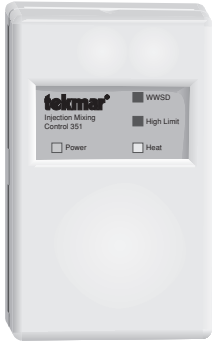


# tekmar® - Data Brochure

## Injection Mixing Control 351

**D 351**

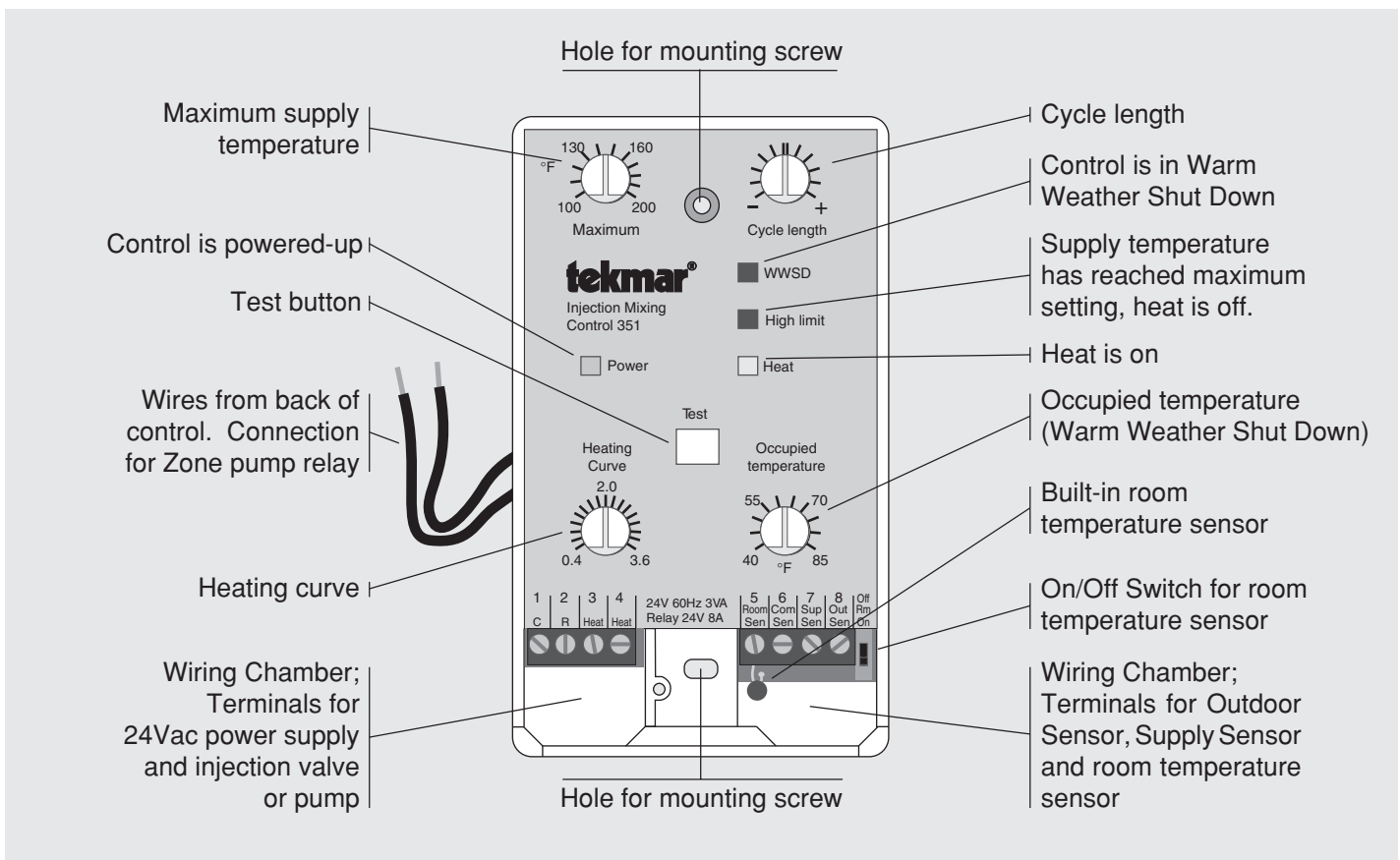
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The Injection Mixing Control 351 is an analog outdoor reset control for small hydronic heating systems. The control regulates the supply water temperature based on the outdoor and optionally the indoor air temperature, by operating a two-way injection valve or pump. Hot water is injected in pulses through the valve or pump into the continually circulating water of the heating system.

This reliable and versatile control has settings for heating curve, occupied room temperature (WWSD), maximum supply water temperature and cycle length. A thermostat is not needed with this control because it has a built-in air temperature sensor. An optional remote indoor air temperature sensor can also be used.

The Injection Mixing Control is a reliable and cost effective control solution for small hydronic radiant floor (HRF) heating systems or zones .



### Technical Data

#### Technical Specifications

Dimension (h x w x d)	— 2-7/8"x 4-3/4" x 1-7/8" (74 x 120 x 22mm)
Weight	— 1 lb (450g)
Ambient	— 30 to 120°F (0 to 50°C) < 90% RH non-condensing
Power supply	— 20 to 28Vac, 60 Hz, 2 VA, class II transformer
Heat Relay capacity	— SPST, 24Vac, 8 A resistive
Pump Relay capacity	— SPST, 24Vac, 15 A resistive
Sensors	— 10 KΩ @ 77 ± 0.4°F (25 ± 0.2°C), curve 3 NTC thermistor accurate with up to 1000ft (300m) of 18 gauge wire.
Control accuracy	— ± 0.5°F (± 0.3°C)

#### Features

Indicator lights	— Power, WWSD, High Limit, Heat
Test button	— turns on control's internal relays

#### Settings

Heating curve	— 0.4 to 3.6
Cycle length	— - to + (1:10 ratio)
Max. Supply Temp	— 100 to 200°F (38 to 93°C)
Occupied	— 40 to 85°F (4 to 29°C)
Room Sensor switch	— on/off

## Sequence of Operation

- *When the Injection Mixing Control 351 is powered-up;* the "Power" light will come on, and the control will use its sensors to measure the outdoor temperature, the system supply water temperature and, if the Room temperature sensor switch is in the "on" position, the room temperature.
- *If the outdoor temperature is warmer than the desired room temperature;* the "WWSD" light will come on. The "Heat" light will be off.
- *If the outdoor temperature is colder than the desired room temperature;* the "WWSD" light will go out and the control will switch on an internal relay, closing a set of dry contacts between the two black leads at the back of the control. These leads are connected to the zone pump relay, which brings on the zone pump, starting water circulation in the zone. The control calculates the desired supply temperature based on the requirements of both the heating curve and the desired room temperature.
- *If the supply temperature is colder than the temperature required by the control;* the "Heat" light will come on and the control will switch on an internal relay to close a set of dry contacts between terminals *Heat — Heat* (3 and 4). This energizes a valve or pump which injects hot water into the circulating water of the zone loop for at least the "on" time of one cycle length, raising the temperature of the zone supply water.
- *When the supply temperature becomes warmer than the temperature required by the control;* the "Heat" light will go off and the contacts between terminals *Heat — Heat* (3 and 4) will open, turning off the injection valve or pump.
- *If the supply temperature becomes warmer than the Maximum setting;* the "High limit" light will come on and the "Heat" light will go off as the control opens the contacts between terminals *Heat — Heat* (3 and 4) to turn off the injection valve or pump. The control will not energize the injection valve or pump as long as the supply temperature is above the Maximum setting, but the zone pump will continue to circulate the water.

## Installation

### Caution

**Improper installation and operation of this control could result in damage to equipment and possibly even personal injury. It is your responsibility to assure that this control is safely installed according to all applicable codes and standards.**

## Step One

### Getting ready

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 agent for assistance.

*Type 351 includes:*

- One electronic control, type 351
- One Outdoor Sensor 070
- One Supply Sensor 071
- One Data Brochure D 351
- One Data Brochure D 001
- One Application Brochure A 351

*Other information available:* • Essay E 001 • Essay E 002

Read Brochure A 351 and select the correct Application for your job.

**Note:** *Carefully read the details of the Application, and the Sequence of Operation section in this brochure to ensure that you have chosen the proper control, and understand its functions within the operational requirements of your system.*

## Step Two

### Mounting

- The control is mounted in accordance with the instructions in the Data Brochure D 001.

## Step Three

### Rough-in Wiring

The control will be mounted on a duplex electrical box. The zone system pump wiring terminates in the electrical box, connecting to the two black wires at the back of the control. All other electrical wiring terminates in the two wiring chambers at the bottom front of the control. The wiring can be roughed-in at the electrical box prior to installation of the control. See Brochure D 001.

**Power should not be applied to any of the wires, during this rough-in wiring stage.**

- Install the Outdoor Sensor 070, and the Supply Sensor 071, according to the instructions in Data Brochure D 001 and run the wiring back to the control. If a remote Indoor Sensor 074 is used, install the sensor and run the wiring back to the control.
- Install a 24Vac Class II transformer with a minimum 5VA rating to power the control, and run the wiring from the transformer to the control. *A Class II transformer must be used. Do not connect any of the transformer terminals to ground.*
- Install the wiring from the zone system pump isolation relay to the electrical box.
- Install the wiring from the injection valve or the injection pump isolation relay to the electrical box.

## Step Four

### Testing and connecting the wiring

#### Caution

- **These tests are to be performed using standard testing practices and procedures and should only be carried out by a properly trained and experienced technician.**
- **A good quality electrical test meter, capable of reading from at least 0 — 200 Volts AC, and at least 0 — 2,000,000 Ohms, is essential to properly test this control.**
- **At no time should voltages in excess of 28Vac be measured at any of the wires connected to this control.**

*Test the sensors*

- This test must be performed *before* power is applied to the control and *before* the external sensors are connected to the terminal strip. Test the Sensors 070, 071 and if used, remote Indoor Sensor 074 according to the instructions printed in the enclosed Data brochure D 001. If it becomes necessary to test the control's built-in room sensor, the lead from terminal *Room Sen* (5) should be carefully pulled out of the terminal, allowing the sensor to be tested using the same procedures.

### Test the Power Supply

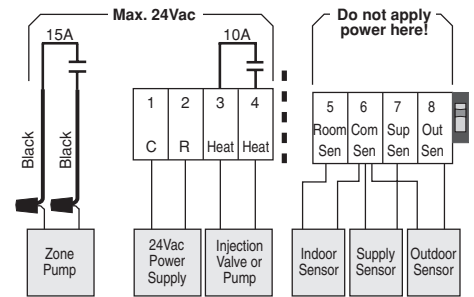
- Ensure that the wires from the power supply transformer are not touching each other, any other wires, or ground. Turn on the power, and using an AC voltmeter, you should measure between 20 and 28 volts at the secondary side of the transformer.
- Turn off the power and complete the electrical connections to the control.

### Power and output connections; **Caution, Maximum 24 Volts**

- Connect the zone pump isolation relay to the two black wires at the back of the control, bring the other wires into their respective wiring chambers and mount the control to the electrical box.
- Connect the transformer wires to terminals *C — R* (1 and 2)
- Connect the injection valve or pump relay to terminals *Heat — Heat* (3 and 4).

### Sensor connections; **Caution, voltage is never applied to these terminals**

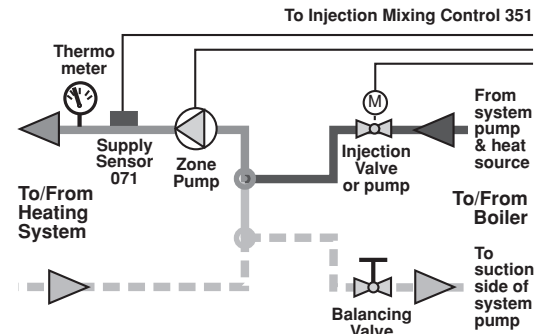
- Connect the Outdoor Sensor 070 to terminals *Com Sen — Out Sen* (6 and 8).
- Connect the Supply Sensor 071 to terminals *Com Sen — Sup Sen* (6 and 7).
- Switch the Room Sensor switch to the "on" position if an Indoor Sensor is to be used. The type 351 is supplied with a 10KΩ thermistor installed in terminal *Room Sen* (5). If a remote Indoor Sensor 074 is to be used, remove the internal thermistor lead from terminal 5, bend it out of the way and connect the wires from the remote Indoor Sensor 074 to terminals *Room Sen — Com Sen* (5 and 6).



## Step five

### Balancing the system *For additional applications and plumbing arrangements, see brochure A 351*

- Close the balancing valve.
- Manually operate the zone pump and heat source.
- Power up the control. The "Power" light should turn on. The "High limit" light must be off.
- Set the Maximum dial to the system design supply water temperature.
- Manually operate the injection valve or pump to run continually.
- Over a 3 minute period, slowly open the balancing valve until the "High limit" light turns on.
- Let the system stabilize for at least 3 minutes.
- Close the balancing valve slowly until the "High limit" light turns off.
- Set the supply temperature limit at least 10°F (6°C) above its present setting (the systems' design supply water temperature) to prevent short cycling of the injection valve or pump on cold days.



## Settings

To obtain the best operation from a reset control, it is important to measure the system water temperature as accurately as possible. Whenever the control is energized, the system pump must be operated to maintain continuous water flow across the supply temperature sensor. See A 351 and E 002.

### Heating Curve

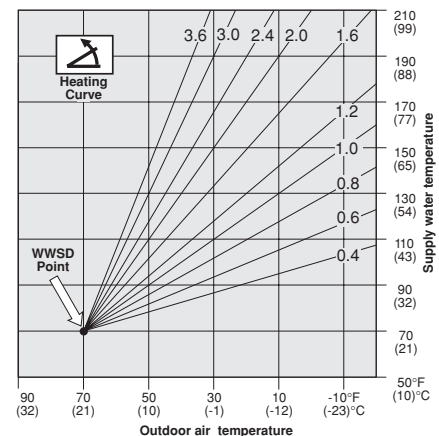
As outdoor temperatures drop, heat losses to a space become greater and the heating system supply water temperature must be raised to maintain a constant room temperature. The heating curve value describes how many degrees the supply water temperature is raised for a one degree drop in outdoor temperature. The supply temperature starts to increase when the outdoor temperature falls below the WWSD setting. To calculate the correct setting for the heating curve, use the following formula.

$$\text{Heating curve} = \frac{\text{design supply temperature} - \text{room temperature}}{\text{room temperature} - \text{design outdoor temperature}}$$

- For example:
- Design outdoor temperature = 10°F (-12°C)
  - Design room temperature = 70°F (21°C)
  - Design supply temperature = 120°F (49°C)

$$\text{Heating curve} = \frac{120^{\circ}\text{F} - 70^{\circ}\text{F}}{70^{\circ}\text{F} - 10^{\circ}\text{F}} = \frac{50^{\circ}\text{F}}{60^{\circ}\text{F}} = 0.8$$

If the actual design supply water temperature used for a system is unknown, a trial setting can be calculated using a typical supply temperature of 100 to 130°F (40 to 55°C) for Hydronic radiant floor systems and 150 to 190°F (65 to 90°C) for baseboard convectors.



### Maximum supply water temperature limit (Maximum)

This adjustment limits the system supply temperature entering the heating system. When the supply water temperature exceeds this limit, the injection valve or pump will be turned off and the "High limit" light will come on. Consult the heating component manufacturer for their recommended maximum supply water temperatures. Typical settings are: Hydronic radiant floor systems — 140°F (60°C), Baseboard systems — 190°F (90°C). The High limit setting is made when balancing the system.

## Cycle Length

The length of time the injection valve or pump stays on and how frequently it comes on is a function of both the response time of the heating zone and the Cycle length adjustment on the control. Normally the Cycle length adjustment can be set in the middle of its range. If unreasonably short or frequent operation of the valve or pump is observed, increase the adjustment towards its "+" position. If the zone valve or pump is not operated often enough then decrease the adjustment towards its "-" position.

## Occupied Temperature

When the Room sensor switch is "off", the type 351 controls the supply temperature based on the outdoor temperature, the Heating Curve setting and the Occupied temperature setting, which becomes the WWSD point. Adjusting the Occupied temperature dial will shift the heating curve up or down accordingly and will control the room air temperature accurately at all outdoor temperatures. When internal heat gains or losses become a significant factor however, either the built-in temperature sensor or the remote Indoor Sensor 074 should be installed and switched on. Using this room temperature feedback allows the control to sense how much the room air temperature deviates from the Occupied temperature setting, and it can then shift the heating curve up or down in order to compensate. For example, if the room is too cold, the control will shift the heating curve up, raising the supply water temperature and increasing the heating system heat output. When the room warms up, the control will shift the curve back down.

## Testing and Troubleshooting

There are four LEDs on the front of the control that will aid in testing and troubleshooting.

The LEDs indicate the following functions:

- **Power light on** — The 24Vac power source has been connected and the control is energized.
- **High limit light on** — The supply sensor is hotter than the setting on the Maximum dial; close off the balancing valve more.
- **WWSD light on** — The outdoor temperature is higher than the Occupied setting, putting the control into Warm Weather Shut Down, and shutting off the zone pump.
- **Heat light on** — The contacts are closed between terminals *Heat* — *Heat* (3 and 4). The injection valve or pump should be on.
- **In addition to the LEDs, this control has a Test button which turns on both internal relays.**

When the Test button is pushed and held down, the internal relays are energized, causing the "Heat" light to come on with the injection valve or pump and the zone pump. If the "Heat" light comes on but the valve or pumps do not operate, check to see that all components are properly installed and fully operational, and that there is power to the circuit. Check that the wiring and plumbing are as shown in the application drawing for your system. Check the wiring from the control to the valve or pumps that are not working and if further information is needed, consult the manufacturer's installation and troubleshooting instructions for these components.

## Before you leave

- Install the wiring cover over the wiring chamber and secure it with the screw provided.
- Place the front cover on the control to cover the setting dials and snap it into place.
- Place this brochure, and all other brochures relating to the installation, in the protective plastic bag supplied with the control.
- Place the bag in a conspicuous location near the control for future reference.
- It is important to explain the operation of this control within the system to the end user and anyone else who may be operating the system.

## 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.

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