tekmar® - Data Brochure

Hydronic Snow/Ice Melting Control type 217

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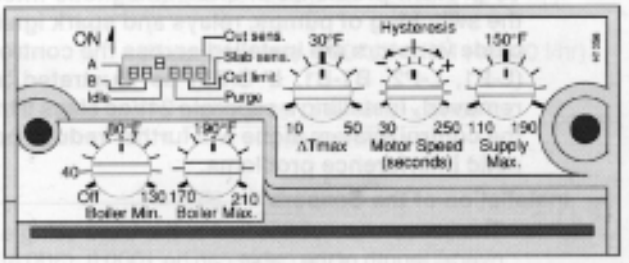
The tekmar® Hydronic Snow/Ice Melting Control is a microprocessor-based control that precisely regulates the rate at which heat is transfered into a snow melting slab. If the slab is brought up to operating temperature too quickly, it may crack due to uneven thermal expansion, but if it is heated too slowly the response time for the system will be rather lengthy. In addition, the control senses the return water temperature to the the heat source in order to protect it from "cold shocks". Modulation of the heat delivery is accomplished through one of four methods: a modulating mixing valve, staging and cycling of boilers, an injection pump, or a modulating steam valve. The Hydronic Snow/Ice Melting Control determines the required supply water temperature from either measurement of the outdoor air temperature or the slab mid-pipe temperature.



type 217 includes: 1x Electronic Control type 217, 1 x Plug-in base, 3 x Sensors type 321 with cable ties, 1 x Slab Sensor type 324

Technical Data

Technical specifications

Dimensions (h x w x d)	—	2-1/2" x 4-1/4" x 2-7/8" (64 x 108 x 73mm)
Weight	—	1.1 lb (0.5 kg)
Ambient	—	30 to 120° F (0 to 50° C) < 95% RH non-condensing
Power supply	—	24Vac ±10%, 60 Hz, 4VA, class 2 transformer
Relay capacity	—	6 amp, SPST
Sensors	—	2 kΩ @ 77°F (25° ± 0.2°C), NTC thermistor, accurate with up to 1000 ft. (300m) of 18 gauge wire

Features

8 Indicator lights	—	On, Pump 1, Pump 2, Boiler 1, Open/Boiler 2, Close, Boiler Return Limit, Idle
4 Operating modes	—	Mixing valve, 2 boiler stages, Injection pump, Steam valve
2 Pump outputs	—	System pump, boiler or injection pump
1 or 2 Boiler stages	—	Dependant on operating mode
1 Mixing valve output	—	24Vac floating signal
System ΔT control	—	Slab thermal shock protection
Boiler return temp. control	—	Boiler thermal shock protection
2 Heat output levels	—	Operating or Idle heat outputs
2 Sensor options	—	Slab temperature or outdoor air temperature sensing
System WWSD	—	Automatic system shut down in warm weather
System CWSD option	—	If selected, system will shut down at –2°F(–19°C) and start up again at 5°F(–15°C)
Boiler purge option	—	Purge heat from boiler when system shuts down

Settings

Boiler Minimum	—	off, 30 to 130°F (0 to 54°C)
Boiler Maximum	—	170 to 210°F (77 to 99°C)
ΔT Maximum	—	10 to 50°F (6 to 28°C)
Motor Speed / Hysteresis	—	30 to 250 seconds / 2 to 41°F (1 to 23°C)
Supply Maximum	—	110 to 190°F (43 to 88°C)
Operating temperature	—	Set to melt 0 to 1" (0 to 25mm) of wet snow, 0 to 5" (0 to 127mm) dry snow per hour
Idle temperature	—	Set to melt 0 to 1/2" (0 to 12mm) of wet snow, 0 to 2-1/2" (0 to 64mm) dry snow per hour

This electronic control does not exceed the Class B limits for radio noise emissions from digital apparatus as set out in the Radio Interference Regulations of the Canadian Department of Communications. If this equipment does cause interference, the user is encouraged to try to correct the interference by reorienting the receiving antenna and/or relocating the receiver with respect to this equipment.

Le présent appareil numérique n'émete pas de bruits radioeléctriques dépassant les limites applicables aux appareils numériques de Classe B prescrites dans le réglement sur le brouillace radioeléctrique édicté par le Ministère des Communications du Canada.

Installation

Caution:

Hydronic Snow/Ice Melting Control type 217 is not intended for use as a primary limit control. Another control that is intended and certified as a limit control must be placed into the control circuit.

The location of this control must be within its specified temperature and humidity ranges. The control system installer must ensure that the control and its wiring are isolated and/or shielded from strong sources of electromagnetic noise.

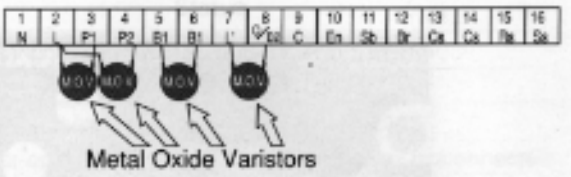
Electrical

All wires to the tekmar control terminate in the plug-in base; no wires are directly connected to the control. This plug-in feature simplifies installation and troubleshooting procedures.

For detailed wiring schematics of each operating mode, see brochure A217.

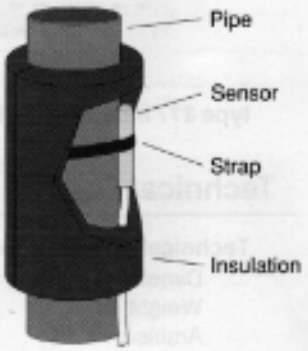
Caution:

To prevent problems of electromagnetic interference caused by the switching of pumps, relays and spark ignition systems, metal oxide varistors are installed across the control's output terminals (L-P1, L-P2, B1-B1, L'-O/B2) as illustrated, and should not be removed. Installing a separate 24Vac class II transformer to power the control system alone will further reduce potential electromagnetic interference problems.



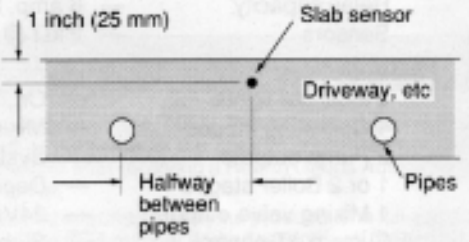
Installation of the Sensors

- The sensors are connected to the base using a 2-conductor cable (eg. 2 x 18 AWG). The overall length of the cable can be 1000 ft. (300 m) but the cable must not be run parallel to any power lines or telephone cables.
- Install the supply sensor onto the supply pipe of the heated slab and run the wires back to terminals *Cs — Ss* (14 and 16) of the control base.
- Install the return sensor onto the return pipe from the slab and run the wires back to terminals *Cs — Rs* (14 and 15) of the control base.
- Install the boiler return sensor onto the return pipe which goes to the boilers and run the wires back to terminals *Cs — Br* (13 and 12) of the control base. **For accurate temperature readings and faster response times, the sensors should be inserted into a standard 3/8" wells.** Optionally, the sensor can be fastened to the pipe surface by the included strap and the pipe then wrapped in insulation. Do not submerse the sensor itself into a liquid.



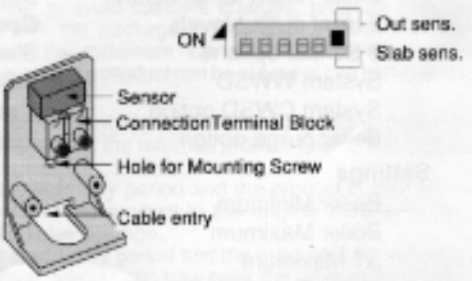
Slab sensor (type 324)

A special epoxy coated sensor with 40 ft (12 m) of oil resistant teflon cased 18 AWG two conductor cable comes with the control. Install the slab sensor in the heated area halfway between the heating pipes and within 1 inch of the surface as shown in the adjacent diagram. The sensor should be approximately 3 feet (1 m) from the edge of the heated area. Connect the two leads of the cable to terminals *Sb — Cs* (11 and 13) of the base.



Outdoor sensor (type 317)

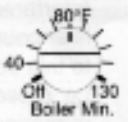
If for any reason the Slab Sensor becomes damaged or it is impossible to install a slab sensor, an outdoor sensor can be ordered as a substitute. If it is necessary to use an outdoor sensor, the DIP switch in position 6 must be switched to the *Out sens.* position. The type 317 should be mounted on a wall near the heated slab. The sensor should not be mounted near a window or ventilation opening. With one round or pan head screw, attach the base of the sensor to the wall. **The hole for the cable entry must face downward** for proper moisture drainage. Connect a two conductor cable from the outdoor sensor terminals to terminals *Sb — Cs* 11 & 13 of the control's base. Slide the cover of the outdoor sensor onto its base.



Settings

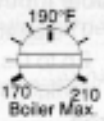
Minimum Boiler Operating Temperature (Boiler Min.)

This adjustment should be set to the boiler manufacturer's specification for the minimum allowable operating temperature of the boilers to prevent problems from condensation of the exhaust gases. If a minimum boiler operating temperature is not required, as with condensing or electric boilers, then this adjustment should be set to 'Off'. Turning the dial slightly clockwise enters the operating range of the adjustment: 30°F to 130°F (0°C to 55°C). If the boiler return water is cooler than this setting, a warning light on the front of the control turns on and the control attempts to operate the equipment in such a way as to correct the problem.



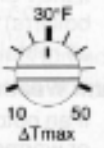
Maximum Boiler Operating Temperature (Boiler Max.)

This adjustment should be set to the maximum expected operating temperature of the boilers. Normally, the boilers will be operated to keep the boiler return water temperature halfway between Max. and Min. This setting is adjustable from 170 to 210°F (77 to 99°C).



Maximum Rate of Heat Delivery (ΔT Max.)

During heat-up the Hydronic Snow-Melting Control regulates the rate of heat delivery to the slab in order to minimize the thermal stress experienced by the slab.The rate of heat delivery is porportional to the rate of water flow to the slab multiplied by the temperature drop (ΔT) of the water: Q∝Flow * ΔT. Assuming the water flow rate is constant, the rate of heat delivery can be controlled by regulating the temperature rise of the water. This setting is adjustable from 10 to 50°F (6 to 28°C).



The ΔT Max. adjustment is calculated as follows:

$$\Delta T \text{ Max.} = \frac{\text{Constant} \times \text{Design heat output of the controlled area}}{\text{Rate of water flow to this area}}$$

In imperial units the constant is: $\frac{\text{US GPM} \cdot °\text{F}}{\text{Btu/hr}}$

In metric units the constant is: $\frac{\text{litres/hr} \cdot °\text{C}}{\text{Watts}}$

Example:

- Rate of delivery = 100 Btu/hr • ft (315 W/m)
- Heated surface area = 6000 ft (560 m)
- Water flow rate = 60 US GPM (13600 l/hr)

$$\Delta T = \frac{0.002 \times 100 \text{ Btu/hr/ft} \times 6000 \text{ ft}}{60 \text{ US GPM}} = 20 °\text{F}$$

$$= \frac{0.86 \times 315 \text{ W/m} \times 560 \text{ m}}{13600 \text{ l/hr}} = 11 °\text{C}$$

Actuating Motor Stroke Time (Motor Speed) / Injection Pump Cycle Length (Hysteresis)
Boiler Differential (Hysteresis)

When using a mixing valve or modulating steam valve this adjustment **must** be set to the time required for the valve to move from fully closed to fully open. The tekmar Actuating Motor runs through its 90° range of travel in 210 seconds.
In a boiler or injection pump system the length of on-off cycles and magnitude of the resulting temperature fluctuations is increased by rotating this adjustment clockwise.

Maximum Supply Temperature (Supply Max.)

The plastic tubing used in many modern snow melt systems should not be continuously operated at a temperature greater than 140°F (60°C).
This setting permits the installer to limit the maximum temperature of the water supplied to the snow melting slab and is adjustable from 110 to 190°F (42 to 88°C).

Operating

The operating adjustment sets how much snow can be melted and evaporated per hour when the control has brought the slab up to its operating temperature. This adjustment has a range of 0 to 8/32 inches of water equivalent per hour (0 to 8mm/hr) with the center position being 4/32 inches/hr (4mm/hr). Actual snowfall per hour required to generate 1/32 inches of water per hour (1mm/hr) is given in the table below.

Idle

The idle adjustment sets how much snow may be melted and evaporated per hour when the control is holding the slab at an idle temperature. This adjustment has a range of ± 4/32 inches of water equilavent per hour (±4mm/hr) with the center position being zero snowfall. A negative snowfall rate setting means that the slab temperature will be held below freezing in the idle mode.

Inches of snow per hour that can be melted in the operating and idle modes at different dial settings

Dial Setting	–		1		2		3		II 2 3 5		5		6		7		+	
Operating/Idle Mode	OPERATING DIAL	IDLE DIAL	OPERATING DIAL	IDLE DIAL	OPERATING DIAL	IDLE DIAL	OPERATING DIAL	IDLE DIAL	OPERATING DIAL	IDLE DIAL	OPERATING DIAL	IDLE DIAL	OPERATING DIAL	IDLE DIAL	OPERATING DIAL	IDLE DIAL	OPERATING DIAL	IDLE DIAL
Very wet snow (inches/hr)	0	0	1/8	0	1/4	0	3/8	0	1/2	0	5/8	1/8	6/8	1/4	7/8	3/8	1	1/2
Wet snow (inches/hr)	0	0	1/4	0	1/2	0	3/4	0	1	0	1-1/4	1/4	1-1/2	1/2	1-3/4	3/4	2	1
Dry snow (inches/hr)	0	0	3/8	0	6/8	0	1-1/8	0	1-1/2	0	1-7/8	3/8	2-1/4	6/8	2-5/8	1-1/8	3	1-1/2
Very dry snow (inches/hr)	0	0	5/8	0	1-1/4	0	1-7/8	0	2-1/2	0	3-1/8	5/8	3-6/8	1-1/4	4-3/8	1-7/8	5	2-1/2

Enable Input (En)

The enable input allows an external input such as a Snow/Ice Detector to switch the system into the operating mode by shorting En to Cs. If the idle switch is off then when En is not connected to Cs the control will shut off the boilers, pumps, etc. If the Idle switch is on then when En is not connected to Cs the control will operate the slab at an idle temperature.

Purge

If the Purge switch is on then whenever the control switches from an operating or idle mode to off, the boiler(s) will be immediately turned off and the pumps and valves operated in such a way as to purge all remaining heat from the boiler(s). Only use purge if the boilers are dedicated to snow melting.

Warm Weather Shut Down

If an outdoor air temperature sensor is installed then the system will be turned off when the outdoor sensor measures 43°F (6°C) or warmer and won't allow the system to turn on until 36°F (2°C) or colder. If the slab sensor is installed then the system will be turned off whenever the control calculates that heat is no longer needed. (ie. the control calculates ΔT between snow melting supply and return temperature = 0) The system pump (P1) will continue running for 10 minutes after the control enters the off mode.

Cold Weather Shut Down

If the outdoor air temperature sensor is installed and the outdoor limit is selected then the snow melt system will be prevented from operating whenever the measured outdoor air is colder than -2°F (-19°C) and will be permitted to run when it is warmer than 5°F (-15°C). At very cold outdoor temperatures it is quite expensive to run the snow melting system at idle temperatures and is therefore cost effective to turn the system off in projects where snow melting is not absolutely necessary.

Sequence of Operation

MIXING VALVE MODE (see A 217 - 1 for mechanical and electical application drawings)

Startup

The control enters a "startup" sequence when one of the following events has occurred:

- The control has just been powered up.
- The control is enabled (short between terminals 10 and 13) and was not idling prior to the enable signal.
- The control is enabled, or the idling option is selected, and has just left Warm Weather Shut Down conditions.

During startup; the boiler pump (P2) is turned on and boiler is operated on a setpoint, the system pump (P1) is held off, and the mixing valve is run closed.

The startup sequence is exited when the boiler temperature has risen above the dialled minimum selection (30 °F (–1°C) if the dialled Boiler Min. = off) and a time delay of 15 seconds has elapsed.

Note: **The time delay for startup is longer (approx. 6 minutes) if the control has just been powered up. This is done to ensure that the mixing valve is completely closed before the control begins putting heat into the slab.**

Operating

After the control has finished the startup sequence, it begins heating the slab. The system pump (P1) is turned on, and the mixing valve is cycled open or closed according to the slab's heat requirements. If the Idle option is selected and the control is not enabled, (Open circuit between terminals *En — Cs*, 10 and 13) it operates the slab at a cooler temperature as determined by the Idle dial setting and the Idle LED is turned on. If the control is enabled, (shorted circuit between terminals *En — Cs*, 10 and 13) it operates the slab at a temperature determined by the Operating dial setting.

The valve will cycle close if the control calculated ΔT between snow melting supply and return temperature is greater than the ΔT max. setting. The valve will also cycle close if the boiler return is slightly less than the Boiler Min. setting or if the supply temperature is greater than the Supply Max. setting.

Boiler Operation

The boiler is fired to maintain a setpoint at the boiler return sensor calculated as follows:

desired boiler temp. = (Boiler Max. setting + Boiler Min. setting) / 2

If dialled Boiler Min. = off then the setpoint is:

desired boiler temp. = Boiler Max. setting less 61 °F (34°C)

The boiler differential is set to a fixed value of 14 °F (8°C).

Purging

If the Purging option is selected a purge sequence will occur when:

- The control is not enabled. (Open circuit between terminals *En — Cs* 10 and 13)
- The control goes into a Warm Weather Shut Down condition from an idling or an operating condition.

A purge sequence lasts for approximately 3 minutes during which time the boiler is turned off, the valve is run open, and both the boiler pump (P2) and the system pump (P1) are left running.

Warm Weather Shut Down

When the control is enabled, (shorted circuit between terminals En — Cs , 10 and 13) or idling is selected, the control will determine warm weather conditions when:

- If a slab sensor is used, then warm weather shut down occurs when the control calculates that the ΔT between snow melting supply and return temperature should be less than 0.
- If an outdoor sensor is used, then warm weather occurs when the outdoor air temperature rises above 43 °F (6°C). The control returns to operating / idling (after a startup sequence) when the air temperature drops to 36 °F(2°C).

Upon detection of warm weather conditions (after the purge sequence if purging has been selected) the boiler is turned off, the boiler pump (P2) is turned off, and the mixing valve is run closed. The system pump (P1) is kept running for an additional 10 minutes after warm weather shut down conditions were first detected, after which P1 is also turned off.

If an outdoor sensor is being used, the Cold Weather Shut Down option may be selected. If selected, the control will shut down in exactly the same manner as for Warm Weather Shut Down when cold weather conditions are detected, that is, when the outdoor air temperature is below -2 °F (-18°C). The control returns to operating / idling when the air temperature rises to above 5 °F (-15°C).

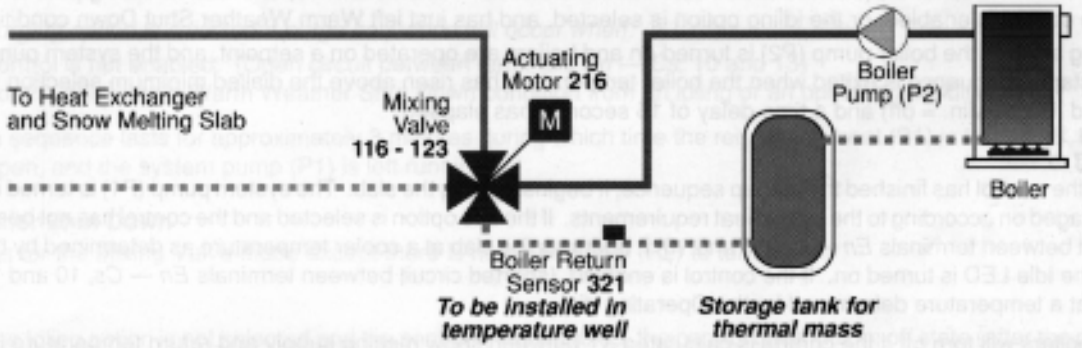
Off

When the Idling option is not selected and the control is not enabled, the control goes into an off state (after the purge sequence if purging has been selected) in which the valve is run closed and the boiler and both pumps are turned off.

Important notice:

When using a dedicated boiler in the mixing valve mode, the boiler loop must have sufficient thermal mass (water volume) between the boiler and the 4-way mixing valve to ensure adequate minimum boiler return temperature control.
On a system startup, the type 217 will initially open the mixing valve. At this point, very cold water from the slab may cause a rapid drop in boiler loop temperature. Because of the time it takes the actuating motor to drive the valve closed, the boilers may be subjected to temperatures below the minimum boiler return temperature setting.
To eliminate this problem:

- Install a storage into the boiler loop return line between the boiler and the mixing valve as illustrated below. The tank should add sufficient additional thermal mass to the loop to temper the return water and allow the control more time to respond to severe temperature changes.
- Install the boiler return sensor ***in a temperature well*** between the mixing valve and the storage tank. This will allow the sensor to more quickly sense the changing water temperature, resulting in faster control response times.



INJECTION PUMP MODE (see A 217 - 2 for mechanical and electrical application drawings)

Startup

The control enters a startup sequence when one of the following events has occurred:

- The control has just been powered up.
- The control is enabled, (shorted circuit between terminals *En — Cs*, 10 and 13) and was not idling prior to the enable signal.
- The control is enabled, or the idling option is selected, and has just left Warm Weather Shut Down conditions.

During startup, both the injection pump (P2), and the system pump (P1) are held off and boiler is operated on a setpoint. The startup sequence is exited when the boiler temperature has risen above the dialled minimum selection (30°F (–1°C) if the dialled Boiler Min. = off) and a time delay of 15 seconds has elapsed.

Operating

After the control has finished the startup sequence, it begins heating the slab. The system pump (P1) is turned on, and the injection pump is turned on according to the slab's heat requirements. If the Idle option is selected and the control is not enabled, (Open circuit between terminals *En — Cs*, 10 and 13) it operates the slab at a cooler temperature as determined by the Idle dial setting and the Idle LED is turned on. If the control is enabled, (shorted circuit between terminals *En — Cs*, 10 and 13) it operates the slab at a temperature determined by the Operating dial setting.

The injection pump will turn off if the control calculated ΔT between supply and return temperature is greater than the ΔT max. setting. The injection pump will also turn off if the boiler return is less than the Boiler Min. setting or if the supply temperature is greater than the Supply Max. setting.

(Injection Pump Mode cont.)

Boiler Operation

The boiler is fired to maintain a setpoint at the boiler return sensor calculated as follows:

desired boiler temp. = (Boiler Max. setting + Boiler Min. setting) / 2

If dialled Boiler Min. = off then the setpoint is:

desired boiler temp. = Boiler Max. setting less 61 °F (34°C)

The boiler differential is set to a fixed value of 14 °F (8°C).

Purging

If the Purging option is selected, a purge sequence will occur when:

- The control is not enabled. (Open circuit between terminals *En — Cs*, 10 and 13)
- The control goes into a Warm Weather Shut Down condition from an idling or an operating condition.

A purge sequence lasts for approximately 2 minutes during which time the boiler is turned off and the boiler pump (P2) and the system pump (P1) are left running.

Warm Weather Shut Down

Same as for the Mixing Valve mode except there is no valve to close.

Off

When the idling option is not selected and the control is not enabled the control goes into an off state (after the purge sequence if Purging has been selected) in which the boiler and pump are turned off.

BOILERS MODE (see A 217 pg 3 for mechanical and electrical application drawings)

Startup

The control enters a startup sequence when one of the following events has occurred:

- The control has just been powered up.
- The control is enabled, (shorted circuit between terminals En — Cs 10 and 13) and was not idling prior to the enable signal.
- The control is enabled, or the idling option is selected, and has just left Warm Weather Shut Down conditions.

During startup, the boiler pump (P2) is turned on and boilers are operated on a setpoint, and the system pump (P1) is held off. The startup sequence is exited when the boiler temperature has risen above the dialled minimum selection (30 °F (-1°C)if the dialled Boiler Min. = off) and a time delay of 15 seconds has elapsed.

Operating

After the control has finished the startup sequence, it begins heating the slab. The system pump (P1) is turned on, and the boilers are staged on according to the slab's heat requirements. If the Idle option is selected and the control has not been enabled, (Open circuit between terminals *En — Cs*, 10 and 13) it operates the slab at a cooler temperature as determined by the Idle dial setting and the Idle LED is turned on. If the control is enabled, (shorted circuit between terminals *En — Cs*, 10 and 13) it operates the slab at a temperature determined by the Operating dial.

The boilers will turn off if the control is calculated ΔT between snow melting supply and return temperature is greater than the ΔT max. setting. The boilers will also stage off if the boiler return is close to the Boiler Max. setting or if the supply temperature is greater than the Supply Max. setting.

If the boiler return temperature is less than the boiler minimum setting the Boiler Return Limit LED will light up. If this LED is lit up constantly during normal operation the system's balancing valves should be adjusted until the LED turns off.

Purging

If the Purging option is selected, a purge sequence will occur when:

- The control is not enabled. (Open circuit between terminals *En — Cs*, 10 and 13)
- The control goes into a Warm Weather Shut Down condition from an idling or an operating condition.

A purge sequence lasts for approximately 2 minutes during which time the boilers are turned off and both the boiler pump (P2) and the system pump (P1) are left running.

Warm Weather Shut Down

Same as for the Mixing Valve mode except both boilers are turned off, and there is no valve to close.

Off

When the Idle option is not selected and the control is not enabled the control goes into an off state (after the purge sequence if Purging has been selected) in which both boilers and both pumps are turned off.

STEAM VALVE MODE (see A 217 - 4 for mechanical and electrical application drawings)

Startup

The control enters a startup sequence when one of the following events has occurred:

- The control has just been powered up.
- The control is enabled (short between terminals 10 and 13) and was not idling prior to the enable signal.
- The control is enabled, or the idling option is selected, and has just left Warm Weather Shut Down conditions.

During startup, the heat request (B1) is turned off, the system pump (P1) is turned off, and the modulating steam valve is run closed. The startup sequence is exited when a time delay of 15 sec. has elapsed.

Note: **The time delay for "startup" is longer (approx. 6 minutes) if the control has just been powered up. This is done to ensure that the steam valve is completely closed before the control begins putting heat into the slab.**

Operating

After the control has finished the startup sequence, it begins heating the slab. The system pump (P1) is turned on, and the steam valve is cycled open or closed according to the slab's heat requirements. If the Idle option is selected and the control is not enabled, (Open circuit between terminals *En — Cs* ,10 and 13) it operates the slab at a cooler temperature as determined by the Idle dial setting and the idle LED is turned on. If the control is enabled, (shorted circuit between terminals *En — Cs*, 10 and 13) it operates the slab at a temperature determined by the Operating dial setting.

The valve will cycle close if the control calculated ΔT between snow melting supply and return temperature is greater than the ΔT max. setting. The valve will also cycle close if the supply temperature is greater than the Supply Max. setting.

If the condensate return temperature is less than the boiler minimum setting the, Boiler Return Limit LED will light up. If this LED is lit up during normal operation, the system's balancing valves should be adjusted until the LED turns off to prevent damage to the steam boiler.

Request for Heat (Boiler) Operation

A request for heat (B1 on) will be made when the steam valve is modulated more than 25% open. The request for heat will remain on until the steam valve has been modulated completely closed.

Purging

If the Purging option is selected a purge sequence will occur when:

- The control is not enabled. (Open circuit between terminals *En — Cs*, 10 and 13)
- The control goes into a Warm Weather Shut Down condition from an idling or an operating condition.

A purge sequence lasts for approximately 3 minutes during which time the request for heat (B1) is turned off, the steam valve is run open, and the system pump (P1) is left running.

Warm Weather Shut Down

Same as for the Mixing Valve mode except there is no boiler pump (P2) to turn off.

Off

When the Idling option is not selected and the control is not enabled, the control goes into an off state (after the purge sequence if purging has been selected) in which the valve is run closed and the boiler is turned off.

Testing and Troubleshooting

Step 1
Test the sensors

Do not plug the control into the base until the following test has been performed. Install the sensors as described on page 2. Using an ohmmeter, measure the resistance between terminals 14 & 15, 14 &16, 11 & 13 and 12 & 13. The following table lists the expected resistance values at various sensor temperatures. The resistance between ground (the pipes), and any of terminals 10 to 16 should be greater than 1,000,000 ohms, and the voltage (AC or DC) must be zero.

Sensor temperature		Resistance	Sensor temperature		Resistance	Sensor temperature		Resistance
°F	°C	Ω	°F	°C	Ω	°F	°C	Ω
-50	-45	59,000	50	10	3,700	150	65	500
-30	-35	33,000	70	20	2,400	170	76	360
-10	-23	17,000	90	32	1,500	190	88	250
10	-12	10,000	110	43	1,000	210	100	180
30	0	5,600	130	54	720	230	110	140

Step 2
Test the power supply

Turn on power to the transformer. Using an AC voltmeter, measure the voltage between terminals 1 & 2. The voltage should be between 21 and 27 volts AC.

Step 3
Test the pumps,valves etc.

Ensure that the pumps operate when terminal 2 is shorted to 3 and 4. Shorting terminals 5 & 6 should turn on boiler stage 1. Shorting terminals 7 & 8 should turn on boiler stage 2, or open the modulating valve, and shorting 7 & 9 should close the modulating valve.

Step 4
Automatic test

Turn off the power. Set the function switches and adjustments on the control according to the instructions on pages 2 to 7. Plug the control into its base and turn on power to the base. The power light should turn on to indicate that the control is operating correctly. The control has background error detection software that continuously monitors operation of the control. The following table lists the status of the control as indicated by the lights.

Power light	Idle light	Boiler Return Limit	Status
On	Off	Off	Normal heating or shutdown.
On	On	Off	Idle operation.
On	On or Off	Flashing	Supply or return sensor is shorted or disconnected.
On	Flashing	On or Off	Slab/Outdoor or Boiler Return sensor is shorted or disconnected.
On	Flashing	Flashing	Injection pump on or off time < 30 seconds. (Increase setting of Hysteresis adjustment)
Off	Off	Off	Check power supply.
On	On or Off	On	Boiler return water is too cold.

Limited Warranty and Product Return Procedure

Limited Warranty: tekmar warrants to the original purchaser each tekmar product against defects in workmanship and materials when the product is installed and used in compliance with tekmar's instructions. This limited warranty covers the cost of parts and labour provided by tekmar to correct defects in materials and/or workmanship. Returned products that are fully operational are not considered a warranty case. tekmar also does not cover parts or labour to remove, transport or reinstall a defective product. tekmar will not be liable for any damage other than repair or replacement of the defective part or parts and such repair or replacement shall be deemed to be the sole remedy from tekmar. This warranty shall not apply to any defects caused or repairs required as a result of unreasonable or negligent use, neglect, accident, improper installation, or unauthorized repair or alterations. In case of defect, malfunction or failure to conform to warranty, tekmar will, for a warranty period of 24 months from the date of invoice to the original purchaser or 12 months from the date of installation of the product, whichever occurs first, repair, exchange or give credit for the defective product. Any express or implied warranty which the purchaser may have, including merchantability and fitness for a particular purpose, shall not extend beyond 24 months from the date of invoice or 12 months from the date of installation of the product, whichever occurs first.

Replacements: tekmar can send replacement products if requested. All replacements are invoiced. Any possible credit for the replacement will only be issued once the replaced product has been returned to tekmar.

Product Return Procedure: Products that are believed to have failed must be returned to tekmar Control Systems Ltd. 4611-23rd Street, Vernon B.C. Canada V1T 4K7 when agreed to by tekmar. The installer or other qualified service person must, at the owner's expense, determine which component has failed. The product must be returned complete with all of its components (sensors, base, etc.). Products must be returned together with the proof of purchase to the original purchaser who then returns the product to tekmar after receiving a Return Goods Authorization (RGA) number from tekmar.

Please include the following information with the product. The full address of the original purchaser, the RGA number and a description of the problem.

From the U.S.A., in order to avoid customs charges, products must be returned via US Post with the package clearly marked with the RGA number, product type and the statement "Canadian Product returned for repair". For shipping purposes the product can be valued at one half list price.

1) If returned during the warranty period and the product is defective, tekmar will issue full credit for the returned product less cost of missing parts.
2) If returned during the warranty period and the product is fully operational, tekmar will return the product to the original purchaser for a testing cost of $30.00 plus postage.
3) If returned during the warranty period and the product is not damaged and is fully operational, tekmar can take back the product for a return charge of 40% of the product's net value. This request has to be specified otherwise the product will be returned with a testing cost of $30.00 plus postage.
4) If returned after the warranty period and the product needs repair, tekmar will repair and return the product. Repair and postage costs will be invoiced. tekmar's repair costs are calculated at $30.00 / hour plus the cost of parts. If the repair costs will be more than $60.00 a repair estimate will be sent to the original purchaser.

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