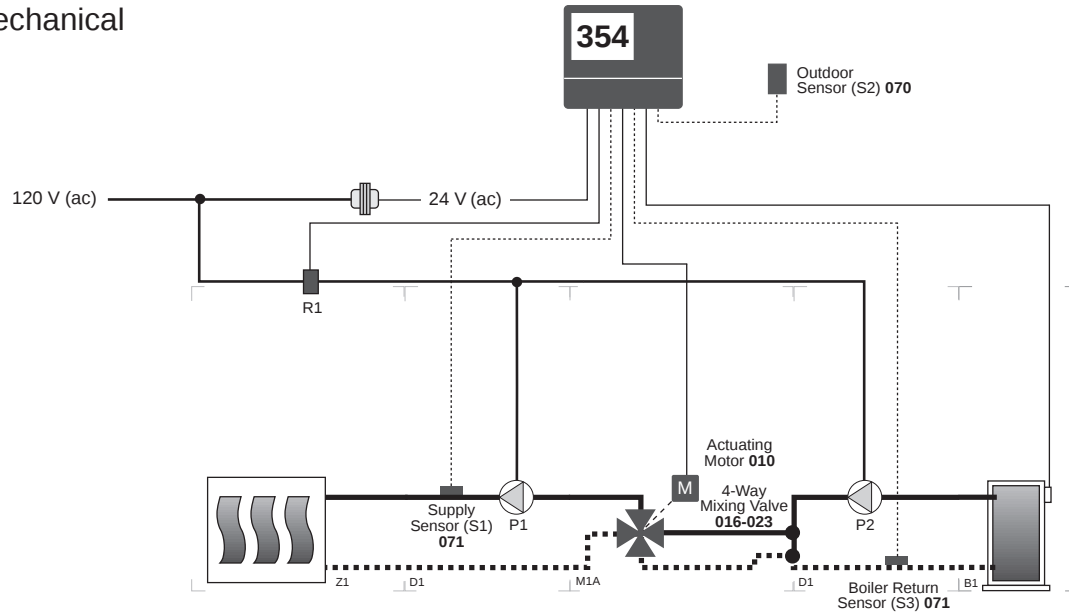
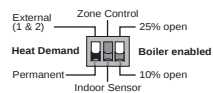


Mechanical

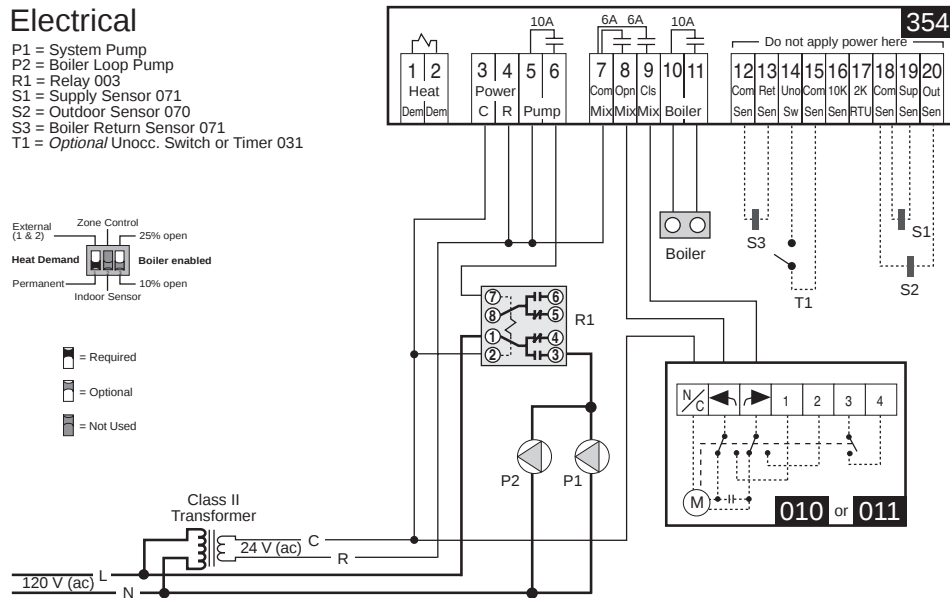


Electrical

P1 = System Pump
P2 = Boiler Loop Pump
R1 = Relay 003
S1 = Supply Sensor 071
S2 = Outdoor Sensor 070
S3 = Boiler Return Sensor 071
T1 = Optional Unocc. Switch or Timer 031



■ = Required
□ = Optional
■ = Not Used

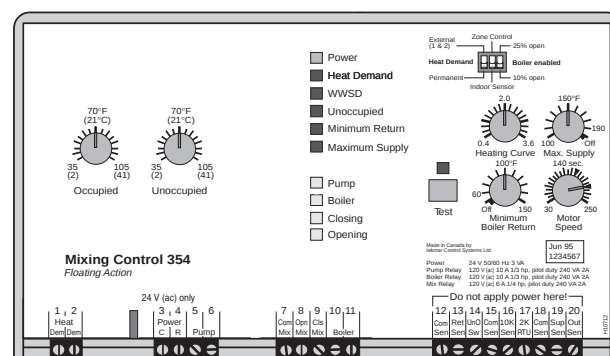


Note: This is only a concept drawing. The designer must determine whether this application will work in his system and must ensure compliance with code requirements. Necessary auxiliary equipment, isolation relays (for loads greater than the specified tekmar internal relay ratings), and other safety and limit devices must be added.

Technical Data

Mixing Control 354 Floating Action

Literature	— A 000, A 354's, D 354, D 001, D 05, D 06, D 070, D 074
Control	— Microprocessor control; This is not a safety (limit) control .
Packaged weight	— 2.8 lb. (1300 g), Enclosure A, PVC plastic
Dimensions	— 6-5/8" H x 7-9/16" W x 2-13/16" D (170 x 193 x 72 mm)
Approvals	— Meets ICES & FCC regulations for EMI/RFI.
Ambient conditions	— Indoor use only, 30 to 120°F (0 to 50°C), < 95% RH non-condensing.
Power supply	— Class 2, 24 V (ac) ±10% 50/60 Hz 3 VA
Mix Relays	— 120 V (ac) 6 A 1/4 hp, pilot duty 240 VA 2 A
Other Relays	— 120 V (ac) 10 A 1/3 hp, pilot duty 240 VA 2 A
Sensors	— NTC thermistor, 10 kΩ @ 77°F (25°C ±0.2°C) β=3892
included:	Outdoor Sensor 070 and Universal Sensor 071.
optional:	10k Sensors or 2k RTU
Occupied	— 35 to 105°F (2 to 41°C)
Unoccupied	— 35 to 105°F (2 to 41°C)
Heating Curve	— 0.4 to 3.6
Max. Supply	— 100 to 190°F, Off (38 to 88°C, Off)
Minimum Boiler Return	— Off, 60 to 150°F (Off, 16 to 66°C)
Motor Speed	— 30 to 250 seconds



System Operation & Specifications

The Mixing Control 354 controls a 4-way mixing valve in order to provide Outdoor Reset to the system loop. With the addition of the optional Boiler Return Sensor 071 (S3) the 354 is capable of providing Boiler Protection.

Piping and Heat Source Details This application consists of a single non-condensing boiler piped in a primary - secondary arrangement using a 4-way valve as the mixing device.

Warm Weather Shut Down (WWSD) When the outdoor air temperature rises above the *Occupied* dial setting, the control enters the Warm Weather Shut Down mode of operation. In this mode of operation, the control continues to monitor its sensors but does not operate the heating system until the outdoor temperature falls below the WWSD point.

Mixing Operation This application has the 354 resetting the system supply water temperature based on the outdoor air temperature while at the same time providing protection for the boiler against cold return water temperatures. The installer / operator is required to adjust the *Heating Curve*, *Max. Supply*, *Minimum Boiler Return*, *Motor Speed*, *Occupied* and *Unoccupied* dials on the 354 in order to obtain the desired performance from the system. As soon as the control is powered up, the *System Pump* contact is closed. The System Pump (P1) and the boiler loop pump (P2) operate continuously unless the 354 enters a Warm Weather Shut Down (WWSD). Using the Outdoor Sensor 070 (S2) and the user adjusted settings, the 354 calculates a system supply water temperature. The control then uses a Floating Action Output to modulate the position of the mixing valve in order to maintain the supply water temperature. At the same time, the 354 uses the input from the Universal Sensor 071 (S3) on the boiler return in order to protect the boiler against cold return water temperatures. The boiler in this application is enabled by the 354 once the mixing valve is opened beyond the *Boiler Enable* position and the boiler operates using its own aquastat.

Boiler Protection If the 354 senses that the boiler return water temperature is approaching the *Minimum Boiler Return* setting, it will begin closing the mixing valve in order to allow the boiler to raise its return water temperature. Whenever the Boiler Return Sensor 071 (S3) is used, the *Minimum Boiler Return* operation takes priority over the system supply temperature.

System Protection The 354 is also capable of providing protection for the system components against excessive temperatures. If the 354 senses that the system supply temperature is approaching the *Max. Supply* setting, the 354 begins closing the valve in order to maintain the system supply below the *Max. Supply* setting.

Additional Functions Additional functions are listed in the table in the Heating Controls section of the Product Catalog I 000 and the Application Catalog A 000.

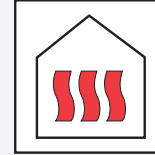


tekmar Control Systems Ltd., Canada
tekmar Control Systems, Inc., U.S.A.
Head Office: 4611 - 23rd Street
Vernon, B.C. Canada V1T 4K7
Tel. (250) 545-7749 Fax. (250) 545-0650



tekmar® - Application

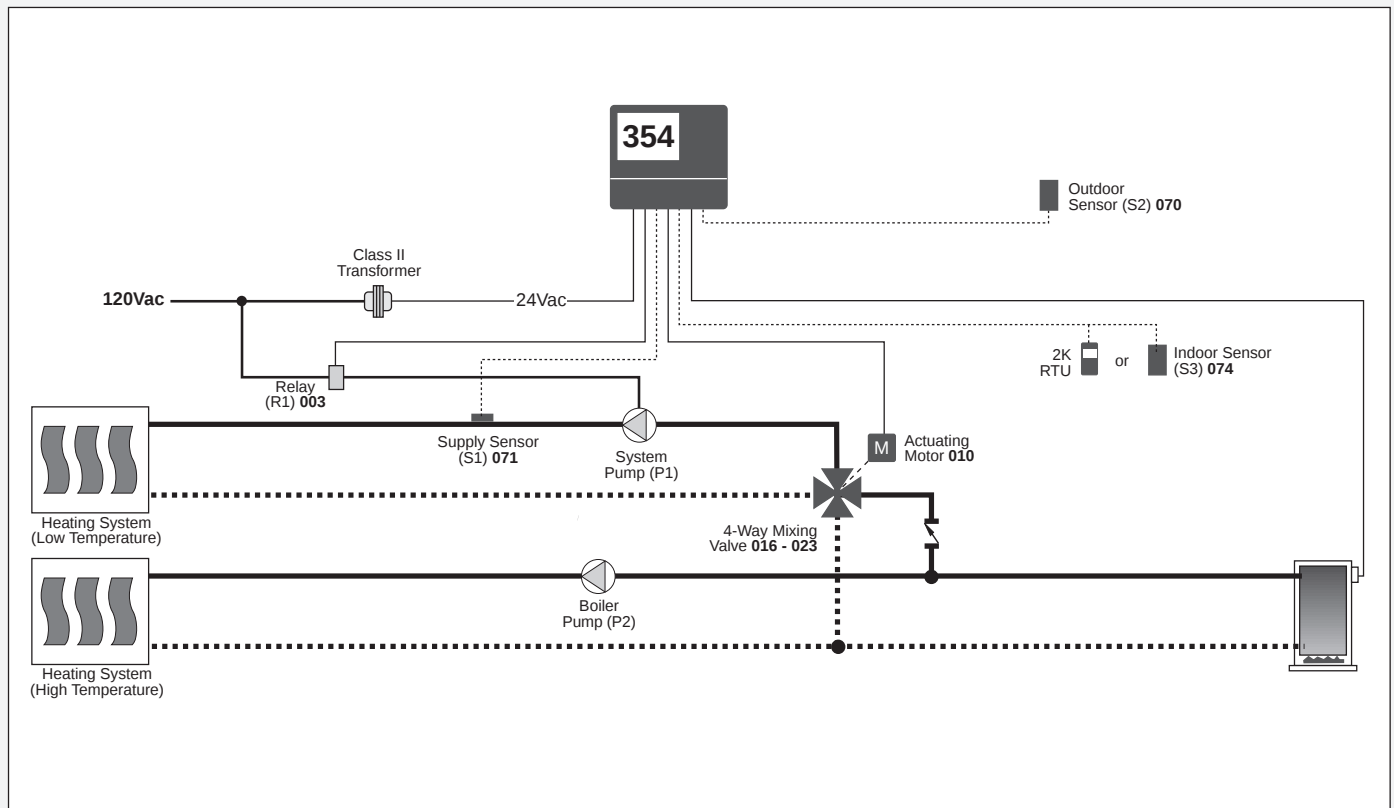
Mixing Control 354



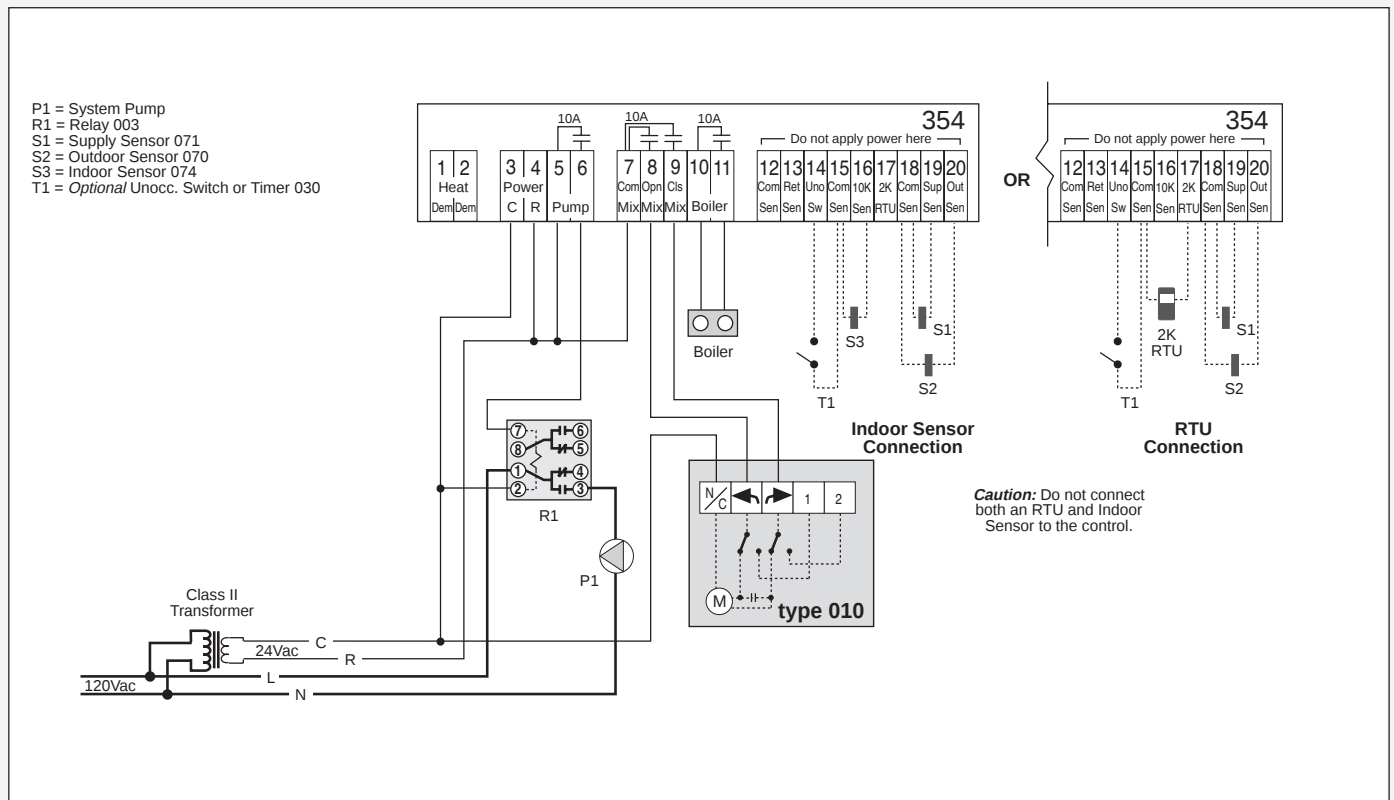
A 354-2

02/94

Mechanical



Electrical



Note: This is only a concept drawing. Designers must determine whether this system will work in each application and must ensure compliance with code requirements. Necessary auxiliary equipment and safety devices must be added.

Operation

The Mixing Control 354 regulates the heating system supply water temperature based on the outdoor and indoor air temperatures by modulating a 4-way mixing valve.

Specifications

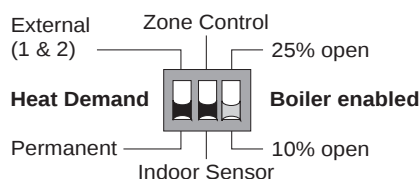
The following are minimum recommended specifications for the control in this application.

- The heating system shall have a system pump (P1) in the supply of the low temperature heating system loop.
 - The mixing valve shall be a 4-way cast iron valve and the actuating motor shall have a 90° output shaft rotation in 3-1/2 minutes and be capable of 310 in-lb (35 N-m) of torque.
 - The control shall have an Unoccupied (setback) switch or timer input enabling an Unoccupied temperature dial on the control.
 - The system pump (P1) and the boiler shall be turned off and the 4-way mixing valve driven fully closed whenever the outdoor air temperature is warmer than the control's Warm Weather Shut Down (WWSD) point.
 - The control's WWSD point shall be calculated based on the Occupied or Unoccupied temperature setting and the actual measured indoor air temperature.
 - If the indoor air temperature is rising above its setpoint, the WWSD point shall be lowered and if the indoor air temperature is falling below its setpoint, the WWSD point shall rise.
 - During operation the system pump (P1), actuating motor and 4-way mixing valve shall be operated through their full range every 3 days to help prevent seizure.
 - The heating system supply water temperature shall be based on the outdoor and indoor air temperatures and the control's Heating Curve (reset ratio) and Occupied or Unoccupied dial settings.
 - The indoor air temperature shall be measured by an indoor sensor and adjusted at the control's Occupied and Unoccupied dials or measured and adjusted by a Room Temperature Unit (RTU).
 - The control shall have an adjustable Maximum Supply water temperature setting to help protect system components from overheating.
 - The control shall modulate the 4-way mixing valve closed if the system supply water temperature rises close to the Maximum Supply temperature setting.
 - The control shall continuously monitor its sensors and provide a LED error message if one is shorted or disconnected.
 - The control shall be microprocessor-based and have 4 SPST internal relays with 10 Amp (resistive) isolated contacts for outputs and have indicator lights for control function and status.
 - The control shall have a test button which activates a pre-programmed test sequence to test all control inputs and outputs.
 - The control shall be compatible with standard North American wiring hardware.
 - The installation location must be maintained within the ambient temperature and humidity ranges specified in the D 354 brochure for this control, with the installer ensuring that the control and its wiring are isolated and/or shielded from strong sources of electromagnetic noise.
- **Order the following components for this application:** one 4-Way Mixing Valve 016 to 023, one Actuating Motor 010, one Mixing Control 354, one Relay 003, and one Indoor Sensor 074 or tekmar RTU 305, 307, 308 or 310.

Settings

Mixing Control 354	Adjustment Range	Recommended Initial Settings
Occupied	35 to 105°F (2 to 41°C)	
Unoccupied	35 to 105°F (2 to 41°C)	
Heating Curve	0.4 to 3.6	
Maximum Supply	100 to 200°F (38 to 93°C), Off	
Minimum Boiler Return	Off, 60 to 150°F (16 to 65°C)	
Motor Speed	30 to 250 seconds	

Mixing Control 354 DIP switch settings for this application.



■ = required setting

□ = optional setting (see D 354)

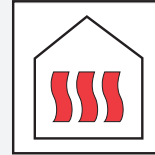
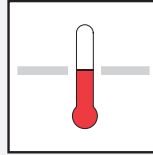
Additional Information

- For control installation, testing and operating instructions see Brochure D 001 and D 354.
- For other control applications see Application Register A 000.
- For control theory and system integration details see E 001 and E 002.

In North America: tekmar Control Systems Ltd., Canada
tekmar Control Systems, Inc., U.S.A.
Head Office: 4611 - 23rd Street
Vernon, B.C. Canada V1T 4K7
Tel. (604) 545-7749 Fax. (604) 545-0650

tekmar® - Application

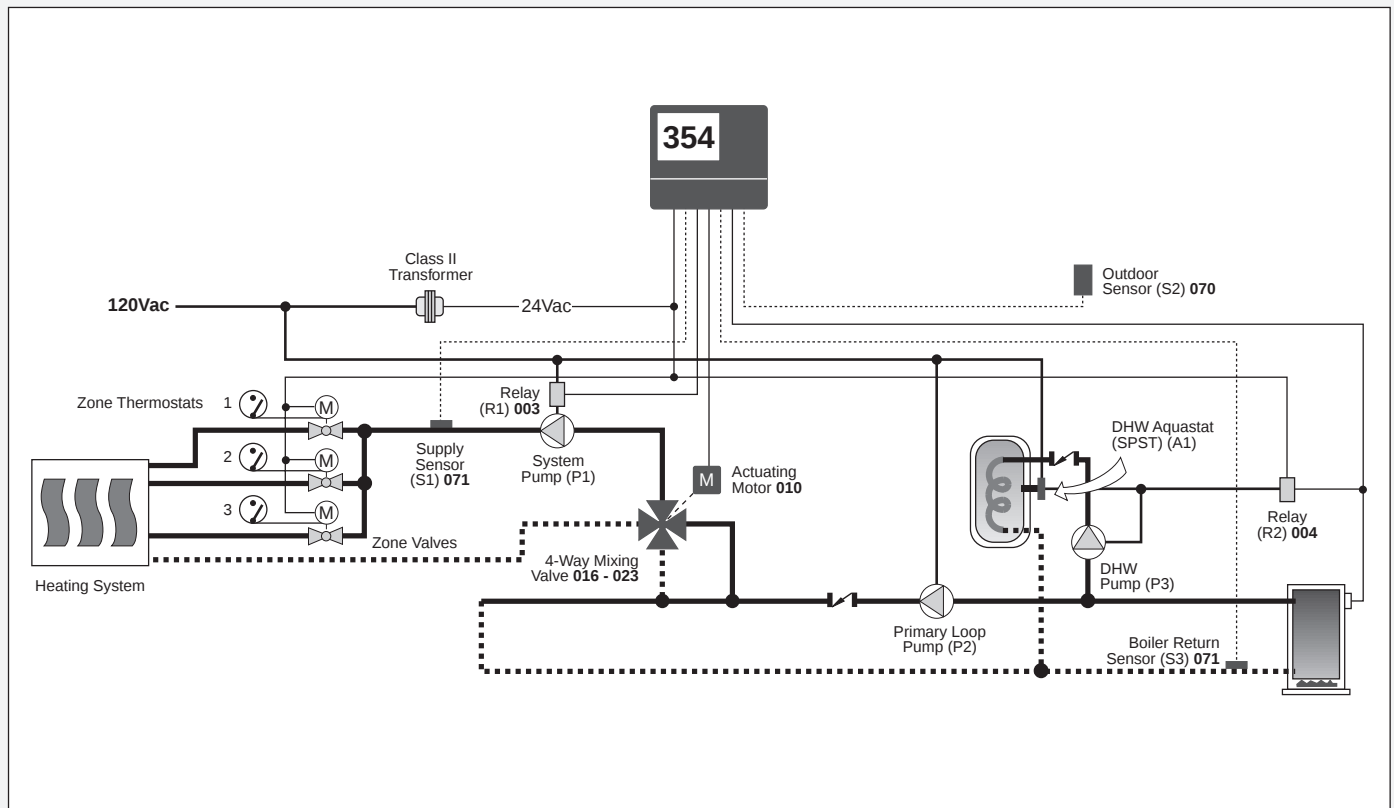
Mixing Control 354



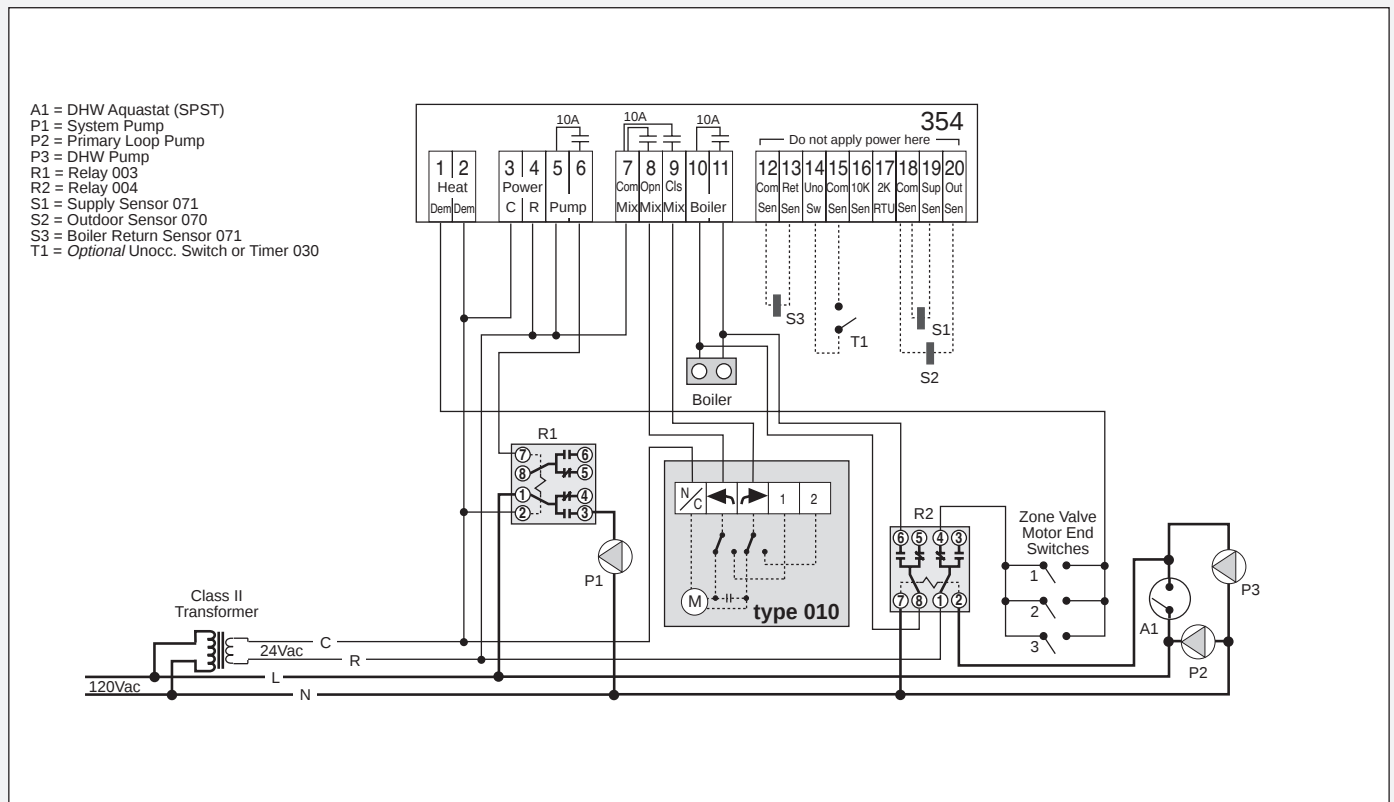
A 354-3

02/94

Mechanical



Electrical



Note: This is only a concept drawing. Designers must determine whether this system will work in each application and must ensure compliance with code requirements. Necessary auxiliary equipment and safety devices must be added.

Operation

The Mixing Control 354 regulates the heating system supply water temperature based on the outdoor air temperature by modulating a 4-way mixing valve. Protection of the boiler from cold return water is an additional feature when the Boiler Return Sensor 071 is used. The heating system is zoned with zone valves and a Domestic Hot Water (DHW) pump gives DHW generation priority over space heating.

Specifications

The following are minimum recommended specifications for the control in this application.

- The heating system shall have a primary loop pump (P2) in the primary loop and a system pump (P1) in the supply of the heating system loop.
 - The mixing valve shall be a 4-way cast iron valve and the actuating motor shall have a 90° output shaft rotation in 3-1/2 minutes and be capable of 310 in-lb (35 N-m) of torque.
 - The control shall have an Unoccupied (setback) switch or timer input enabling an Unoccupied temperature dial on the control.
 - The system pump (P1) and the boiler shall be turned off and the 4-way mixing valve driven fully closed until there is a "call for heat" from the zone valve motor end switches and the outdoor air temperature is colder than the control's Warm Weather Shut Down (WWSD) point.
 - The Occupied or Unoccupied (when in setback) temperature dial setting shall be the control's WWSD point.
 - During operation the system pump (P1), actuating motor and 4-way mixing valve shall be operated through their full range every 3 days to help prevent seizure.
 - The heating system supply water temperature shall be based on the outdoor air temperature and the control's Heating Curve (reset ratio) and Occupied or Unoccupied dial settings.
 - The control shall have an adjustable Maximum Supply water temperature setting to help protect system components from overheating.
 - The control shall have an adjustable Minimum Boiler Return temperature setting to help prevent cold shock to the boiler and condensation of flue gases.
 - The control shall modulate the 4-way mixing valve closed if the system supply water temperature rises close to the Maximum Supply or if the boiler return temperature drops close to the Minimum Boiler Return setting.
 - On a "call for DHW" the DHW pump (P3) shall be turned on, the boiler shall be turned on, the system pump (P1) shall be turned off, and the 4-way mixing valve shall be driven fully closed.
 - The control shall continuously monitor its sensors and provide a LED error message if one is shorted or disconnected.
 - The control shall be microprocessor-based and have 4 SPST internal relays with 10 Amp (resistive) isolated contacts for outputs and have indicator lights for control function and status.
 - The control shall have a test button which activates a pre-programmed test sequence to test all sensors and control outputs.
 - The control shall be compatible with standard North American wiring hardware.
 - The installation location must be maintained within the ambient temperature and humidity ranges specified in the D 354 brochure for this control, with the installer ensuring that the control and its wiring are isolated and/or shielded from strong sources of electromagnetic noise.
- **Order the following components for this application:** one 4-Way Mixing Valve 016 to 023, one Actuating Motor 010, one Mixing Control 354, one Relay 003, one Relay 004, and one Universal Sensor 071.

Settings

Mixing Control 354

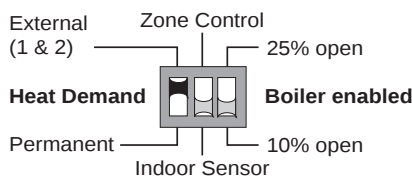
Occupied
Unoccupied
Heating Curve
Maximum Supply
Minimum Boiler Return
Motor Speed

Adjustment Range

35 to 105°F (2 to 41°C)
35 to 105°F (2 to 41°C)
0.4 to 3.6
100 to 200°F (38 to 93°C), Off
Off, 60 to 150°F (16 to 65°C)
30 to 250 seconds

Recommended Initial Settings

Mixing Control 354 DIP switch settings for this application.



■ = required setting

□ = optional setting (see D 354)

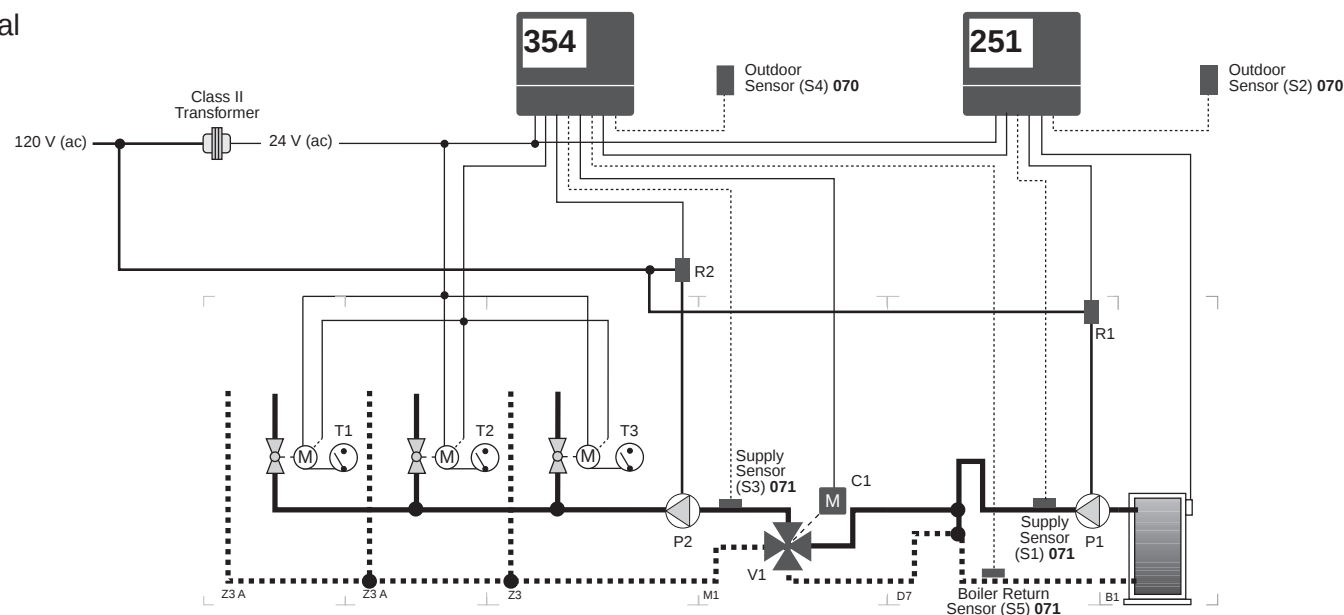
Additional Information

- For control installation, testing and operating instructions see Brochure D 001 and D 354.
- For other control applications see Application Register A 000.
- For control theory and system integration details see E 001 and E 002.

In North America: tekmar Control Systems Ltd., Canada
tekmar Control Systems, Inc., U.S.A.
Head Office: 4611 - 23rd Street
Vernon, B.C. Canada V1T 4K7
Tel. (604) 545-7749 Fax. (604) 545-0650

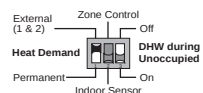
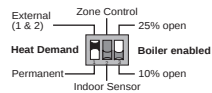


Mechanical



Electrical

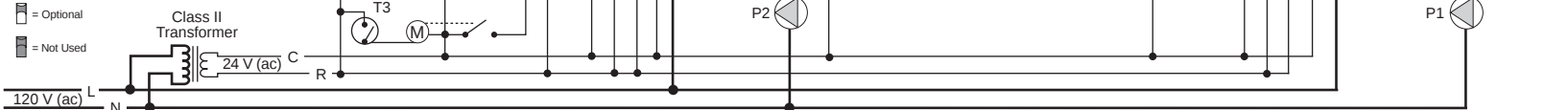
C1 = Actuating Motor 010 / 011
P1 = Boiler Pump
P2 = System Pump
R1, R2 = Relay 003
S1, S3 = Supply Sensor 071
S2, S4 = Outdoor Sensor 070
S5 = Boiler Return Sensor 071
T1, T2, T3 = Thermostats
V1 = 4-Way Mixing Valve 016 - 023



■ = Required

■ = Optional

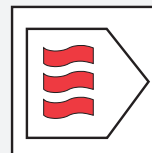
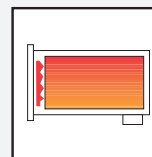
■ = Not Used



Note: This is only a concept drawing. The designer must determine whether this application will work in his system and must ensure compliance with code requirements. Necessary auxiliary equipment, isolation relays (for loads greater than the specified tekmar internal relay ratings), and other safety and limit devices must be added.

tekmar® - Application

Mixing Control 354 & One Stage Boiler & DHW Control 251

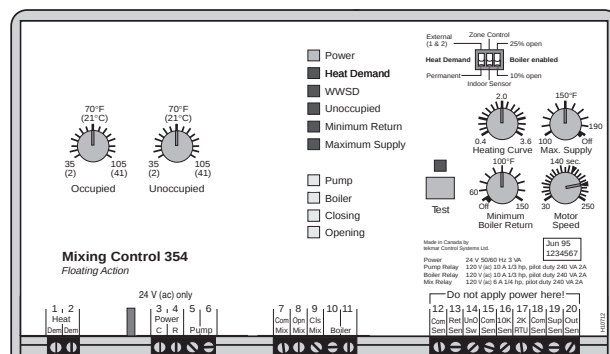


A 354-5
12/96

Technical Data

Mixing Control 354 Floating Action

Literature	— A 000, A 354's, D 354, D 001, D 05, D 06, D 070, D 074
Control	— Microprocessor control; This is not a safety (limit) control .
Packaged weight	— 2.8 lb. (1300 g), Enclosure A, PVC plastic
Dimensions	— 6-5/8" H x 7-9/16" W x 2-13/16" D (170 x 193 x 72 mm)
Approvals	— Meets ICES & FCC regulations for EMI/RFI.
Ambient conditions	— Indoor use only, 30 to 120°F (0 to 50°C), < 95% RH non-condensing.
Power supply	— Class 2, 24 V (ac) $\pm 10\%$ 50/60 Hz 3 VA
Mix Relays	— 120 V (ac) 6 A 1/4 hp, pilot duty 240 VA 2 A
Other Relays	— 120 V (ac) 10 A 1/3 hp, pilot duty 240 VA 2 A
Sensors	— NTC thermistor, 10 k Ω @ 77°F (25°C $\pm 0.2^\circ$ C) $\beta=3892$
included:	Outdoor Sensor 070 and Universal Sensor 071.
optional:	10k Sensors or 2k RTU
Occupied	— 35 to 105°F (2 to 41°C)
Unoccupied	— 35 to 105°F (2 to 41°C)
Heating Curve	— 0.4 to 3.6
Max. Supply	— 100 to 190°F, Off (38 to 88°C, Off)
Minimum Boiler Return	— Off, 60 to 150°F (Off, 16 to 66°C)
Motor Speed	— 30 to 250 seconds



System Operation & Specifications

The Mixing Control 354 and One Stage Boiler & DHW Control 251 combine in this application to provide Boiler Reset, Mixing Reset and Boiler Protection.

Piping and Heat Source Detail This application consists of a single non-condensing boiler and a 4-way mixing valve piped in a primary - secondary arrangement. The 354 has sensors to provide System Protection, Mixing Reset based on outdoor air temperature, and with the addition of the optional Return Sensor, Boiler Return Protection. The 251 provides the system with Boiler Reset based on outdoor air temperature.

Warm Weather Shut Down (WWS) When the outdoor air temperature rises above the *Occupied* dial setting, the controls enter the Warm Weather Shut Down mode of operation. In this mode of operation, the controls continue to monitor their sensors but do not operate the heating system until the outdoor temperature falls below the WWS point.

Boiler Operation Once the mixing valve is opened past the *Boiler Enable* position, the 354 closes its *Boiler* contact sending a Heat Demand signal to the 251. The 251 now closes its *System Pump* contact and enables the boiler pump (P1). The 251 monitors the boiler supply temperature using the Universal Sensor 071 (S1) and operates the boiler as required to provide Outdoor Reset.

Mixing Operation In this application, zone valve end switches are used to provide a Heat Demand to the 354. When an end switch closes, the 354 closes its *Pump* contact enabling the system pump (P2), and begins modulating the mixing valve using a Floating Action Output in order to provide the reset supply water temperature. The supply water temperature is based on the outdoor air temperature provided by the Outdoor Sensor 070 (S4) and the user selected *Heating Curve*.

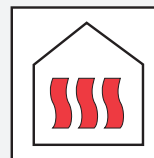
Boiler Protection The 354 provides Boiler Protection by monitoring the boiler return temperature using the Universal Sensor 071 (S5). As the boiler return temperature approaches the *Minimum Boiler Return* dial setting, the 354 closes the mixing valve in order to allow more water to recirculate through the boiler.

Additional Functions Additional control functions are listed in the table in the Heating Controls section and in the Boiler / DHW Controls section of the Product Catalog I 000 and the Application Catalog A 000.

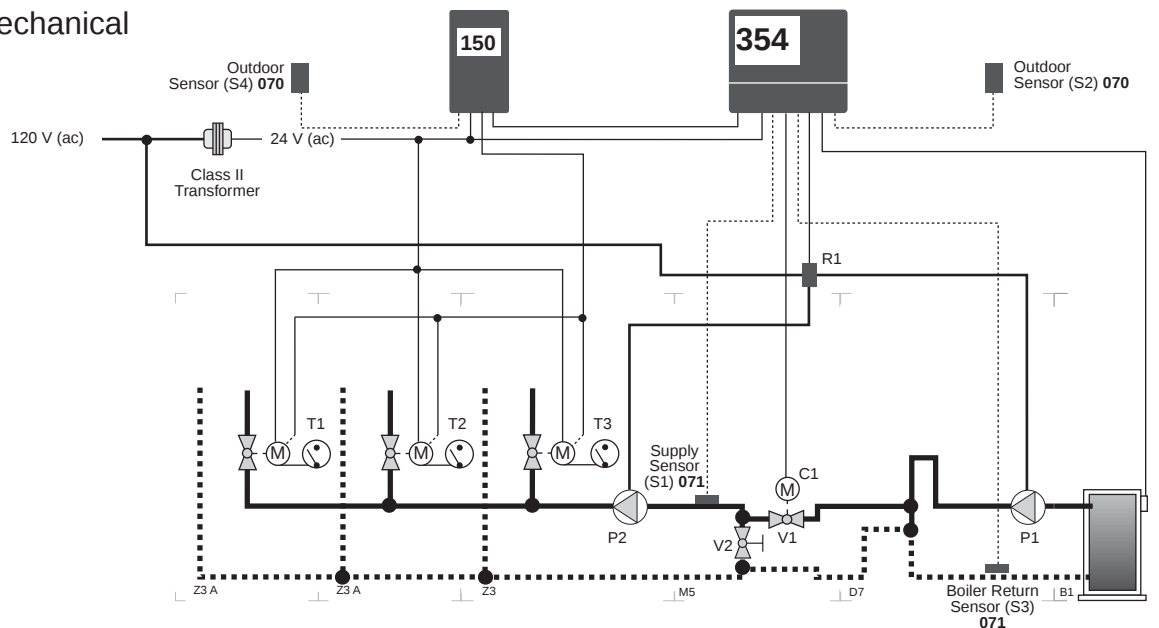


tekmar Control Systems Ltd., Canada
tekmar Control Systems, Inc., U.S.A.
Head Office: 4611 - 23rd Street
Vernon, B.C. Canada V1T 4K7
Tel. (250) 545-7749 Fax. (250) 545-0650



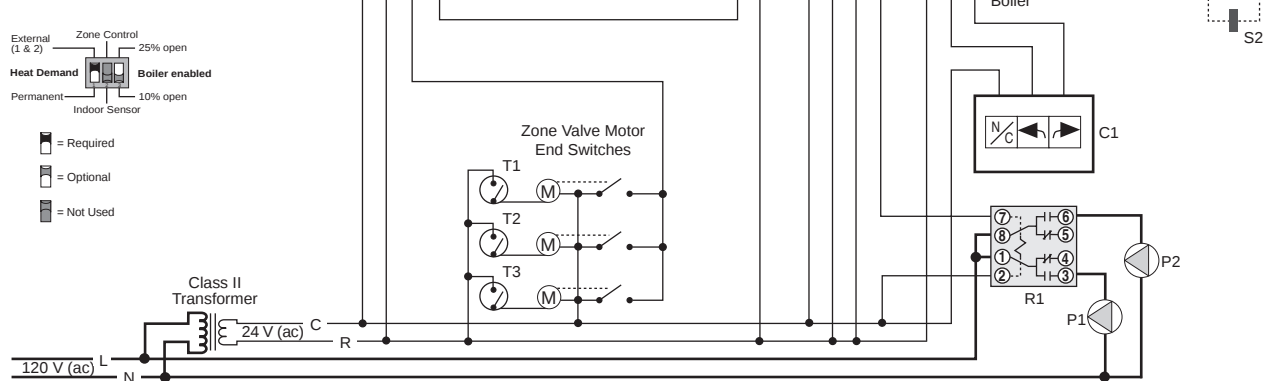


Mechanical



Electrical

C1 = Actuating Motor
P1 = Boiler Pump
P2 = System Pump
R1 = Relay 003
S1 = Supply Sensor 071
S2, S4 = Outdoor Sensor 070
S3 = Boiler Return Sensor 071
T1, T2, T3 = Thermostats
V1 = Modulating 2 - Way Valve
V2 = Balancing Valve or
Globe Valve

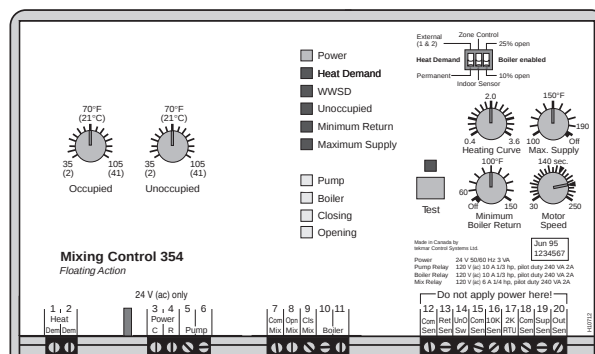


Note: This is only a concept drawing. The designer must determine whether this application will work in his system and must ensure compliance with code requirements. Necessary auxiliary equipment, isolation relays (for loads greater than the specified tekmar internal relay ratings), and other safety and limit devices must be added.

Technical Data

Mixing Control 354 Floating Action

Literature	— A 000, A 354's, D 354, D 001, D 05, D 06, D 070, D 074
Control	— Microprocessor control; This is not a safety (limit) control .
Packaged weight	— 2.8 lb. (1300 g), Enclosure A, PVC plastic
Dimensions	— 6-5/8" H x 7-9/16" W x 2-13/16" D (170 x 193 x 72 mm)
Approvals	— Meets ICES & FCC regulations for EMI/RFI.
Ambient conditions	— Indoor use only, 30 to 120°F (0 to 50°C), < 95% RH non-condensing.
Power supply	— Class 2, 24 V (ac) ±10% 50/60 Hz 3 VA
Mix Relays	— 120 V (ac) 6 A 1/4 hp, pilot duty 240 VA 2 A
Other Relays	— 120 V (ac) 10 A 1/3 hp, pilot duty 240 VA 2 A
Sensors	— NTC thermistor, 10 kΩ @ 77°F (25°C ±0.2°C) β=3892
included:	— Outdoor Sensor 070 and Universal Sensor 071.
optional:	— 10k Sensors or 2k RTU
Occupied	— 35 to 105°F (2 to 41°C)
Unoccupied	— 35 to 105°F (2 to 41°C)
Heating Curve	— 0.4 to 3.6
Max. Supply	— 100 to 190°F, Off (38 to 88°C, Off)
Minimum Boiler Return	— Off, 60 to 150°F (Off, 16 to 66°C)
Motor Speed	— 30 to 250 seconds



System Operation & Specifications

The One Stage Setpoint Control 150 and the Mixing Control 354 combine in this application to provide Mixing Reset, Boiler Protection and an adjustable Warm Weather Shut Down (WWSD).

Piping and Heat Source Details This application consists of a single non-condensing boiler providing heat to three high temperature fan coil zones. The system is piped using a primary - secondary arrangement and utilizes a 2-way modulating valve as the mixing device. A balancing valve or globe valve (V2) is placed in the secondary loop in order to induce flow through the injection loop when the modulating valve is open.

Warm Weather Shut Down (WWSD) In this application, the 150 acts as the WWSD control. Once the outdoor temperature drops below the WWSD setpoint, the 150 closes its contacts and connects the zone valve end switches to the 354.

Mixing Operation The 354 modulates the mixing valve and enables the boiler in order to provide a reset mixed water temperature to the fan coil zones based on the information provided by the Outdoor Sensor 070 (S2) and the Universal Sensor 071 (S1) on the system supply. However, in order to provide adequate temperatures to the fan coil units throughout the heating season, the Heating Curve must be shifted up by adjusting the *Occupied* dial. This prevents cool water from circulating through the fan coil zones and causing discomfort to the occupants, but at the same time puts the WWSD point at a very high temperature. In order to provide a normal WWSD point, the 150 is used.

Boiler Protection The 354 provides Boiler Protection through the use of the optional Boiler Return Sensor 071 (S3). As the boiler return temperature approaches the *Minimum Boiler Return* setting, the 354 modulates the mixing valve closed. This allows more water to recirculate through the boiler and less cool water to enter the boiler loop.

Additional Functions Additional functions are listed in the table in the Heating Controls and Setpoint Controls sections of the Product Catalog I 000 and the Application Catalog A 000.

Note: For applications that require elevated starting water temperatures, use the following equations to calculate the correct settings for the *Heating Curve* and *Occupied* dials on the Mixing Control 354. The Setpoint Control 150 is adjusted to the WWSD temperature.

Heating Curve Adjustment Example:

Starting water temperature = 100°F
Design water temperature = 190°F
Design outdoor temperature = -10°F

WWSD temperature = 60°F
(150 setting)

$$\begin{aligned} \text{Heating Curve} &= \frac{\text{Design water} - \text{Starting water}}{\text{WWSD} - \text{Design outdoor}} \\ (354 \text{ setting}) &= \frac{190^\circ\text{F} - 100^\circ\text{F}}{60^\circ\text{F} - (-10^\circ\text{F})} = 1.29 \end{aligned}$$

$$\begin{aligned} \text{Occupied Dial Setting} &= \frac{\text{Design water} + (\text{Heating Curve} \times \text{Design Outdoor})}{\text{Heating Curve} + 1} \\ (354 \text{ setting}) &= \frac{190^\circ\text{F} + (1.29 \times (-10^\circ\text{F}))}{1.29 + 1} = 77.3^\circ\text{F} \end{aligned}$$

tekmar®
Control Systems

tekmar Control Systems Ltd., Canada
tekmar Control Systems, Inc., U.S.A.
Head Office: 4611 - 23rd Street
Vernon, B.C. Canada V1T 4K7
Tel. (250) 545-7749 Fax. (250) 545-0650

