



# HAYWARD®

# CAT 2000

## AUTOMATED CONTROLLER



## OWNER'S MANUAL

INSTALLATION  
OPERATION  
MAINTENANCE  
SPECIFICATIONS

## FOREWORD

Congratulations on your wise investment. The product you have selected from the CAT 2000 line of automated controllers should provide you with substantially reduced chemical maintenance, improved compliance with Health Department operating standards, chemical cost savings, and many years of reliable operation. All CAT controllers incorporate state of the art microprocessor-based design technology to provide sophisticated control functions at an affordable price.

Although CAT controllers are relatively simple to install, please take the time to read this entire manual, compare package contents with the parts list, and gather all tools required before beginning installation. Improper installation may void the warranty and create unnecessary hazards. Properly preparing for installation will also reduce facility down-time.

For the purposes of this manual, it is presupposed that the installer is familiar with the physical characteristics of the pool or spa to be automated. As is the case when installing any filtration system component, all recirculating pumps, heaters, etc. need to be turned off prior to installation of the controller. If the filtration system is located below water level, additionally adjust all valves required to eliminate pressure from the system.

Physically, installation of a CAT controller is no more challenging than installation of a chemical feeder. Any swimming pool contractor or maintenance engineer should have the tools and knowledge to perform the installation. Our technical support line can also be used to answer any questions pertaining to controller installation.

Remember that your new CAT controller is not a substitute for performing and recording manual water testing in conformance with your state or local health department regulations. Never operate a water chemistry controller without a flow sensor, power interlock, or other means of ensuring that chemicals will not be fed without proper filtration system recirculation.

Congratulations on your purchase and welcome to the world of chemical automation. Please complete and return your warranty registration card today.

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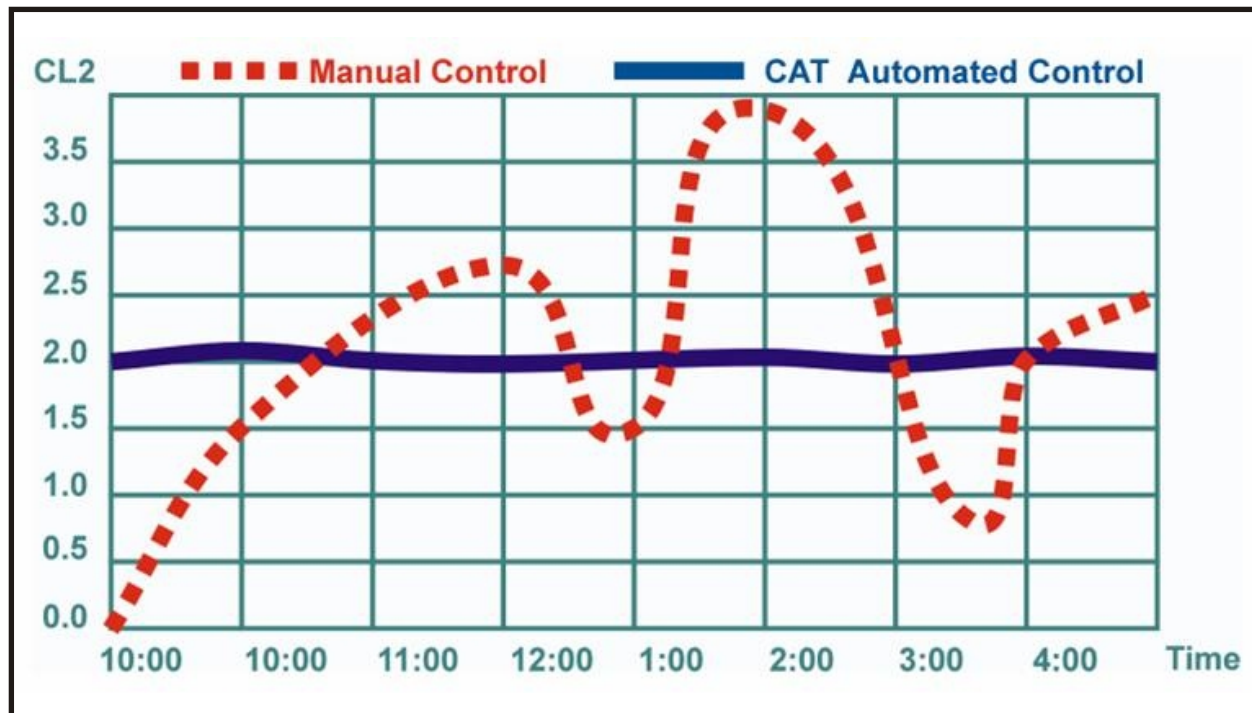
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## SECTION 1. CHEMICAL AUTOMATION WITH THE CAT 2000

A pool operator typically checks and adjusts pool or spa water chemistry hourly at best. The CAT 2000 continuously monitors pH and sanitizer activity, constantly adjusting the feeding of chemicals on a basis proportional to the demand. The results include elimination of "human error", accurate and reliable maintenance of chemical levels twenty-four hours a day, compliance with Health Department chemistry standards, reduced burden on operating staff, and a reduction of chemical usage and costs.

The following graph (Illustration 1.) compares typical chlorine levels when chemistry is adjusted manually versus automatically with the CAT 2000 controller.

ILLUSTRATION 1.  
MANUAL -VS- CAT AUTOMATED CONTROL



## **SECTION 2.**

### **COMPONENTS OF A CAT 2000 AUTOMATED SYSTEM**

The following is a description of the components incorporated in a typical CAT 2000 controller system:

**The Professional-Series pH Sensor** samples water from the filtration system and sends signals to the controller indicating the acidity of the water. The ideal pH range for pools and spas is 7.4 - 7.6. The CAT 2000 controller is preset from the factory to maintain pH 7.5. If pH is maintained below 7.4 (too acidic), eye irritation, corrosion of equipment, and damage to the pool or spa surface can occur. If pH is maintained above 7.6 (too alkaline), sanitizer activity is reduced, water may become cloudy, and eye irritation may result.

**The Professional-Series ORP Sensor** samples water from the filtration system and sends signals to the controller indicating the oxidation-reduction potential (redox) of the water. ORP is an actual measure of sanitizer activity (chlorine, bromine, ozone, etc.) and bacteriological water quality rather than an expression of chemical residual levels. The CAT 2000 controller is preset from the factory to maintain ORP at 650 millivolts.

**The Flow Sensor** (required) monitors the rate of flow across the pH and ORP sensors and signals the controller to disable automated chemical feeding during periods when the filtration system is off or low recirculation flow is detected.

**The Flow Cell** provides a convenient location for mounting the pH, ORP and Flow Sensor while ensuring ideal hydraulic conditions to maximize sensor performance and life.

**The CAT 2000 controller unit** scans and interprets the signals from the pH and ORP probes, displays water quality readings in digital format, and activates chemical feeders in proportion to the demand required to maintain setpoint pH and ORP levels. The unit incorporates audible and visual safeguard alarms for out of range conditions, calibration adjustment for pH, and mode selections to manually feed or disable feeding for either channel. The CAT 2000 controller unit also features an internal micro-computer for unsurpassed accuracy, adaptability, and ease of use. All user-entries and adjustments are made through the touch-screen interface front panel.

## **SECTION 3.**

## **IMPORTANT SAFETY INFORMATION**

### **IMPORTANT SAFETY INFORMATION**

1. **WARNING** - Important safety information is contained throughout this manual. Read complete instructions prior to installation.
2. **WARNING** - Risk of Electric Shock. Connect controller only to a grounding type receptacle protected by a ground-fault circuit interrupter (GFI). CAT Controllers recommends installation to a dedicated GFI circuit breaker performed by a licensed electrician.
3. **WARNING** - Disconnect power before servicing. Other than the fuses, there are no user serviceable parts inside the controller.
4. **WARNING** - All power cords should be inspected frequently. Any damaged power cords must be replaced immediately to reduce the risk of electric shock. Never operate a controller without functional flow protection.
5. **WARNING** - Installation requires a properly located GFI protected receptacle. Never use an extension cord for electrical connections to the controller.
6. **WARNING** - Always mount controller in a safe area not subject to damage by moving objects. Never bury controller power cords.
7. **WARNING** - Any person using, adjusting, or monitoring the controller must be at least 18 years of age and be familiar with these instructions and the contents of this manual.
8. **WARNING** - Always take and record manual water chemistry readings in conformance with Health Department requirements. Although automated controllers are a great aid in maintaining healthy water quality, controllers are not a substitute for manual water testing with an accurate test-kit.
9. **WARNING** - Always read and become familiar with Material Safety Data Sheets (MSDS) and safe handling instructions for all chemicals used with the controller.
10. **Caution:** The automatic controller should not be installed where it is accessible to the public.

## SECTION 4.

## PACKAGE CONTENTS

Please unpack your new controller system carefully. Do not use a razor or sharp instrument to remove contents. Report any shipping or handling damage immediately to your shipping company. Enclosed in the packaging you should find all of the following:

- (1) CAT 2000 Water Chemistry Controller
- (1) Professional Series pH Sensor with 24" Cable and BNC Connector
- (1) Professional Series ORP Sensor with 24" Cable and BNC Connector
- (2) BNC Connector Protective Covers (Remove to Connect Sensors)
- (2) Sensor Storage Containers
- (1) CAT 2000 Owner's Manual

### **The CAT 2000 Pro-Pack includes the following additional items:**

- (1) PVC Backboard with Mounting Holes and Stainless Hardware
- (1) Machined Acrylic Flow Cell assembled with:
  - (3) 1/4" NPT x 3/8" Tubing Asahi Ball Valves
  - (1) Rotary Flow Sensor with Cable and Specialty Connector
- (1) 30' Roll, Blue Poly Installation Tubing (3/8" OD)
- (2) 1/4" NPT x 3/8" Tubing True-Seal Connectors
- (1) Pro-Pack Quick Start Guide

Before commencing installation, please confirm that items listed above have been included. Please report any shortages immediately to the factory.

## **SECTION 5.**

## **INSTALLATION WITH FLOWCELL**

The following tools are recommended for installation:

- Drill (Cordless preferred)
- 7/16" Drill Bit
- 1/4" NPT (National Pipe Tapered) Tap
- Masonry Drill Bit & Anchors (if required)
- 13/16" Wrench or Channel-Lock Pliers.

### **INSTALLATION PROCEDURES**

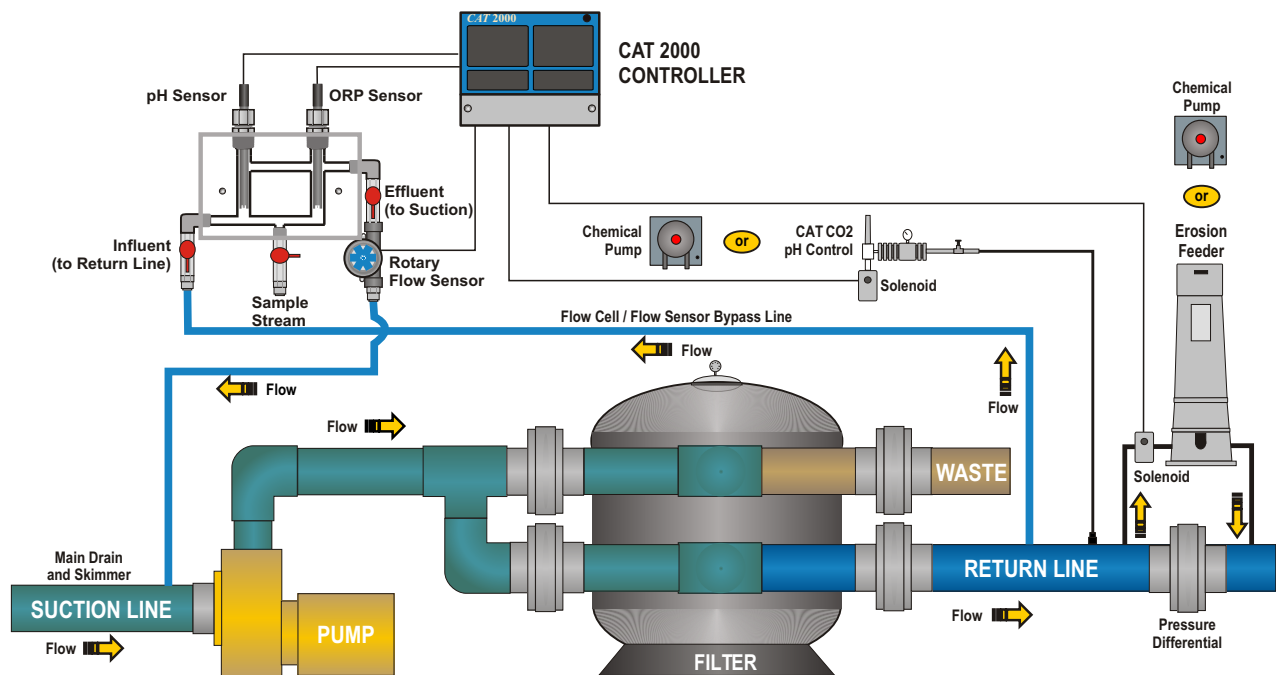
The key to a successful flow cell installation is in the plumbing. A pressure differential is required to allow clean, untreated water to pass through the cell and across the sensors. We recommend using a CAT Flowcell and fittings to create a pressure-suction "loop" line.

1. Turn off heater, chemical feeders, pump, and any other related equipment. Relieve pressure from filtration system.
2. Select a convenient mounting location for the controller unit which will meet the following criteria:
  - A. Facilitates a combined (influent and effluent) maximum tubing run of 30'.
  - B. Located a minimum of ten feet from pool or spa.
  - C. GFI protected power source available.
  - D. Easily accessible to pool or spa operator.
  - E. Away from corrosive materials and physical hazards.
3. Securely mount Controller or PVC Backboard on vertical wall.
4. Drill and tap a 1/4" NPT port at a location just down-stream of the filter, but up-stream from any chemical injection point. Install a tubing connector, and run flex tubing to the influent flow cell port.
5. Drill and tap a 1/4" NPT port at a location subject to vacuum or reduced pressure. Install the remaining tubing connector and run flex tubing to the effluent flow cell port.
6. Cut a 3" to 6" length of flex tubing and insert into the sample stream port.
7. Remove pH and ORP sensors from the plastic storage bottles and save bottles and storage fluid for future use. Thread sensors into flow cell.



8. Remove BNC protective covers from left side of controller unit and store for future use. These covers protect the controller unit from electro-static discharge (ESD) and should be used whenever handling or transporting the controller unit.
9. Connect the pH, ORP and Flow sensor cables to the controller unit as labeled. Sensor cables are constructed from a specialized material - never cut or splice.
10. If new or additional chemical feeders are to be used with the controller, install according to manufacturers instructions at this time.
11. Connect chemical feeders to the controller as labeled.
12. Check all electrical and mechanical connections. Resume filtration system operation and check for any leaks.

## ILLUSTRATION 2. CAT 2000 INSTALLATION DIAGRAM WITH FLOWCELL



**ALL CHEMICALS MUST BE INJECTED DOWN STREAM FROM HEATER & FLOW CELL**

## **SECTION 6. INSTALLATION WITH BYPASS LINE**

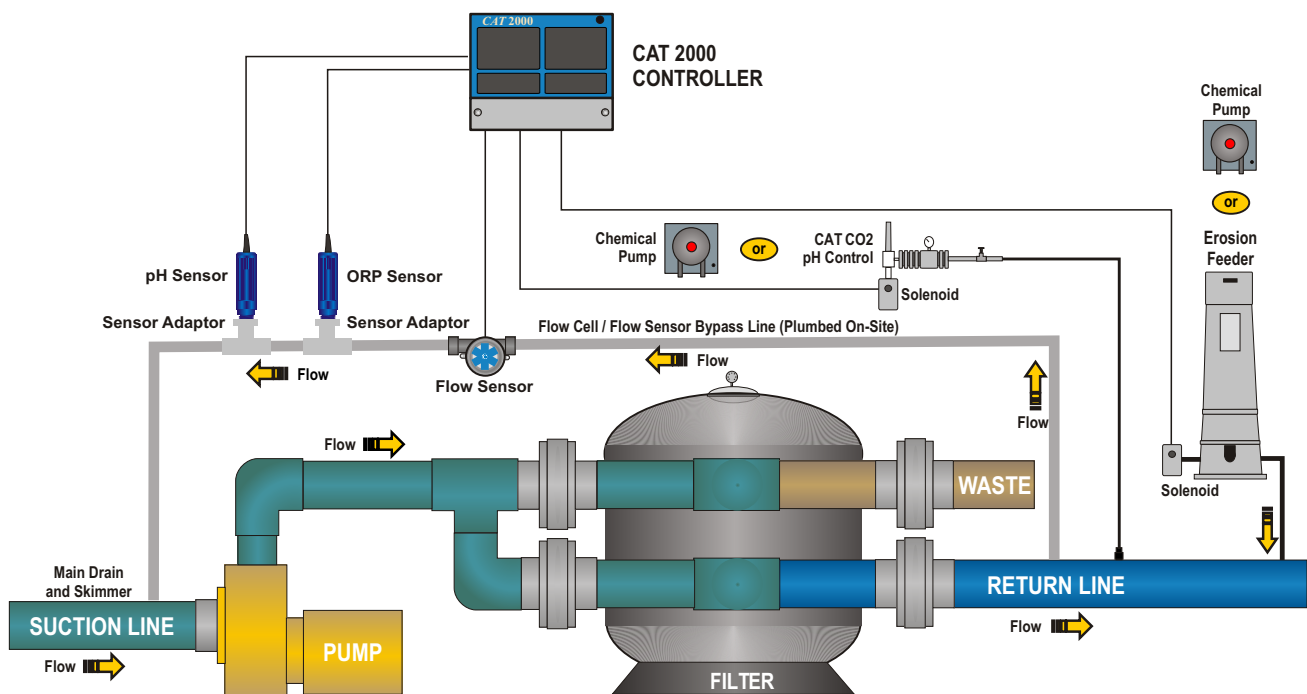
CAT recommends the use of a CAT Flowcell and Rotary Flow Sensor for all recreational water applications. The CAT Flowcell provides a controlled flow to maximize sensor life, convenient sample port for manual water tests, integrated mounting of Rotary Flow Sensor, and fast professional installation with flexible tubing and Tru-seal connectors.

Construction of a bypass line should only be performed by experienced technicians familiar with the procedures for plumbing with PVC as well as the material used in the existing filtration system. Refer to Illustration 3 for a typical bypass diagram.

1. Turn off heater, chemical feeders, pump, and any other related equipment. Relieve pressure from filtration system.
2. Select a convenient mounting location for the controller unit which will meet the following criteria:
  - A. Facilitates unobstructed bypass line plumbing.
  - B. Located a minimum of ten feet from pool or spa.
  - C. GFI protected power source available.
  - D. Easily accessible to pool or spa operator.
  - E. Away from corrosive materials and physical hazards.
3. Securely mount the CAT 2000 controller on a vertical wall.
4. Install one "reducing tee" or "saddle tee" fitting each on the incoming suction line to the pump and the return line upstream from heater as shown in Illustration 3.
5. Install ball valves on bypass inlet and effluent immediately adjacent to tee fittings.
6. Install in-line filter (optional) immediately downstream from bypass inlet valve.
7. Install flow meter (optional) immediately downstream from in-line filter (if applicable) or bypass inlet valve.
8. Install two tee fittings to accommodate ½" NPT Professional Series pH & ORP sensors as shown in Illustration 3.
9. Install Rotary Flow Sensor in bypass line as shown in Illustration 3.

10. Remove pH and ORP sensor storage caps and save for future use.
11. Remove BNC protective covers from left side of controller unit and save for future use. NOTE: These covers protect the controller unit from electro-static discharge (ESD) and should be used whenever handling the controller unit.
12. Insert the pH and ORP sensors into the two ½" tee fittings. Teflon tape may be used to seal threads.
13. Carefully route sensor cables to the controller unit, and connect the sensor cables to the controller unit as labeled. NOTE: Sensor cables are constructed from a specialized coaxial material - never cut or splice sensor cables.
14. Label and support all new piping. If new chemical feeders are to be used with the controller, install according to instructions provided by the manufacturer.
15. Connect chemical feeders to the controller unit as labeled.
16. Resume operation of the filtration system and check for leaks.

### ILLUSTRATION 3. CAT 2000 INSTALLATION DIAGRAM WITH BYPASS LINE



## **SECTION 7.**

## **PREPARING WATER CHEMISTRY**

Now that your new controller has been physically installed, water chemistry should be tested and adjusted prior to initiating automated control of the pool or spa. Confirm that your pool or spa water conforms to the following ranges before powering on and setting up the CAT 2000.

<b>TEST</b>	<b>MINIMUM</b>	<b>IDEAL</b>	<b>MAXIMUM</b>
<b>pH</b>	<b>7.2</b>	<b>7.5</b>	<b>7.8</b>
<b>Free Chlorine (PPM)</b>	<b>1</b>	<b>2</b>	<b>3</b>
<b>Bromine (PPM)</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>Cyanuric Acid (PPM)</b>	<b>0</b>	<b>-</b>	<b>100</b>
<b>ORP (mV)</b>	<b>650</b>	<b>-</b>	<b>-</b>
<b>Total Alkalinity</b>	<b>80</b>	<b>-</b>	<b>120</b>
<b>Calcium Hardness</b>	<b>200</b>	<b>-</b>	<b>400</b>

The above table indicates generally accepted guidelines. Always maintain water chemistry according to standards set by your local or State Health Department.

All CAT water quality controllers maintain sanitizer levels (chlorine, bromine, ozone, etc.) based on ORP. Although ORP is a superior index of water quality compared to part per million sanitizer residual levels, factors such as pH, cyanuric acid concentration and total dissolved solids can affect sanitizer residual readings relative to ORP.

CAT strongly recommends establishing desired pH, sanitizer residual, calcium hardness, total alkalinity, temperature and cyanuric acid levels prior to initiating automated control of the pool or spa. The ORP setpoint will need to be changed periodically as described later in this section if the goal is to provide consistent sanitizer residual levels rather than consistent control of ORP.

## **SECTION 8. SETTING AND OPERATING THE CAT 2000**

Once desired start up chemistry parameters have been established, you are ready to set the CAT 2000 to automatically maintain pH and sanitizer levels. Please refer to Illustration 4 for controller unit button designations. Button designations appear in bold type.

### **Selecting Acid or Base Feed**

The CAT 2000 is preset from the factory to operate in the acid feed mode (when pH exceeds the setpoint, the pH chemical feeder is activated). If the sanitizer used at your facility causes the pH to decrease you must select base feed mode. To switch the controller between acid feed and base feed modes, perform the following steps.

1. Press and hold the **Hidden Button (#1)** for five seconds to enter advanced setup mode.
2. Scroll to pFD and press the enter key. Scroll to select A for acid feed or B for base feed. Press the Enter key to set your selection, then press the **Hidden Button (#1)** again to return to normal operating mode.

As the unit powers on, the digital pH readout will display an "A" or "B" indicating whether acid feed or base feed mode has been activated.

### **Calibrating pH**

Readings from the CAT 2000 are far more accurate than those obtained from most liquid test standards. To match manual water testing results or compensate for a depleted or unclean pH sensor, the pH channel of the controller may be calibrated as follows:

1. Press the **pH Setpoint Adjustment Button (#4)** twice, illuminating the green "CALIBRATE" LED.
2. Press the arrow-shaped **pH Channel Increase Button (#2)** or **pH Channel Decrease Button (#3)** until the digital display matches your manual pH test reading.
3. The controller will automatically return to the normal operating mode after twenty seconds, storing any changes.

### Changing the pH Setpoint

The CAT 2000 is preset from the factory to maintain pH at 7.5. To set pH control at a different level, perform the following:

1. Press the **pH Setpoint Adjustment Button (#4)** until the green "SET" LED is illuminated.
2. Press the arrow-shaped **pH Channel Increase Button (#2)** or **pH Channel Decrease Button (#3)** until the digital display matches your desired pH control level.
3. The controller will automatically return to the normal operating mode after twenty seconds, storing any changes.

### Changing the ORP Setpoint

The CAT 2000 is preset from the factory to maintain ORP at 650 mV. This is the generally accepted world standard for safe drinking water. In order to meet Health Department standards for a particular pool or spa, the ORP setpoint may be changed to maintain a desired sanitizer level by performing the following:

1. Manually test pool or spa to confirm that the current sanitizer reading (chlorine, bromine, etc.) is the level you wish to maintain.
2. Note the ORP reading displayed by the controller.
3. Press the **ORP Setpoint Adjustment Button (#8)** until the green "SET" LED is illuminated.
2. Press the arrow-shaped **ORP Channel Increase Button (#6)** or **ORP Channel Decrease Button (#7)** until the digital display matches the ORP reading previously noted.
3. The controller will automatically return to the normal operating mode after twenty seconds, storing any changes.

The ORP setpoint should be changed as needed to maintain sanitizer residuals in conformance with Health Department standards.

### Manually Activating pH Feed

To manually enable the pH chemical feeder press the **pH Channel Mode Selection Button (#5)** until the green "MANUAL" LED is illuminated. The chemical feeder will operate continuously for 30 minutes, and then automatically revert to "Auto" to prevent accidental over-feeding.

### **Manually Activating ORP Feed**

To manually enable the ORP chemical feeder press the **ORP Channel Mode Selection Button (#9)** until the green "MANUAL" LED is illuminated. The chemical feeder will operate continuously for 30 minutes, and then automatically revert to "Auto" to prevent accidental over-feeding

### **Manually Disabling pH Feed**

To manually prevent operation of the pH chemical feeder press the **pH Channel Mode Selection Button (#5)** until the red "OFF" LED is illuminated. Automatic pH feeding will be disabled. So that the user may have time to enter selections, the chemical feeding cycle will not be interrupted for approximately ten seconds.

### **Manually Disabling ORP Feed**

To manually prevent operation of the pH chemical feeder press the **ORP Channel Mode Selection Button (#9)** until the red "OFF" LED is illuminated. Automatic ORP feeding will be disabled. So that the user may have time to enter selections, the chemical feeding cycle will not be interrupted for approximately ten seconds.

### **Automatically Controlling pH Feed**

For automated control of the pH chemical feeder press the **pH Channel Mode Selection Button (#5)** until the green "AUTO" LED is illuminated. The chemical feeder will operate automatically in proportion to chemical demand. So that the user may have time to enter selections, the chemical feeding cycle will not be interrupted for approximately ten seconds.

### **Automatically Controlling ORP Feed**

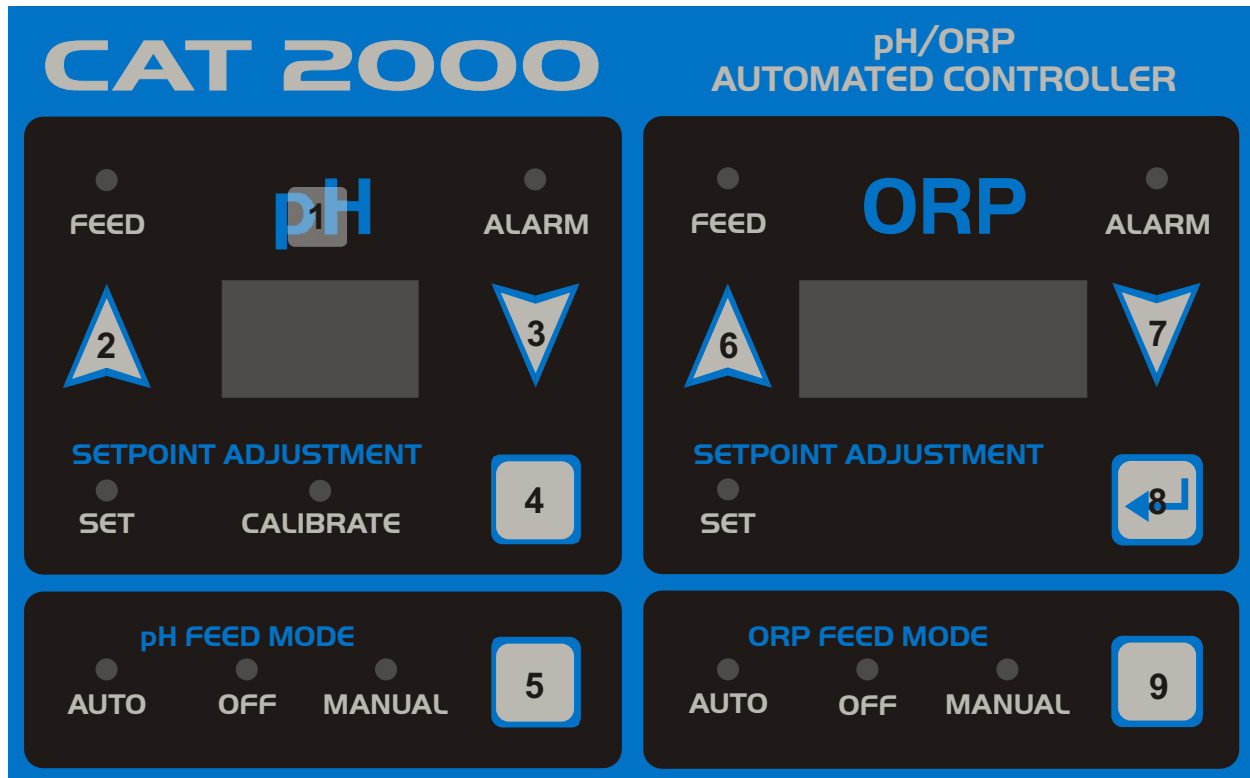
For automated control of the ORP chemical feeder press the **ORP Channel Mode Selection Button (#9)** until the green "AUTO" LED is illuminated. The chemical feeder will operate automatically in proportion to chemical demand. So that the user may have time to enter selections, the chemical feeding cycle will not be interrupted for approximately ten seconds.

### **About Proportional Feed**

The CAT 2000 features an advanced proportional feed algorithm which constantly analyzes demand for chemicals and initiates feeding in intervals based on the relationship between setpoint and actual water sample values. This feature is highly valuable in maintaining precise control of water chemistry in most applications, but should be disabled for use with salt chlorine systems.

**ILLUSTRATION 4.  
CAT 2000 SWITCH AND KEYPAD FUNCTIONS**

<b>BUTTON DESIGNATION</b>	<b>DESCRIPTION</b>
<b>POWER</b>	<b>Controller Unit Power Switch</b>
<b>1</b>	<b>Hidden Button (Located Behind "pH" Text)</b>
<b>2</b>	<b>pH Channel Increase Button</b>
<b>3</b>	<b>pH Channel Decrease Button</b>
<b>4</b>	<b>pH Channel Setpoint Adjustment Button</b>
<b>5</b>	<b>pH Channel Mode Selection Button</b>
<b>6</b>	<b>ORP Channel Increase Button</b>
<b>7</b>	<b>ORP Channel Decrease Button</b>
<b>8</b>	<b>ORP Channel Setpoint Adjustment Button</b>
<b>9</b>	<b>ORP Channel Mode Selection Button</b>





## **SECTION 9.**

## **Advanced (Dealer) Setup Options**

Beginning with the 2008 model year, the CAT 2000 controller incorporates an advanced programming menu and enhanced features. The advanced programming menu contains features which are usually implemented during initial dealer setup and do not need to be routinely changed by the operator.

### **Enhanced No-Flow Alarm**

The no-flow alarm displays the prompt on the LED displays, in addition to activating both channel Alarm indicators and sounding the audible alarm:

*no flow*

### **Power On Display**

At power on, the controller displays the pH feed mode and firmware version number. The pH feed mode is displayed on the pH channel LED display:

*A*

*3.17*

*A* Acid feed selected.

*b* Base feed selected.

The firmware version number is displayed on the ORP channel LED display:

*3.17*

Firmware version number (or later).

### **Entering Advanced Setup Mode**

Find the **Hidden Button** (#1) located behind the large pH text over the pH digital display.

1. Press and hold the **Hidden Button** (#1) for five seconds to enter advanced setup mode.
2. Press the **Up** (#6) and **Down** (#7) arrow buttons to scroll through programming options.
3. Press the **Enter Button** (#8) to make a selection.

### **pH Feed Mode (Acid or Base Feed)**

**P.F d** pH Feed. Selects the condition under which the pH feed output is activated.

**A** Acid (default). pH feed output is activated when the measured pH is greater than the pH setpoint, indicating the need to feed acid to decrease the pH of the water.

**b** Base. pH feed output is activated when the measured pH is less than the pH setpoint, indicating the need to feed base to increase the pH of the water.

### **pH Priority**

**P.P r** pH Priority. Inhibits ORP feed when pH is not within .2 of setpoint.

**OFF** Off (default). The pH feed and ORP feed decisions are independent of each other.

**On** On. The pH Priority feature is enabled. Inhibits the ORP feed output when the measured pH value differs from the pH setpoint by more than 0.2 pH units. For example, when the pH setpoint is 7.5, then the ORP feed output will be enabled when the measured pH value is in the range 7.3 to 7.7; and inhibited when the measured pH is any value outside this range.

### **pH Proportional Feed**

**P.P F** pH Proportional Feed. Selects either fixed setpoint or proportional control.

**OFF** Off. The pH feed output is activated based on a simple above or below setpoint decision. When the measured pH value is less than or equal to the pH setpoint (pH Feed: Acid selected) or greater than or equal to the pH setpoint (pH Feed: Base selected) the pH output feed is turned off. Otherwise, the pH feed output is turned on.

**On** On (Default). The pH feed output is activated based on the difference between the pH setpoint and the measured pH value. As the difference increases, the duration the pH feed output is turned on increases to 20, 30, 40, and 50 seconds of the 60 second cycle, and then the pH feed output is turned on continuously.

### **pH Overfeed Timer**

**P.OF** pH Overfeed Timer. When Off is selected, the pH feed output will remain activated as long as a pH feed condition is indicated. When any other selection is made, an overfeed limit timer is enabled on the pH feed output. After the pH feed output has been turned on for a period of time greater than this limit, the pH channel is turned off and placed into an overfeed alarm condition which must be manually reset.

If pH Proportional Feed: On has been selected, the pH feed output must be on continuously for the overfeed time limit, rather than in the part of the proportional feed cycle in which the pH feed output is on for only a portion of the 60 second proportional feed cycle.

After the pH feed channel is placed into the overfeed alarm condition, the pH channel is turned off and the pH Feed Mode indicator flashes rapidly to indicate the alarm. Press the pH Feed Mode button to return the pH channel to the off, manual or automatic feed mode. This will reset the pH overfeed alarm and restart the overfeed timer. The pH overfeed alarm will also be reset if the controller is powered off and then back on.

The pH overfeed timer is disabled when the pH Feed Mode button is used to place the pH channel in the manual feed state.

<b>OFF</b>	Off - The pH feed output will remain on for an unlimited amount of time.
<b>15</b>	15 Minutes.
<b>30</b>	30 Minutes.
<b>60</b>	60 Minutes (1 Hour).
<b>120</b>	120 Minutes (2 Hours).
<b>180</b>	180 Minutes (3 Hours).
<b>240</b>	240 Minutes (4 Hours) - default

### **pH Low Alarm Limit**

**P.AL** pH Alarm Limit Low. Sets the low alarm point for the pH channel. When the measured pH value is less than this limit, the audible alarm will be activated and the pH feed output will be disabled. The alarm will be cleared and feed will resume automatically when the measured pH value returns to within the non-alarm range.

**6.8** Use the UP and DOWN buttons to select a value between 6.0 and 9.0 pH. The value must be less than the pH alarm high value.

The default value is 6.8 pH.

### **pH Alarm High Limit**

**P.A.H** pH Alarm Limit High. Sets the high alarm point for the pH channel. When the measured pH value is greater than this limit, the audible alarm will be activated and the pH feed output will be disabled. The alarm will be cleared and feed will resume automatically when the measured pH value returns to within the non-alarm range.

**8.2** Use the UP and DOWN buttons to select a value between 6.0 and 9.0 pH. The value must be greater than the pH alarm low value.

The default value is 8.2 pH.

### **ORP Proportional Feed**

**O.P.F** ORP Proportional Feed. Selects either fixed setpoint or proportional control.

**OFF** Off. The ORP feed output is activated based on a simple above or below setpoint decision. When the measured ORP value is less than or equal to the ORP setpoint, the ORP output feed is turned on. Otherwise, the ORP feed output is turned off.

**On** On (Default). The ORP feed output is activated based on the difference between the ORP setpoint and the measured ORP value. As the difference increases, the duration the ORP feed output is turned on increases to 20, 30, 40, and 50 seconds of the 60 second cycle, and then the ORP feed output is turned on continuously.

### **ORP Overfeed Timer**

**O.O.F** ORP Overfeed Timer. When Off is selected, the ORP feed output will remain activated as long as an ORP feed condition is indicated. When any other selection is made, an overfeed limit timer is enabled on the ORP feed output. After the ORP feed output has been turned on for a period of time greater than this limit, the ORP channel is turned off and placed into an overfeed alarm condition which must be manually reset.

If ORP Proportional Feed: On has been selected, the ORP feed output must be on continuously for the overfeed time limit, rather than in the part of the proportional feed cycle in which the ORP feed output is on for only a portion of the 60 second proportional feed cycle.

After the ORP feed channel is placed into the overfeed alarm condition, the ORP channel is turned off and the ORP Feed Mode indicator flashes rapidly to indicate the alarm. Press the ORP Feed Mode button to return the ORP channel to the off, manual or automatic feed mode. This will reset the ORP overfeed alarm and restart the overfeed timer. The ORP overfeed alarm will also be reset if the controller is powered off and then back on.

### ORP Overfeed Timer - Continued

The ORP overfeed timer is disabled when the ORP Feed Mode button is used to place the ORP channel in the manual feed state.

<b>OFF</b>	Off - The ORP feed output will remain on for an unlimited amount of time.
<b>15</b>	15 Minutes.
<b>30</b>	30 Minutes.
<b>60</b>	60 Minutes (1 Hour).
<b>120</b>	120 Minutes (2 Hours).
<b>180</b>	180 Minutes (3 Hours).
<b>240</b>	240 Minutes (4 Hours) - default

### ORP Alarm Low Limit

**0.9L** ORP Alarm Low Limit. Sets the low alarm point for the ORP channel. When the measured ORP value is less than this limit, the audible alarm will be activated and the ORP feed output will be disabled. The alarm will be cleared and feed will resume automatically when the measured ORP value returns to within the non-alarm range.

**525** Use the UP and DOWN buttons to select a value between 200 and 995 pH. The value must be less than the pH alarm high value.

The default value is 525 mV.

### ORP Alarm High Limit

**0.9H** ORP Alarm Limit High. Sets the high alarm point for the ORP channel. When the measured ORP value is greater than this limit, the audible alarm will be activated and the ORP feed output will be disabled. The alarm will be cleared and feed will resume automatically when the measured ORP value returns to within the non-alarm range.

**900** Use the UP and DOWN buttons to select a value between 400 and 995. The value must be greater than the ORP alarm low value.

The default value is 900 mV.

### Clear All Programming and Restore Factory Defaults

**[ ] r** Factory Clear. Returns all controller operating parameters to their default values.

### Demonstration Mode

**dEo** Places the controller in Demo Mode for showroom display, presentations, etc.

### Audible Alarm (Beeper)

**bPr** The Beeper setting allows the audible alarm to be enabled (default) or disabled.

### Serial Interface

**Sr I** The CAT 2000 includes a standard Rs232 serial interface. A header assembly and cable are required to connect.

**On I** Online Communications. Use this selection when the controller is attached to a PC or building automation system.

**Pr n** Printer (default). Use this selection when the controller is attached to a CAT Serial Printer to make a hard-copy record of controller operating parameters. The printer is supplied with a cable to connect it to the controller. The CAT Serial Printer prints one data record at 15 minute intervals. Data recorded includes pH and ORP measured values, and the feed output and alarm status of both channels.

When all desired settings have been entered, press the Hidden Button or wait 30 seconds and the controller will return to default operating mode.

## **SECTION 10.**

## **DISPLAY FUNCTIONS**

Please refer to Illustration 5 with reference to designations of the various LED indicator lights on the front panel. Please note that for enhanced viewing the CAT 2000 features a "dead-front" display panel, so only illuminated indicators will be visible to the user. All lights and indicators are activated during power-on.

### **pH Feed Indicator (#1)**

This green LED is illuminated whenever the pH chemical feeder is automatically or manually activated.

### **pH Alarm Indicator (#2)**

Illumination of this red indicator is accompanied by an audible alarm and indicates that pH is outside of the safe operating range. Check that the pH chemical feeder is functioning properly and that an adequate chemical supply is available.

### **pH Digital Display (#3)**

The red digital numeric display of the pH channel normally indicates the current pH of the pool or spa water (as calibrated) passing through the filtration system. Pressing the **pH Setpoint Adjustment Button** until the red "SET" LED is illuminated causes the pH setpoint to be displayed.

### **pH Setpoint Adjustment Mode Indicator (#4)**

This green LED is illuminated whenever the controller is in the pH setpoint adjustment mode. Setpoint adjustment is allowed only when this LED is illuminated.

### **pH Calibrate Mode Indicator (#5)**

This green LED is illuminated whenever the controller is in the pH calibration mode. Calibration of the pH display is allowed only when this LED is illuminated.

### **pH Automatic Control Indicator (#6)**

This green LED is illuminated when pH is under automated control.

### **pH Manual Off Indicator (#7)**

This red LED is illuminated when pH feeding is manually disabled.

### **pH Manual On Indicator (#8)**

This green LED is illuminated when pH feeding is manually activated.

### **ORP Alarm Indicator (#10)**

Illumination of this red indicator is accompanied by an audible alarm and indicates that ORP is outside of the safe operating range. Check that the ORP chemical feeder is functioning properly and that an adequate supply sanitizer is available.

### **ORP Digital Display (#11)**

The red digital numeric display of the ORP channel of the controller normally indicates the current ORP (oxidation-reduction potential) of the pool or spa water passing through the filtration system. Pressing the **ORP Setpoint Adjustment Button** until the red "SET" LED is illuminated causes the ORP setpoint to be displayed.

### **ORP Setpoint Adjustment Mode Indicator (#12)**

This green LED is illuminated whenever the controller is in the ORP setpoint adjustment mode.

### **ORP Automatic Control Indicator (#13)**

This green LED is illuminated when ORP is under automated control.

### **ORP Manual Off Indicator (#14)**

This red LED is illuminated when ORP feeding is manually disabled.

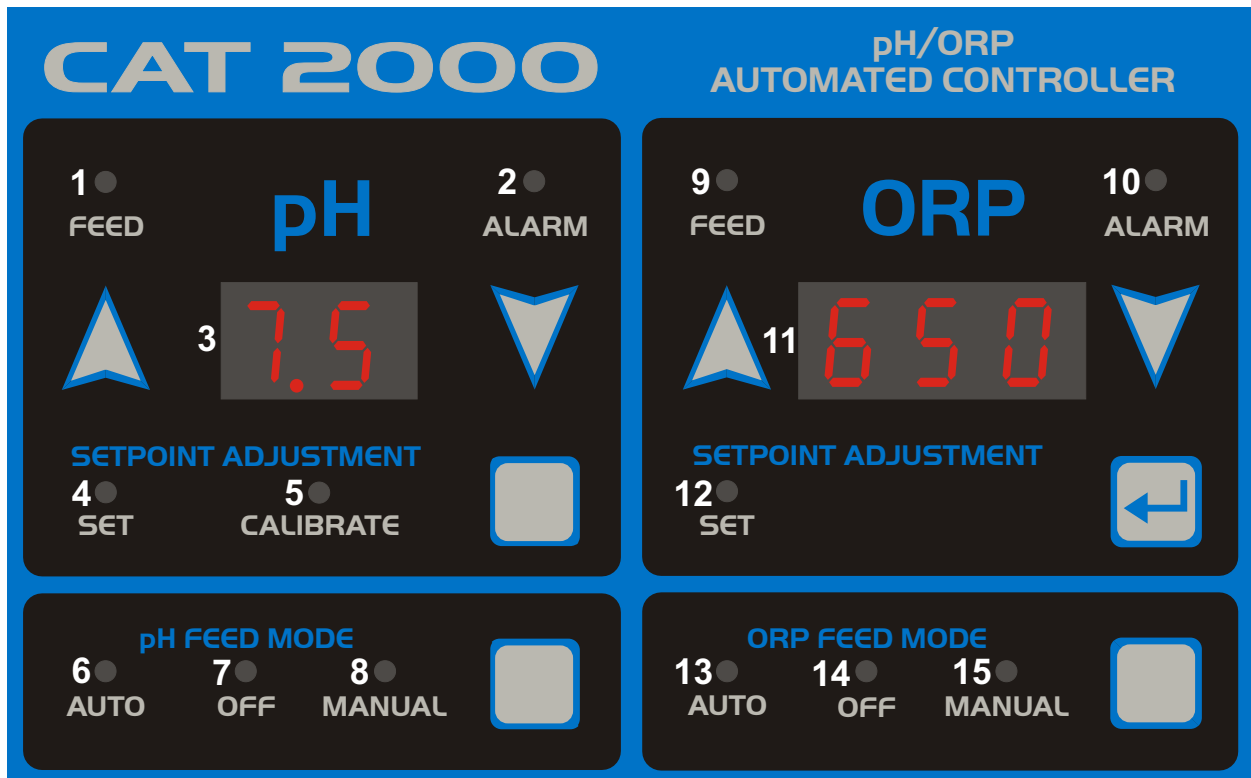
### **ORP Manual On Indicator (#15)**

This green LED is illuminated when pH feeding is manually activated.



**ILLUSTRATION 4.  
CAT 2000 INDICATOR DESIGNATIONS & FUNCTIONS**

DESIGNATION	COLOR / TYPE	DESCRIPTION
1	GREEN LED	pH FEED INDICATOR
2	RED LED	pH OUT OF RANGE ALARM
3	DIGITAL DISPLAY	pH INDICATOR/SETPOINT/CALIBRATION
4	GREEN LED	pH SETPOINT ADJUSTMENT MODE INDICATOR
5	GREEN LED	pH CALIBRATION MODE INDICATOR
6	GREEN LED	AUTOMATIC pH CONTROL INDICATOR
7	RED LED	pH FEED MANUALLY DISABLED
8	GREEN LED	pH FEED MANUALLY ACTIVATED
9	GREEN LED	ORP FEED INDICATOR
10	RED LED	ORP OUT OF RANGE ALARM
11	DIGITAL DISPLAY	ORP INDICATOR/SETPOINT
12	GREEN LED	ORP SETPOINT ADJUSTMENT MODE INDICATOR
13	GREEN LED	AUTOMATIC ORP CONTROL INDICATOR
14	RED LED	ORP FEED MANUALLY DISABLED
15	GREEN LED	ORP FEED MANUALLY ACTIVATED



**CAT 2000 CONTROLLER**

The CAT 2000 controller unit is virtually maintenance free. Cleaning of the enclosure, front panel and flow cell can be performed using a clean, soft cloth moistened with mild soap and water solution or glass cleaner. Use of abrasives or harsh chemicals may damage the enclosure and membrane switch panel.

**WATER MAINTENANCE**

Always test and record water chemistry readings in compliance with Health Department requirements using a quality manual test kit. Calibrate pH periodically as described earlier in this manual.

It is important to note that changes in pH, cyanuric acid concentration, total dissolved solids, and use of additional or alternative sanitizers will all affect the primary sanitizer residual level relative to ORP. It is important to maintain total alkalinity on a regular basis to ensure pH stability. To maintain a consistent sanitizer residual in parts-per-million (ppm), periodically adjust the ORP setpoint.

**PRECISION CALIBRATION**

The CAT 2000 controller provides instrument-grade accuracy which exceeds that of most liquid-standard water testing kits. Therefore, it may be preferable to calibrate pH using commercially available reference solutions.

**SENSOR MAINTENANCE**

The sensors must be clean and free from oil, chemical deposits and contamination to function properly. After saturation in pool or spa water, the sensors may need to be cleaned on a weekly or monthly basis depending on bather load and other facility-specific characteristics. Slow response, increased need to calibrate pH, and inconsistent readings are indications that the sensors are in need of cleaning.

To clean the sensors, disconnect from the controller and carefully remove them from the flow cell. Clean the reference junction (the white teflon ring at the bottom of sensor body) with a soft tooth brush and regular tooth paste. A household liquid dishwashing detergent may also be used to remove any oil. Rinse with fresh water, replace teflon thread-seal tape, and reinstall sensors. Hand tighten only.

Never allow a pH or ORP sensor to dry completely. Drying will damage the reference junction and void the sensor warranty.

## **SENSOR REPLACEMENT**

CAT Professional Series pH and ORP sensors are engineered to provide the highest performance and longest possible functional service life. If properly cleaned sensors provide unstable readings or require excessive calibration, the pair of sensors should be replaced. For optimum controller performance, replace with genuine CAT Professional Series sensors PRO15-2 and PRO25-2.

## **SENSOR STORAGE**

Exposure to atmospheric conditions will cause the sensor tips to dry out. Always remove and properly store sensors in the soaking caps provided if sensors are to be removed or stored for one hour or longer. Although CAT Professional Series sensors are freeze-resistant, they must be protected from freezing temperatures when not in use.

Store sensors in the soaking caps provided, making sure that each container is filled with the original storage solution or clean water. If the storage containers have been misplaced, store sensors individually in small glass or plastic containers with clean water covering sensor tips.

## **CONTROLLER STORAGE**

The controller unit is subject to damage by electro-static discharge (ESD) when the sensor cables are disconnected. Always reinstall the BNC protective covers prior to storing or transporting the CAT 2000 controller unit.

## **WINTERIZATION**

The sensors should be prepared for storage as outlined above and protected from freezing temperatures. Although the CAT 2000 controller is designed to withstand a broad temperature range, winter storage in a secure location is desirable.

The flow cell and poly tubing must be drained prior to exposure to freezing temperatures. Either purge all water using compressed air or thoroughly drain through the valve ports and tubing connections.

## **SECTION 12.**

## **TROUBLESHOOTING**

Each CAT 2000 controller is manufactured to the highest quality standards and then thoroughly tested before leaving the factory. State of the art design and fabrication technology ensure years of trouble free operation. Most apparent malfunctions can be solved through the following corrective actions:

### **No lights are illuminated when controller is powered on.**

1. Check circuit breaker and/or receptacle for proper operation. Connect to functional grounding-type GFCI protected power source.
2. Check for damaged power cord or connector.

### **Alarm light(s) and tone are observed.**

1. Ensure that filtration system is functioning properly, flow is adequate, and water chemistry is in balance.
2. Ensure that sensors and power cables are properly connected to their respective connectors on the controller unit.
3. Check chemical feeders for proper operation.
4. Ensure that flow sensor is properly installed and connected.

### **Both pH and ORP digital readouts display illogical values.**

1. Sensor cable connections may be reversed. Ensure that sensor cables are properly connected to their respective BNC connectors on the controller unit.
2. Ensure that filtration system is functioning properly, flow is adequate, and water chemistry is in balance.

### **ORP pH chemical feeder is not activated as expected.**

1. Make sure "auto" ORP feed mode is selected.
2. Check ORP setpoint.

### **pH chemical feeder is not activated as expected.**

1. Ensure that acid/base feed mode is properly set for your chemical feeding requirements.
2. Make sure "auto" pH feed mode is selected.
3. Check pH Setpoint.

**Chlorine or bromine residual is too high or too low.**

1. pH, cyanuric acid concentration, total dissolved solids, and use of additional or alternative sanitizers will all effect the sanitizer residual level relative to ORP. Consider the effect of any chemicals recently added to the pool or spa.
2. Check and adjust ORP setpoint.

**pH requires frequent calibration.**

1. Clean the sensors as outlined in the maintenance section. If sensors continue to provide unstable readings after cleaning, replace sensors.

**pH or ORP readings are inconsistent or slow in response.**

1. Ensure that sensor cables are properly connected to their respective BNC connectors on the controller unit.
2. Clean the sensors as outlined in the maintenance section. If sensors continue to provide unstable readings after cleaning, replace sensors.
3. Check to ensure that all electrical equipment in the facility pump room is properly bonded.

**pH or ORP chemical feeder runs continuously.**

1. Make sure "auto" feed mode is selected.
2. Ensure that chemical feeders are properly connected to their respective connectors on the controller unit.

**pH or ORP feeding overshoots the setpoint.**

1. Ensure that each chemical feeder is properly sized.
2. Check concentration of sanitizer or pH chemical.

**pH or ORP feeding does not reach the setpoint.**

1. Ensure that each chemical feeder is properly sized.
2. Check concentration of sanitizer or pH chemical.
3. Check chemical feeders and injection points for proper operation.

## SECTION 13.

## TECHNICAL SPECIFICATIONS

<b>Display Range:</b>	<b>pH</b>	<b>0.0 - 9.9</b>
	<b>ORP</b>	<b>100 - 995 mV</b>
<b>Setpoint Range:</b>	<b>pH</b>	<b>7.0 - 8.0</b>
	<b>ORP</b>	<b>525 - 995 mV</b>
<b>Default Settings:</b>	<b>pH</b>	<b>7.5</b>
	<b>ORP</b>	<b>650 mV</b>
<b>Calibration Range:</b>	<b>pH</b>	<b>2.0 pH +/-</b>
<b>Control Accuracy:</b>	<b>pH</b>	<b>0.1 pH</b>
	<b>ORP</b>	<b>5.0 mV</b>
<b>Mode Selections:</b>	<b>pH Feed</b>	<b>Auto/Off/Manual</b>
	<b>ORP Feed</b>	<b>Auto/Off/Manual</b>
	<b>pH Selection</b>	<b>Acid/Base</b>
	<b>pH Mode</b>	<b>Auto/Set/Calibrate</b>
	<b>ORP Mode</b>	<b>Auto/Set</b>
<b>Safety Systems:</b>	<b>pH &amp; ORP</b>	<b>Audible &amp; Visual Alarms</b>
	<b>Controller Unit</b>	<b>Diagnostic Self Test</b>
	<b>Required</b>	<b>Flow Sensor</b>
	<b>Optional</b>	<b>Remote Alarm</b>
<b>pH &amp; ORP Sensors:</b>	<b>Casing Material</b>	<b>Molded ABS</b>
	<b>Junction Type</b>	<b>Teflon Reference</b>
	<b>Wet End</b>	<b>½" NPT</b>
	<b>Connector</b>	<b>Shielded BNC</b>
<b>Sensor Output Signal Requirements</b>	<b>0-14 pH</b>	<b>0-1000mV ORP</b>
<b>Power Input:</b>	<b>120/240 Volt AC, 10 AMP 50/60 Hz</b>	
<b>Outputs:</b>	<b>pH Feed</b>	<b>4 Amp / 120 VAC</b>
		<b>4 Amp/ 240 VAC</b>
		<b>1 Amp / Dry Contact</b>
	<b>ORP Feed</b>	<b>4 Amp / 120 VAC</b>
		<b>4 Amp / 240 VAC</b>
		<b>1 Amp / Dry Contact</b>
	<b>Remote Alarm</b>	<b>1 Amp / Dry Contact</b>
<b>Optional Equipment</b>	<b>RS232 Computer Interface Cable</b>	
	<b>Thermal Printer</b>	
	<b>Three-Year Professional Series Sensors</b>	

**LIMITED WARRANTY**

Hayward® warrants the CAT 2000 automated controller to be free of defects in material and workmanship for a period of five years from date of shipment from our factory or authorized distributor. Liability under this warranty is limited to the repair or replacement of any device or component which is returned to the factory within five years of delivery to original purchaser, shipping prepaid, and which is found to be defective upon examination.

Hayward® warrants all flow sensors, fittings and accessories to be free of defects in material and workmanship for a period of one year from date of shipment from our factory or authorized distributor. Professional Series pH and ORP sensors are warranted for a period of two years from date of shipment from our factory or authorized distributor. Liability under this warranty is limited to the repair or replacement of any device or component which is returned to the factory within the warranty period, shipping prepaid, and which is found to be defective upon examination.

Hayward® disclaims all liability for damage during transportation, for consequential damage of whatever nature, for damage due to handling, improper installation or operation, and for determining suitability for the use intended by the purchaser. Hayward® makes no warranties, either expressed or implied, other than those stated above. No representative has authority to change or modify this warranty in any respect. After obtaining a Return Merchandise Authorization form, any warranty claims should be directed to the following address:

Hayward Commercial Pool Products  
10101 Molecular Drive Suite 200  
Rockville, MD 20850 (USA)  
800-657-2287  
301-838-4001