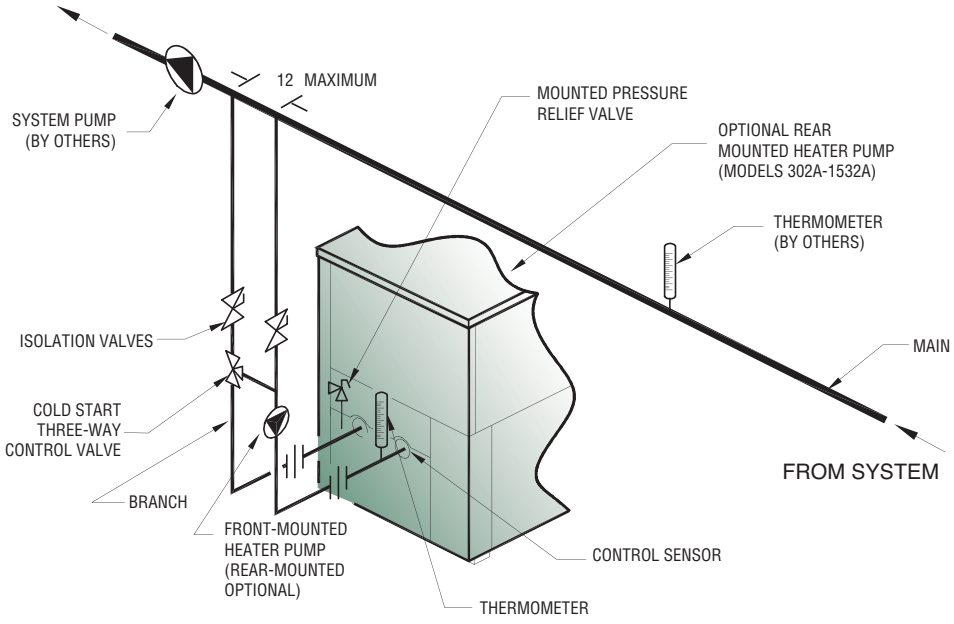
Domestic Hot Water Supply
- Restaurants
- Weekend Shut-down (e.g. 6-day/week shopping center)
- Dump Loads
- 87% Efficiency Water Heaters
- Intermittent Industrial Process

TECHNICAL DATA

COLD WATER START

Order Option		Heater		Pipe Size	Pump	
Bronze	Cast Iron	Hi Delta Model	ΔT (°F)		Location	Flow Rate (GPM)
P-12	P-22	302A	12	2”	Front	36-50
		402A	16			
		502A	20			
		602A	24			
		752A	30			
P-13	P-23	502A	12	2”	Rear	70-80
		602A	15			
		752A	18			
		902A	20			
P-14	P-24	992A	20	2-1/2”	Rear	85-95
		1262A	24			
		1532A	30			
P-15	P-25	992A	15	2-1/2”	Front	105-115
		1262A	20			
		1532A	24			
		1802A	30			
P-16	P-26	1532A	20	2-1/2”	Front	115-130
		1802A	24			
		2002A	26			
		2072A	27			
		2342A	30			

TYPICAL BOILER PIPING*

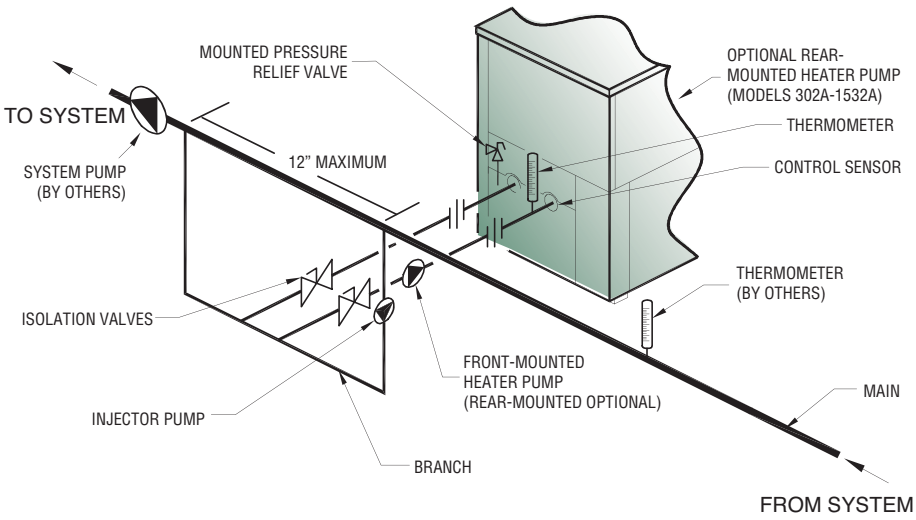


* Items required for cold water operation are shown.
Other standard system components have been omitted for clarity.

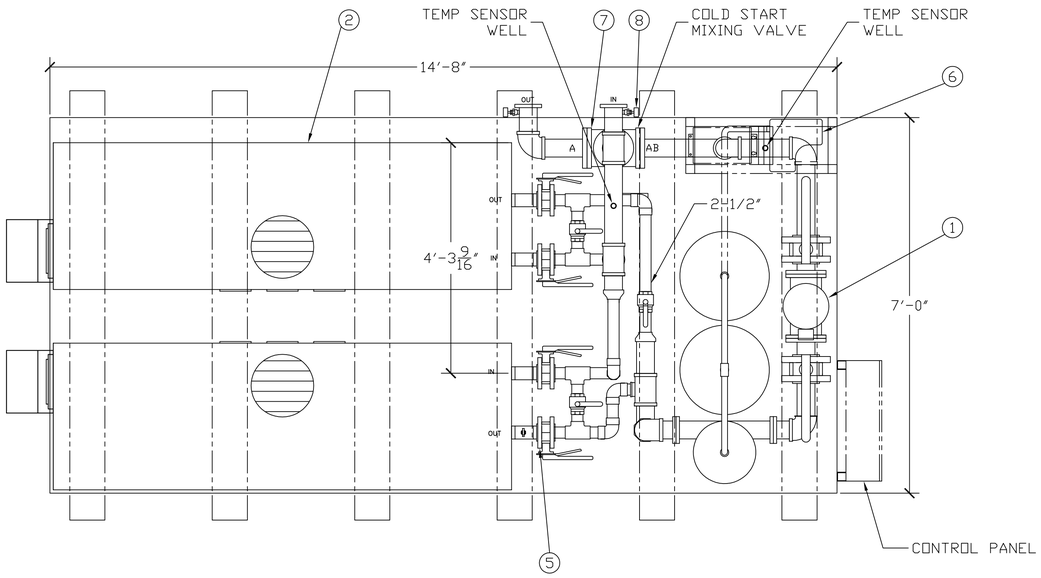
COLD WATER RUN

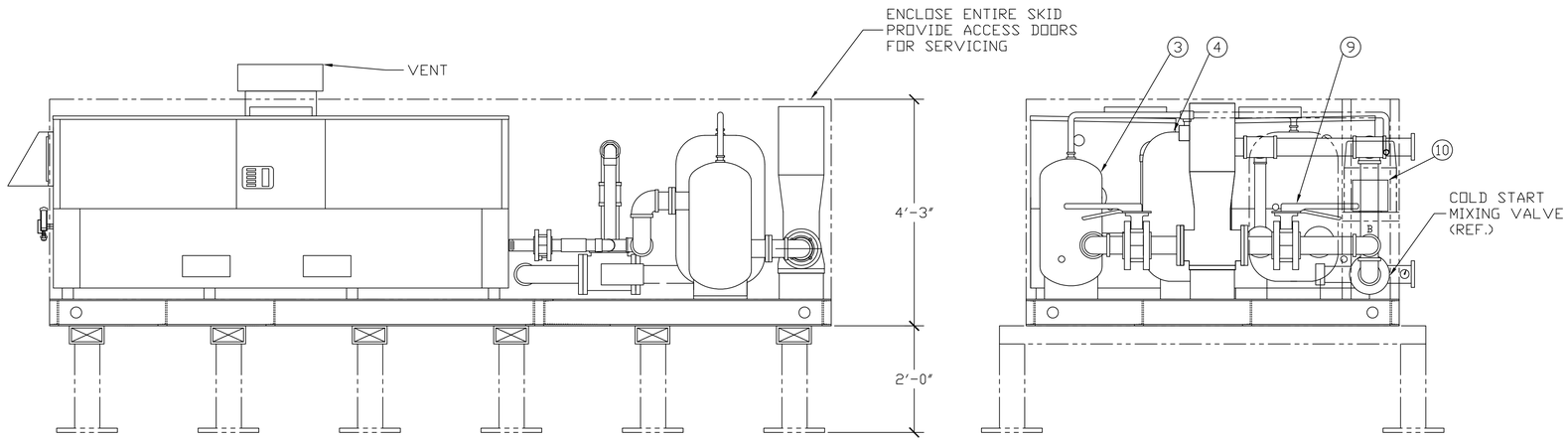
Order Option		Heater				Injector Pump	
Bronze	Cast Iron	Hi Delta Model	Flow Rate (GPM)	ΔT (°F)	Pump Location	Flow Rate (GPM)	HP
P-30	P-36	302A	32	16	Front	13	1/4
		402A	34	20	Front	17	1/4
P-31	P-37	502A	42	20	Rear	22	1/4
		652A	55	20	Rear	28	1/4
P-32	P-38	752A	63	20	Rear	32	1/4
		902A	76	20	Rear	38	1/4
P-33	P-39	992A	83	20	Rear	42	1/4
		1262A	107	20	Rear	54	1/3
P-34	P-40	1532A	120	22	Front	62	1/3
		1802A	120	25	Front	68	1/3
P-35	P-41	2002A	132	26	Front	74	3/4
		2072A	132	27	Front	75	3/4
		2342A	132	30	Front	80	3/4

TYPICAL BOILER PIPING*



* Items required for cold water operation are shown.
Other standard system components have been omitted for clarity.





Skid assembly weight details
Estimated dry weight : 4,982 lbs
Estimated wet weight : 5,670 lbs
Components:
Boiler weight each (dry) : 1,450 lbs
Boiler weight each (wet) : 1,490 lbs
Pump weight : 272 lbs

EQUIPMENT LIST

ITEM	QTY.	DESCRIPTION
1	1	GRUNDFOS PUMP TYPE: CR 64-1-1 60 HZ
2	2	RAYPAK HIDELTA BOILER MODEL NO.: 2072B
3	1	WESSELS AIR SEPARATOR MODEL NO.: SPA-4
4	2	WESSELS EXPANSION TANK MODEL NO.: NTA-80
5	4	WATTS 2-1/2" BUTTERFLY VALVE WITH 10 POSITION LEVER
6	1	AXIOM INDUSTRIES GLYCOL MAKEUP FEEDER MODEL# MF200
7	1	RAYPACK COLD START MIXING VALVE MODEL# 012232
8	2	RAYPACK T&P GAUGE MODEL# 007205F
9	2	WATTS 4" BUTTERFLY VALVE WITH 10 POSITION LEVER
10	1	DONGAN ELECTRIC MFG. CO. TRANSFORMER ITEM# 26512 85-1055SH DON 5KVA 1PH GP 3R ENCAP

CHERRY CREEK SNOW MELT SKID

SCALE: 1:16

LEGEND:
T = THERMOSTAT
= MANIFOLD
= SLAB SENSOR

NOTE:
1. ALL CIRCUIT LENGTHS INCLUDE A 5' SUPPLY AND A 5' RETURN ALLOWENCE FOR RISERS TO MANIFOLD AND PLACEMENT TOLERANCE.
2. ALL THERMOSTAT LOCATIONS ARE APPROXIMATE, MUST BE APPROVED BY OWNER.
3. CONTRACTOR TO VERIFY DIMENSIONS IN FIELD.

LIABILITY

This drawing and our recommendations and suggestions, are intended to assist our customers. Our design represents our best judgment based on our experience and the best facts provided to us, any use thereof is at the sole risk of the customer.

It is assumed that the customer will install the THAW-PAK system in compliance with all local, state and national codes.

CONSULTANTS:
E&S CONST. ENG.
4326 MOUNTAIN RD. MARYLAND
PASADENA

thaw-PAK Snow Melting & Radiant Heating Systems

PROJECT NAME:
CHERRY CREEK MALL
3000 EAST 1ST AVENUE COLORADO
DENVER

THAW-PAK DISTRIBUTOR:
PERFORMANCE engineering group

DRAWN BY: *Gordon Faustich*
REVIEWED BY: *AD*
APPROVED BY: *AD*
ISSUED FOR

02/12/15	APPROVAL

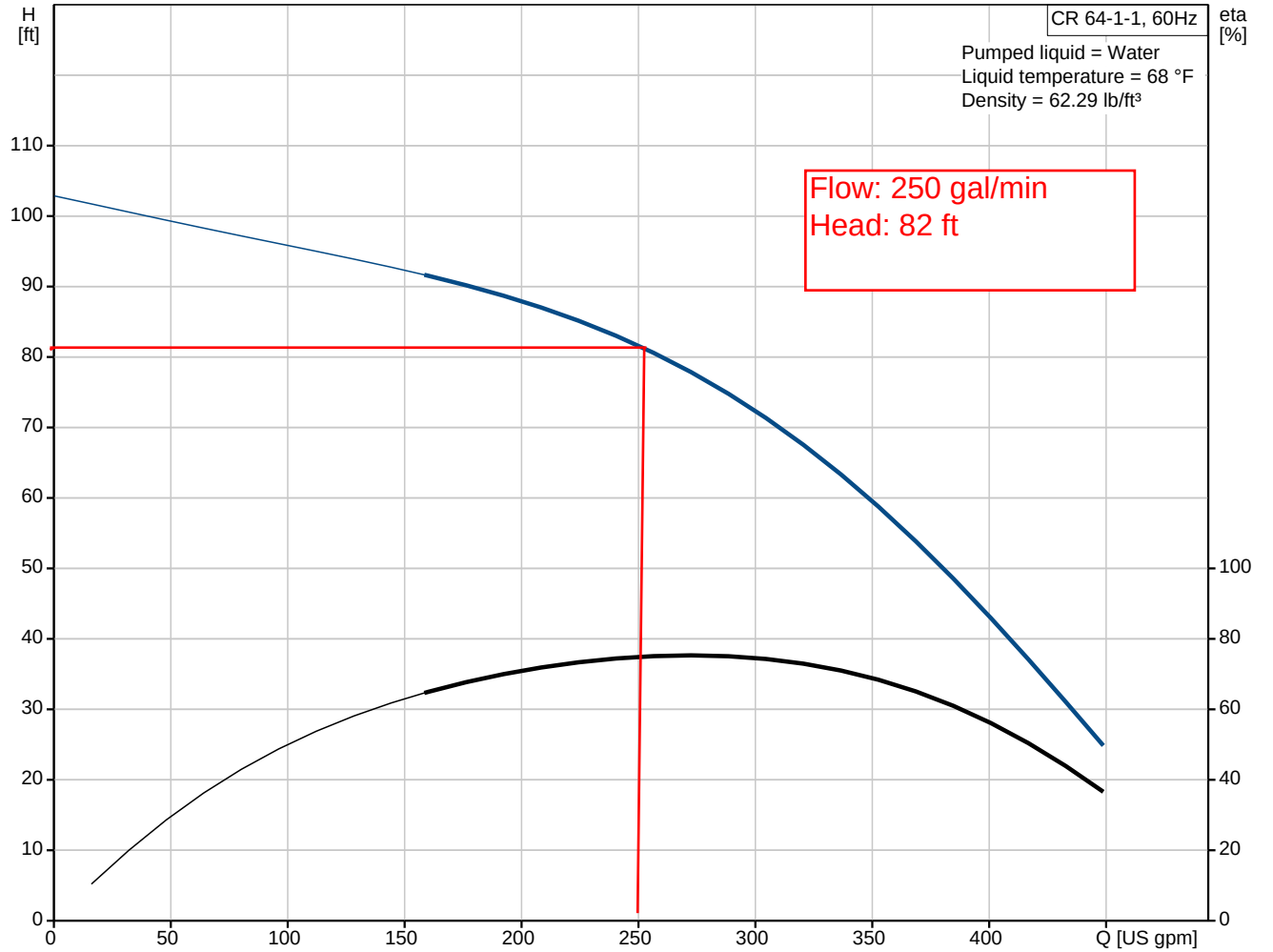
DRAWING NO.
PEG14-023S

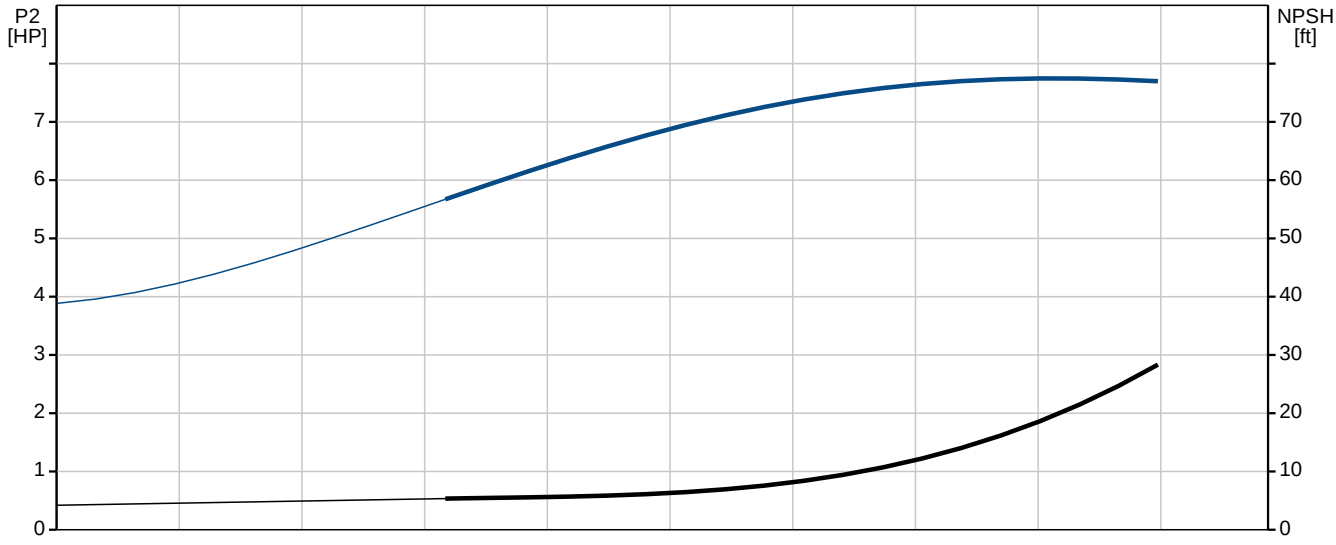
SHEET NO.
M3

Company name:	-
Created by:	-
Phone:	-
Fax:	-
Date:	-

CCK Mall
Snow melt system pump

97533269 CR 64-1-1 60 Hz



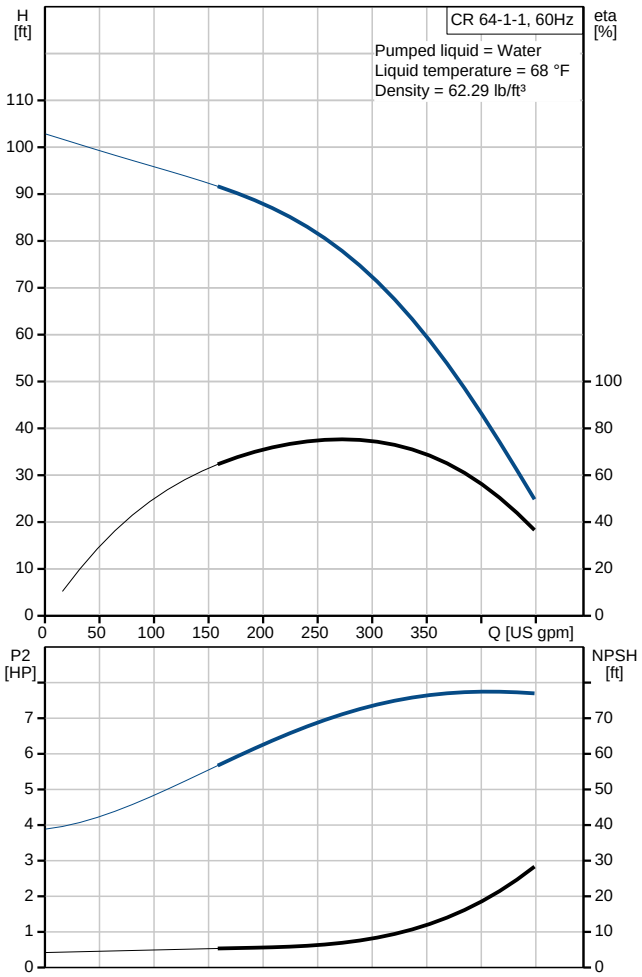


GRUNDFOS

Company name: -
Created by: -
Phone: -
Fax: -
Date: -

Description	Value
General information:	
Product name:	CR 64-1-1 A-G-A-E-HQQE
Product No.:	97533269
EAN:	5700317941267
Price:	On request
Technical:	
Speed for pump data:	3467 rpm
Rated flow:	339 US gpm
Rated head:	68.2 ft
Head max:	105 ft
Impellers:	1
Impeller reduc.:	1
Shaft seal:	HQQE
Curve tolerance:	ISO 9906:1999 Annex A
Stages:	1
Pump version:	A
Model:	B
Cooling:	TEFC
Materials:	
Pump housing:	Cast iron
	EN-JS1050
	ASTM 80-55-06
Impeller:	Stainless steel
	DIN W.-Nr. 1.4301
	AISI 304
Material code:	A
Code for rubber:	E
Installation:	
Maximum ambient temperature:	140 °F
Max pressure at stated temperature:	232 psi / 250 °F
Flange standard:	ANSI
Connect code:	G
Pipe connection:	4"
Pressure stage:	125 Lb.
Flange size for motor:	213TC
Liquid:	
Liquid temperature range:	-22 .. 248 °F
Electrical data:	
Motor type:	132FA
Rated power - P2:	10 HP
Main frequency:	60 Hz
Rated voltage:	3 x 208-230YY/460Y V
Service factor:	1,15
Motor efficiency at full load:	90,0-90,2 %
Motor efficiency at 1/2 load:	91,4-89,7 %
Motor protection:	PTC
Thermal protec:	external
Motor Number:	85903410
Others:	
Net weight:	254 lb
Gross weight:	272 lb
Sales region:	Namreg

7.5 HP



Company name:	-
Created by:	-
Phone:	-
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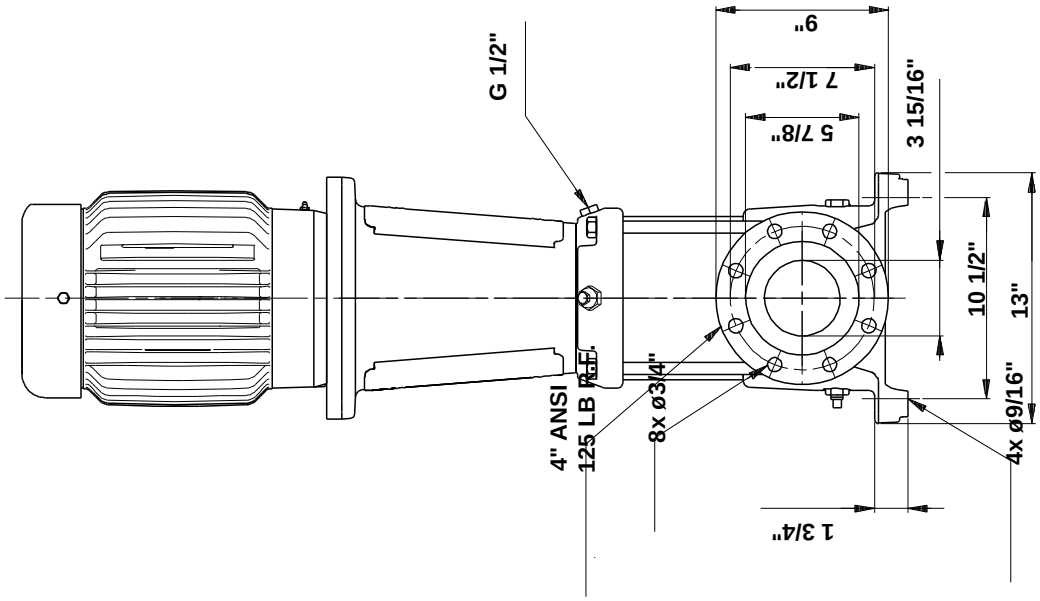
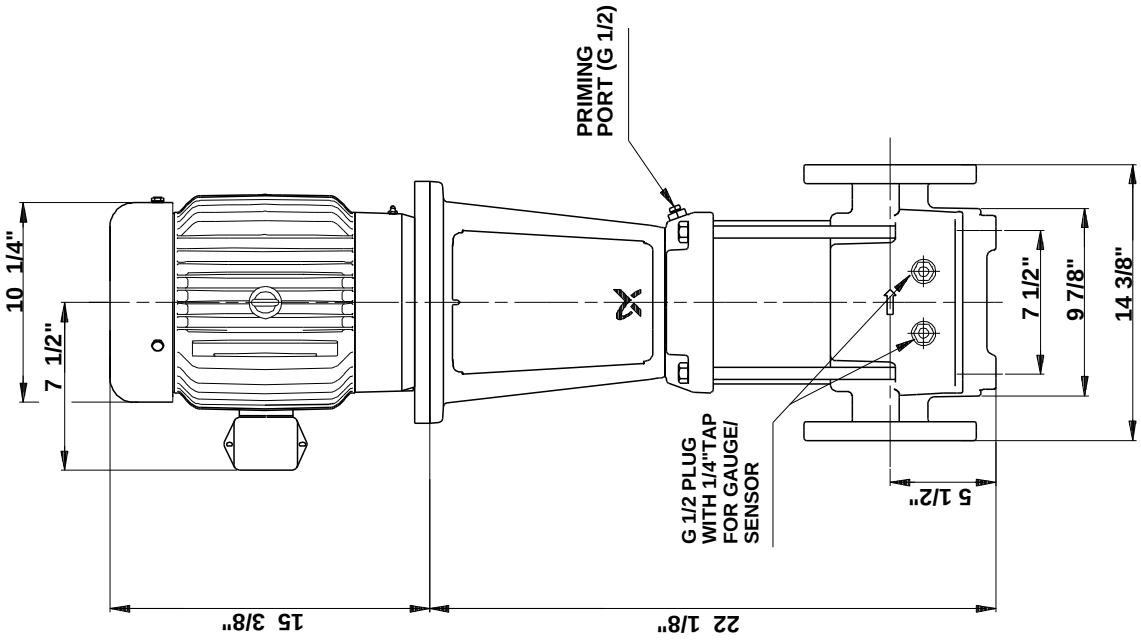
Date:	-

97533269 CR 64-1-1 60 Hz





Note! All units are in [mm] unless otherwise stated.
Disclaimer: This simplified dimensional drawing does not show all details.

Technical Data/Submittal

Three-way Threaded Equal Percentage Ball Valves with Non-fail-safe Actuators

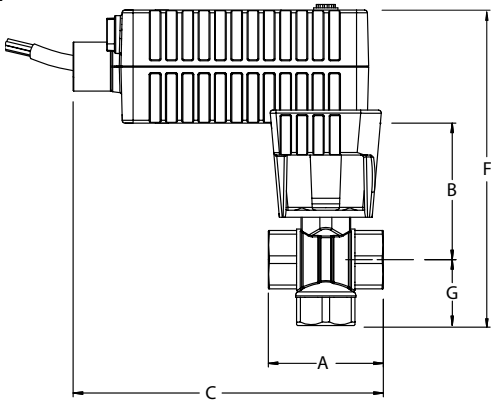
NEMA 4

ELODRIVE

Valve Specifications	
Static Pressure/Temp:	360 PSI / 250°F (600 WOG)
Service:	Chilled water, hot water, up to 50% Glycol
Flow Characterizing Disc:	Glass Filled Polymer
Body Material:	Forged Brass ASTM B283
End Connections:	Brass NPT
Stem:	Brass
Stem Seals:	EPDM O-Rings
Ball:	Nickel-plated brass
Ball Seals:	Teflon Seals with EPDM O-Rings
Angle of Rotation:	0–90°

Dimensions (nominal)

(measured in inches unless noted)



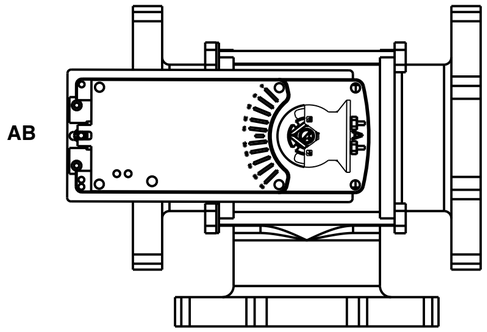
SIZE	A: Length	B:HEIGHT	C:LENGTH	D:DEPTH (NOT SHOWN)	F:HEIGHT	G:HEIGHT
	FNPT	FNPT	FNPT		FNPT	FNPT
0.5	2.6	2.9	6.5	3.0	7.5	2.4
0.75	2.8	2.9	6.6	3.0	7.5	2.0
1	2.8	3.3	6.6	3.0	7.5	2.0
1	3.0	3.4	6.7	3.0	8.0	2.6
1	4.2	3.6	7.3	3.0	9.0	3.3
1.25	3.0	3.4	6.7	3.0	8.0	2.5
1.25	3.6	3.6	7.0	3.0	8.6	2.8
1.5	3.5	3.6	7.0	3.0	8.8	2.8
1.5	4.0	4.1	7.2	3.0	9.6	3.3
2	4.0	4.1	7.2	3.0	9.7	3.3
2	5.0	4.5	7.7	3.0	10.8	3.8
2.5	5.3	4.8	7.8	3.0	11.0	4.0

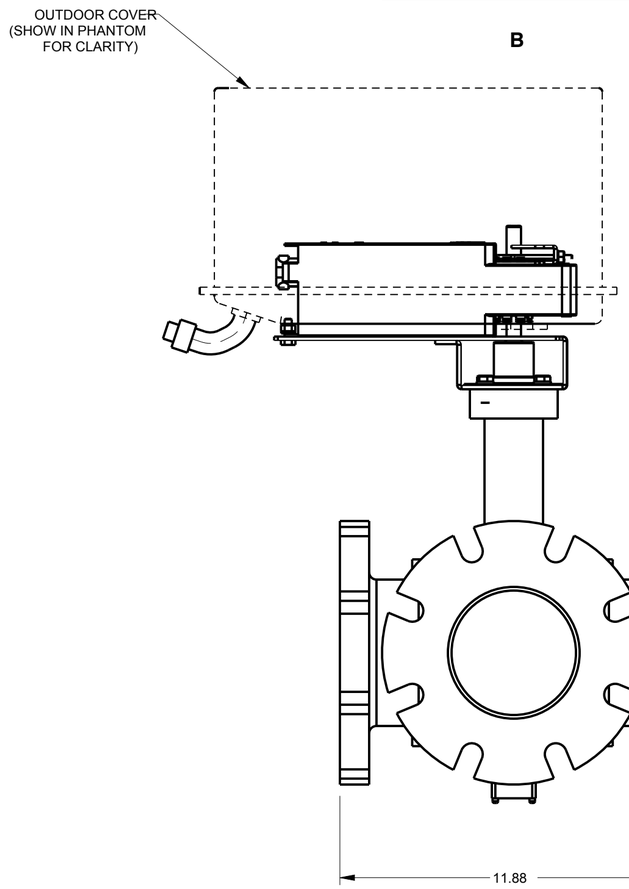
Three-way valve coil and bypass streams flow simultaneously through the ball. Bypass Cv is always 80% of coil Cv so there is always enough pressure drop in bypass mode. Three-way over-flow problems are eliminated.

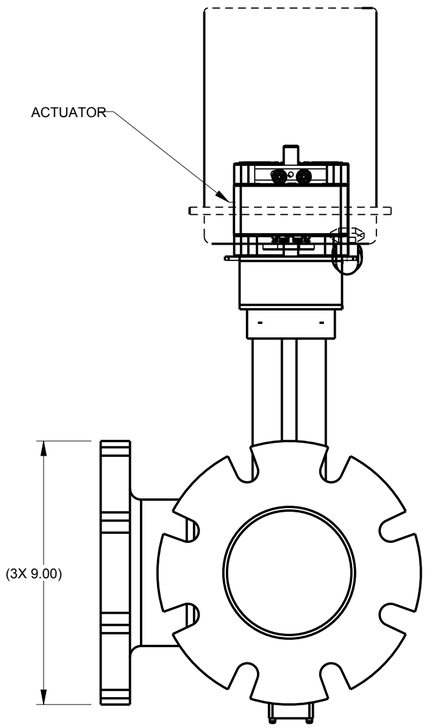
Flow characterizing disc:

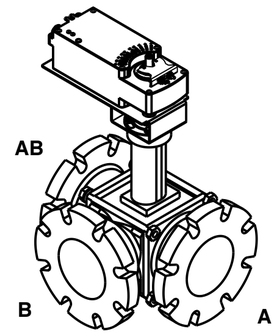
- Equal percentage flow mirrors equal percentage coil characteristic.
- Molded from GE NORYL, a blend of a polymide with reinforced modified polymer PPE for retention of mechanical properties, chemical resistance, and dimensional stability.
- Because the disc is press fit into the ball where flow exits, the valve is able to modulate where differential pressure is over 160 psi without affecting the disc.
- Tapered shape means the back of the disc is too large to be forced through the ball's port.
- Good chemical resistance to: alcohol, alkalis (base), cooling and heating system liquids (ethylene and propylene glycol), chlorinated water, detergents/ cleaners. Poor chemical resistance to acids (high concentration), hydrocarbons, ketones, phenol.

REVISIONS						
REV	ZONE	DESCRIPTION	E.O.	BY	DATE	CHECK
[redacted]						









SCALE 0.125

601843T | 3

SPECIFICATIONS:

LOW TORQUE
STAINLESS STEEL BALL & STEM
CAST IRON VALVE BODY
STANDARD ANSI 125 FLANGE CONNECTIONS
EXTERNAL LIMIT STOP
FLOW INDICATION ARROWS
POWER - 24 VAC ±20%, 50/60Hz
MAX POWER CONSUMPTION
15.5 VA
AMBIENT TEMPERATURE
-40° F TO 131° F
3 POSITION MODULATING 0(2)-10 VDC
SPRING RETURN
NEMA 4 WEATHER PROOF ENCLOSURE
UL & CSA RATED

APPROVED VENDORS: [redacted]

TABULATION

PART NO.	P/N REV	DESCRIPTION	[redacted]
601843	3	VALVE ASSY-WATER 3 WAY 152 CV	
601837	3	VALVE ASSY-WATER 3 WAY 254 CV	
601844	3	VALVE ASSY-WATER 3 WAY 327 CV	

UNLESS OTHERWISE SPECIFIED:
ALL UNITS ARE IN INCHES
FRACTIONS ±1/32 ANGLES ±1°
X. = ±.12 X.X = ±.06
X.XX = ±.03 X.XXX = ±.010
DRAFT___ WALL___ RADII___
CONCENTRICITIES .020 DIA.
SQUARENESS .015 IN./IN.
BREAK EDGES .015 MAX.
SURFACE FINISH PER
ASME Y14.36M-1996

APPROVED	DATE	Raypak	OXNARD, CALIFORNIA
CHECKED	DATE		
DRAWN: J. PARSONS	DATE: 03/26/07	E.O.: 3890	SCALE: 0.250
SIZE: C			

TITLE: VALVE ASSY-3 WAY 152 CV 4" — PRO/E

MAT'L.	SERIES/MODEL	DWG. NO.	REV
- -	-	601843T	3

AXIOM INDUSTRIES LIMITED

Specification:

AXIOM Industries Hydronic Mini System Feeder: MF200-S

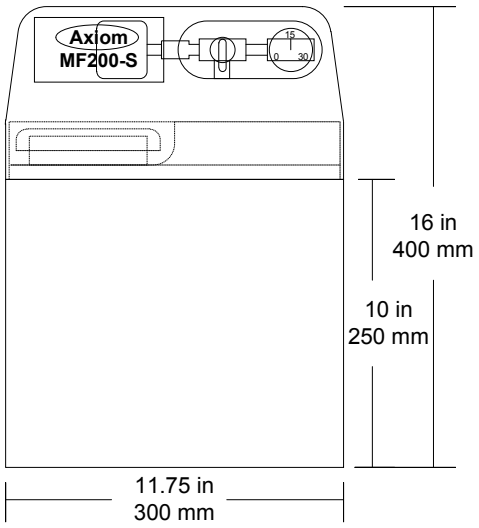
Hydronic system feeder shall be AXIOM INDUSTRIES LTD. Model MF200-S. System shall include 25 litre (6.6 U.S. gallon) storage/mixing tank with molded-in level gauge, 125 mm (5") fill/access opening and cover; pump suction hose with inlet strainer and check valve; pressure pump with fuse protection; low fluid level pump cut-out float switch; manual diverter valve for purging air and agitating contents of storage tank; pressure switch with snubber and two sets of SPST dry contacts, each individually adjustable from 170 kPa (25 psig) to 240 kPa (35 psig) cut-out pressure; factory cut-out pressure set to 240 kPa (35psig); and liquid filled pressure gauge. Unit to be c/w UL listed and fused power supply adapter with LED power indicator light, 115/60/1 to 24 VDC 50 watts AC, supplied loose for field installation.

Feeder shall be compatible with glycol solutions of up to 50% concentration. Pump shall be capable of running dry without damage. The second set of contacts in the pressure switch shall be wired to a terminal strip for use as low pressure alarm contacts for remote alarm circuit supplied by others. Unit shall be completely assembled.

OPTION

MF200-1430 – Tank Mounting Shelf

RIA10-1-SAA – Low Level Alarm Panel c/w Remote Monitoring Dry Contacts and Selectable Audible Alarm. See RIA10-1-SAA product page for Alarm Panel Specifications



Depth - 11.75 in 300 mm
Clearances – Right Side - 12 in 305 mm
Weight When Full 60 lbs/27 kg.
Discharge 1/2" FPT

2615 Wentz Avenue, Saskatoon, SK S7K 5J1 Ph: (306) 651-1815 Fax: (306) 651-2293
email: sales@axiomind.com website: www.axiomind.com

SINCE 1908
wessels company

SUBMITTAL

TYPE: SPA ASME AIR SEPARATOR WITH STRAINER

MODELS: SPA 2S TO SPA 24S

SUBMITTAL SHEET No. B-3305 Date: 2-01

JOB CCK Snowmelt System
Air Separator

Unit Tag No. _____
Engineer _____
Contractor _____

Wessels Representative _____

Order No. _____ Date _____
Submitted By _____ Date _____
Approved By _____ Date _____

DESCRIPTION

Wessels SPA Vortex type Air Separators eliminate air quickly and efficiently from open and closed loop heating/cooling systems. Water enters and exits through unique "tangential" connections, which promote a low velocity swirling effect in the center of the unit. Natural centrifugal forces allow the heavier air-free water to move towards the outer edges while entrained air is captured within the “eye” of the vortex and released out the top of the separator. The water then exits near the bottom of the unit, bubble free, protecting the system against the noise, corrosion, and damage commonly caused by entrained air. SPA shall have a system strainer.

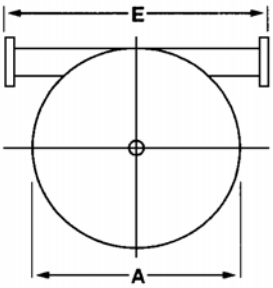
CONSTRUCTION

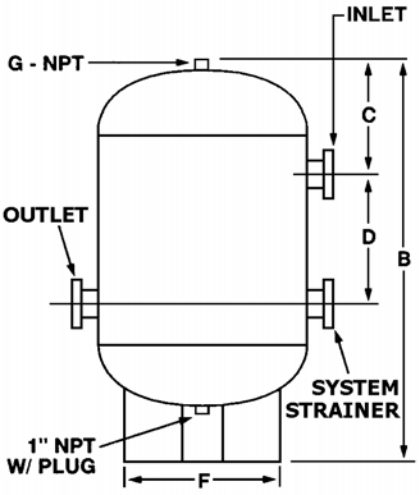
Shell: Carbon steel
Heads: Carbon steel

PERFORMANCE LIMITATIONS

Maximum Design Pressure: 125 PSIG
Maximum Design Temperature: 450°F

Model Number	Max GPM	Conn. Size	Type	Dimensions in inches							Approx. Lbs.
				A	B	C	D	E	F	G	
SPA 2S	56	2	NPT	12	22 1/2	5 1/2	8 1/2	16 5/8	9 1/2	1 1/4	55
SPA 2-1/2S	90	2.5	NPT	12	22 1/2	5 1/2	8 1/2	16 5/8	9 1/2	1 1/4	61
SPA 3S	190	3	FLANGED	12	22 1/2	5 3/4	8	19 3/4	9 1/2	1 1/4	66
SPA 4S	300	4	FLANGED	14	32	9 1/8	10 3/4	21 3/4	11 1/2	1 1/2	99
SPA 5S	530	5	FLANGED	14	32	9 1/8	10 3/4	21 3/4	11 1/2	1 1/2	163
SPA 6S	850	6	FLANGED	20	44	13 1/4	14 1/2	28	18	2	210
SPA 8S	1900	8	FLANGED	20	44	13 1/4	14 1/2	28	18	2	417
SPA 10S	3200	10	FLANGED	30	60 1/2	19	20	41	24	2	658
SPA 12S	4800	12	FLANGED	30	60 1/2	19	20	41	24	2	1042
SPA 14S	6100	14	FLANGED	36	78	22	31 1/2	46 3/8	30	2	1848
SPA 16S	8000	16	FLANGED	48	108	30	40	60	38	2	2530
SPA 18S	9700	18	FLANGED	54	124	33	50	66	44	2	3559
SPA 20S	12000	20	FLANGED	60	138	35	60	72	50	2	5610
SPA 22S	15000	22	FLANGED	66	150	38	66	78	56	2	6765
SPA 24S	17000	24	FLANGED	72	150	38	66	78	56	2	7931





TYPICAL SPECIFICATION

Furnish and install as shown on plans, a vortex type air separator Model SPA_____ with system strainer, sized for_____GPM, with _____” (NPT / Flanged) tangential connections, as manufactured by Wessels Company. The air separator shall be designed in accordance with the latest revisions of the ASME Code for Boilers and Pressure Vessels, Section VIII, Division 1, and shall be constructed and stamped for 125 PSI working pressure @ 450°F. A blowdown connection shall be provided to facilitate routine cleaning of the unit. Each air separator shall be Wessels SPA _____ or approved equal.

101 TANK STREET, GREENWOOD, IN 46143 TEL: 317-888-9800 FAX: 317-888-9988 www.westank.com

SINCE 1908
wessels company

SUBMITTAL

NTA-SERIES

HYDRONIC EXPANSION TANKS

Models: NTA-15 thru NTA-280
Submittal Sheet No. A-1004B Date: 10/12

Job Name	CCK Snowmelt System	Submitted By	A D	Date	11-6-14
Location	Denver, CO	Approved By		Date	
		Order No.		Date	
Engineer	E & S	Notes			
Contractor	HPE				
Sales Rep.	Performance Engineering Group				

Description

Wessels NTA series are ASME fixed diaphragm type pre-charged expansion tanks. They are designed to absorb the expansion forces and control the pressure in heating/cooling systems. The system's expanded water (fully compatible with water/glycol mixtures) is contained in heavy-duty diaphragm that prevents tank corrosion and waterlogging problems. All NTA expansion tanks can be installed vertically or horizontally.

Construction

Shell: Carbon Steel
Bladder: Heavy Duty Butyl
System Connection: Carbon Steel

Performance Limitations

Maximum Design Temperature: 240°F
Maximum Design Pressure: 125 PSIG*
NTA 15 thru NTA 60: 150 PSIG*
NTA 80 thru NTA 280: 125 PSIG*
*200 & 250 PSIG available

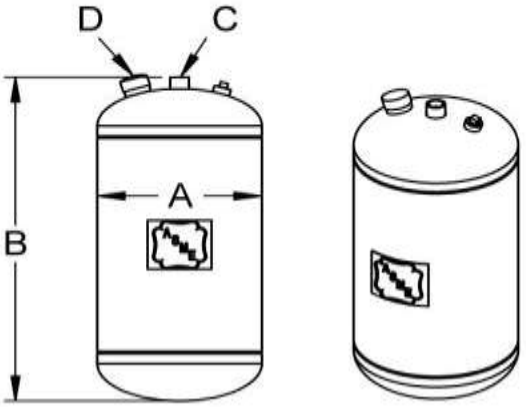
Model Number	Part Number	Tank Volume (Gallons)	Acceptance Volume (Gallons)	Tagging Information	Quantity
NTA-15	19010015	7.8	6.3		
NTA-20	19010020	10.9	8.8		
NTA-40	19010040	25	20.2		
NTA-60	19010060	35	28		
NTA-80	19010080	45	36		2
NTA-100	19010100	60	48.5		
NTA-120	19010120	70	56.5		
NTA-144	19010144	80	65		
NTA-180	19010180	90	73		
NTA-200	19010200	115	93		
NTA-240	19010240	140	113.5		
NTA-260	19010260	158	128		
NTA-280	19010280	211	171		

Typical Specification

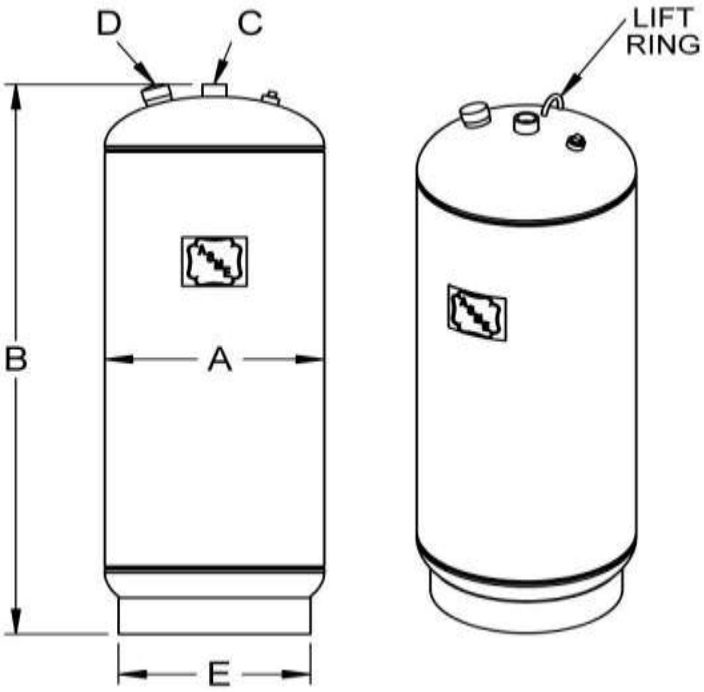
Furnish and install, as shown on plans, a _____ gallon _____" diameter X _____" (high) pre-charged steel expansion tank with a fixed heavy-duty butyl diaphragm. The tank shall be equipped with a NPT system connection, and a 0.302"-32 charging valve connection (standard tire valve) to facilitate the on-site charging of the tank to meet system requirements. The tank must be constructed in accordance with most recent addendum of Section VIII Division 1 of the ASME Boiler and Pressure Vessel Code.

Each tank shall be Wessels model number NTA-_____ or approved equal.

101 TANK ST ● GREENWOOD, IN 46143 ● (317) 888-9800 ● (317) 888-9988 FAX ● www.westank.com



NTA 15 & NTA 20



NTA 40 thru NTA 280

Dimensions & Weights

Model Number	Dimensions in Inches					Approx. Ship Weight (lbs)
	A	B	System Connection	Charging Valve	E	
			C	D		
NTA-15	12	19	3/4	0.302" -32NC	-	42
NTA-20		25				52
NTA-40	16	34	1		14	84
NTA-60		45				97
NTA-80	20	39			18	148
NTA-100		50				175
NTA-120	24	47	1 1/2		22	259
NTA-144		50				268
NTA-180		53				283
NTA-200		67				325
NTA-240		79				362
NTA-260	30	64			24	591
NTA-280		82				752

Notes

- Tanks are factory pre-charged at 12 psi and field adjustable.
- California code-sight glass is available upon request.
- Available with mounting clips.

Quazite®

Precast Polymer Concrete Enclosures for Underground Construction

2008 National Electric Code

SECTION - 314.30:
Handhole enclosures shall be designed and installed to withstand all loads likely to be imposed.

FPN: See ANSI/SCTE 77
"Specification for Underground Enclosures Integrity," for additional information on deliberate and non-deliberate traffic loading that can be expected to bear on underground enclosures.

ANSI/SCTE 77 Minimum Testing Requirements:

- Accelerated service exposure per ASTM D756 Procedure E
- Chemical resistance per ASTM D543, section 7
- Simulated sunlight exposure per ASTM G154
- Water absorption per ASTM D570, sections 5, 6.1 and 6.5
- Cover impact resistance per ASTM D2444
- Fire resistance per RUS PE-35, RUS 7 CFR 1755.910 paragraph xiii
- Maximum deflection criteria for:
  - lateral sidewall loads
  - vertical sidewall loads
  - vertical cover loads

QUAZITE® enclosures are UL Listed to ANSI/SCTE 77 as referenced in the NEC 2008.

Quazite® Underground Handhole Enclosure Selection Guide

PG Style

Stackable for increased depth. Straight sides for easy adjustment of box to grade.

- Available in sizes:

11" x 18"	24" x 24"	30" x 60"	36" x 72"	48" x 96"
13" x 24"	24" x 36"	36" x 36"	48" x 48"	
17" x 30"	30" x 48"	36" x 60"	48" x 72"	

- Design load: 22,500 lbs. Test load: 33,750 lbs. (Loadings comply with ANSI/SCTE 77. These boxes, with a design load of 22,500 lbs. and a test load of 33,750 lbs., meet ANSI Tier 22 test provisions.)
- 12" - 48" depths

PD Style

Enclosures with 1° (degree) flare for maximum strength. Flared design optimizes internal volume and prevents frost heave.

- Available in sizes: 13" x 24", 17" x 30", 24" x 36", 30" x 48"
- Design load: 22,500 lbs. Test load: 33,750 lbs. (ANSI Tier 22)
- 18" - 48" depths

PR Style

Round enclosures. Cover cannot fall into the box.

Available in sizes:
27" dia. x 36" & 48" depths
39" dia. x 18", 24", 36" & 48" depths.

- Design load: 22,500 lbs. Test load: 33,750 lbs. (ANSI Tier 22)

PC Style

Straight sides permit easy movement of box should grade level change. Gasketing also available. All sizes are stackable.

- Sizes: 6" x 8" , 8" x 18", 11" x 18" and 12" x 12"
  Design load: 15,000 lbs. Test load: 22,500 lbs. (ANSI Tier 15)
- Sizes: 13" x 24" and 17" x 30"
  Design load: 5,000 lbs. Test load: 7,500 lbs. (ANSI Tier 5)
- Sizes: 8" x 8"
  Design load: 22,500 lbs. Test load: 33,750 lbs. (ANSI Tier 22)
- 6" - 18" depths

PX Style

Service box assemblies with flared sides. Nestable for compact storage.

- PX Size: 12" x 12" x 24"
  Design load: 15,000 lbs. Test load: 22,500 lbs. (ANSI Tier 15)

PT Style

Flared design prevents frost heave. Covers are interchangeable with many precast concrete parts. Nestable for compact storage.

- Sizes: 10" x 15", 13" x 24", 17" x 30"
- Design load: 15,000 lbs. Test load: 22,500 lbs. (ANSI Tier 15)
- 18" deep

Application Tiers & Static Vertical Wheel Load Ratings per ANSI/SCTE 77 2007 "Specification for Underground Enclosure Integrity"

NOTE *- QUAZITE® products are not intended for use in deliberate traffic areas.*

Application Tiers	Loading Requirements				UL Listed to meet ANSI 77 Requirements[2]
TIER 5[1] Sidewalk applications with a safety factor for occasional non-deliberate vehicular traffic	**Vertical**	**Design Load**	22.2 kN	5,000 lbs.	PC 13"x24" or PC 17"x30" style enclosure and cover assemblies with standard covers (**CA**) and standard covers w/o bolts (**WA**).
		Test Load	33.3 kN	7,500 lbs.	
	Lateral	**Design Load**	28.7 kPa	600 lbs./sq. ft.	
		Test Load	43.1 kPa	900 lbs./sq. ft.	
TIER 8[1] Sidewalk applications with a safety factor for non-deliberate vehicular traffic	**Vertical**	**Design Load**	35.6 kN	8,000 lbs.	PG and PT style enclosure and cover assemblies up to 30" x 48" and PC style in sizes 6"x8", 8"x18", 11"x18" and 12"x12" with standard covers (**CA**) and standard covers w/o bolts (**WA**).
		Test Load	53.4 kN	12,000 lbs.	
	Lateral	**Design Load**	28.7 kPa	600 lbs./sq. ft.	
		Test Load	43.1 kPa	900 lbs./sq. ft.	
TIER 15[1] Driveway, parking lot, and off-roadway applications subject to occasional non-deliberate heavy vehicular traffic	**Vertical**	**Design Load**	66.7 kN	15,000 lbs.	PG, PT and PC style enclosure and cover assemblies up to 30"x48" with heavy duty covers (**HA**).
		Test Load	100.1 kN	22,500 lbs.	
	Lateral	**Design Load**	38.3 kPa	800 lbs./sq. ft.	
		Test Load	57.5 kPa	1,200 lbs./sq. ft.	
Tier 22[1] Driveway, parking lot, and off-roadway applications subject to occasional non-deliberate heavy vehicular traffic	**Vertical**	**Design Load**	100.1 kN	22,500 lbs.	PC, PD, PG and PT style enclosure and cover assemblies up to 30" x 48" with extra heavy duty covers (HH).
		Test Load	150.1 kN	33,750 lbs.	
	Lateral	**Design Load**	38.3 kPa	800 lbs./sq. ft.	
		Test Load	57.5 kPa	1,200 lbs./sq. ft.	
AASHTO H-20 Deliberate vehicular traffic applications ONLY. Quazite does not currently offer any enclosures for this application tier.	Certified precast concrete, cast iron or other AASHTO recognized materials.* **There are no AASHTO design or test provisions for polymer composites. Therefore there is no recognized method of testing for qualification. Applying other material testing methods to polymer composites is not recognized by AASHTO.* **BUYER BEWARE !**				

QUAZITE® underground handhole enclosures are designed to meet or exceed the tier loadings set forth in the American National Standards Institute's ANSI/SCTE 77 2007 "Specification for Underground Enclosure Integrity"[1]. ANSI tier designations are minimum specifications used by the industry to ensure the safe and reliable performance of underground handhole enclosures.

The ANSI application tier number relates to a nominal design load times 1,000 pounds (i.e.: Tier 8 = 8 x 1,000 lbs. = 8,000 lbs.). All ANSI tier loadings will have a corresponding test load which is 50% greater than the design load. The maximum deflection at the indicated design load shall be 1/2 inch for vertical tests and 1/4 inch per foot of length for lateral tests.

1 Electronic file available at www.scte.org/documents/pdf/ANSISCTE%2077%202007.pdf.

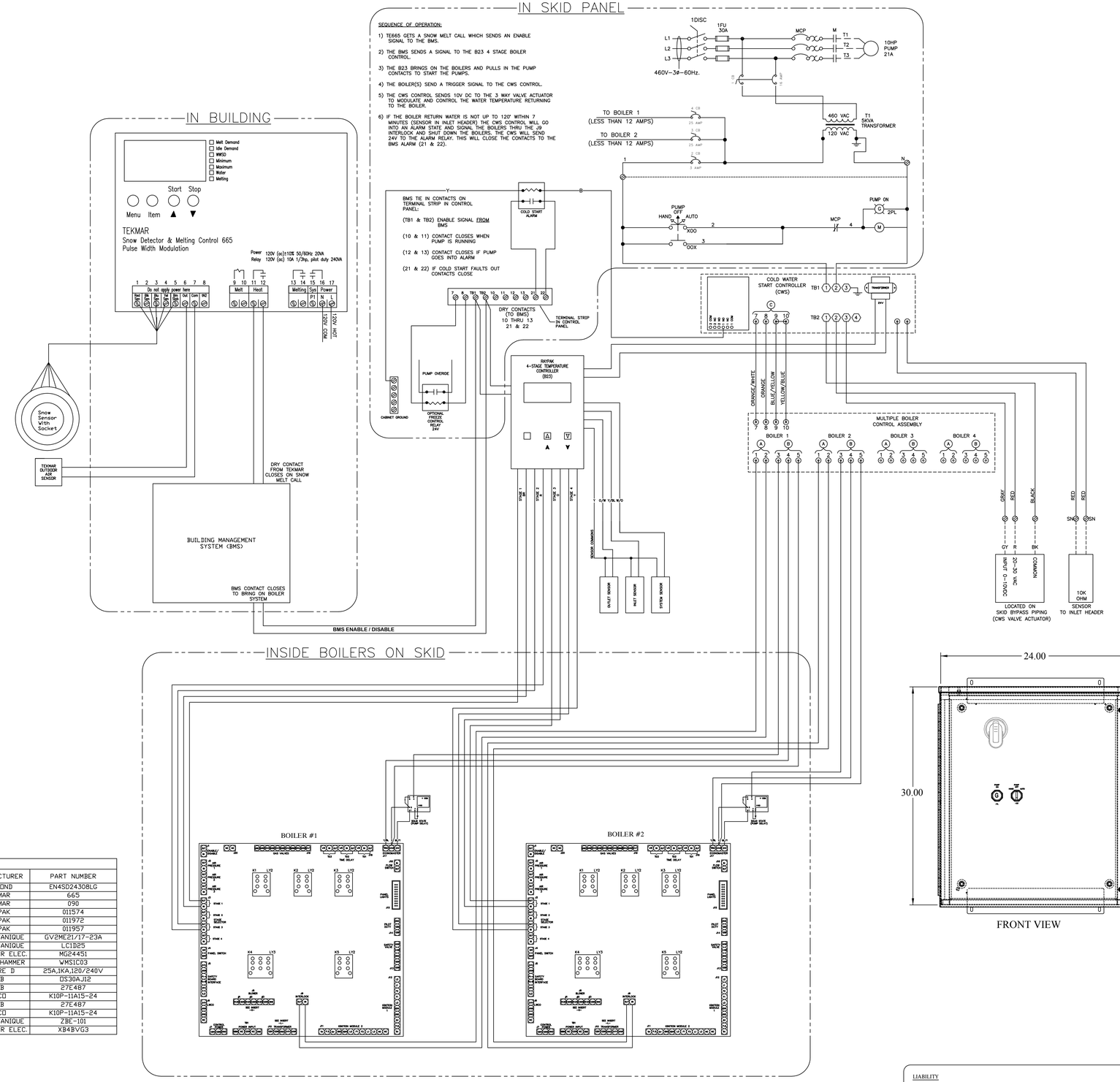
2 Some QUAZITE® products are currently not UL Listed. Refer to Quazite catalog pg. 15 for a complete listing of products.

Yellow highlights indicate UL Listing

NOTE: Because Hubbell has a policy of continuous product improvement, we reserve the right to change design and specifications without notice.

HUBBELL LENOIR CITY, INC.
QUAZITE®
3621 Industrial Park Drive
Lenoir City, TN 37771
Phone: 800-346-3062 or 865-986-9726
Fax: 865-986-0585
Web: http://www.quazite.com
e-mail: hpsliterature@hps.hubbell.com

QZ-4
June, 2008



PARTS LIST			
QTY.	DESCRIPTION	MANUFACTURER	PART NUMBER
1	24" X 30" X 8" ENCLOSURE	HAMMOND	EN4SD24308LG
1	SNOW MELT CONTROL	TEKMAR	665
1	SNOW MELT SENSOR	TEKMAR	090
1	TEMPTRACKER B23	RAYPAK	011574
1	P50 CWS/CWR CONTROLLER	RAYPAK	011972
1	CWS/CWR INTERLOCK CONTROL	RAYPAK	011957
1	THERMAL OVERLOAD	TELEMECANIQUE	GV2ME21/17-23A
1	PUMP CONTACTOR	TELEMECANIQUE	LC1D25
1	CIRCUIT BREAKER (CB1)	SCHNEIDER ELEC.	MG24451
1	CIRCUIT BREAKER (CB2)	CUTLER HAMMER	WMSIC03
2	CIRCUIT BREAKER (CB3 & 4)	SQUARE D	25A,1KA,120/240V
1	MAIN CIRCUIT BREAKER	ABB	QS30AJ12
1	CWS ALM. RELAY SOCKET	P&B	27E487
1	CWS ALARM RELAY	TYCO	K10P-11A15-24
1	FREEZE PROT. RELAY SOCKET	P&B	27E487
1	FREEZE PROTECTION RELAY	TYCO	K10P-11A15-24
1	AUTO/MANUAL SWITCH	TELEMECANIQUE	ZBE-101
1	PILOT LIGHT (GREEN)	SCHNEIDER ELEC.	XB4BVG3

CONTROLS PLAN

SCALE: NONE

LIABILITY

This drawing and our recommendations and suggestions, are intended to assist our customers. Our design represents our best judgment based on our experience and the best facts provided to us, any use thereof is at the sole risk of the customer.

It is assumed that the customer will install the THAW-PAK system in compliance with all local, state and national codes.

CONSULTANTS:
E&S CONST. ENG.
4326 MOUNTAIN RD.
PASADENA MARYLAND

thaw-PAK Snow Melting & Radiant Heating Systems

PROJECT NAME:
CHERRY CREEK MALL
3000 EAST 1ST AVENUE
DENVER COLORADO

THAW-PAK DISTRIBUTOR:
PERFORMANCE engineering group

DRAWN BY: *Gordon Faustich*
REVIEWED BY: *AD*
APPROVED BY: *AD*
ISSUED FOR

02/12/15	APPROVAL
03/12/15	UPDATED CTRLS. AND DETAILS.

PROPERTY OF THAW-PAK

This drawing is the property of THAW-PAK, it has been prepared to assist in the installation of our system. Customer agrees to keep confidential and not disclose this drawing or copies thereof without our written consent.

DRAWING NO.
PEG14-023S_A

SHEET NO.
E1

Job: _____

Engineer: _____

Contractor: _____

Prepared By: _____

Date: _____

TempTracker™

2- and 4-Stage Controllers

For Hi Delta® and Raytherm®
Boilers & Water Heaters

TempTracker is designed to sequence multiple boilers up to four total stages, whether it's one to four on/off boilers, two two-stage boilers, or one boiler with up to four stages. It is available factory-mounted or loose on **Hi Delta** boilers, and loose on **Raytherm** boilers. This control can be used for space heating and hot water supply with six application-specific modes to meet various applications, including outdoor reset for heating systems. It monitors and displays inlet and outlet temperatures on all applications as well as monitors outdoor temperature when an outdoor reset mode is utilized.

Features

- 1-4 boilers/stages
- Selectable P or PID logic
- LCD display
- NEMA 1 enclosure
- Boiler-in and boiler-out water sensors
- System water sensor
- Outdoor air sensor
  (Models B-27 and B-23)
- Alarm ready (pilot duty)
- 24 VAC, 60 Hz, 3 VA Supply Power
- Relay Ratings
  Stage 1: 5A @ 120 VAC
  Stages 2 to 4: 3A @ 120 VAC

Programmable Functions

- 6 programming modes
- Adjustable outdoor reset
- Min. system water temperature (70 °F)
- Max. system water temperature
  - o Heating – 220 °F
  - o DHW – 190 °F
- Temperature differential (2 to 42 °F)
- Boiler target (70 to 220 °F)
- Outdoor cutoff (35 to 85 °F)
- Boiler mass (low, med, high)
- Stage-on delay (P mode)
  (10 sec. to 8 min.)
- System pump-off delay (0 to 20 min.)
- Temperature measurement (°F or °C)

Model Information

- ☐ B-26 2-stage setpoint
- ☐ B-27 2-stage outdoor reset
- ☐ B-21 4-stage setpoint
- ☒ B-23 4-stage outdoor reset

Raypak, Inc. ▪ 2151 Eastman Avenue, Oxnard, CA 93030 ▪ (805) 278-5300 ▪ Fax (800) 872-9725 ▪ www.raypak.com

Catalog No.: 5100.30A Effective: 2-1-08 Replaces: 8-1-07

Material Safety Data Sheet

Product Name: 8406-40% **Revision Date: March 18, 2013**

Section #1: Chemical Product and Company Identification

Product Name: 8406-40%
Manufacturer / Distributor: Enerco Corporation
Address: 317 N. Bridge St., Grand Ledge, MI 48837
Telephone: (800) 292-5908 Fax: (517) 627-8037

For chemical emergency - spill, leak, fire, exposure or accident - call CHEMTREC - day or night - (800) 424-9300

Section #2: Composition/Information on Ingredients

	Chemical Name	CAS Number	Weight %	OSHA PEL	ACGIH TLV
☐	Propylene Glycol	57-55-6	40%	unknown	unknown

☑ Indicates hazardous substances. Remainer of components comprise proprietary information. This document is prepared pursuant to the OSHA Hazard Communication Standard, 29 CFR 1910.1200. In addition, other substances not "hazardous" per this OSHA standard may be listed.

Section #3: Hazards Identification

EMERGENCY OVERVIEW: May cause irritation to skin and eyes.

Potential Health Effects: See Section 11 for toxicological data

Effects of Acute Exposure: Eye: Mild irritation may occur.
Skin: Mild irritation may occur.
Inhalation: Harmful effects are not expected from short term inhallation.
Ingestion: Not expected to result in harmful effects under anticipated conditions of normal use. Excessive ingestion may cause central nervous system effects.

Effects of Chronic Exposure: Normal use of this product does not result in chronic exposure.

Medical Conditions Generally Aggravated by Exposure: May aggrevate pre-existing eye disease.

Section #4: First Aid Measures

Eye: Immediately flush with water for 15 minutes - be sure eyelids are held open during flushing. If irritation occurs, consult physician.

Skin: Flush with water for 15 minutes. If irritation occurs, consult physician.

Inhalation: First aid not normally required. Remove to fresh air if effects occur. Consult physician if symptoms persists.

Ingestion: First aid not normally required. If symtoms develop, consult physician - get medical attention. Never give anything by mouth to an unconscious person.

Continued on next page...

Material Safety Data Sheet

Continued from previous page...

Section #5: Fire-Fighting Measures

NFPA Hazard Codes - (Health / Flammability / Reactivity):

0 / 1 / 0

NFPA Code Legend
4 - Severe Hazard
3 - Serious Hazard
2 - Moderate Hazard
1 - Slight Hazard
0 - Minimal Hazard

Flash Point: Greater than 200°F.

Flammable Limits: Not determined.

Extinguishing Media: Water, fog, dry chemical, carbon dioxide, foam.

Special Fire Fighting Procedures: Fire fighters should wear full protective gear including self-contained breathing apparatus.

Unusual Fire and Explosive Hazards: May form carbon dioxide and carbon monoxide.

Section #6: Accidental Release Measures

Spill and Leak Procedure: Contain spill. Keep out of drains, sewers, lakes, streams, or other water systems. Use absorbent to clean up. Transfer to suitable container for disposal.
Large spills: Dike or contain material and recover it for use as originally intended.

Disposal: Dispose of in accordance with applicable environmental standards.

Section #7: Handling and Storage

Precautions to be Taken in Handling: Avoid contact with eyes, skin, and clothing. Avoid breathing vapor. Keep container tightly closed when not in use. Do not ingest.

Precautions to be Taken in Storage: Store in a cool, dry place. Store below 120°F. Normal shelf life 1 year. Do not store with or near food supplies or potable water.

Continued on next page...

Material Safety Data Sheet

Section #8: Exposure Controls / Personal Protection

Ventilation: Good general ventilation should be sufficient to control airborne levels of vapor and mist.

Eye Protection: Chemical safety goggles.

Skin Protection: Rubber gloves.

Respiratory Protection: None needed, if ventilation is adequate.

Other Protection Equipment: Any other protective clothing or use of equipment necessary to prevent eye and skin contact.

Permissible Exposure Limits: None established for product.

Section #9: Physical and Chemical Properties

Appearance:	Clear Liquid (Unless Dye Specified)	**Boiliing Point (deg. F):**	Greater than 212
Odor:	Little Or No Odor	**Vapor Pressure:**	<0.1 mm Hg
pH (1% sol'n, unless noted):	9.0-10.0	**Vapor Density:**	2.6 (air = 1)
Solubility in Water:	Complete	**Evaportation Rate:**	Similar to water

Section #10: Stability and Reactivity

Chemical Stability: Stable

Conditions to Avoid: Avoid storage temperatures above 120°F or below 40°F.

Incompatibility: Strong bases. Strong acids. Oxidizing agents.

Hazardous Decomposition Products: Carbon monoxide and other toxic vapors.

Hazardous Polymerization: Will not occur.

Section #11: Toxicological Information

Skin and eye (mild irritation) are expected to be the primary target organs of this product. May be harmful if ingested in large quantities.

Ingredients as Carcinogens: To the best of our knowledge, this product does not contain any substances that are considered by OSHA, NTP, IARC, or ACGIH to be 'probable' or 'suspected' human carcinogens.

Section #12: Ecological Information

Practicallly non toxic to mammalian wildlife. Insignificant toxic hazard to aquatic organisms and fish.

Section #13: Disposal Considerations

Best route is to use product for its originally intended purpose.
Dispose of in accordance with applicable environmental standards.

Material Safety Data Sheet

Section #14: Transport Information

DOT Proper Shipping Name: Not hazardous as regulated by DOT.

DOT Hazard Class: Not Applicable. **DOT UN Number:**

DOT Label: Not Applicable **DOT Packing Group:** None

The shipping name listed above applies to a 55 gallon drum of the product. This product may have more than one proper shipping name, depending on packaging, product properties, and mode of shipment.

Section #15: Regulatory Information

TSCA: All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

RCRA Hazard Class: No components of this product are listed.

CERCLA RQ: No components of this product are listed.

SARA Title III

Extremely Hazardous Substance: No components of this product are listed.

Hazardous Substance: Hazard due to: Irritability

Hazard Catagorization:

- ☐ Sudden Release of Pressure
- ☐ Reactive
- ☐ Fire
- ☑ Immediate (Acute) Health
- ☐ Delayed (Chronic) Health

Section 313 Chemicals: No components of this product are listed.

STATE RIGHT-TO-KNOW

CHEMICAL NAME	CAS NUMBER	LIST
Propylene Glycol	57-55-6	MN, PA1

MN=Minnesota Hazardous Substance PA1=Pennsylvania Hazardous Substance (present at greater than or equal to 1.0%)

California Proposition 65 (Safe Drinking Water and Toxic Enforcement Act of 1986) This product when clear contains no listed substances know to the State of California to cause cancer, birth defects or other reproductive harm, at levels which would require a warning under the statute.

Section #16: Other Information

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tekmar® - Data Brochure

Snow Detector & Melting Control 665

D 665

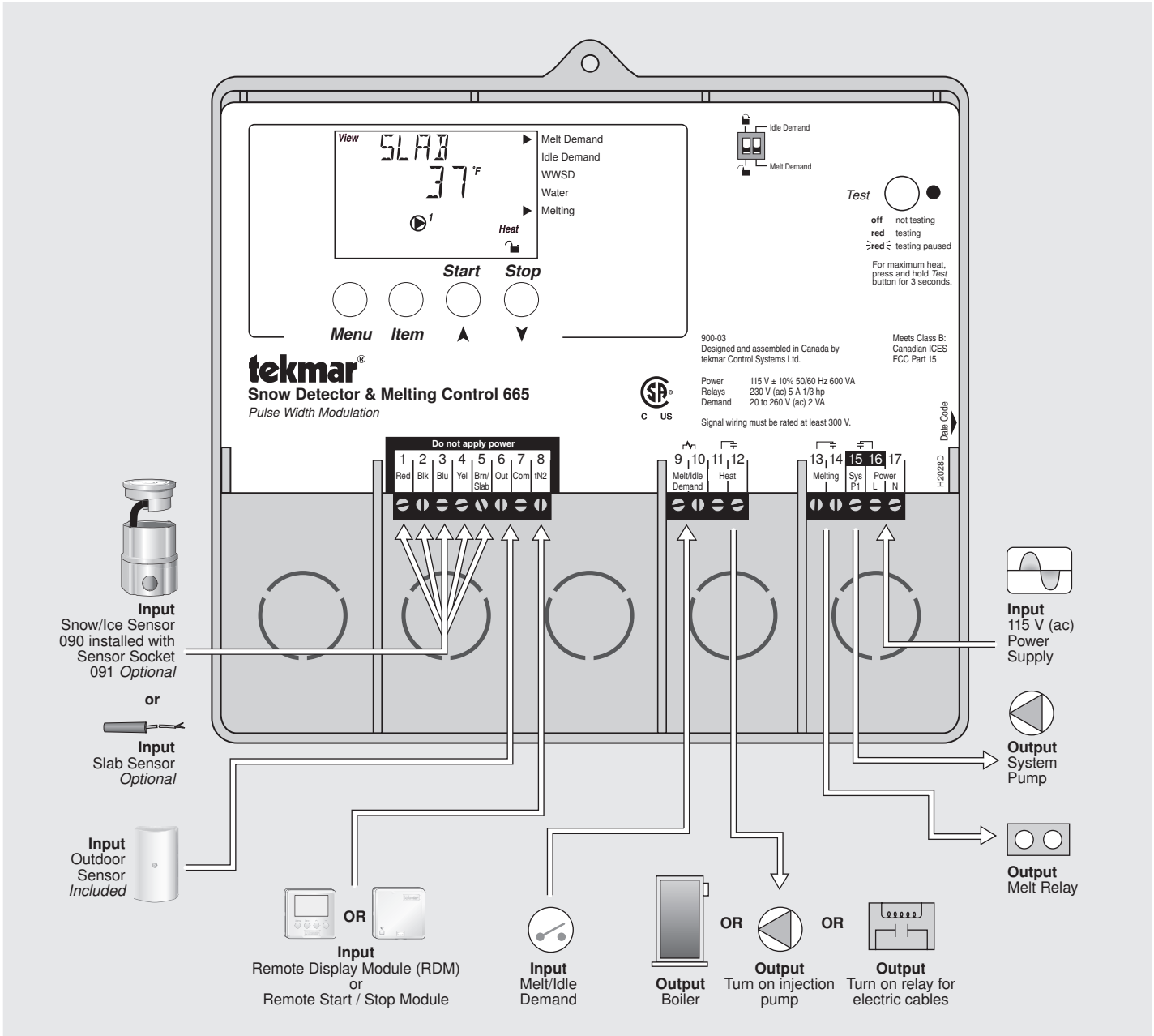
04/12

Replaces: 12/08

The Snow Detector & Melting Control 665 is a microprocessor-based control which operates a single zone snow melting system. The control can operate automatically when a Snow / Ice Sensor 090 is installed or the user can manually enable and/or disable the system. When the control is in the melting mode, the slab is maintained at a “Melting” temperature through an on/off output which operates a contactor for electrical cables, a boiler, an injection pump or an injection valve. When the control is not in the melting mode, the melt system can either be shut down or it can be maintained at an idle temperature for faster response and improved safety. The 665 control includes a large Liquid Crystal Display (LCD) in order to view system status and operating information.

Additional features include:

- Slab Outdoor Reset
- Automatic snow detection and melt control (with 090 sensor)
- Temporary Idle
- Manual Override
- Warm Weather Shut Down
- Cold Weather Cut Out
- Remote display and adjustment capabilities
- Test sequence to ensure proper component operation
- Equipment Exercising
- CSA C US certified (approved to applicable UL standards)



How to Use the Data Brochure

This brochure is organized into four main sections. They are: 1) *Sequence of Operation*, 2) *Installation*, 3) *Control Settings*, and 4) *Troubleshooting*. The Sequence of Operation section has 5 sub-sections. We recommend reading Section A: General of the *Sequence of Operation*, as this contains important information on the overall operation of the control. Then read to the sub-sections that apply to your installation.

The *Control Settings* section (starting at DIP Switch Settings) of this brochure describes the various items that are adjusted and displayed by the control. The control functions of each adjustable item are described in the *Sequence of Operation*.

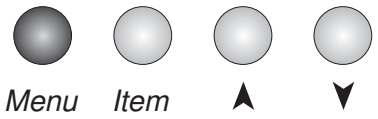
Table of Contents

User Interface

The 665 uses a Liquid Crystal Display (LCD) as the method of supplying information. You use the LCD in order to setup and monitor the operation of your system. The 665 has four push buttons (***Menu***, ***Item***, ▲ (Start), ▼ (Stop)) for selecting and adjusting settings. As you program your control, record your settings in the ADJUST Menu table which is found in the second half of this brochure.

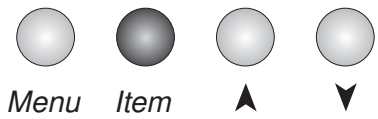
Menu

All of the items displayed by the control are organized into various menus. These menus are listed on the left hand side of the display (Menu Field). To select a menu, use the ***Menu*** button. By pressing and releasing the ***Menu*** button, the display will advance to the next available menu. Once a menu is selected, there will be a group of items that can be viewed within the menu.



Item

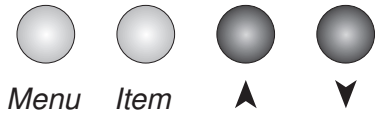
The abbreviated name of the selected item will be displayed in the item field of the display. To view the next available item, press and release the ***Item*** button. Once you have reached the last available item in a menu, pressing and releasing the ***Item*** button will return the display to the first item in the selected menu.



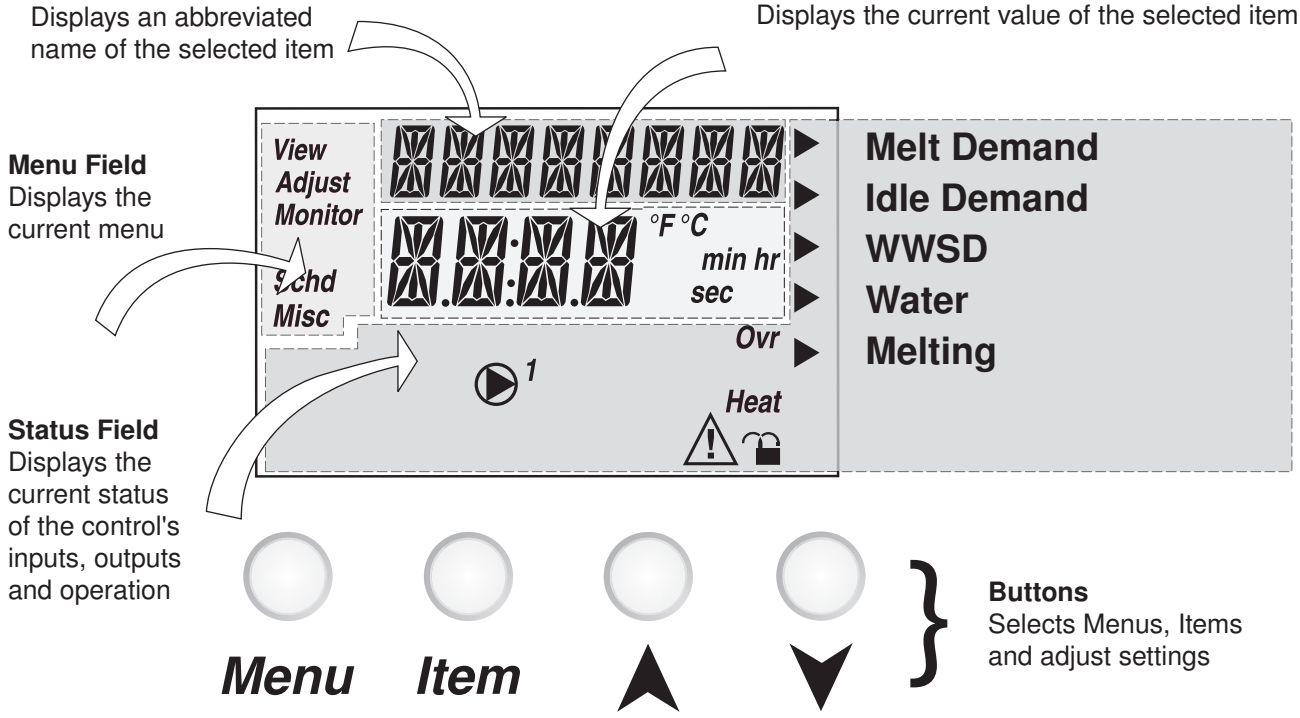
Adjust

To make an adjustment to a setting in the control, begin by selecting the appropriate menu using the ***Menu*** button. Then select the desired item using the ***Item*** button. Finally, use the ▲ and / or ▼ button to make the adjustment.

Additional information can be gained by observing the Status field of the LCD. The status field will indicate which of the control's outputs are currently active. Most symbols in the status field are only visible when the VIEW Menu is selected.



Display



Symbol Description

1	**Pump** Displays when the system pumps are operating.	▶	**Pointer** Displays the control operation as indicated by the text.
Ovr	**Override** Displays when the control is in override mode.	°F °C min hr sec	**°F, °C, min, hr, sec** Units of measurement.
⚠	**Warning** Displays when an error exists or when a limit has been reached.	Heat	**Heat** Displays when the Heat relay is turned on.
🔓	**Lock / Unlock** Displays when the access levels are locked or unlocked.		

Definitions

The following defined terms and symbols are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning the life of the product.

⚠ - Warning Symbol: Indicates presence of hazards which can cause severe personal injury, death or substantial property damage if ignored.

⧈ - Double insulated

INSTALLATION CATEGORY II - Local level, appliances

Sequence of Operation

Section A: General Operation

POWERING UP THE CONTROL

When the Snow Detector & Melting Control 665 is powered up, the control displays all LCD segments for 2 seconds, then the control type number in the LCD for 2 seconds. Next, the software version is displayed for 2 seconds. Finally, the control enters into the normal operating mode and the LCD defaults to displaying the current outdoor air temperature.

EXERCISING (EXERCISE)

The 665 has a built-in pump exercising function. The exercising period is adjustable and is factory set at 70 hours. If a pump output has not been operated at least once during every exercising period, the control turns on the output for 10 seconds. This minimizes the possibility of a pump or valve seizing during a long period of inactivity.

Note: The exercising function does not work if power to the control or pumps is disconnected.

Section B: Snow Melting

Section B1: General Snow Melting

WARM WEATHER SHUT DOWN (WWSD)

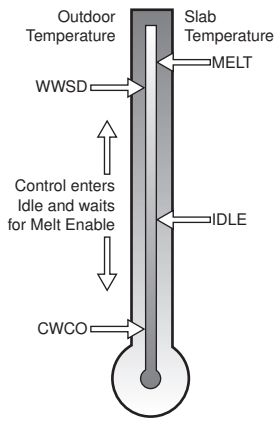
The control has a warm weather shut down that prevents the control from entering the melt or idle modes in order to conserve energy. While in WWSD, the word WWSD is displayed in the STATUS item in the VIEW menu and the WWSD pointer is on the display. The WWSD item in the ADJUST menu can be either set to Automatic or it can be set to a temperature.

Automatic (Auto)

When the WWSD is set to *AUTO*, the WWSD occurs when the slab temperature and the outdoor temperature exceed the *Melting* setting by 2°F (1°C). The control exits the WWSD when the slab or outdoor temperature falls to the *Melting* setting temperature.

Adjustable WWSD

When the WWSD is set to a temperature, the WWSD occurs when the outdoor air temperature exceeds the *WWSD* setting by 1°F (0.5°C) and when the slab temperature exceeds 34°F (1°C). The control exits WWSD when the outdoor air temperature falls 1°F (0.5°C) below the *WWSD* setting or if the slab temperature falls below 34°F (1°C). This allows the *Melting Temperature* setting to be set higher than the WWSD. This is useful where high slab temperatures are required to melt the snow or ice. A good example of this is installations using paving bricks on top of sand and concrete layers.



COLD WEATHER CUT OUT (CWCO)

Maintaining the system at either the melting or idling temperature during extremely cold temperatures can be expensive or impossible. The control turns the snow melting system off when the outdoor air temperature drops below the Cold Weather Cut Out (CWCO) temperature. While the control is in CWCO, the word CWCO is displayed in the STATUS item in the VIEW menu. The heater in the sensor is kept on during CWCO until the control detects moisture. If water is detected, the heater is turned off but the control retains the moisture detected information. When the outdoor temperature rises above the CWCO temperature, the control exits CWCO and if the Snow / Ice Sensor 090 detected moisture during CWCO, the control initiates Melting mode. If the control has been started prior to the CWCO, it resumes the Melting mode once the outdoor air temperature rises above the CWCO temperature.

RUNNING TIME (RUN TIME)

The running time is the length of time that the system operates once it has reached its slab target temperature. During the time that the system is approaching its slab target temperature, the RUN TIME does not decrease. Once the system reaches its slab target temperature, the RUN TIME begins counting down. When the RUN TIME reaches 0:00 as displayed in the Status item in the VIEW menu, the system has finished melting.

Note: The running time is only applicable when a manual melting enable signal starts the snow melting system. Refer to Section C1 for a description of a manual melting enable.

STATUS (STATUS)

While in the VIEW menu there are a number of items available to determine the current status of the system. To view the current status of the system, select the STATUS item in the VIEW menu.

- **STRT** The word STRT is displayed after the snow melting system has been manually enabled. It is displayed until the zone reaches its slab target temperature. If the zone is at its slab target temperature, STRT is displayed for five seconds after the snow melting system has started operation. This is to verify that the control has entered into the Melting mode.
- **STOP** The word STOP is displayed for five seconds after the snow melting system has been manually disabled. The word STOP is also displayed if either a Remote Start / Stop Module 039, Remote Display Module 040 or the ***Stop*** on the control stops the snow melting system and an external melt demand is still present.
- **IDLE** The word IDLE is displayed as long as the zone is operating at its idling temperature.
- **"IDLE"** The word IDLE is flashed on the display as long as the zone is operating in temporary idle.
- **EXT** The word EXT is displayed when the RUN TIME has reached 0:00 and the control still has an external melt demand. In this situation, the zone continues melting until the melt demand is removed or the control is stopped.
- **DET** The word DET is displayed after the snow melting system has been automatically enabled by the Snow / Ice Sensor 090 and the zone is at its slab target temperature. DET is also displayed once the control is manually enabled after automatic detection by the 090 and the running time has counted down to 0:00.
- **0:00 to 23:59 hr** While the zone is up to temperature and melting, the remaining RUN TIME is displayed.
- **INF** If an infinite RUN TIME is selected and the zone is melting, INF is displayed.
- **WWSD** When the zone is in Warm Weather Shut Down, WWSD is displayed.
- **CWCO** When the control is in Cold Weather Cut Out, CWCO is displayed.

SNOW MELTING OVERRIDE

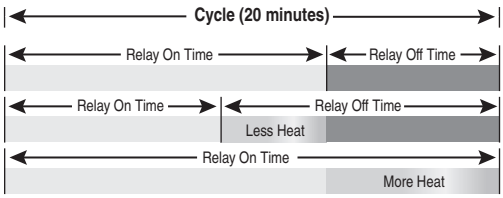
If the *AWAY* setting is selected in the SCHEDULE menu, the snow melting system is shut down. Both the Melting and Idling temperatures are ignored as long as the control remains in the Away mode.

SYSTEM PUMP OPERATION (SYS P1)

The system pump (*Sys P1*) contact closes and remains closed as long as the system is either in the Melting or Idling mode. The system pump contact shuts off if the control is in CWCO, WWSD, or if there is no call for Melting or Idling.

HEAT CONTACT OPERATION

The control uses the *Heat* contact to control the temperature of the slab. When the control is either Melting or Idling, the *Heat* contact operates on a 20 minute cycle. If the slab requires more heat, the on time in each cycle is increased. If the slab requires less heat, the on time of each cycle is decreased. The *Heat* contact shuts off if the control is in Cold Weather Cut Out (CWCO), Warm Weather Shut Down (WWSD), or if there is no call for Melting or Idling.



MELTING CONTACT OPERATION

The *Melting* contact (terminals 13 and 14) closes and remains closed as long as the system is in the melting mode. This contact can be used as an external signal to indicate that the system is currently in the melting mode. This contact can also be used as a means of prioritizing or enabling multiple snow melting controls.

PURGE

The system pump (*Sys P1*) and zoning device continue to operate for 20 seconds after the last demand is removed. This purges the residual heat from the boiler(s) into the snow melting slab.

Section C: Melting Enable / Disable

Section C1
Snow Melting
Enable

Section C2
Snow Melting
Disable

Section C1: Snow Melting Enable

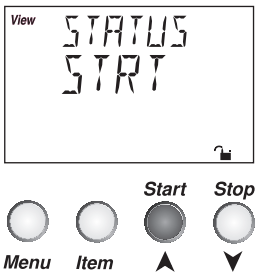
The snow melting system can be enabled manually or automatically. A melting enable signal applied to the control places the system into the melting mode. If a melting enable signal is applied once the system is already in the melting mode, the control responds to the last command received.

MANUAL MELTING ENABLE

A manual melting enable signal requires the user to manually start the snow melting system and can be provided from the ***Start*** button on the control, Remote Start / Stop Module 039, Remote Display Module 040, or an external melt demand.

Start Button on the Control

The snow melting system is enabled by pressing the ***Start*** button on the control while in the VIEW menu. The control then displays the *RUN TIME* setting to allow the user to adjust it. Once the snow melting system is enabled, the word STRT is displayed for at least 5 seconds in the STATUS item while in the VIEW menu. If the ***Start*** button on the control is pressed while the system is already melting and up to temperature, the running time counter is reset to the *RUN TIME* setting.

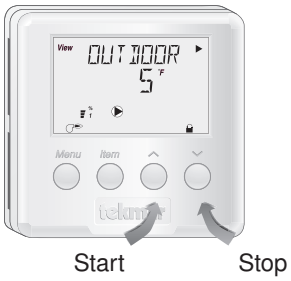


Remote Start / Stop Module 039

The snow melting system is enabled by pressing the button on the front of the 039. While the zone is coming up to temperature, a green indicator light flashes on the front of the 039. Once the zone is up to temperature and the RUN TIME is counting down, the green indicator light on the front of the 039 is on solid.

Remote Display Module 040

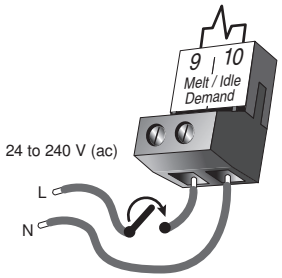
The snow melting system is enabled by pressing the ▲ button on the 040 while in the VIEW menu. The 040 then displays the *RUN TIME* setting to allow the user to adjust it. Once the snow melting system is enabled, the word STRT is displayed for at least 5 seconds in the STATUS item while in the VIEW menu.

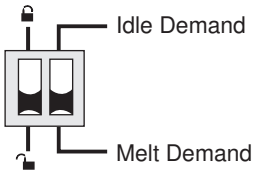


External Melt Demand (DIP switch set to Melt Demand)

The snow melting system is enabled when a voltage between 24 and 240 V (ac) is applied across the *Melt/Idle Demand* terminals (9 and 10). An external melt demand must be present for at least 4 seconds in order to start the snow melting system. If the RUN TIME reaches 0:00 and the external melt demand is still present, the control continues melting until the external melt demand is removed or the system is otherwise stopped.

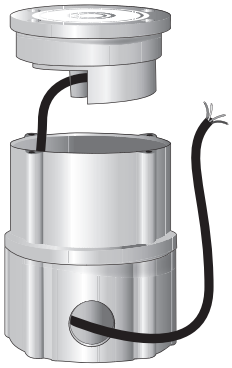
Note: This operation only occurs if the Idle Demand / Melt Demand DIP switch is set to the *Melt Demand* position.





AUTOMATIC MELTING ENABLE (Snow / Ice Sensor 090)

The 665 uses the Snow / Ice Sensor 090 to provide an automatic melting enable signal to start the snow melting system. The control continually monitors the 090 for the presence of moisture. Once moisture is detected, the *water* pointer is displayed in the LCD and the snow melting system is enabled.



Water Detection Sensitivity (SENSTVTY)

The 665 has a *Sensitivity* setting which compensates for varying outdoor conditions which could affect how the moisture detector in the 090 interprets the presence of moisture. This adjustable setting is available through the SENSTVTY item in the ADJUST menu of the control. As snow becomes contaminated with dirt, and as the sensor itself becomes dirty, the control may incorrectly indicate the presence of water. If this condition occurs, clean the surface of the sensor and / or turn down the SENSTVTY setting. If the snow in your area is very clean, the SENSTVTY setting may need to be increased before snow is detected. If AUTO is selected, the control automatically adjusts the sensitivity level used to detect moisture.

Section C2: Snow Melting Disable

The snow melting system can be disabled manually or automatically. A melting disable signal applied to the control takes the zone out of the melting mode. Once the snow melting system is disabled, the zone operates in the idling mode. The idling mode allows the zone to be operated at either a lower temperature or turned off.

MANUAL MELTING DISABLE

A manual melting disable signal requires the user to manually stop the snow melting system and can be provided from the ***Stop*** button on the control, Remote Start / Stop Module 039, Remote Display Module 040, or an external idle demand.

Stop Button on the Control

The ***Stop*** button on the control can be used to stop the snow melting system. The snow melting system is disabled by pressing the ***Stop*** button on the control while in the VIEW menu. Once the snow melting system is disabled, the word STOP is displayed for 5 seconds in the STATUS item of the appropriate zone while in the VIEW menu.

Remote Start / Stop Module 039

A Remote Start / Stop Module 039 can be used to stop the snow melting system. The snow melting system is disabled by pressing the button on the face of the 039. When the system is stopped, a solid Red Indicator Light is displayed on the face of the 039 for five seconds. If the snow melting system is disabled while there is still an external melt demand for snow melting, the 039 displays a solid red indicator light until the external demand is removed.

Remote Display Module 040

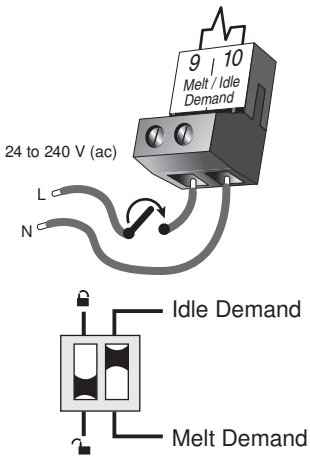
A Remote Display Module 040 can be used to stop the snow melting system. The snow melting system is disabled by pressing the ▼ button on the 040 while in the VIEW menu. Once the snow melting system is disabled, the word STOP is displayed for 5 seconds in the STATUS item while in the VIEW menu.

External Idle Demand (DIP switch set to Idle Demand)

The snow melting system is disabled when a voltage between 24 and 240 V (ac) is applied across the *Melt/Idle Demand* terminals (9 and 10). An external idle demand must be present for at least 4 seconds in order to stop the snow melting system.

Note: This operation only occurs if the Idle Demand / Melt Demand DIP switch is set to the Idle Demand position.

If the snow melting system is placed into Idling mode by an external idle demand, then a manual melting enable signal is applied, the idle demand is overridden until either the running time has expired, a stop signal is given, or the external idle demand is removed and reapplied.



AUTOMATIC MELTING DISABLE (Snow / Ice Sensor 090)

Once the 090 is dry, the *Water* pointer turns off in the LCD. The system slab temperature has to be at least the slab target temperature for a minimum of thirty minutes in order for the system to turn off. If a manual melting disable signal is applied the snow melting system turns off immediately.

Section D: Melting Operation

Section D1
General Melting Operation

Section D1: General Melting Operation

In order for the snow melting system to be started, one of the methods described in section D1 must be used. Once a melting enable signal is applied and the system is not in WWSD or CWCO, the Melting mode begins. When the control is in the Melting mode, the *Melting* pointer is visible in the VIEW menu. The *MELT* setting in the ADJUST menu sets the slab surface temperature. When the system is melting and the slab temperature is warming up to the slab target temperature, STRT is displayed in the STATUS item while in the VIEW menu. The system finishes melting when the slab temperature has been at least the slab target temperature for a period of time. This period of time is based on whether an automatic or manual melting enable signal starts the snow melting system.

If an automatic melting enable signal starts the snow melting system and the slab temperature reaches the slab target temperature, DET is displayed in the STATUS item while in the VIEW menu. The system continues to melt until the 090 becomes dry and any additional running time has expired. Once the Melting mode is complete, the system operates in the Idling mode.

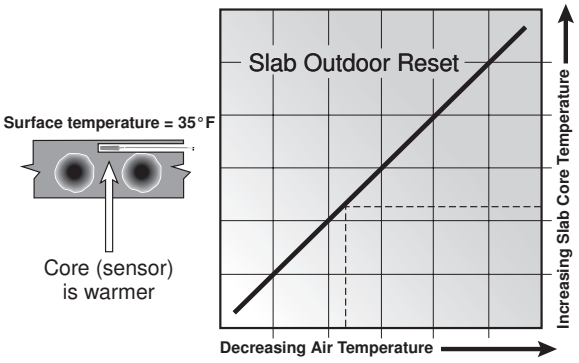
If a manual melting enable signal starts the snow melting system, the Running Time is displayed in the STATUS item while in the VIEW menu and begins counting down once the slab temperature reaches the slab target temperature. The system continues to melt until the running time counts down to 0:00 and there is no external melt demand. Once the Melting mode is complete, the system operates in the Idling mode. The table on page 14 describes how the control responds to enable and disable signals.

SLAB TEMPERATURE CONTROL

The 665 uses a snow / ice sensor or slab sensor to provide slab temperature control.

Slab Sensor

If a Slab Sensor is used, the control assumes that the sensor is approximately 1 inch below the surface of the snow melting slab. Since this point is closer to the source of the heat, this point is warmer than the surface of the slab. Therefore, the sensor must be maintained at a higher temperature in order to ensure that the surface of the slab is maintained at the correct temperature. The amount of temperature difference between the surface of the slab and the slab sensor changes with the outdoor temperature. Therefore, the slab core temperature is increased as the outdoor air temperature drops. The temperature displayed as SLAB is the temperature of the slab sensor.



Slab Surface Temperature is Constant

Snow / Ice Sensor 090

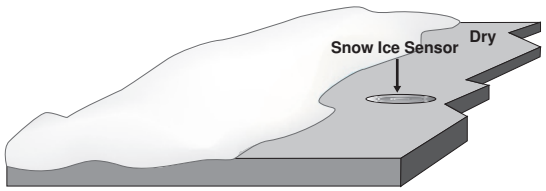
The slab temperature is displayed as SLAB in the VIEW menu. This temperature is calculated from the edge and center sensors built into the 090.

SLAB TARGET TEMPERATURE (SLB TRG)

The SLAB TRG temperature is determined from the *Melting* setting, or *Idle* setting and the outdoor air temperature. The control displays the temperature that it is currently trying to maintain at the slab sensor. If the control does not presently have a requirement for heat, it displays "– – –" in the STATUS item while in the VIEW menu.

ADDITIONAL MELTING TIME (ADD MELT)

In cases where areas of the snow melting system haven't completely melted after the melting mode has finished and the 090 is dry, the 665 has a function in which additional time can be added to melt the zone. This is an adjustable time through the ADD MELT item in the ADJUST menu of the control. The ADD MELT time is calculated into a running time and is displayed in the STATUS item while in the VIEW menu. Once the 090 becomes dry and the slab temperature is at least the slab target temperature, the ADD MELT time starts counting down.



Section E: Idling Operation

Section E1
General Idling Operation

Section E2
Temporary Idle

Section E1: General Idling Operation

When the snow melting system starts from a cold temperature, the time required for the system to reach the melting temperature may be excessive. To decrease this start up time, the 665 has an idling feature which can maintain the zone at a lower temperature. This feature is also useful for preventing frost and light ice formation. The *IDLING* setting in the ADJUST menu sets the slab surface temperature while the control is in the idling mode. When in the idling mode, IDLE is displayed in the STATUS item of the VIEW menu. If idling is not desirable, the *IDLING* setting may be set to *OFF*.

Section E2: Temporary Idle (TMPY IDL)

The temporary idle allows the control to enter the idle state for a set amount of time. If the snow ice detector does not detect snow during the temporary idle period, the control then leaves the idle state and returns to the OFF state. This is useful in applications where there is the possibility of snow and the slab can be pre-heated in order to have a short heat up time if snow is detected.

To enable a temporary idle, the *Temporary Idle* setting in the ADJUST menu must be set from OFF to the length of the temporary idle. The DIP Switch must be set to IDLE DEMAND and the IDLING must be set to a temperature. To activate a temporary idle, a voltage between 24 and 240 V (ac) must be applied across the *Melt/Idle Demand* terminals for at least 4 seconds.

When a *Temporary Idle* time is selected, the control has three available states: OFF, Temporary Idle, and Melting. The table below describes the action of the control:

Control State	Action	Result
OFF	External Idle Demand	Temporary Idle
OFF	Manual or Auto Melt Start	Melting
Melting	External Idle Demand	Melting
Melting	Manual or Auto Melt Start	Melting
Melting	Manual or Auto Melt Stop	OFF
Temporary Idle	Temporary Idle Expires	OFF
Temporary Idle	Manual or Auto Melt Start	Melting
Temporary Idle	Manual Melt Stop	OFF

Installation

CAUTION

Improper installation and operation of this control could result in damage to the equipment and possibly even personal injury. It is your responsibility to ensure that this control is safely installed to all applicable codes and standards. This electronic control is not intended for use as a primary limit control. Other controls that are intended and certified as safety limits must be placed into the control circuit. Do not open the control. Refer to qualified personnel for servicing. Opening voids warranty and can result in damage to the equipment and possibly even personal injury.

STEP ONE — GETTING READY

Check the contents of this package. If any of the contents listed are missing or damaged, please contact your wholesaler or tekmar sales representative for assistance.

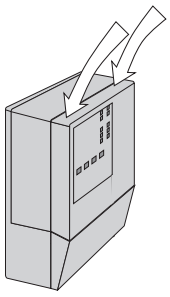
Type 665 includes: One Snow Detector & Melting Control 665, One Outdoor Sensor 070, Data Brochures D 665, User Brochure U 665, and Application Brochure A 665.

Note: Carefully read the details of the Sequence of Operation to ensure that you have chosen the proper control for your application.

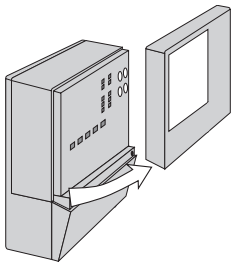
STEP TWO — CONTROL INSTALLATION

Enclosure A

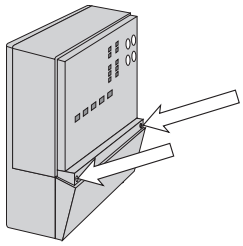
Enclosure A is a robust housing for the control and associated wiring. Safety dividers in the wiring chamber are provided to separate low and high voltage wiring.



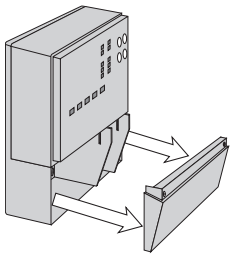
Press down at the fingertip grips on top of the front cover and pull out and down.



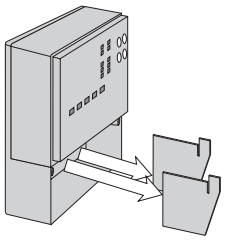
Lift the front cover up and away from the control.



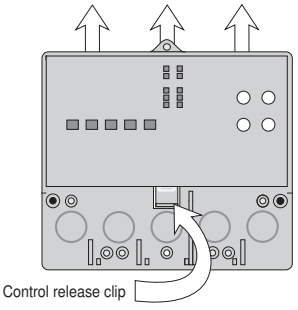
Loosen the screws at the front of the wiring cover.



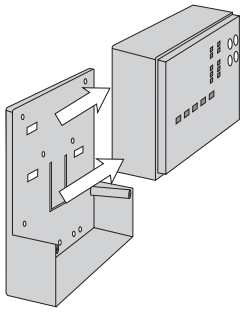
The wiring cover pulls straight out from the wiring chamber.



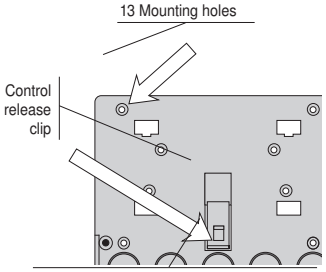
Remove the safety dividers from the wiring chamber by pulling them straight out of their grooves.



Press the control release clip on the base inside the wiring chamber and slide the control upwards.

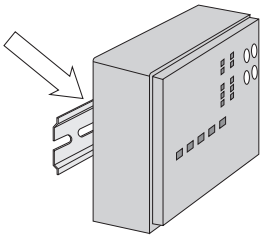


The control lifts up and away from the base.

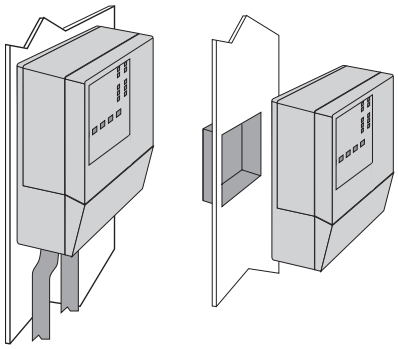


The base is ready for mounting.

The control can be mounted on a standard DIN rail. First remove the control from its base and then, using the hooks and spring clip on the back of the control, mount it onto the DIN rail. This will be a popular option for those who prefer to mount the control inside a larger electrical panel.



The wiring can enter the bottom or the back of the enclosure. Knock-outs provided in the base allow the wiring to be run in conduit up to the enclosure. The base also has holes that line up with the mounting holes of most common electrical boxes.



STEP THREE — SENSOR INSTALLATION

Caution: Do not run sensor wires parallel to telephone or power cables. If the sensor wires are located in an area with strong sources of electromagnetic interference, shielded cable or twisted pair should be used or the wires can be run in a grounded metal conduit. If using shielded cable, the shield wire should be connected to the Sensor Common terminal on the control and not to earth ground.

All electrical wiring terminates in the two wiring chambers on the control. If the control is to be mounted on an electrical box, the wiring can be roughed-in at the electrical box prior to installation of the control.

Power must not be applied to any of the wires during the rough-in wiring stage.

Mounting the Outdoor Sensor

Note: The temperature sensor (thermistor) is built into the enclosure.

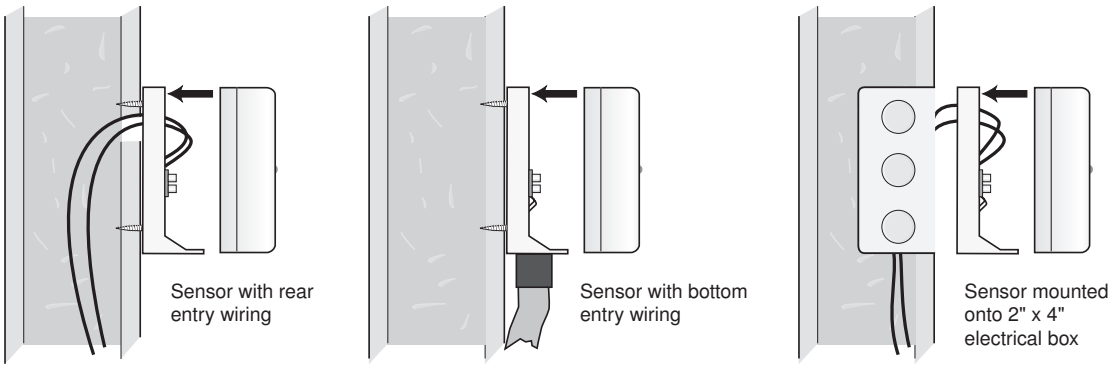
Remove the screw and pull the front cover off the sensor enclosure.

The sensor can either be mounted directly onto a wall or a 2” x 4” electrical box . When wall mounted, the wiring should enter through the back or bottom of the enclosure. Do not mount the sensor with the conduit knockout facing upwards as rain could enter the enclosure and damage the sensor.

In order to prevent heat transmitted through the wall from affecting the sensor reading, it may be necessary to install an insulating barrier behind the enclosure.

The Outdoor Sensor should be mounted on a wall which best represents the heat load on the building (a northern wall for most buildings and a southern facing wall for buildings with large south facing glass areas). The sensor should not be exposed to heat sources such as ventilation or window openings.

The sensor should be installed at an elevation above the ground that will prevent accidental damage or tampering.

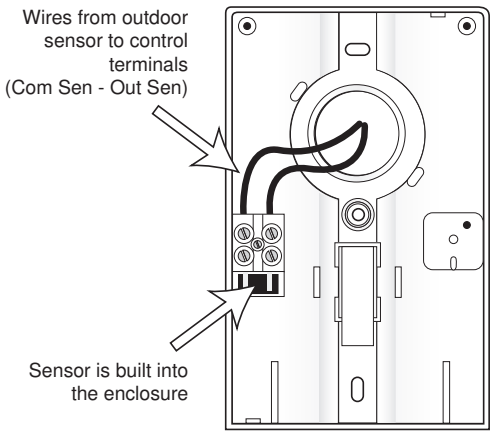


Wiring the Outdoor Sensor

Connect 18 AWG or similar wire to the two terminals provided in the enclosure and run the wires from the sensor to the control. Do not run the wires parallel to telephone or power cables. If the sensor wires are located in an area with strong sources of electromagnetic interference (EMI), shielded cable or twisted pair should be used or the wires can be run in a grounded metal conduit. If using shielded cable, the shield wire should be connected to the Com or Com Sen terminal on the control and not to earth ground.

Follow the sensor testing instructions in this brochure and connect the wires to the control.

Replace the front cover of the sensor enclosure.



STEP FOUR — ROUGH-IN WIRING

All electrical wiring terminates in the control base wiring chamber. The base has standard 7/8" (22 mm) knockouts which accept common wiring hardware and conduit fittings. Before removing the knockouts, check the wiring diagram and select those sections of the chamber with common voltages. Do not allow the wiring to cross between sections as the wires will interfere with safety dividers which should be installed at a later time.

- Power must not be applied to any of the wires during the rough-in wiring stage.
- All wires are to be stripped to a length of 3/8" (9mm) to ensure proper connection to the control.
- Install the Outdoor Sensor 070 and run the wiring back to the control.
- Install the Snow / Ice Sensor 090 according to the installation instructions in the Data Brochure D 090 and run the wiring back to the control. See Data Brochure D 090 for very important details on sensor location and installation.
- If a Slab Sensor is used, install the slab sensor according to the installation instructions in the Data Brochure provided with the sensor, and run the wiring back to the control.
- If a Remote Display Module (RDM) 040 is used, install the RDM according to the installation instructions in the Data Brochure D 040 and run the wiring back to the control.
- If a Remote Start / Stop Module 039 is used, install the module according to the installation instructions in the Data Brochure D 039 and run the wiring back to the control.
- Run wire from other system components (pumps, boiler, etc.) to the control.
- Run wires from the 115 V (ac) power to the control. Use a clean power source with a minimum 15 A circuit to ensure proper operation. Multi-strand 16 AWG wire is recommended for all 115 V (ac) wiring due to its superior flexibility and ease of installation into the terminals.

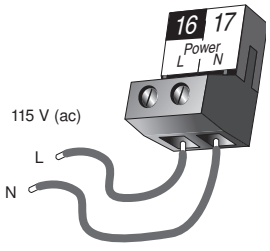
STEP FIVE — ELECTRICAL CONNECTIONS TO THE CONTROL

The installer should test to confirm that no voltage is present at any of the wires. Push the control into the base and slide it down until it snaps firmly into place.

⚠ *Powered Input Connections*

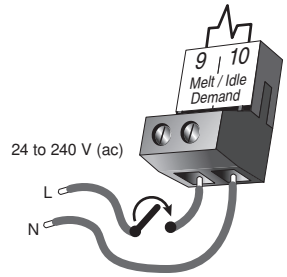
115 V (ac) Power

Connect the 115 V (ac) power supply to the *Power L* and *Power N* terminals (16 and 17). This connection provides power to the microprocessor and display of the control. As well, this connection provides power to the *Sys P1* terminal (15) from the *Power L* terminal (16).



Melt / Idle Demand

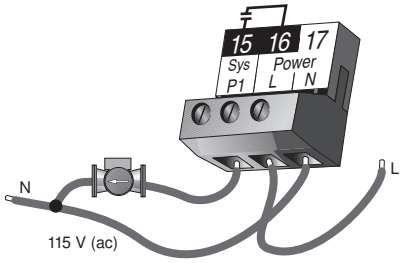
To generate a melt demand or idle demand, a voltage between 24 V (ac) and 240 V (ac) must be applied across the *Melt / Idle Demand* terminals (9 and 10).



⚠ *Output Connections*

System Pump Contact (Sys P1)

The *Sys P1* output terminal (15) on the 665 is a powered output. When the relay in the 665 closes, 115 V (ac) is provided to the *Sys P1* terminal (15) from the *Power L* terminal (16). To operate the system pump, connect one side of the system pump circuit to terminal and the second side of the pump circuit to the neutral (N) side of the 115 V (ac) power supply.



Melting Contact

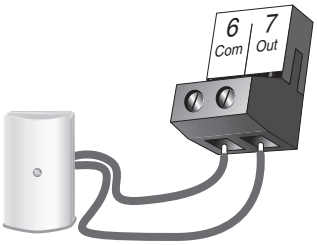
The *Melting* terminals (11 and 12) are an isolated output in the 665. There is no power available on these terminals from the control. These terminals are used as a switch to make or break an external circuit.

⚠ *Sensor and Unpowered Input Connections*

Do not apply power to these terminals as this will damage the control.

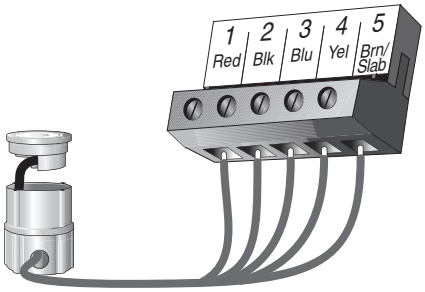
Outdoor Sensor

Connect the two wires from the Outdoor Sensor 070 to the *Out* and *Com* terminals (6 and 7). The outdoor sensor is used by the 665 to measure the outdoor air temperature.



EITHER: Snow / Ice Sensor 090

Connect the red wire from the sensor cable to the *Red* terminal (1), connect the black wire from the sensor cable to the *Blk* terminal (2), connect the blue wire from the sensor cable to the *Blu* terminal (3), connect the yellow wire from the sensor cable to the *Yel* terminal (4) and connect the brown wire from the sensor cable to the *Brn / Slab* terminal (5). The snow / ice sensor is used by the 665 to measure the slab surface temperature of the zone. This sensor must be installed flush with the slab surface and 1/2 way between the heating pipes. See Data Brochure D 090 for installation instructions regarding the Snow / Ice Sensor 090 and Sensor Socket 091



OR: Slab Sensor

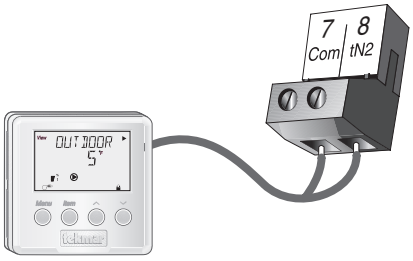
If a Snow / Ice Sensor 090 is not used, a slab sensor can be used. If a slab sensor is used, connect the two wires from the slab sensor to the *Blk* and *Brn / Slab* terminals (2 and 5). The slab sensor is used by the 665 to measure the slab temperature of the zone.

Note: Proper sensor placement is critical for correct operation of the 665 control. The slab sensor must be installed 1/2 way between the heating pipes and 1'' (25 mm) below the surface of the slab. Although the sensor can be installed directly into the slab, we recommend that the sensor be installed in tubing or conduit in such a manner that the sensor can be removed and replaced in case of failure.

tekmarNet® (tN2) Device

A Remote Display Module (RDM) 040 or Remote Start / Stop Module 039 can be connected to the tekmar*Net*® (tN2) input. Connect the *Com* terminal from the appropriate tN2 device to the *Com* terminal (7) on the 665. Connect the *tN2* terminal from the appropriate tN2 device to the *tN2* terminal (8) on the 665.

Note: The wires from the RDM and Remote Start / Stop Module are polarity sensitive. The tN2 device does not operate correctly if the wires are reversed.



STEP SIX — TESTING THE WIRING

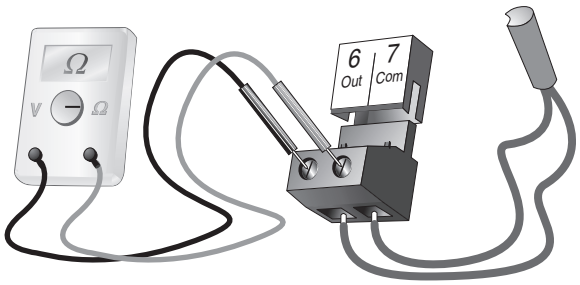
Each terminal block must be unplugged from its header on the control before power is applied for testing. To remove the terminal block, pull straight down from the control.

The following tests are to be performed using standard testing practices and procedures and should only be carried out by properly trained and experienced persons.

A good quality electrical test meter, capable of reading from at least 0 – 300 V (ac) and at least 0 – 2,000,000 Ω, is essential to properly test the wiring and sensors.

⚠ *Test the Sensors*

In order to test the sensors, the actual temperature at each sensor location must be measured. A good quality digital thermometer with a surface temperature probe is recommended for ease of use and accuracy. Where a digital thermometer is not available, a spare sensor can be strapped alongside the one to be tested and the readings compared.



Test the Sensor Wiring

A good quality test meter capable of measuring up to 5,000 kΩ (1 kΩ = 1000 Ω) is required to measure the sensor resistance. In addition to this, the actual temperature must be measured with either a good quality digital thermometer, or if a thermometer is not available, a second sensor can be placed alongside the one to be tested and the readings compared.

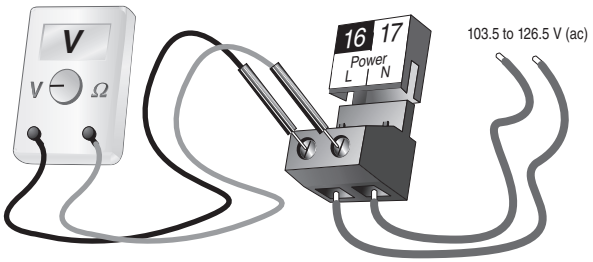
First measure the temperature using the thermometer and then measure the resistance of the sensor at the control. The wires from the sensor must not be connected to the control while the test is performed. Using the chart below, estimate the temperature measured by the sensor. The sensor and thermometer readings should be close. If the test meter reads a very high resistance, there may be a broken wire, a poor wiring connection or a defective sensor. If the resistance is very low, the wiring may be shorted, there may be moisture in the sensor or the sensor may be defective. To test for a defective sensor, measure the resistance directly at the sensor location.

Do not apply voltage to a sensor at any time as damage to the sensor may result.

Temperature		Resistance	Temperature		Resistance	Temperature		Resistance	Temperature		Resistance
°F	°C	Ω	°F	°C	Ω	°F	°C	Ω	°F	°C	Ω
-50	-46	490,813	20	-7	46,218	90	32	7,334	160	71	1,689
-45	-43	405,710	25	-4	39,913	95	35	6,532	165	74	1,538
-40	-40	336,606	30	-1	34,558	100	38	5,828	170	77	1,403
-35	-37	280,279	35	2	29,996	105	41	5,210	175	79	1,281
-30	-34	234,196	40	4	26,099	110	43	4,665	180	82	1,172
-25	-32	196,358	45	7	22,763	115	46	4,184	185	85	1,073
-20	-29	165,180	50	10	19,900	120	49	3,760	190	88	983
-15	-26	139,403	55	13	17,436	125	52	3,383	195	91	903
-10	-23	118,018	60	16	15,311	130	54	3,050	200	93	829
-5	-21	100,221	65	18	13,474	135	57	2,754	205	96	763
0	-18	85,362	70	21	11,883	140	60	2,490	210	99	703
5	-15	72,918	75	24	10,501	145	63	2,255	215	102	648
10	-12	62,465	80	27	9,299	150	66	2,045	220	104	598
15	-9	53,658	85	29	8,250	155	68	1,857	225	107	553

⚠ *Test The Power Supply*

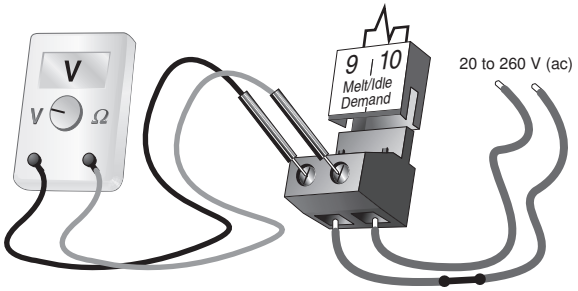
Make sure exposed wires and bare terminals are not in contact with other wires or grounded surfaces. Turn on the power and measure the voltage between the *Power L* and *Power N* terminals (16 and 17) using an AC voltmeter, the reading should be between 103.5 and 126.5 V (ac).



⚠ *Test The Powered Inputs*

Melt / Idle Demand

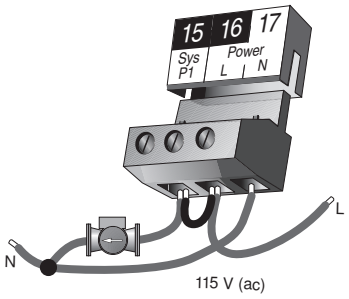
If a Melt/Idle demand is used, measure the voltage between the *Melt/Idle Demand* terminals (9 and 10). When the melting or idling device calls for heat, you should measure between 20 and 260 V (ac) at the terminals. When the melting or idling device is off, you should measure less than 5 V (ac).



⚠ *Test The Outputs*

System Pump (Sys P1)

If a system pump is connected to the *Sys P1* terminal (15), make sure that power to the terminal block is off and install a jumper between the *Sys P1* and *Power L* terminals (15 and 16). When power is applied to the *Power L* and *Power N* terminals (16 and 17), the system pump should start. If the pump does not turn on, check the wiring between the terminal block and pump and refer to any installation or troubleshooting information supplied with the pump. If the pump operates properly, disconnect the power and remove the jumper.



Heat Contact

If a zone pump or zone valve is connected to *Heat* terminals (11 and 12), make sure power to the pump or valve circuit is off and install a jumper between the *Heat* terminals (11 and 12). When the circuit is powered up, the zone pump should turn on or the valve should open completely. If no response occurs, check the wiring between the terminal and the pump or valve and refer to any installation or troubleshooting information supplied with these devices.

Melting

If a device is connected to the *Melting* terminals (13 and 14), make sure power to the circuit is off, and install a jumper between the terminals. When the circuit is powered up, the device should operate. If the device does not operate, refer to any installation or troubleshooting information supplied with the device. If the device operates properly, disconnect the power and remove the jumper.

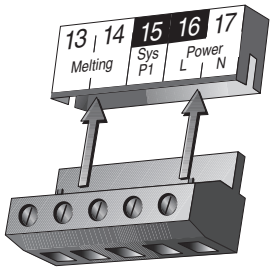
⚠ *Connecting The Control*

Make sure all power to the devices and terminal blocks is off, and remove any remaining jumpers from the terminals.

Reconnect the terminal blocks to the control by carefully aligning them with their respective headers on the control, and then pushing the terminal blocks into the headers. The terminal blocks should snap firmly into place.

Install the supplied safety dividers between the unpowered sensor inputs and the powered wiring chambers.

Apply power to the control. The operation of the control on power up is described in the Sequence of Operation section of the brochure.

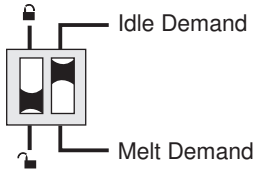


Cleaning

The control's exterior can be cleaned using a damp cloth. Moisten cloth with water and wring out prior to wiping control. Do no use solvents or cleaning solutions.

DIP Switch Settings

The DIP switch settings on the control are very important and should be set to the appropriate settings prior to making any adjustments to the control through the User Interface. The DIP switch settings change the items that are available to be viewed and / or adjusted in the User Interface.



LOCK / UNLOCK (FACTORY SETTING IS UNLOCK)

The Lock / Unlock DIP switch is used to lock and unlock the access level of the control and tekmarNet® tN2 device. Once locked, access levels can not be changed. To determine if the control is currently locked or unlocked, a small segment representing a padlock is viewed in the bottom right hand corner of the display. When the padlock is closed, the access level cannot be changed.

To change the access level, set the DIP switch to the unlocked, or down position. The current access level of the control or tekmarNet® tN2 device is viewed in its Miscellaneous (*Misc*) menu. While viewing the access level, use the ▲ and ▼ keys to select between the Limited (LTD), User (USER), Installer (INST) or Advanced (ADV) access levels.

To lock the access level, select the appropriate access level in the Miscellaneous (Misc) and move the DIP switch from the unlocked position to the locked position. As long as the DIP switch is in the locked position, the access level of the control or tekmarNet® tN2 device can no longer be viewed or adjusted in its Miscellaneous (*Misc*) menu.

IDLE DEMAND / MELT DEMAND (FACTORY SETTING IS MELT DEMAND)

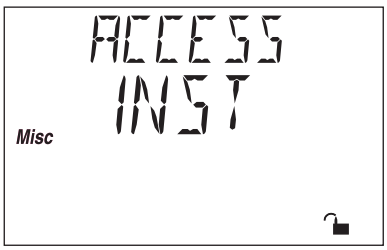
The Idle Demand / Melt Demand DIP switch is used for melting and idling operation. The position of the DIP switch determines what the *Melt/Idle Demand* terminals (9 and 10) are used for. When the DIP switch is set to the Melt Demand position, the *Melt/Idle Demand* terminals (9 and 10) are used to place the snow melting system into melting mode.

When the DIP switch is set to the Idle Demand position, the *Melt/Idle Demand* terminals (9 and 10) are used to force the snow melting system into idling mode.

Access Levels

The tekmar Snow Detector & Melting Control 665 comes with four Access Level settings. These Access Levels restrict the number of Menus, Items and Adjustments that can be accessed by the user. The four access levels are Limited (LTD), User (USER), Installer (INST) and Advanced (ADV).

The access level of the control is found in the Miscellaneous (Misc) menu when the Lock / Unlock DIP switch is set to the Unlocked position. In the Advanced access level, all of the control settings are available to the user. In the User access level, only a few of the menus and items are available. The Limited access level is the most restricted of them all. The control's factory setting is Installer (INST). This access level is sufficient for the normal set up of the control. Once the control is set up, the appropriate access level should be selected for the people that deal with the control on a regular basis.



665 View Menu (1 of 1)

Item Field	Section	Access Level: LTD	USER	INST	ADV	Description	Range
OUTDOOR		●	●	●	●	**Outdoor** Current outdoor air temperature as measured by the outdoor sensor.	-67 to 149°F (-55 to 65°C)
SLAB TRG	D1			●	●	**Slab Target** Slab sensor target temperature.	– – –, 20 to 110°F (– – –, -7 to 43°C)
SLAB	D1		●	●	●	**Slab** Current slab sensor temperature.	-58 to 167°F (-50 to 75°C)
STATUS	B1	●	●	●	●	**Status** Operating status.	STRT, STOP, IDLE, EXT, 0:00 to 23:59 hr, ———, INF, WWSD, CWCO, DET, IDLE

665 **Adjust** Menu (1 of 1)

Item Field	Section	Access Level: LTD	USER	INST	ADV	Description	Range	Actual Setting
RUN TIME	B1	●	●	●	●	**Run Time** The time for which a zone is operated once it has reached its melting temperature. This item cannot be viewed if a Remote Start / Stop Module 039 has been connected.	0:30 to 17:00 hr, INF (Infinity) Default = 4:00 hr	
ADD MELT	D1				●	**Add Melt** The additional time for which a zone is operated once the Snow / Ice Sensor 090 becomes dry. **090 is present**	0:00 to 6:00 hr Default = 0:30 hr	
SENSTVTY	C1		●	●	●	**Sensitivity** Sensitivity of water detection of the Snow / Ice Sensor 090. **090 is present**	AUTO, 20 to 80% Default = AUTO	
MELTING	D1		●	●	●	**Melting** The desired slab surface temperature while in the Melting mode.	32 to 95°F (0 to 35°C) Default = 36°F (2°C)	
IDLING	E1			●	●	**Idling** The desired slab surface temperature while in the Idling mode.	OFF, 20 to 95°F (OFF, -7 to 35°C) Default = OFF	
TMPY IDL	A				●	**Temporary Idle** Time for which the temporary idle is active.	OFF, 0:30 to 40:00 hr Default = OFF	
WWSD	B			●	●	**WWSD** Warm Weather Shut Down. Slab must exceed 34°F to enter WWSD.	AUTO, 32 to 95°F (AUTO, 0 to 36°C) Default = AUTO	
CWCO	B1			●	●	**CWCO** The Cold Weather Cut Out temperature for the snow melting system.	OFF, -30 to 50°F (OFF, -34 to 10°C) Default = 10°F (-12°C)	
EXERCISE	A				●	**Exercise** The frequency with which the control exercises the pumps and valves that are operated by the control.	30 to 240 hours, (in 10 hour steps) Default = 70 hr	

665 **Monitor** Menu (1 of 1)

Note: To clear the recorded information in the specific item field, press and hold ▲ and ▼.

Item Field	Access Level (LTD / USER / INST / ADV)	Description	Range
OUT HI	● ● ● ●	**Outdoor High** The highest recorded outdoor air temperature since this item was last cleared.	-67 to 149°F (-55 to 65°C)
OUT LO	● ● ● ●	**Outdoor Low** The lowest recorded outdoor air temperature since this item was last cleared.	-67 to 149°F (-55 to 65°C)
SLAB HI	● ● ●	**Slab High** The highest recorded temperature at the slab sensor since this item was last cleared.	-58 to 167°F (-50 to 75°C)
SLAB LO	● ● ●	**Slab Low** The lowest recorded temperature at the slab sensor since this item was last cleared.	-58 to 167°F (-50 to 75°C)
SYS PUMP	● ●	**System Pump** The total number of system pump (Sys P1) running hours since this item was last cleared.	0 to 9999 hr
HEAT	● ●	**Heat** The total number of running hours of the *Heat* contact since this item was last cleared.	0 to 9999 hr
HEAT CYC	●	**Heat Cycle** The total number of cycles of the *Heat* contact since this item was last cleared. This item can be used in conjunction with the Heat item to determine the average cycle length of the *Heat* contact.	0 to 9999 hr
NO HEAT	●	**No Heat** This item is an adjustable warning. If the slab temperature does not reach its slab target temperature within the set time, the control displays a warning message.	1 to 24 hr, OFF Default = OFF
COP	●	**Cop** The number of times that the microprocessor in the control has reset since this item was last cleared. The control will reset itself if it has experienced some form of interference that has disrupted its operation. This can be used to give an indication of the quality of the electrical environment that the control has been installed in.	0 to 255
NON-COP	●	**Non-Cop** The number of times that the control has been powered up since this item was last cleared. This number will increase if there is a lowering of the input voltage beyond the control's usable range. This item can be used as an indication of the quality of the power source.	0 to 255
tN2 COMM	●	**tN2 Communication** The number of times that a communication error has been detected between the control and either an RDM or Remote Start / Stop Module since this item was last cleared. If the wires between the control and the tekmarNet® tN2 device are run in a noisy electrical environment, this can cause interference in the communication between the control and the tN2 device.	0 to 255

665 **Schd** (Schedule) Menu (1 of 1)

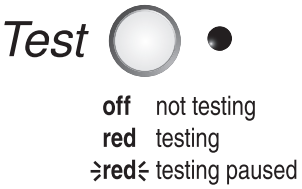
Item Field	Section	Access Level: LTD	USER	INST	ADV	Description	Range
OVERRIDE	B1	●	●	●	●	**Override** The setback override that is in effect for the snow melting system.	NONE, AWAY (Ovr) Default = NONE

665 **Misc** (Miscellaneous) Menu (1 of 1)

Item Field	Access Level: LTD	USER	INST	ADV	Description	Range
UNITS		●	●	●	**Units** The units of measure that all of the temperatures are to be displayed in by the control.	°F, °C Default = °F
BACKLITE		●	●	●	**Backlite** The operating mode for the back lighting on the LCD as well as time of keypad inactivity until the control automatically returns to the default display.	OFF, 30 sec, ON Default = ON
ACCESS	●	●	●	●	**Access** The access level that is to be used by the control. **DIP switch = *Unlock***	ADV, INST, USER, LTD Default = INST

Testing the Control

The Snow Detector & Melting Control 665 has a built-in test routine which is used to test the main control functions. The 665 continually monitors the sensors and displays an error message whenever a fault is found. See the following pages for a list of the 665's error messages and possible causes. When the ***Test*** button is pressed, the test light is turned on. The individual outputs and relays are tested in the following test sequence.



TEST SEQUENCE

Each step in the test sequence lasts 10 seconds.

During the test routine, the test sequence is paused by pressing the ***Test*** button. While paused, the control displays the testing step as well as the word PAUS. If the ***Test*** button is not pressed again for 5 minutes while the test sequence is paused, the control exits the entire test routine. If the test sequence is paused, the ***Test*** button can be pressed again to advance to the next step. This can also be used to rapidly advance through the test sequence. To reach the desired step, repeatedly press and release the ***Test*** button until the appropriate device and segment in the display turn on

Step 1 The system pump contact (*Sys P1*) is turned on for 10 seconds.

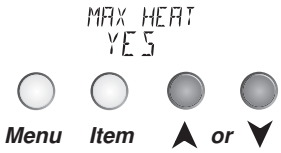
Step 2 The *Heat* contact is turned on for 10 seconds. After 10 seconds, the *Heat* relay and the *Sys P1* relay are turned off.

Step 3 The *Melting* contact is turned on for 10 seconds. After 10 seconds, the melting relay is turned off**.**

MAX HEAT

The Snow Detector & Melting Control 665 has a function called Max Heat. In this mode, the 665 turns on and operates the system up to the maximum set temperatures, and the mixing device at the set percentage. The control continues to operate in this mode for up to 24 hours or until either the ***Item***, ***Menu*** or ***Test*** button is pressed. This mode may be used for running all circulators during system start-up in order to purge air from the piping. To enable the Max Heat feature, use the following procedure.

1) Press and hold the ***Test*** button for more than 3 seconds. At this point, the control displays the words MAX HEAT and the word NO.
2) Using the ▲ or ▼ buttons, select the word YES. After 3 seconds, the control flashes the word MANUAL and the number 100. This number represents the % on time of the Heat relay during each 20 minute cycle.
3) Set the desired Heat relay % on time by using the ▲ and / or ▼ buttons on the control.
4) To cancel the Max Heat mode, press either the ***Item***, ***Menu***, or ***Test*** button.
5) Once the Max Heat mode has either ended or is cancelled, the control resumes normal operation.



Troubleshooting

When troubleshooting any heating system, it is always a good idea to establish a set routine to follow. By following a consistent routine, many hours of potential headaches can be avoided. Below is an example of a sequence that can be used when diagnosing or troubleshooting problems in a hydronic heating system.

Establish the Problem

Establish the problem. Get as much information from the customer as possible about the problem. Is there too much heat, not enough heat, or no heat? Is the problem only in one particular zone or area of the building or does the problem affect the entire system? Is this a consistent problem or only intermittent? How long has the problem existed for? This information is critical in correctly diagnosing the problem.

Understanding the Sequence of Operation

Understand the sequence of operation of the system. If a particular zone is not receiving enough heat, which pumps or valves in the system must operate in order to deliver heat to the affected zone? If the zone is receiving too much heat, which pumps, valves or check valves must operate in order to stop the delivery of heat?

Use the Test Routine

Press the ***Test*** button on the control and follow the control through the test sequence as described in the Testing section. Pause the control as necessary to ensure that the correct device is operating as it should.

Sketch the Piping in the System

Sketch the piping of the system. This is a relatively simple step that tends to be overlooked, however it can often save hours of time in troubleshooting a system. Note flow directions in the system paying close attention to the location of pumps, check valves, pressure bypass valves and mixing valves. Ensure correct flow direction on all pumps. This is also a very useful step if additional assistance is required.

Document the Control

Document the control for future reference. Before making any adjustments to the control, note down all of the items that the control is currently displaying. This includes items such as error messages, current temperatures and settings, and which devices should be operating as indicated by the LCD. This information is an essential step if additional assistance is required to diagnose the problem.

Isolate the Problem

Isolate the problem between the control and the system. Now that the sequence of operation is known and the system is sketched, is the control operating the proper pumps and valves at the correct times? Is the control receiving the correct signals from the system as to when it should be operating? Are the proper items selected in the menus of the control for the device that is to be operated?

Test the Contacts, Voltages and Sensors

Test the contacts, voltages and sensors. Using a multimeter, ensure that the control is receiving adequate voltage to the power terminals and the demand terminals as noted in the technical data. Use the multimeter to determine if the internal contacts on the control are opening and closing correctly. Follow the instructions in the Testing the Wiring section to simulate closed contacts on the terminal blocks as required. Test the sensors and their wiring as described in the Testing section.

Monitor the System

Monitor the system over a period of time. Select the applicable items in the MONITOR menu of the control and reset them to zero. Allow the system and the control to operate over a known period of time and then record the Monitor items. Use this information to help diagnose any remaining problems.

Error Displayed	Description of Error
CTRL ERR EE W	The control was unable to store a piece of information into its EEPROM. This error can be caused by a noisy power source. The control will display the error message and will continue to operate as normal. Pressing either the ***Menu*** or ***Item*** button will clear this error.
CTRL ERR ADJS	The control was unable to read a piece of information stored in the ADJUST menu. Because of this, the control was required to load the factory settings into all of the items in the ADJUST menu. The control will stop operation until all of the items available in the ADJUST menu of the control have been checked by the user or installer. ***Note:*** Access level must be ADV in order to clear the error.
CTRL ERR MNTR	The control was unable to read a piece of information stored in the MONITOR menu. Because of this, the control was required to load the factory settings into all of the items in the MONITOR menu. The control will continue to display the error message until all of the items available in the MONITOR menu of the control have been checked by the user or installer. ***Note:*** Access level must be ADV in order to clear the error.
CTRL ERR SCHD	The control was unable to read a piece of information stored in the SCHEDULE menu. Because of this, the control was required to load the factory settings into all of the items in the SCHEDULE menu. The control will continue to display the error message until all of the items available in the SCHEDULE menu of the control have been checked by the user or installer. ***Note:*** Access level must be ADV in order to clear the error.
CTRL ERR MISC	The control was unable to read a piece of information stored in the MISCELLANEOUS menu. Because of this, the control was required to load the factory settings into all of the items in the MISCELLANEOUS menu. The control will continue to display the error message until all of the items available in the MISCELLANEOUS menu of the control have been checked by the user or installer. ***Note:*** Access level must be ADV in order to clear the error.
tN2 TYPE	An incorrect device has been connected to the *tekmarNet® tN2* input terminal. Once the problem has been corrected, press either the ***Menu*** or ***Item*** button to clear the error message from the control.
tN2 SHRT	A short circuit has been read between the *tN2* terminal and a *Com* terminal on the control. Either the wires leading to the tN2 device are shorted or the polarity of the wires is reversed. Determine the cause and remove the short. To clear this error, press either the ***Menu*** or ***Item*** button.
OUTDOOR SHRT	The control is no longer able to read the outdoor sensor due to a short circuit. In this case the control assumes an outdoor temperature of 32°F and continues operation. Locate and repair the problem as described in the Testing section. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.
OUTDOOR OPEN	The control is no longer able to read the outdoor sensor due to an open circuit. In this case the control assumes an outdoor temperature of 32°F and continues operation. Locate and repair the problem as described in the Testing section. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.
SLAB SHRT	The control is no longer able to read the slab sensor due to a short circuit. In this case, if the control is currently in the Melting mode, the control turns off the Heat relay. Locate and repair the problem as described in the Data Brochure supplied with the sensor. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.

665 **Error** Messages (2 of 2)

Error Displayed	Description of Error
SLAB OPEN	The control is no longer able to read the slab sensor due to an open circuit. In this case, if the control is currently in the Melting mode, the control will turn off the Heat relay. Locate and repair the problem as described in the Data Brochure supplied with the sensor. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.
YELLOW SHRT	The control is no longer able to read the yellow sensor due to a short circuit. In this case, the control will turn off the heater in the Snow / Ice Sensor 090. Check the 090 yellow temperature sensor (*black* and *yellow* wires, terminals 2 and 4), and the wiring from the terminal plug to the sensor. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.
YELLOW OPEN	The control is no longer able to read the yellow sensor due to an open circuit. In this case, the control will turn off the heater in the Snow / Ice Sensor 090. Check the 090 yellow temperature sensor (*black* and *yellow* wires, terminals 2 and 4), and the wiring from the terminal plug to the sensor. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.
BLUE SHRT	The control is no longer able to read the water detection circuit due to a short circuit. In this case, if the control is currently in the Melting mode, the control will finish the snow melting cycle. The snow melting system can only be operated using an external melt demand, Remote Display Module 040, Remote Start / Stop Module 039 or the ***Start*** button on the control. Otherwise, the control will operate as if the Snow / Ice Sensor 090 is dry. Check the 090 water detection circuit (*black* and *blue* wires, terminals 2 and 3) according to the Data Brochure D 090. To clear the error message from the control after the error has been repaired, press either the ***Menu*** or ***Item*** button.
BLUE OPEN	The control is no longer able to read the water detection circuit due to an open circuit. In this case, if the control is currently in the Melting mode, the control will finish the snow melting cycle. The snow melting system can only be operated using an external melt demand, Remote Display Module 040, Remote Start / Stop Module 039 or the ***Start*** button on the control. Otherwise, the control will operate as if the Snow / Ice Sensor 090 is dry. Check the 090 water detection circuit (*black* and *blue* wires, terminals 2 and 3) according to the Data Brochure D 090. To clear the error message from the control after the error has been repaired, press either the ***Menu*** or ***Item*** button.
RED ERR	The control is reading a heater malfunction. In this case, unless the yellow sensor becomes too hot, the heater continues to try to operate. The snow melting system can only be operated using an external melt demand, Remote Display Module 040, Remote Start / Stop Module 039 or the ***Start*** button on the control. Check the 090 heater circuit (*red* and *black* wires, terminals 1 and 2) according to the Data Brochure D 090. Make sure the yellow and brown wires are not reversed. To clear the error message from the control after the error has been repaired, press either the ***Menu*** or ***Item*** button.
CTRL ERR HOT	The control's internal sensor is too hot (Above 160°F (71°C)). In this case, the control will turn off the heater in the Snow / Ice Sensor 090 until the control cools off. To clear the error message from the control after the error has been repaired, press either the ***Menu*** or ***Item*** button.
NO HEAT SLAB	This warning message will be displayed if the Slab temperature does not increase to the SLAB TRG temperature while the system is melting within a set time. The time limit is set using the NO HEAT item in the MONITOR menu. To clear this warning, press either the ***Menu*** or ***Item*** button.

Notes

Notes

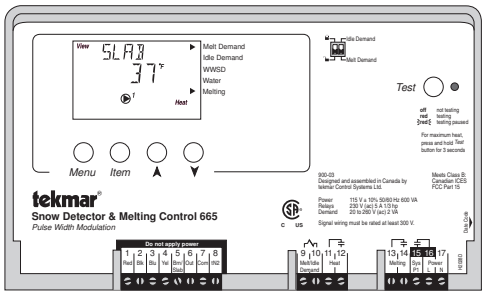
Notes

Sensor Technical Data

Outdoor Sensor 070	
Literature	D070, C070
Packaged weight	0.4 lb. (180 g)
Dimensions	4-1/2” H x 2-7/8” W x 1-1/2” D (73 x 114 x 38 mm)
Enclosure	White PVC plastic, NEMA type 2
Approvals	CSA C US
Operating range	-60 to 140°F (-51 to 60°C)
Sensor	NTC thermistor, 10 kΩ @ 77°F (25°C ±0.2°C) ß=3892
Warranty	Limited 3 Year (See D070 for full warranty)

Technical Data

Snow Detector & Melting Control 665 *Pulse Width Modulation*	
Literature	D665, A665, U665, C665
Control	Microprocessor control. This is not a safety (limit) control
Packaged weight	3.1 lb. (1400 g)
Dimensions	6-5/8” H x 7-9/16” W x 2-13/16” D (170 x 193 x 72 mm)
Enclosure	Blue PVC plastic, NEMA type 1
Approvals	CSA C US, meets class B: ICES & FCC Part 15
Ambient conditions	Indoor use only, 32 to 122°F (0 to 50°C), RH ≤90% Non-condensing
Power supply	115 V (ac) ±10%, 50/60 Hz, 600 VA
Relay capacity	230 V (ac) 5 A, 1/3 hp
Demand	20 to 260 V (ac) 2 VA
Sensors	NTC thermistor, 10 kΩ @ 77°F (25°C ±0.2°C) ß=3892
–Included	Outdoor Sensor 070
–Optional	tekmar type #: 039, 040, 072, 073, 090, 091, 094
Warranty	Limited 3 Year (See D665 for full warranty)



The installer must ensure that this control and its wiring are isolated and/or shielded from strong sources of electromagnetic noise. Conversely, this Class B digital apparatus complies with Part 15 of the FCC Rules and meets all requirements of the Canadian Interference-Causing Equipment Regulations. However, if this control does cause harmful interference to radio or television reception, which is determined by turning the control off and on, the user is encouraged to try to correct the interference by re-orientating or relocating the receiving antenna, relocating the receiver with respect to this control, and/or connecting the control to a different circuit from that to which the receiver is connected.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Caution The nonmetallic enclosure does not provide grounding between conduit connections. Use grounding type bushings and jumper wires.

Attention Un boîtier nonmétallique n´assure pas la continuité électrique des conduits. Utiliser des manchons ou des fils de accord spécialement conçus pour la mise á la terre.

Limited Warranty and Product Return Procedure

Limited Warranty ***The liability of tekmar under this warranty is limited. The Purchaser, by taking receipt of any tekmar product (“Product”), acknowledges the terms of the Limited Warranty in effect at the time of such Product sale and acknowledges that it has read and understands same.***

The tekmar Limited Warranty to the Purchaser on the Products sold hereunder is a manufacturer’s pass-through warranty which the Purchaser is authorized to pass through to its customers. Under the Limited Warranty, each tekmar Product is warranted against defects in workmanship and materials if the Product is installed and used in compliance with tekmar’s instructions, ordinary wear and tear excepted. The pass-through warranty period is for a period of twenty-four (24) months from the production date if the Product is not installed during that period, or twelve (12) months from the documented date of installation if installed within twenty-four (24) months from the production date.

The liability of tekmar under the Limited Warranty shall be limited to, at tekmar’s sole discretion: the cost of parts and labor provided by tekmar to repair defects in materials and/or workmanship of the defective product; or to the exchange of the defective product for a warranty replacement product; or to the granting of credit limited to the original cost of the defective product, and such repair, exchange or credit shall be the sole remedy available from tekmar, and, without limiting the foregoing in any way, tekmar is not responsible, in contract, tort or strict product liability, for any other losses, costs, expenses, inconveniences, or damages, whether direct, indirect, special, secondary, incidental or consequential, arising from ownership or use of the product, or from defects in workmanship or materials, including any liability for fundamental breach of contract.

The pass-through Limited Warranty applies only to those defective Products returned to tekmar during the warranty period. This Limited Warranty does not cover the cost of the parts or labor to remove or transport the defective Product, or to reinstall the repaired or replacement Product, all such costs and expenses being subject to Purchaser’s agreement and warranty with its customers.

Any representations or warranties about the Products made by Purchaser to its customers which are different from or in excess of the tekmar Limited Warranty are the Purchaser’s sole responsibility and obligation. Purchaser shall indemnify and hold tekmar harmless from and against any and all claims, liabilities and damages of any kind or nature which arise out of or are related to any such representations or warranties by Purchaser to its customers.

The pass-through Limited Warranty does not apply if the returned Product has been damaged by negligence by persons other than tekmar, accident, fire, Act of God, abuse or misuse; or has been damaged by modifications, alterations or attachments made subsequent to purchase which have not been authorized by tekmar; or if the Product was not installed in compliance with tekmar’s instructions and/or the local codes and ordinances; or if due to defective installation of the Product; or if the Product was not used in compliance with tekmar’s instructions.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, WHICH THE GOVERNING LAW ALLOWS PARTIES TO CONTRACTUALLY EXCLUDE, INCLUDING, WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, DURABILITY OR DESCRIPTION OF THE PRODUCT, ITS NON-INFRINGEMENT OF ANY RELEVANT PATENTS OR TRADEMARKS, AND ITS COMPLIANCE WITH OR NON-VIOLATION OF ANY APPLICABLE ENVIRONMENTAL, HEALTH OR SAFETY LEGISLATION; THE TERM OF ANY OTHER WARRANTY NOT HEREBY CONTRACTUALLY EXCLUDED IS LIMITED SUCH THAT IT SHALL NOT EXTEND BEYOND TWENTY-FOUR (24) MONTHS FROM THE PRODUCTION DATE, TO THE EXTENT THAT SUCH LIMITATION IS ALLOWED BY THE GOVERNING LAW.

Product Warranty Return Procedure All Products that are believed to have defects in workmanship or materials must be returned, together with a written description of the defect, to the tekmar Representative assigned to the territory in which such Product is located. If tekmar receives an inquiry from someone other than a tekmar Representative, including an inquiry from Purchaser (if not a tekmar Representative) or Purchaser’s customers, regarding a potential warranty claim, tekmar’s sole obligation shall be to provide the address and other contact information regarding the appropriate Representative.

tekmar® Control Systems

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All specifications are subject to change without notice.
Printed in Canada. D 665 - 04/12.

tekmar® - Data Brochure Addendum

Snow Detector & Melting Control 665

D 665A

06/04

The tekmar Snow Detector & Melting Control 665 has been modified to include the following features:

- Temporary Idle
- Adjustable Warm Weather Shut Down

The changes are included in controls starting with Lot 11. The date code and lot number is listed on the right hand side of the 665.

Added Features

Features listed below have been added to the 665 Snow Detector & Melting Control. The sections in this addendum now supplement the D 665 brochure dated 09/02.

Section A: Temporary Idle (TMPY IDL)

The temporary idle allows the control to enter the idle state for a set amount of time. If the snow ice detector does not detect snow during the temporary idle period, the control then leaves the idle state and returns to the OFF state. This is useful in applications where there is the possibility of snow and the slab can be pre-heated in order to have a short heat up time if snow is detected.

To enable a temporary idle, the *Temporary Idle* setting in the ADJUST menu must be set from OFF to the length of the temporary idle. The DIP Switch must be set to IDLE DEMAND and the IDLING setting must be set to a temperature. To activate a temporary idle, a voltage between 24 and 240 V (ac) must be applied across the *Melt/Idle Demand* terminals for at least 4 seconds.

When a temporary idle is selected, the control has three available states: OFF, Temporary Idle, and Melting. The table below describes the action of the control:

Control State	Action	Result
OFF	External Idle Demand	Temporary Idle
OFF	Manual or Auto Melt Start	Melting
Melting	External Idle Demand	Melting
Melting	Manual or Auto Melt Start	Melting
Melting	Manual or Auto Melt Stop	OFF
Temporary Idle	Temporary Idle Expires	OFF
Temporary Idle	Manual or Auto Melt Start	Melting
Temporary Idle	Manual Melt Stop	OFF

Section B: Warm Weather Shut Down (WWSD)

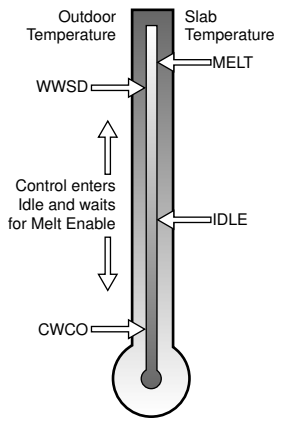
The control has a warm weather shut down that prevents the control from entering the melt or idle modes in order to conserve energy. While in WWSD, the word WWSD is displayed in the STATUS item in the VIEW menu and the WWSD pointer is on the display. The WWSD item in the ADJUST menu can be either set to Automatic or it can be set to a temperature.

AUTOMATIC (AUTO)

When the WWSD is set to AUTO, the WWSD occurs when the slab temperature and the outdoor temperature exceed the *Melting* setting by 2°F (1°C). The control exits the WWSD when the slab or outdoor temperature falls to the *Melting* setting temperature.

ADJUSTABLE WWSD

When the WWSD is set to a temperature, the WWSD occurs when the outdoor air temperature exceeds the *WWSD* setting by 1°F (0.5°C) and when the slab temperature exceeds 34°F (1°C). The control exits WWSD when the outdoor temperature falls 1°F (0.5°C) below the *WWSD* setting or if the slab temperature falls below 34°F (1°C). This allows the *Melting Temperature* setting to be set higher than the WWSD. This is useful where high slab temperatures are required to melt the snow or ice. A good example of this is installations using paving bricks on top of sand and concrete layers.



The following items have been added to the menus of the D 665 brochure dated 09/02.

665 **View** Menu (1 of 1)

Item Field	Section	LTD	USER	INST	ADV	Description	Range
STATUS		●	●	●	●	**Status** Operating status.	STRT, STOP, IDLE, EXT, 0:00 to 23:59 hr, ––:––, INF, WWSD, CWCO, DET, IDLE

665 **Adjust** Menu (1 of 1)

Item Field	Section	LTD	USER	INST	ADV	Description	Range	Actual Setting
TMPY IDL	A				●	**Temporary Idle** Time for which the temporary idle is active.	OFF, 0:30 to 40:00 hr Default = OFF	
WWSD	B			●	●	**WWSD** Warm Weather Shut Down. Slab must exceed 34°F to enter WWSD.	AUTO, 32 to 95°F (AUTO, 0 to 36°C) Default = AUTO	

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tekmar® - Data Brochure

Snow / Ice Sensor 090 / 094, Sensor Socket 091

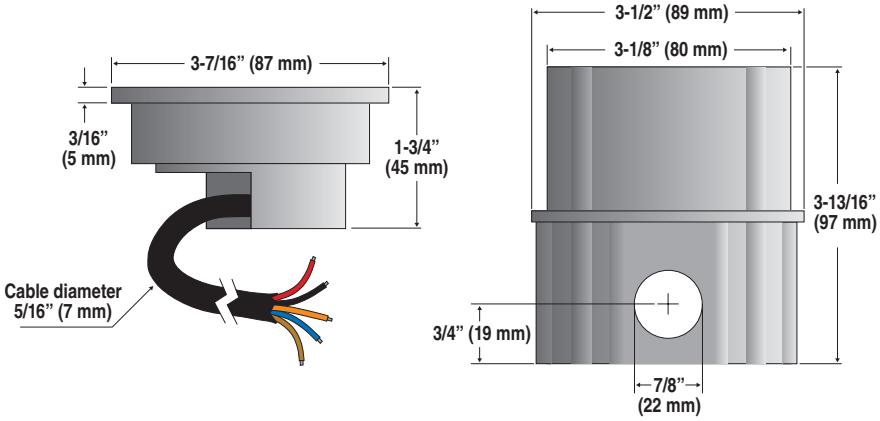
D 090

08/05

The tekmar Snow/Ice Sensor 090/094 and tekmar Sensor Socket 091 are used with all tekmar snow/ice melt controls. The 090 has a 65' (20 m) cable while the 094 has a 210' (64 m) cable.

The Snow/Ice Sensor is designed to sit flush with the slab surface after being mounted into the Sensor Socket. The socket is installed directly into the snow melt slab halfway between the heating elements or pipes.

The sensor measures the slab temperature, sensor surface temperature and sensor surface moisture level.



Installation

CAUTION

Improper installation and operation of this sensor could result in damage to equipment and possibly even personal injury. It is your responsibility to ensure that this sensor is safely installed according to all applicable codes and standards. Please follow these step-by-step instructions to gain a full understanding of this device.

STEP ONE — GETTING READY

Check the Contents

Check the contents of this package. If any of the contents listed are missing or damaged, please refer to the Limited Warranty and Product Return Procedure on the back of this brochure and contact your wholesaler or tekmar sales representative for assistance.

Type 090 includes: • One Snow/Ice Sensor 090 with "O" ring • Four, #6-32 x 3/8" screws • Four, #4-40 x 7/16" screws • One Data Brochure D 090

Type 094 includes: • One Snow/Ice Sensor 094 with "O" ring • Four, #6-32 x 3/8" screws • Four, #4-40 x 7/16" screws • One Data Brochure D 090

Type 091 includes: • One Snow/Ice Sensor Socket 091 • One protective plastic plug • One plastic mounting plate • Eight, #6-32 x 3/8" screws • One Data Brochure D 090

STEP TWO — MOUNTING THE SENSOR

Location of the Sensor

- The location of the snow/ice sensor determines how well the snow melt detector responds to conditions on the snow melting slab. The sensor measures the temperature of the slab surface, and would normally be installed in a location that is representative of the average surface temperature and moisture conditions. The only exception to this practice would be those applications where the sensor is placed in a specific problem area where ice or snow often forms first.
- The installer should be careful to place the sensor in a location where it will not be affected by abnormal temperature conditions that may occur near buildings, hot air exhaust ducts or other heat sources, or sunny areas within a larger slab area.
- As well as reading temperatures, the sensor also detects surface water. The installer should be careful not to place the sensor where standing water could accumulate on its surface. This may cause the snow melt system to be held on far longer than necessary, as the control will be getting a signal that water is present even through the rest of the slab surface may be dry. In addition, the sensor should not be placed in areas where drainage is considerably better than the surrounding area.
- The snow/ice sensor should not be installed in locations where vehicles park, near building overhangs or near trees since this may interfere with snow fall accumulation. If in doubt about the location of these obstacles, a second spare socket and conduit can be installed in order to provide a backup sensor location if the first location is not found to be ideal.
- Vehicle tire and pedestrian traffic can track water and contaminants onto the snow melt area. If the snow/ice sensor is located in the traffic area, snow melting will be triggered by the passing traffic. This may be desirable in commercial areas where excessive traffic can cause the surface to become icy. In residential installations, the amount of traffic is usually limited, and it may be desirable to locate the snow/ice sensor away from the traffic area. This will reduce the number of snow melt events that occur and thereby reduce the annual fuel consumption.
- The location of the sensor should be midway between the heating pipes or elements.

Conduit

Place the sensor socket at the chosen location and run a conduit for the cable from the socket to the snow/ice detection control. If more than 210' (64 m) of cable is required to reach the control, run the conduit to a weatherproof junction box. The sensor cable should be run in its own conduit and not in combination with high voltage wiring.

The conduit length from the sensor to the junction box should be less than the 210' (64 m) of cable supplied with the 094 snow/ice sensor.

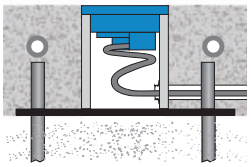
At the junction box, additional 18 AWG, 5 conductor cable can be spliced on to increase the total length to 500' (150 m) from the sensor to control.

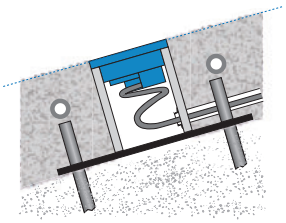
Avoid tying the conduit to the rebar within 6' (2 m) of the socket. This allows the rebar grid to move without disturbing the position of the socket.

Sloped Surfaces

The top of the snow/ice sensor should be flush and parallel to that of the snow melt surface.

When the sensor is installed on a sloped driveway, the sensor must be installed near the lowest elevation of the slope. This is required since the melting snow or ice runoff water will drain toward the lowest point on the driveway and keep this area wet for longer periods of time.





Installing the Socket

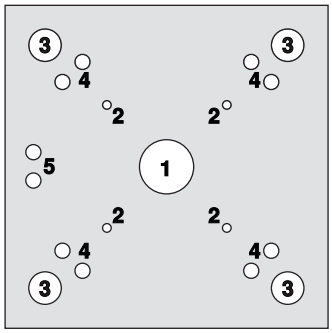
A mounting plate has been included to simplify the installation of the sensor socket. When possible, the mounting plate should be located directly on top of gravel in order to provide good drainage. If the slab is more than 4" thick, a mound of crushed rock or a styrofoam or wooden block can be used to elevate the socket. A hole must be punched or drilled in the styrofoam or wooden block in order to provide drainage.

Failure to provide adequate drainage under the socket may reduce the life expectancy of the snow/ice sensor.

The mounting plate can be fastened to the ground by driving 1/2" (12.7 mm) rebar through the four holes located on each of the four corners and then tying the mounting plate to the rebar.

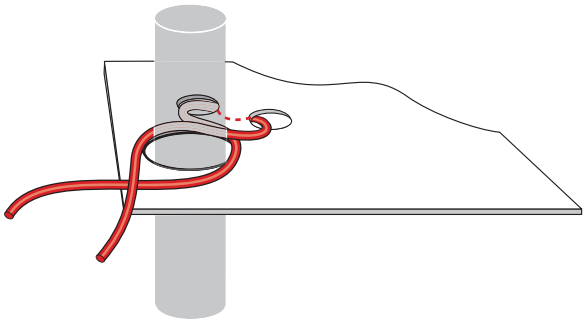
1) Cut four pieces of rebar at least 12" (300 mm) long.
2) Drive the rebar into the ground through each of the mounting plate rebar holes. Leave approximately 2" (50 mm) of rebar above the ground.
3) Cut several 12" (300 mm) pieces of steel wire.
4) Form a "U" shape and pull wire through the rebar tie hole from the bottom to the top side.
5) Repeat by pulling the "U" shape from the top to the bottom side.
6) Repeat (4) and (5) for each of the four corners.
7) Cross the wire, then wrap around the rebar.
8) Twist wire using pliers to tighten.

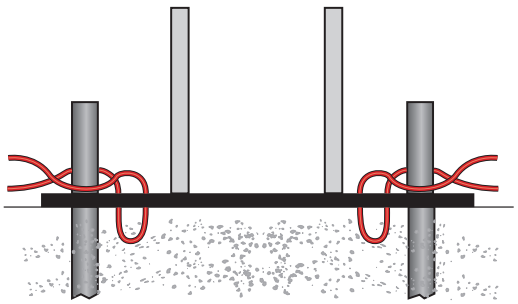
The mounting plate also has conduit tie holes to allow a cable tie or steel wire to fasten the conduit to the mounting plate.



Mounting Plate

1. Drainage hole
2. Socket screw holes
3. Rebar holes
4. Rebar tie holes
5. Conduit tie holes





Placing Concrete

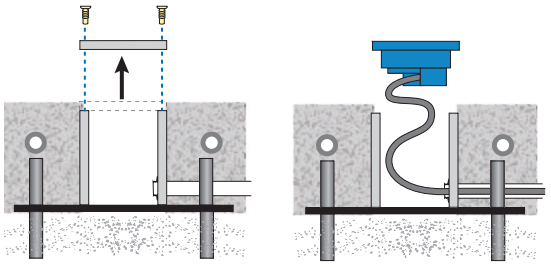
A plastic plug is provided with the socket to prevent it from being accidentally filled with concrete. The plastic plug is the same thickness as the sensor flange. This allows the finished surface of the concrete (asphalt, etc.) to be troweled flush with the plug. The plug must be installed prior to placing the concrete. Also ensure that the mounting plate drainage hole remains unplugged once the concrete has cured.

Installing Brick Pavers

If using brick pavers instead of concrete, it is recommended to mortar surrounding brick pavers to the side of the socket. This ensures good thermal conduction from the brick pavers to the socket. The top of the brick pavers should be level with the socket when the plastic plug is installed.

Install the Sensor and Cable

When the snow melt surface is finished, remove the plastic plug from the socket and fish the cable through the conduit until there is only 6 to 12" (150 to 300 mm) of cable between the sensor and conduit. Loop this remaining extra wire in a loose coil so as to not twist it, and place it, and the sensor into the socket. Secure the sensor to the socket with the four screws provided, making sure the "O" ring is in place and properly seated.



Replacing old 090 or 094

Current versions of the Snow/Ice socket 091 use #6-32 screws. Previous versions of the 091 used smaller #4-40 screws. When replacing an 090 or 094, both sets of screws are provided. It is recommended to try the smaller screws first to avoid cross threading.

Salt and Brine Contamination

The performance of the snow/ice sensor water detection can be compromised when exposed to deicing agents such as road salt, magnesium chloride, or calcium chloride. These contaminants can permanently damage the sensor. It is recommended to locate the sensor away from areas exposed to these deicing agents when at all possible. Locations to avoid could include tire track areas or areas close to a curb where traveling vehicles may splash contaminated water on to the sensor.

Maintenance

The Snow/Ice Sensor is installed in a hostile environment. Accumulation of dirt, salty grime, etc., on its surface will inhibit proper water detection. It should be checked on a regular basis and, when necessary, cleaned. Before cleaning, the control power should be shut off to prevent the control from entering the snow melt mode. Next, use a soft bristle brush and warm soapy water to clean the sensor surface. Do not use a steel wire brush as this will damage the sensor. Then use a paper towel to thoroughly dry the sensor surface. After cleaning, re-power the control and push the test button to cycle the control through the test routine.

STEP THREE — WIRING THE SENSOR

Electrical Connections

The snow/ice sensor cable has 5 wires: Red, Black, Blue, Yellow, and Brown. The wires connect to the respective Red, Black, Blue, Yellow and Brown terminals on the Snow Detector & Melting Control.

Testing and Troubleshooting

TEST THE SENSOR

When performing these tests:

- The sensor head should be installed in the slab.
- The five cable wires at the control should be disconnected (unplug terminal plug).
- Use a good quality electrical testing meter with an ohm scale range of 0 to 2,000,000 Ohms.

The sensor has two 10k Ohm thermistors. One reads slab surface temperature, and the other checks sensor heater temperature.

If the sensor has been disconnected from the control for an hour or more, the readings for both thermistors should be very close.

- Using the ohmmeter and standard testing practices, measure the resistance between:

  (a) the yellow and black sensor wires (sensor temperature), and

  (b) the brown and black sensor wires (slab temperature).

The table below lists the expected resistance values at various sensor temperatures.

- Measure the resistance between the blue and black wires. When the sensor surface is dry, the reading should be 2,000,000 Ohms. When the sensor surface is wet it should be between 10,000 and 300,000 Ohms.
- Measure the resistance between the red and black wires of the heating element. This reading should be close to 50 Ohms.

Temperature		Resistance	Temperature		Resistance	Temperature		Resistance
°F	°C	Ω	°F	°C	Ω	°F	°C	Ω
-49	-45	472,000	5	-15	72,900	59	15	15,700
-40	-40	337,000	14	-10	55,300	68	20	12,500
-31	-35	243,000	23	-5	42,300	77	25	10,000
-22	-30	177,000	32	0	32,600	86	30	8,060
-13	-25	130,000	41	5	25,400	95	35	6,530
-4	-20	97,000	50	10	19,900	104	40	5,330

Technical Data

Snow / Ice Sensor 090 / 094	
Literature	D 090
090 Packaged weight	4.4 lbs (2000 g)
094 Packaged weight	10.5 lbs (4762 g)
Dimensions	1-3/4" H x 3-7/16 O.D. (45 x 87 O.D. mm)
Material	Brass, epoxy
Cable material	18 AWG, 5 conductor stranded wire with polyethylene jacket
090 Cable length	65' (20 m)
094 Cable length	210' (64 m)
Approvals	CSA C US with applicable tekmar snow melting controls
Operating range	-30 to 170°F (-34 to 77°C)
Sensor	NTC thermistor, 10kΩ @ 77°F (25°C ± 0.2°C), ß = 3892

Snow / Ice Sensor Socket 091	
Literature	D 090
Packaged weight	1.5 lbs (675 g)
Dimensions	3-13/16" H x 3-1/2 O.D. (97 x 89 O.D. mm)
Socket material	Brass
Cap material	Polyethylene
Mounting plate material	Polyethylene
Approvals	CSA C US with applicable tekmar snow melting controls

Limited Warranty and Product Return Procedure

Limited Warranty ***The liability of tekmar under this warranty is limited. The Purchaser, by taking receipt of any tekmar product ("Product"), acknowledges the terms of the Limited Warranty in effect at the time of such Product sale and acknowledges that it has read and understands same.***

The tekmar Limited Warranty to the Purchaser on the Products sold hereunder is a manufacturer's pass-through warranty which the Purchaser is authorized to pass through to its customers. Under the Limited Warranty, each tekmar Product is warranted against defects in workmanship and materials if the Product is installed and used in compliance with tekmar's instructions, ordinary wear and tear excepted. The pass-through warranty period is for a period of twenty-four (24) months from the production date if the Product is not installed during that period, or twelve (12) months from the documented date of installation if installed within twenty-four (24) months from the production date.

The liability of tekmar under the Limited Warranty shall be limited to, at tekmar's sole discretion: the cost of parts and labor provided by tekmar to repair defects in materials and / or workmanship of the defective product; or to the exchange of the defective product for a warranty replacement product; or to the granting of credit limited to the original cost of the defective product, and such repair, exchange or credit shall be the sole remedy available from tekmar, and, without limiting the foregoing in any way, tekmar is not responsible, in contract, tort or strict product liability, for any other losses, costs, expenses, inconveniences, or damages, whether direct, indirect, special, secondary, incidental or consequential, arising from ownership or use of the product, or from defects in workmanship or materials, including any liability for fundamental breach of contract.

The pass-through Limited Warranty applies only to those defective Products returned to tekmar during the warranty period. This Limited Warranty does not cover the cost of the parts or labor to remove or transport the defective Product, or to reinstall the repaired or replacement Product, all such costs and expenses being subject to Purchaser's agreement and warranty with its customers.

Any representations or warranties about the Products made by Purchaser to its customers which are different from or in excess of the tekmar Limited Warranty are the Purchaser's sole responsibility and obligation. Purchaser shall indemnify and hold tekmar harmless from and against any and all claims, liabilities and damages of any kind or nature which arise out of or are related to any such representations or warranties by Purchaser to its customers.

The pass-through Limited Warranty does not apply if the returned Product has been damaged by negligence by persons other than tekmar, accident, fire, Act of God, abuse or misuse; or has been damaged by modifications, alterations or attachments made subsequent to purchase which have not been authorized by tekmar; or if the Product was not installed in compliance with tekmar's instructions and / or the local codes and ordinances; or if due to defective installation of the Product; or if the Product was not used in compliance with tekmar's instructions.

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PLUMBING

TechData
PRODUCT SPECIFICATION SHEET

viega

PureFlow SYSTEMS

ViegaPEX™ Cross-linked Polyethylene (PEX)

Scope
This material specification designates the requirements for ViegaPEX hot and cold water distribution tubing. All ViegaPEX tubing is copper tube size dimension (CTS), SDR-9 wall thickness and meets the respective requirements of ASTM F876 and F877.

Materials
All ViegaPEX tubing is manufactured from a cross-linkable high density polyethylene produced by grafting organo-silanes onto a polyethylene base. A catalyst (accelerator) added to the cross-linkable polyethylene during extrusion initiates the cross-linking process. Cross-linking is completed with hot water or steam (sauna). ViegaPEX tubing is available in red, white, or blue for easy identification of hot and cold lines.

Marking and Certification
All ViegaPEX tubing is marked with the name Viega as the manufacturer, nominal size, plastic tubing material designation code (PEX 1006), design pressure and temperature ratings, relevant ASTM standards, manufacturing date and production code, as well as both the NSF-pw and the NSF CL-R/CL-TD stamps indicating third-party certification by NSF International for meeting and exceeding performance and toxicological standards, as well as achieving the highest chlorine resistance rating (NSF Protocol P171) in the PEX industry. NSF conducts random on-site inspections of Viega manufacturing facilities and independently tests ViegaPEX tubing for compliance with physical, performance and toxicological standards. ViegaPEX is also certified to meet the Uniform Plumbing Code, IAPMO, CSA B137.5 Warnock Hersey, the ICBO Evaluation Service and HUD (Housing and Urban Development).

Recommended Uses
ViegaPEX tubing is intended and recommended for use in hot and cold potable water distribution systems. Design temperature and pressure ratings for ViegaPEX is 160 psi @ 73°F and 100 psi @ 180°F. ViegaPEX tubing can also be used in "continuously-recirculating" plumbing systems at temperatures of up to 140°F while still maintaining excellent chlorine resistance. For information on the suitability for other hot and cold water applications not listed here, consult with your Viega representative.

Handling and Installation
ViegaPEX cross-linked polyethylene tubing is tough yet flexible. However, it is softer than metals and may be damaged by abrasion or by objects with a cutting edge. Use of these materials in hot and cold water distribution systems must be in accordance with good plumbing practices, applicable code requirements, and current installation practices available from Viega. ViegaPEX is manufactured to meet written national standards. Contact a Viega representative or the applicable code enforcement bureau for information about approvals for specific applications.

Property	ASTM Test Method	Typical Values	
		English Units	SI Units
Density	D 792	–	0.946 g/cc
Melt Index[1] (190°C/2.16 kg)	D 1238	–	0.7g/10 min
Flexural Modulus[2]	D 790	120,000 psi	830 MPa
Tensile Strength @ Yield (2 in/min)	D 638	2,900 psi	20 MPa
Coefficient of Linear Thermal Expansion @ 68°F	D 696	$8x10^{2}$/°F	$15x10^{-5}$/°C
Hydrostatic Design Basis @ 73°F (23°C)	D 2837	1,250 psi	8.6 MPa
Hydrostatic Design Basis @ 180°F (82°C)	D 2837	800 psi	5.5 MPa
Vicat Softening Point	D 696	255°F	124°C
Thermal Conductivity	D 177	2.4 Btu-in (hr)(ft^2)(°F/in)	$3.5x10^{-3}$ Watts/(cm^2)(°C/cm)

1. Before Cross-linking
2. 73°F

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viega

Vanguard Piping Systems, Inc.
A Viega Company

TechData
PRODUCT SPECIFICATION SHEET

PLUMBING

viega

PureFlow SYSTEMS

ViegaPEX™

Quality Assurance
When the product is marked with the ASTM F876/F877 designation, it affirms that the product was manufactured, inspected, sampled and tested in accordance with these specifications and has been found to meet the specified requirements.

Certifications
NSF-pw - tested for health effects to ANSI/NSF standard 61 and performance to ANSI/NSF standard 14.

NSF CL-R/CL-TD - Tested and conforms to NSF Protocol P171, Chlorine Resistance of Plastic Piping Materials. Meets and exceeds pass/fail criteria of both Traditional Domestic and Domestic Continuous Recirculation ratings. NSF tested according to ASTM Standard F2023, Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Tubing and Systems to Hot Chlorinated Water greatly exceeding the minimum chlorine resistance requirements of ASTM F876.

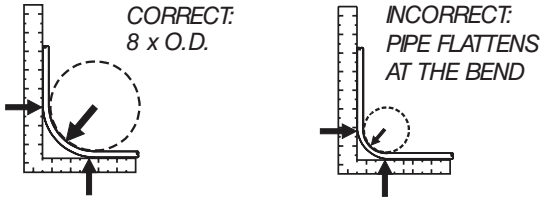
- **IAPMO Certified**

- **ICBO ER #5287** - listed for plumbing and hydronic heating applications.

- **Intertek Testing Services** (Warnock Hersey) - certification to CSA B137.5 (Canadian Standards Association)

HUD (Housing and Urban Development) - MR 1276

Minimum Bend Radius



NOTE: ViegaPEX tubing may be bent to a minimum of 5 x O.D. with approved bend support.

SDR-9 PEX Tubing
ASTM F876/F877/CTS-OD SDR-9

STOCK CODE	TUBING SIZE	O.D.	WALL THICKNESS	NOM. I.D.	WEIGHT PER FT	VOLUME (Gal.) PER 100 FT
PX2	3/8"	0.500±.003	0.070+.010	0.350	.0413	0.50
PX3	1/2"	0.625±.004	0.070+.010	0.475	.0535	0.92
PX4	3/4"	0.875±.004	0.097+.010	0.671	.1023	1.82
PX5	1"	1.125±.005	0.125+.013	0.863	.1689	3.04

NOTE: Dimensions are in English units. Tolerances shown are ASTM requirements. ViegaPEX is manufactured within these specifications.

Pressure Drop Table
Expressed as PSI/ft. Pressure Drop

GPM	SIZE 3/8"	1/2"	3/4"	1"
1	.070	.016		
1.5	.149	.034		
2.2	.303	.069		
2.5	.385*	.087		
3	.539	.122	.023	
3.5	.717	.162	.030	
4		.208*	.039	
5		.314	.059	
6		.440	.082	.024
7		.586	.109	.032
8			.140	.041
9			.174*	.051
10			.211	.062
11			.252	.074
12			.296	.087
13			.343	.101
14				.116
16				.148*
18				.184
20				.224
22				.267

EXAMPLE: To calculate the pressure drop of a 1/2" line, 40 ft. long, with a 3 gpm flow rate, calculate .122 psi x 40 ft. = 4.9 psi pressure drop. Most plumbing codes require 8 psi residual pressure at the fixture. Refer to your local code requirements.

*Indicates 8 fps maximum velocity required by some plumbing codes. NOTE: Maximum flow for each size based on 12 FPS velocity. PSI x 2.307 = head loss.

Minimum Burst Pressure (PSI) Per ASTM F876/F877

SIZE	73°F (23°C)	180°F (82°C)
3/8"	620	275
1/2"	480	215
3/4"	475	210
1"	475	210

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