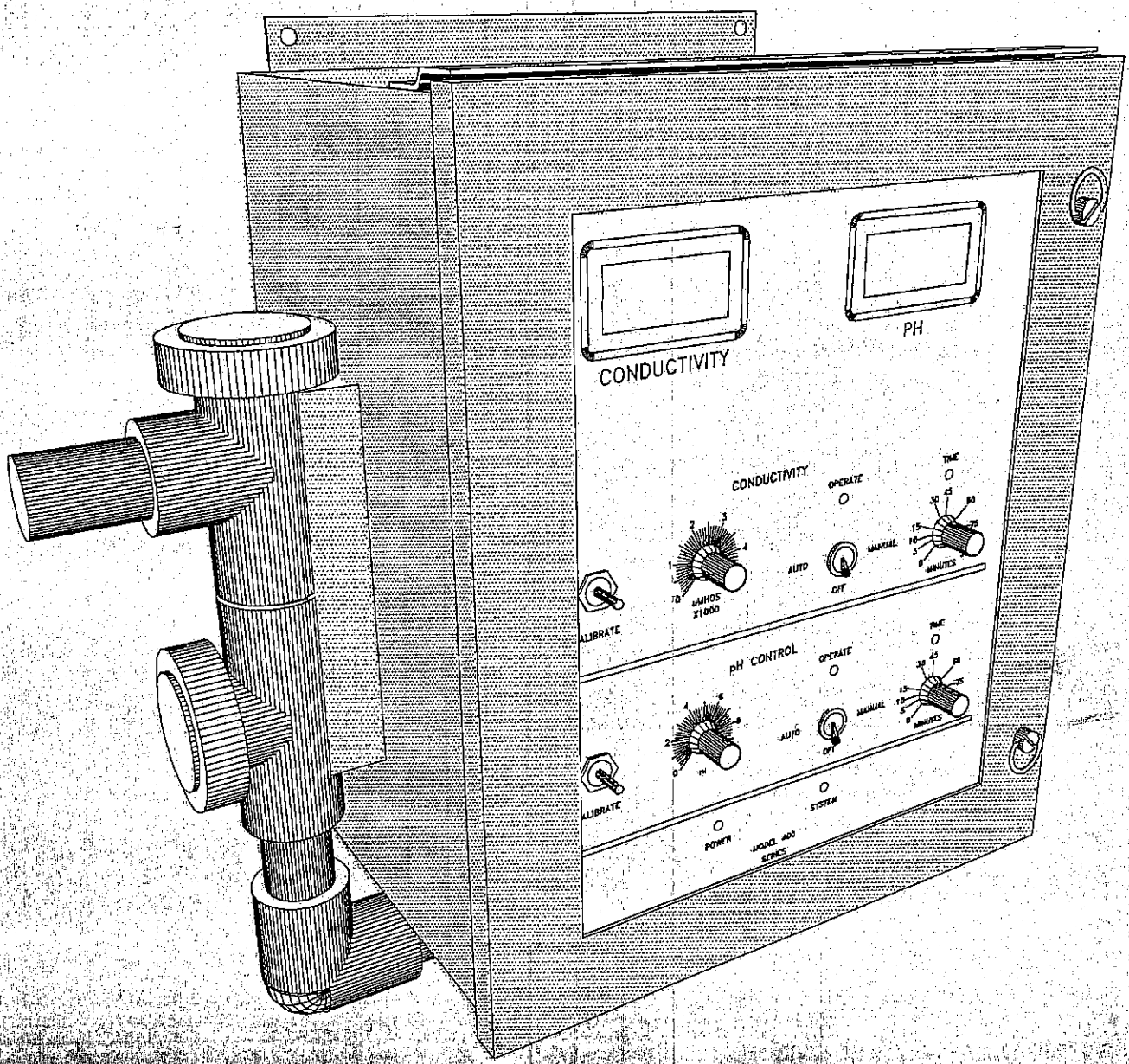
MODEL 412 and 420

pH and Conductivity
Cooling Water Controller
Installation and Operations Manual



Lakewood INSTRUMENTS INC.
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Phoenix, AZ 85043
602-272-5100 FAX: 602-272-0400

Serial #:

Important

CAUTION

CHEMICAL FEED

All electromechanical devices are subject to failure from a variety of causes. These include mechanical stress, component degradation, electromagnetic fields, mishandling, improper setup, physical abuse, chemical abuse, improper installation, improper power feeds and exposure.

While every precaution is taken to insure proper functioning, extra precautions should be taken to limit the ability of over-feeding by limiting chemical quantities available, secondary shut-downs, alarms and redundancy or other available methods.



CAUTION

POWER SOURCE AND WIRING

Low voltage wiring and high voltage (110 plus) should not be run in the same conduit. Always run separately. Even shielded low voltage is not a guarantee of isolation.

Every precaution should be taken to insure proper grounding and elimination of shorting or Electromagnetic field (EMF) interference.

MODEL 412 & 420
INSTALLATION AND OPERATION MANUAL

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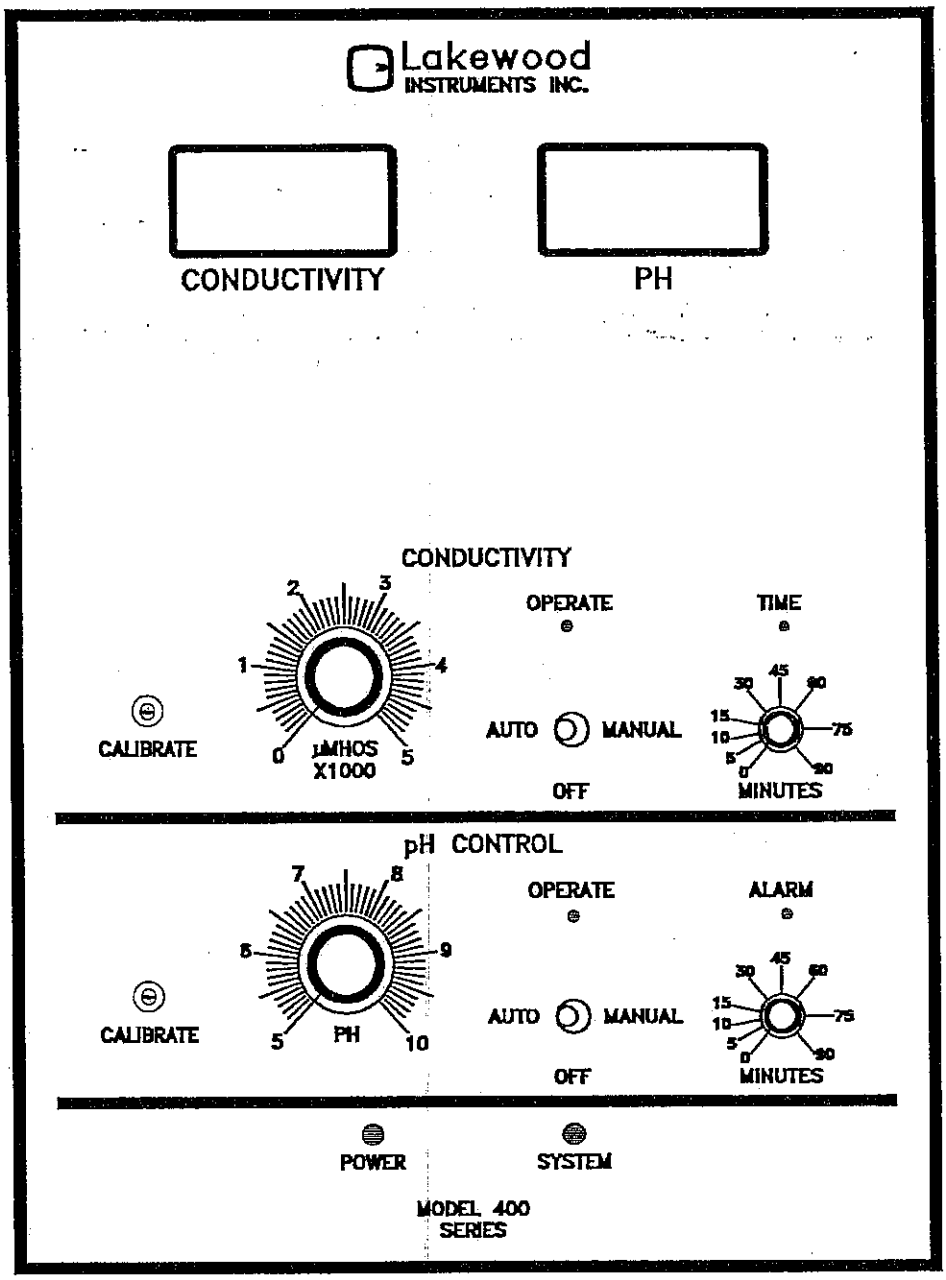
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MODEL 412
STANDARD FACE PLATE



MODEL 412 and 420

POCKET GUIDE: START UP AND CALIBRATION

Programming and calibrating the Model 412 is easy. Just work all the way through these steps. To set up optional features, use your Model 412 I & O Manual. This is just a pocket guide. MAKE SURE YOU READ THROUGH THE ENTIRE I & O MANUAL!

1) Mount, plumb and wire the Model 412 (See plumbing/wiring diagrams in I & O Manual).
   - Insert and lock the two pH sensors in place.
   - Plumb outlet/inlet flow including an inlet sample shut-off valve and a sample valve spout for ease of use.
   - Plug in or directly wire your chemical/acid pumps into the proper outlets or terminal blocks.

2) Turn both of the AUTO-OFF-MANUAL switches OFF.

3) Turn the Model 412 or 420 controller ON using the power switch on the bottom.

4) Turn the water flow ON. Make sure flow sight float is up and the SYSTEM light is ON, indicating proper flow.

5) Use a calibrated hand-held pH/conductivity meter(s) to measure the pH\conductivity levels of water taken from the inlet sample valve spout. Write down both the pH and the conductivity levels.

CONDUCTIVITY CONTROLLER

6) Adjust the conductivity CALIBRATE shaft until the conductivity LCD reads the same as the sample measurement.

7) Set the conductivity set point at the level your Water Treatment Engineer recommends.

8) Set the conductivity TIME alarm to 60 minutes or the specific time recommended. The alarm timer stops chemical feed if the blowdown fails to open. The exception to this is the -RT Option where the timer is used to proportion chemical feed to a make up water meter.

pH CONTROLLER

9) Adjust the pH CALIBRATE shaft until the pH LCD reads the same as the sample measurement.

10) Set the pH set point at 7.5pH or the level your Water Treatment Engineer recommends.

11) Set the pH ALARM timer to 15 minutes or as recommended.

OPERATION and ACID/CHEMICAL PUMPS

12) Turn both of the AUTO-OFF-MANUAL switches to AUTO.
   a) If your conductivity level is higher than your set point, the OPERATE light will come ON indicating the blowdown processes are operational.
      - The blowdown valve is open.
      - The inhibitor pump is ON.
      - The TIME alarm is activated and will shut-off the inhibitor pump if blowdown fails.
      - The blowdown valve and inhibitor pump remain open until the conductivity set point level is achieved.
      - The OPERATE light goes OFF when the blowdown process is complete (set point level is reached) and the TIME alarm is automatically reset.
   b) If your pH level is higher than your set point, the OPERATE light will come ON indicating the acid pump outputs are operational.
      - The acid pump(s) should be ON.
      - The ALARM timer is activated and will shut-off the acid pump(s) when it times out if the set point has not already been achieved. **Make sure that you allow ample time for the acid pump(s) to operate.** If not, you will have to manually reset the timer by turning the A-O-M switch OFF then back to AUTO. When the set point level is achieved, the OPERATE light goes OFF and the ALARM timer is automatically reset.

13) Set the inhibitor chemical pump output at 30% capacity or as recommended. After you determine the proper amount of inhibitor needed for your system, adjust the chemical pump output capacity to get the recommended PPM residual level.

14) Adjust the acid pump output capacity until the pH swing is no more than 0.2 pH on either side of the set point level.

MODELS 412 AND 420
FEATURES AND OPTIONS

STANDARD FEATURES:

- Sensor Wiring and Sensor Plumbing
- Alarm Timers to Prevent Excessive Chemical Feed
- Convenient Lock Ring Sensor Flowcell
- UL Listing for Model 412 Indoor Applications (with or without powercord)
- UL Listing for Model 420 Indoor Applications (with or without powercord)

POPULAR OPTIONS:

- Caustic Feed Instead of Acid Feed
- Special Conductivity or pH Range
- Water Meter Actuated Counter and Reset Timer
- Heavy Duty 1/4 to 3/4 HP Pump Motors
- 250 VAC, 50/60 Hz for Export
- Dry Alarm Status Contacts for Flow and pH Alarm
- Audible and Visible Alarm with Push to Silence

SPECIFICATIONS

CONDUCTIVITY:

Range	0 to 5,000 umhos
Accuracy	0.5% of full scale
Repeatability	1% of full scale
Deadband	30 umhos
Automatic temperature compensation	32 - 140°F
Overfeed alarm timer	Adjust–5 to 90 min.

pH:

Range	5 to 10 pH
Accuracy	.01 pH
Repeatability	.01 pH
Drift for clean sensors	.02 pH/monthly
Deadband	.05 pH
Overfeed alarm timer	Adjust–5 to 90 min.
Low pH alarm	Fixed at 5.5 pH

PLUMBING:

Built in flow sight, flow switch and back check.
Material is ABS, LEXAN or Schedule 80 PVC.

SENSORS:

Temperature limit	140°F (60°C)
Pressure limit	150 psi (10 bar)
Sensor removal	Lock ring
Body material	PVC or ABS
pH glass sensor	Part No. 700181
pH reference electrode	Part No. 700182
Conductivity sensor	Part No. 700185

ELECTRICAL:

Power	115 VAC

Outlets on the Model 412 are UL standard with 5 amps for chemical pumps.

Model 412-WP has conduit knockouts instead of outlets. UL listed. For outdoor service.

Model 420 has conduit knockouts instead of outlets. UL listed. For corrosive environments.

ORDERING INFORMATION

412	Basic pH and conductivity cooling water controller
420	Basic controller in molded fiberglass enclosure. NEMA 4X

CONTROLLER CONFIGURATION OPTIONS

-C	Caustic feed instead of acid feed
-WP	Weatherproof steel enclosure for Model 412. No outlets.
-CR	Special conductivity or pH range. Must specify the special values.
-COR	Corrosion Monitor and Alarm.
-RT	Pulse counter (from a water meter) and reset timer for inhibitor feed based on makeup.
-HR	Heavy duty slave power relays for 1/4 or 1 hp motors.
-F	250 VAC 50 Hz power for export.
-AL	Dry alarm status contacts for flow and pH alarm.
-AV	Audible and visible alarm with push to silence.

OUTPUT OPTIONS

-35C	Isolated 4-20 mA for conductivity recording or monitoring.
-35P	Isolated 4-20 mA for pH recording or monitoring.
-39P	Proportional pump pulser for pH control.
-39F	Frequency output contact.
-42C	High and Low dry alarm contacts for conductivity.
-42P	High and Low dry alarm contacts for pH.
-44C	Isolated 4-20 mA plus high/low dry alarm contacts for conductivity.
-44P	Isolated 4-20 mA plus high/low dry alarm contacts for pH.

RECORDER OPTIONS

-21C	Trend chart recorder to record conductivity. NEMA 4X case.
-21P	Trend chart recorder to record pH. NEMA 4X case.
-23	Dual pen trend chart recorder for both pH and conductivity. NEMA 4X case.

BIOCIDE TIMERS

-63	Electromechanical 7 day timer with skip day feature for one biocide.
-66	Microprocessor based timer for two biocides, dispersant feed based on clock time and a delay timer to extend the lock out timer after biocide feed.
-MP	This is a 316SS mounting plate for the 412 or 420 and a recorder or biocide timer option requiring two enclosures. All components will be prewired and mounted.

412-RT-44C-44P-66-MP

Example Order:
pH and conductivity basic controller.
Counter and reset timer for make up based inhibitor feed.
Isolated 4-20 mA outputs for pH and conductivity for a computer.
High and Low dry alarm contacts for a computer.
Biocide timer for two biocides with delay timer.
Prewired on a 316SS mounting plate.

--Your Order

NOTE: Models 412 and 420 can be installed in prefabricated chemical systems using lockable double doors (-21) or a wall mounted 316SS pump shelf (-25). Ask your Lakewood Factory Rep. for details.

MODEL 412
Introduction

The Model 412* pH and Conductivity Cooling Water Controller helps you protect your capital investments while reducing your operating costs. One unit allows you to control both conductivity and pH levels in your water treatment program.

As water in a cooling tower evaporates, solids remain. The presence of these minerals (salts) increases the level of conductivity in the water. Untreated cooling water will corrode, deposit scale and promote bacteria, algae and slime growth. Fouling results which, in turn, causes increased power consumption and can potentially damage products and plant equipment.

FIGURE 1

ENERGY INCREASE REQUIRED TO OVERCOME SCALE

FOULING FACTOR	INCHES OF SCALE*	% INCREASE IN ENERGY
0.0005	0.006	5.0
0.001	0.012	11.0
0.002	0.024	21.5
0.003	0.036	32.0
0.004	0.048	43.0
0.005	0.060	53.0

* Scale assumed to be calcium carbonate type with a thermal conductivity of: 1 BTU/(hr)(sq ft)(F)

COST EXAMPLE:
The energy consumption of a 500 ton air conditioning compressor is approximately 500 kilowatts an hour. To operate the unit for 30 days, 24 hours a day, it would require 360,000 kw-hr:

(500) x (24) x (30) = 360,000 kw-hr

If this same system operated with 0.012 inches calcium carbonate type scale on the condenser tubes (0.001 fouling factor), the monthly increase in energy required would be 11% or 39,600 kw-hr. At a cost of $0.10 per kw-hr, this **scale deposit costs $3,960.00 per month.**

One way to limit the increasing salt concentrations is to "blowdown" some of the concentrated cooling water. Fresh makeup water replaces the highly conductive water that is released. The Model 412 allows you to efficiently control water consumption during blowdown. While conserving a precious natural resource you are also reducing operating costs. This unit can help you maintain compliance with EPA and local discharge regulations.

Chemical treatments are also used to control water quality. Your Water Treatment Engineer can tell you what chemicals you use. Some chemicals are very expensive so the Model 412 is designed to allow you to control both the inhibitor chemical feed processes during blowdown as well as your acid feeds to control pH levels. Through proper control of chemical and acid feeds, you maximize their effectiveness.

The brief descriptions of the Conductivity and the pH Controller functions that follow will help you when it comes time to program your unit.

*** The Model 420 is exactly the same as a Model 412 except it has a NEMA 4X watertight fiberglass enclosure for use in corrosive environments.**

CONDUCTIVITY CONTROLLER

Set Point

Located on the front of the Model 412, the set point establishes the maximum level of conductivity before blowdown and chemical feed occurs. The set point range on your unit is determined by the options you selected. Your Water Treatment Engineer will recommend the set point based on the number of cycles of concentrations to be maintained. For instance, if you want to maintain 4 cycles of concentration and the make up water is 500 umhos (micromhos, the unit of conductivity), adjust the conductivity set point to 2,000 umhos.

When the conductivity level rises above the set point, blowdown processes are triggered. Once the conductivity level drops below the set point, the Model 412 shuts down blowdown.

The conductivity DEADBAND determines the amount of variance or tolerance allowable. The standard 412 deadband is factory adjusted to about 30 umhos. The conductivity count will fluctuate +/- this amount on the LCD (Liquid Crystal Display).

Inhibitor Feed

Corrosion inhibitor chemical is fed during blowdown. If the inhibitor pump is powered by the outlet marked INH PUMP, which is connected to the blowdown valve's power source, the feeding will be proportional to the amount of inhibitor lost to blowdown. When the conductivity level exceeds the set point, the blowdown valve is opened and the inhibitor pump begins to feed inhibitor. The TIME alarm is activated when the inhibitor pump turns on in case the blowdown valve fails for some reason. If the set point cannot be satisfied, then the inhibitor pump is turned off when the alarm times out. That keeps you from wasting chemicals. In such cases, when the alarm times out, the TIME light remains on to let you know there is a problem. After a successful blowdown procedure, however, the inhibitor pump and the blowdown valve both shut off when the set point is reached and the TIME alarm resets in preparation for the next blowdown process.

Conductivity TIME Alarm

The TIME alarm is on the front panel and can be set between 5 and 90 minutes. The alarm shuts off the inhibitor pump after the time expires. This prevents the controller from emptying a drum of inhibitor in system if the blowdown valve fails or becomes clogged. The alarm works both in the AUTO and MANUAL positions; it resets automatically after the blowdown valve and inhibitor pump both shut off after the set point is achieved (when the conductivity OPERATE light goes off).

If you have the **RT Option**, the TIME alarm operates in a different manner (See MODEL 412 OPTIONS SETUP INSTRUCTIONS).

Auto-Off-Manual Switch

The conductivity A-O-M switch controls the power outputs to the blowdown valve and inhibitor pump. On AUTO, the unit operates based on the programmed set point and alarm times. On OFF, both outputs are inoperative. You can reset the alarm by turning the A-O-M switch to OFF and then back to AUTO or MANUAL. On MANUAL, you can override the programmed set point. Both outputs turn on and the TIME alarm is activated. When the alarm times out, the inhibitor pump shuts off, but the blowdown valve remains open until you turn the A-O-M switch to OFF or AUTO.

pH CONTROLLER

Set Point

Your Water Treatment Engineer should advise in the set point determination and chemical selection process. Some general information about pH, however, will be helpful in following the set up instructions. The Model 412 helps you with pH control in order to prevent calcium carbonate from forming in the cooling water so you can reduce scaling on heat exchanger surfaces.

As pH decreases the system becomes more corrosive.

As pH values increase above 7 pH, scaling tendencies also increase. Specialty chemical inhibitors can help reduce scaling in the 7.5 to 8.5 range. Some will work in higher pH ranges.

NOTE: Consult your Water Treatment Engineer for recommended set points.

If the pH set point is set at 7.5 pH and the actual tower pH is 8.0 pH, the acid pump will turn on and pump acid into the system. The acid will lower the pH until it reaches the set point value--7.5 pH in this case. As the cooling water evaporates, the normal tendency is for the pH to rise. By adding acid, the controller keeps the water at 7.5 pH.

A DEADBAND of .05 pH is preset at the factory. There is an adjustment on the rear of the front panel to increase deadband. Normally the deadband of the whole system due to acid mixing will be 0.2 pH at best. This is considered good control. Refer to print B-5100909 for the "pH DEADBAND" adjustment screw.

Auto-Off-Manual Switch

Controls the acid pump power output. Some units may have more than one acid pump output. On AUTO, the unit operates based on the programmed set point and alarm times. On OFF, the output is inoperative. You can reset the alarm by turning the A-O-M switch to OFF and then back to AUTO or MANUAL. On MANUAL, you can override the programmed set point. The output turns on and the ALARM timer is activated. When it times out, the output turns off and remains off until you reset the alarm.

pH ALARM Timer

The pH ALARM timer is on the front panel and can be set from 5 to 90 minutes. The alarm shuts off the acid pump(s) after the time expires. This prevents the controller from emptying a drum of acid in the system if the set point cannot be satisfied for some reason. The timer will operate in the AUTO or MANUAL position when the OPERATE light is on. It is automatically reset each time the OPERATE light goes off. When the maximum feed time has been reached, the power to the acid pump is locked out. If the controller is set up for CAUSTIC feed (- C option) it may be desirable to lock out this timer. Refer to print B-5100909 for location of the lockout switch.

Low pH Alarm

It operates the same ALARM light as the alarm timer. The Low pH Alarm is factory set at 5.5 pH. If the pH drops below 5.5 pH, the acid pump will be locked out.

FLOW SWITCH

The flow switch is located on the left side of the controller. The float has a magnet that rises due to flow. When water flow is present, the float rises in the flow sight and a magnetically operated reed switch activates the SYSTEM light and all power outlets are operative. Without flow, the float is not visible in the flow sight, the SYSTEM light is off, and all of the outlets are off.

OPTIONS

-RT (Water meter counter - reset timer option)

A contacting head water meter is connected to the low power terminal block located on the back circuit board. A contact closure from the water meter advances a one to ten counter. Each contact closure represents a preset number of gallons based on the contact head you select. You preset the counter so it will activate the Reset Timer after the correct number of gallons have passed through the water meter. Refer to prints A-5100841and B-5100909.

The Reset Timer can be set to feed chemical between 0.5 and 9 minutes. Your Water Treatment Engineer should advise you in selecting a proper feed time. The controller uses a modified conductivity alarm timer dial for the -RT option and the conductivity A-O-M switch will not control the inhibitor pump output on this model.

A push button on the back of the front panel, near the center, simulates a water meter closure for test purposes.

OPTIONS (cont.)

-35C and -35P (4-20 mA Output for Recorder or Computer)

These two cards plug directly into the Model 412 back panel to provide isolated milliamp output for external recorders or computer monitoring. Two cards are required if you want to monitor both pH and conductivity: -35C is for the Conductivity Controller and the -35P is for the pH Controller. The output is factory adjusted to read the same as the controller. The cards can also be calibrated in the field, if required, by adjusting the zero and span screws.

-42C and -42P (High and Low Dry Alarm Contacts)

The -42C and -42P cards plug directly into the Model 412 back panel to provide high and low dry alarm contacts. Two cards are required if you want to monitor both pH and conductivity (-42C is for the Conductivity Controller; -42P is for the pH Controller). The cards are factory adjusted as follows:

Conductivity: High (3000); Low (1000) pH: High (8.5); Low (7.0)

The cards can also be calibrated in the field, if necessary.

-44C and -44P (Isolated 4-20 mA Outputs and High/Low Dry Alarm Contacts for Conductivity and pH)

These two cards plug directly into the Model 412 back panel and combine the features of the -35 and -42 cards. The -44C card combines the -35C and the -42C features. The -44P card combines the -35P and the -42P features.

-21 and -23 (Strip Chart Recorders)

The strip chart recorders do not require the -35 output board. They operate on the 0 - 1 milliamp output shown in print B-5103582. Refer to the chart recorder operating manual for chart paper loading and other details.

The -21 external chart recorder is a single channel strip chart recorder. It records the pH signal over the standard five to ten pH range.

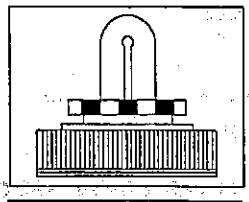
The -23 external chart recorder is a dual channel strip chart recorder. It records both conductivity from 0 to 5,000 umhos and pH from five to ten pH units. Refer to the chart recorder manual for further details.

MODEL 412
START UP AND CALIBRATION

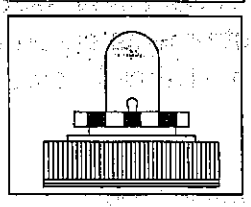
Programming and calibrating the Model 412 is easy. Just start at the beginning of this section and work all the way through the Conductivity Controller and pH Controller sections.

Inspection: All the plumbing and wiring needs to be properly attached before turning on the flow or power [see Plumbing and Wiring Sections]. Check for loose wire connections and make sure the red pH sensor lock rings are locked. First, make sure the power is ON (power light is on). Then make sure both the Conductivity and the pH AUTO-OFF-MANUAL switches are turned OFF. After you turn the water flow on, check for leaks in the plumbing.

Flow Switch: Turn the water flow ON with the sample line inlet valve to check the flow switch.



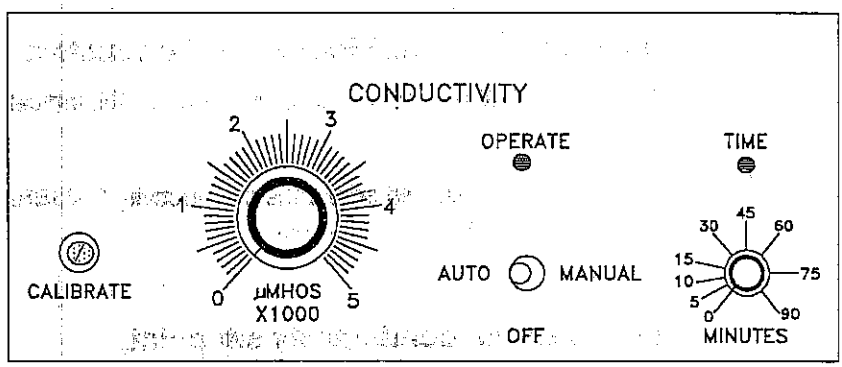
The SYSTEM light should come on and the float should rise in the flow sight to indicate flow is ON.

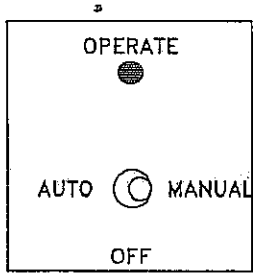


Now turn the water flow OFF with the sample line inlet valve. The SYSTEM light should go off and the float should drop to indicate there is no flow.

Turn the flow back ON for the rest of the start up.

Conductivity Controller Section

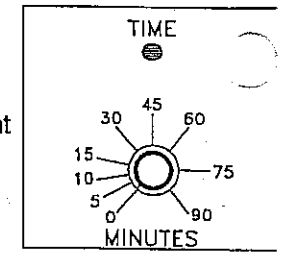




Turn the AUTO-OFF-MANUAL (A-O-M) switch to MANUAL. This allows you to make sure the switch and the TIME alarm are working. (SUGGESTION: During the set up tests, you can plug test lights into the outlets instead of the actual pumps.)

- The conductivity OPERATE light should come on.
- The blowdown valve should open.
- And the inhibitor pump should operate.

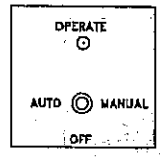
Turn the TIME alarm dial counterclockwise to just above "0" (Omit if you have the -RT option. Instead, go to "Turn the A-O-M switch to OFF" below).



- Wait about five minutes for the timer to alarm out. When it does, the TIME light turns on, the inhibitor pump turns off, and the blowdown valve remains open.
- The inhibitor pump should be locked off for the rest of the blowdown process.
- The blowdown valve stays open as long as the A-O-M switch is on MANUAL.
  - When the A-O-M switch is on AUTO, once the timer has alarmed out, the inhibitor pump will go off and the blowdown valve will remain open until the conductivity level reaches the set point.
  - After the blowdown valve and inhibitor pump both shut off, the OPERATE light goes off and the timer automatically resets in preparation for the next blowdown process.

Turn the A-O-M switch to OFF.

- TIME alarm light should go off. Timer will reset.



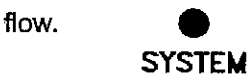
In order to calibrate your unit and to determine the appropriate conductivity set point, you must first measure the cooling tower water. You can use a Lakewood Instruments calibrated hand-held conductivity meter, a Myron L unit, or other similar meters. A small straight screwdriver is also needed to adjust the CALIBRATE shaft.

Take a sample of the cooling water. Use the sample valve spout.

- Measure the water conductivity level with a calibrated hand-held conductivity meter. If you do not have a meter, contact your Water Treatment Engineer for instructions or a service call.
- Let the water run for a few seconds to get a good sample. Make careful note of the level since you will use it to calibrate your unit.

Now you can CALIBRATE the Conductivity Controller on your Model 412 .

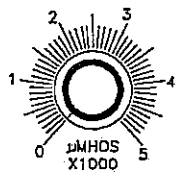
- Make sure your SYSTEM light is ON, indicating flow.





- You should adjust the conductivity CALIBRATE shaft until the LCD reads the same as the sample read on the hand-held meter.

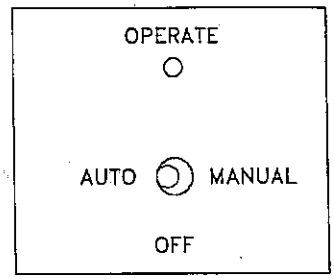
Establish the conductivity set point.



- Now adjust the set point to the value your Water Treatment Engineer recommends. In most cases, you can take your cooling water conductivity level and multiply it by 3 in order to maintain 3 cycles of concentration (i.e. 1500umhos x 3 = 4500umhos set point).

Set the conductivity TIME alarm.

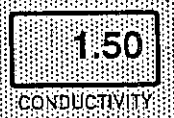
- Turn the conductivity TIME alarm dial to 60 minutes or the specific time your Water Treatment Engineer recommends.



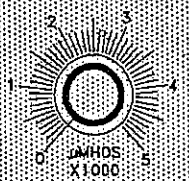
Turn the A-O-M switch to AUTO for the rest of this section.

You can test the set point operation based on the example below:

EXAMPLE: Assume the water measured 1500 umhos on your hand-held meter. After calibration, the Conductivity LCD looks like:



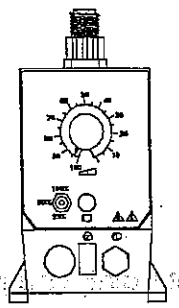
– The LCD shows 1500 umhos (1.50x1000).



– To see how the set point operates, turn the set point knob to 1400 umhos so the conductivity level (1500) is higher than the set point. The OPERATE light should be ON indicating the inhibitor chemical pump and the blowdown valve are ON.

– Turn the set point to 1600 umhos so the conductivity level (1500) is lower than the set point. The OPERATE light should turn OFF indicating that both the inhibitor pump and the blowdown valve are OFF.

Set the inhibitor chemical pump output.



– Set the inhibitor chemical pump to 30% output capacity or as recommended.

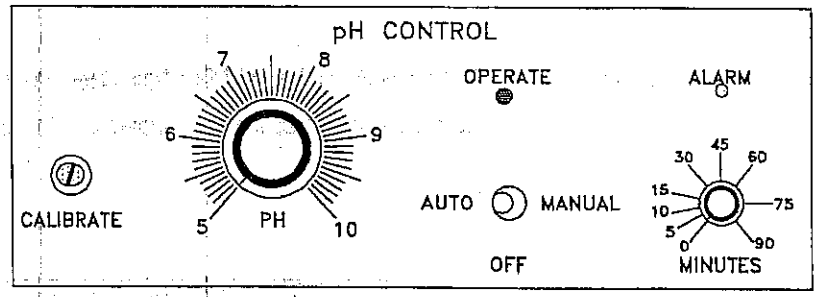
– Allow the system to run for a day. After you, or your Water Treatment Engineer, determine the proper amount of inhibitor needed for your system, you can adjust the chemical pump output capacity to get the recommended PPM residual level.

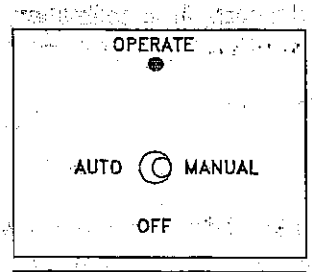
– If you have the -RT Option, the 0-9 minute timer in the conductivity section may be adjusted to get the recommended PPM residual level.

Your conductivity controller is now ready for use.

CAUTION!
Do not feed alkaline corrosion/scale inhibitor into a sample line. Alkaline corrosion/scale inhibitor should be added directly into the cooling tower basin. Please ask your Water Treatment Engineer for information and directions on proper feed methods.

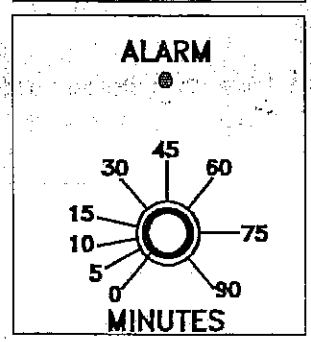
pH CONTROL Section





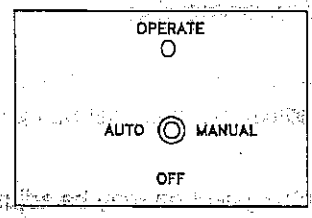
Turn the AUTO-OFF-MANUAL (A-O-M) switch to MANUAL.

- The pH OPERATE light should turn ON.
- The acid pump(s) should turn ON.
- The inhibitor pump should turn on if it is plugged into the acid pump outlet.
- Unplug the pump(s) for the next section. (If you are using test lights you can leave them plugged in.)



Check the ALARM timer.

- Turn the ALARM set knob counterclockwise to just above "0".
- Make sure the A-O-M switch is still on MANUAL.
- Wait about five minutes for the ALARM to time out.
- When time is up, the ALARM light comes ON and the acid pump(s) should turn OFF. Plug in the acid pump(s) again. They should be OFF.



Turn the A-O-M switch to OFF.

- This will clear the ALARM so the pump(s) will operate.

In order to calibrate your pH Controller and to determine the appropriate pH set point, you must first determine the cooling tower water pH level. You can use a Lakewood Instruments calibrated hand-held pH meter, or other similar meters. You can also use a liquid titration method. A small straight screwdriver is needed to adjust the CALIBRATE shaft.

Take a sample of the cooling tower water. Use the sample valve spout.

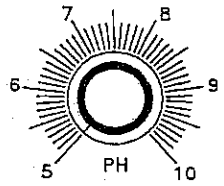
- Determine the pH level with a hand-held pH meter. A color test is OK too. A litmus paper test is **NOT** advisable. If you do not have a meter, contact your Water Treatment Engineer. Make careful note of the level.

Now you can CALIBRATE the pH Controller on your Model 412.

- Make sure the SYSTEM light is still ON, indicating flow.
- Adjust the CALIBRATE shaft so the pH LCD reads the same as the tested sample.



CALIBRATE



Establish the pH set point.

– Adjust the set point to 7.5 pH or the level your Water Treatment Engineer recommends.

Set the pH ALARM timer.

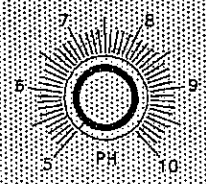
– Turn the ALARM timer to 15 minutes or as recommended.

Turn the A-O-M switch to AUTO for the rest of this section.

You can test the set point operation based on the example below:

EXAMPLE: Assume the water measured 8.0 pH on your hand-held meter. After calibration, the pH LCD looks like:





– To see how the pH set point operates, turn the knob to 7.9 pH so the pH level is higher than the set point. The OPERATE light and acid pump output(s) should be ON.

– Turn the set point to 8.1 pH so the pH level is lower than the set point. The OPERATE light and the acid pump output(s) should turn OFF.

WARNING! If you do not have an accurate method of determining the pH of the cooling water, do not feed any acid. If the controller is way out of calibration, you may damage the cooling heat exchangers and related piping due to acid overfeed.

pH CONTROL RESPONSE TEST

In order to maintain a proper pH level, you need to adjust your acid pump output capacity. If you do not already have a method for determining the proper capacity, follow the example procedure described below.

EXAMPLE: Assume your pH set point is at 7.5 and your current pH level is above 8.5.

– Turn the acid pump to 100% to get the pH down to 8.0. The ALARM timer may activate but just reset it by turning the A-O-M switch OFF and then back to AUTO.

– After the pH level is reduced to 8.0 pH, reduce the pump capacity to 25% output. Watch closely as the pH level approaches the 7.5 pH set point.

– If the process takes too long, the ALARM timer may activate again. If so, simply reset it by turning the A-O-M switch OFF and then back to AUTO.

– Once the pH set point is reached, if the pH level swings more than .3 pH to either side of the set point (i.e. 7.2 to 7.8), decrease the acid pump output until the pH swing is .2 pH or less (i.e. 7.3 to 7.7).

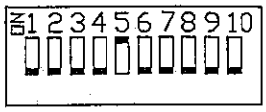
Make sure that you set the ALARM timer so you have enough acid feed time to satisfy the set point. Otherwise, you will have to manually reset the pH controller by turning the A-O-M switch OFF and then back to AUTO so additional acid can be fed. Make sure, in such cases, that the pump(s) is primed and that there is acid in the drum(s).

Your pH Controller is now ready for use.

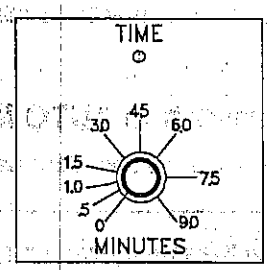
Model 412 Options
Set Up Instructions

-RT Option

The water meter actuated counter and reset timer replaces the conductivity alarm timer. Inhibitor feeding is controlled by water meter pulses. If you have the RT Option, you may want to make sure it is operating properly. In order to perform the following test, you need to unscrew the acorn lock nuts on the face plate and swing open the front panel. Use print A-5100841 to wire the water meter. Use print B-5100909 to locate the counter and water meter simulator. The reset timer dial is on the face plate, replacing the standard conductivity TIME alarm.



- Set the counter for five counts on the DIP switch.



- Set the timer for 0.5 minutes.



- Push the water meter simulator button five times.
- The inhibitor pump should operate for about 30 seconds, then shut off.

Now you can set the counter switch, the reset timer, and the inhibitor pump output capacity according to your Water Treatment Engineer's recommendations.

-35C and -35P Options

The Model 412 can be equipped with isolated 4-20 mA outputs for a recorder or computer. These options allow you to monitor your system from a remote location. Both of these interface cards are factory calibrated to read the same as the controller. You can use the charts and prints below for calibration. Before you calibrate, wire the recorder or computer to terminal block TF (See print B-5103582).

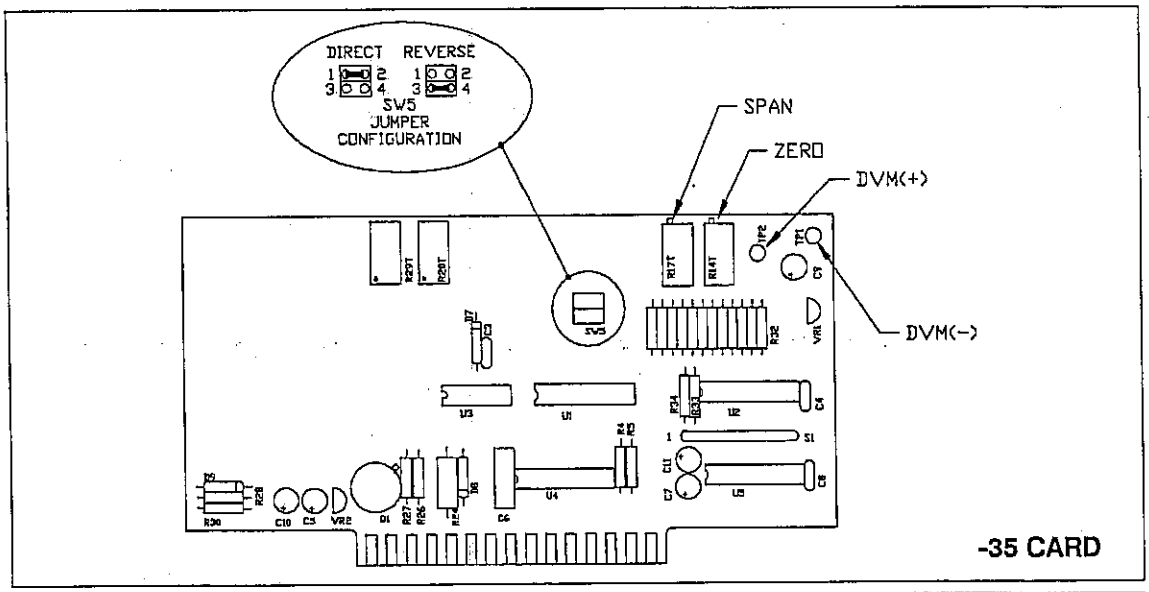
Conductivity calibration. -35C

- Connect a DC volt meter (DVM) to the -35C card -- [(+) to TP-2 and (-) to TP-1]
- On the face plate, turn the conductivity CALIBRATE shaft until the conductivity LCD reads "0" -- the 4 mA value.
- Then turn the R-14 (ZERO) adjustment screw on the -35C card until your DVM reads "0" Volts -- the 4 mA value.
- Now turn the CALIBRATE shaft on the face plate until the LCD reads "5000" -- the 20 mA value.
- Finally, turn the R-17 (SPAN) adjustment screw on the -35C card until your DVM reads "4" Volts -- the 20 mA value.
- Because the extreme ranges have been set, the mid-ranges should be automatic. To check the proportional adjustments, turn the CALIBRATE shaft until the LCD reads "2500". The DVM should read "2" Volts -- the 12 mA value.
- When completed with this procedure, you must re-calibrate your conductivity controller based on the sample water reading (See Start Up and Calibration--Conductivity Controller Section).

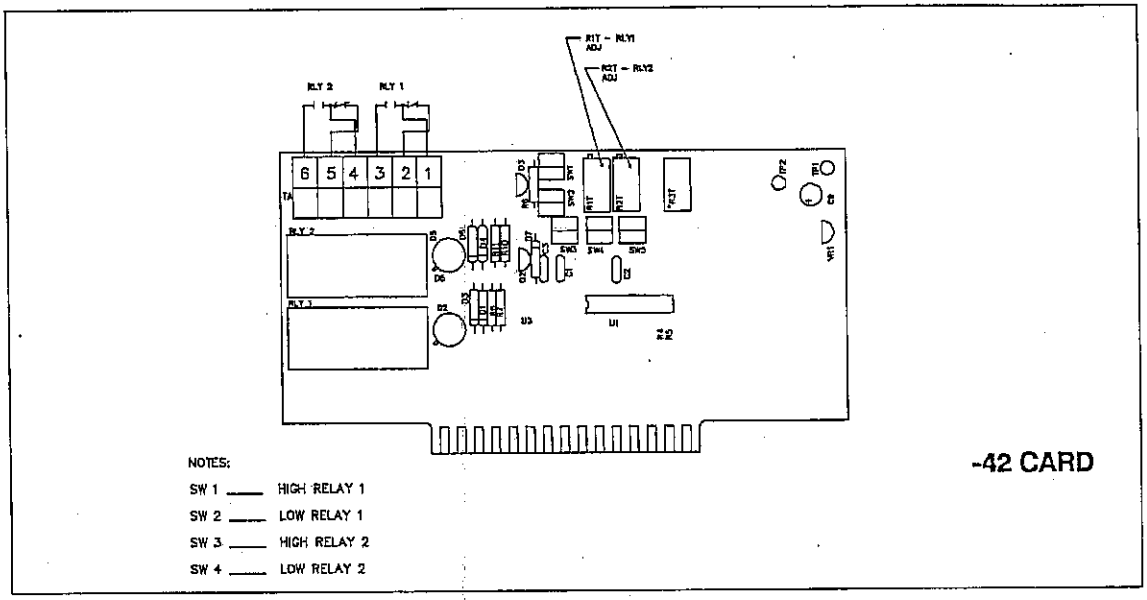
Conductivity	mA	Volts
0	4	0
2500	12	2
5000	20	4

pH calibration. -35P

OUTPUT OPTIONS



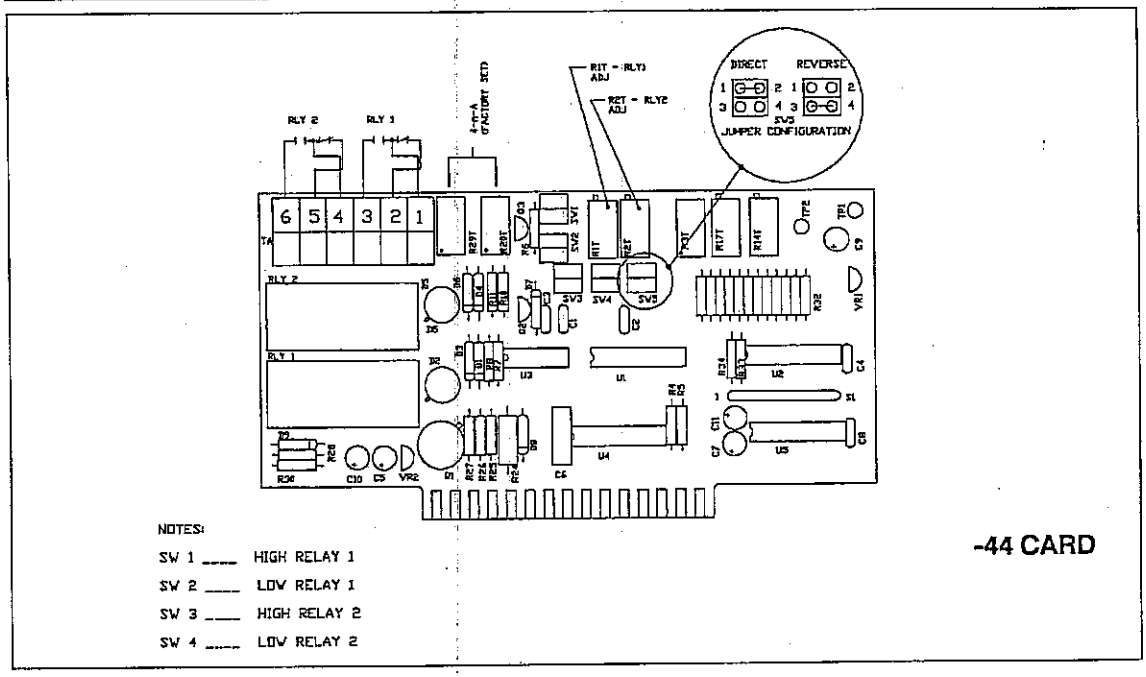
-35 CARD



NOTES:

SW 1 ____ HIGH RELAY 1
SW 2 ____ LOW RELAY 1
SW 3 ____ HIGH RELAY 2
SW 4 ____ LOW RELAY 2

-42 CARD



NOTES:

SW 1 ____ HIGH RELAY 1
SW 2 ____ LOW RELAY 1
SW 3 ____ HIGH RELAY 2
SW 4 ____ LOW RELAY 2

-44 CARD

pH calibration. -35P

- First, unplug the acid pump(s).
- Connect a DC volt meter (DVM) to the -35P card -- [(+) to TP-2 and (-) to TP-1].
- On the face plate, turn the pH CALIBRATE shaft until the pH LCD reads "5" -- the 4 mA value.
- Then turn the R-14 (ZERO) adjustment screw on the -35P card until your DVM reads "0" Volts -- the 4 mA value.
- Now turn the CALIBRATE shaft on the face plate until the LCD reads "10.0" -- the 20 mA value.
- Finally, turn the R-17 (SPAN) adjustment screw on the -35P card until your DVM reads "4" Volts -- the 20 mA value.
- Because the extreme ranges have been set, the mid-ranges should be automatic. To check the proportional adjustments, turn the CALIBRATE shaft until the LCD reads "7.5". The DVM should automatically read "2" Volts -- the 12 mA value.
- When completed with this procedure, you must re-calibrate your pH controller based on the sample water reading (See Start Up and Calibration--pH Control Section).
- Plug in the acid pump(s).

pH	mA	Volts
5.0	4	0
7.5	12	2
10.0	20	4

-42C and -42P High/Low Alarms Options

High and Low Alarms with transfer contacts are available with these options. The card plugs into the back panel where the -35 card goes. (NOTE: If you want both the -35 and -42 options, you need the -44 option.)

Conductivity High/Low Alarm. -42C

- Unplug your inhibitor pump and blowdown valve.
- On the face plate, turn the conductivity CALIBRATE shaft until the conductivity LCD reads the value you desire for your Low Alarm trip point.
- Then open the panel. On the -42C card, turn the Low Alarm screw (R-1T) counterclockwise until the alarm is activated. Your Low Conductivity Alarm is now set.
- Return to the face plate and turn the CALIBRATE shaft until the LCD reads the value you desire for your High Alarm trip point.
- Then return to the inside panel. On the -42C card, turn the High Alarm screw (R-2T) clockwise until the alarm is activated. Your High Conductivity Alarm is now set.
- When completed with this procedure, you must re-calibrate your conductivity controller based on a sample water reading (See Start Up and Calibration--Conductivity Controller Section). Plug your inhibitor pump and blowdown valve back into their proper outlets.

pH High/Low Alarm. -42P

- Unplug your acid pump(s).
- On the face plate, turn the pH CALIBRATE shaft until the pH LCD reads the value you desire for your pH Low Alarm trip point.
- Then open the panel. On the -42P card, turn the Low Alarm screw (R-1T) counterclockwise until the alarm is activated. Your Low pH Alarm is now set.
- Return to the face plate and turn the CALIBRATE shaft until the LCD reads the value you desire for your High Alarm trip point.
- Then return to the inside panel. On the -42P card, turn the High Alarm screw (R-2T) clockwise until the alarm is activated. Your High pH Alarm is now set.
- When completed with this procedure, you must re-calibrate your pH controller based on the sample water reading (See Start Up and Calibration--pH Control Section). Plug the acid pump(s) back into its proper outlet(s).

-44C and -44P Options

The -35 and -42 options are combined on one card so you can operate a 4-20 mA output and the High/Low Alarms at the same time. Refer to the set up procedures for both cards described above.

-21 Option

Inkless 60 day strip chart recorders available for conductivity or pH.

- Refer to the chart recorder manual for paper loading and start up instructions.
- See print B-5103582 to locate the TF terminal block to wire the recorder to the 412.

-23 Option

A dual channel chart recorder for conductivity and pH.

- Refer to the chart recorder manual for paper loading and start up instructions.
- See print B-5103582 to locate the TF terminal block to wire the recorder to the 412.

MODEL 412
INSTALLATION

CHECKING

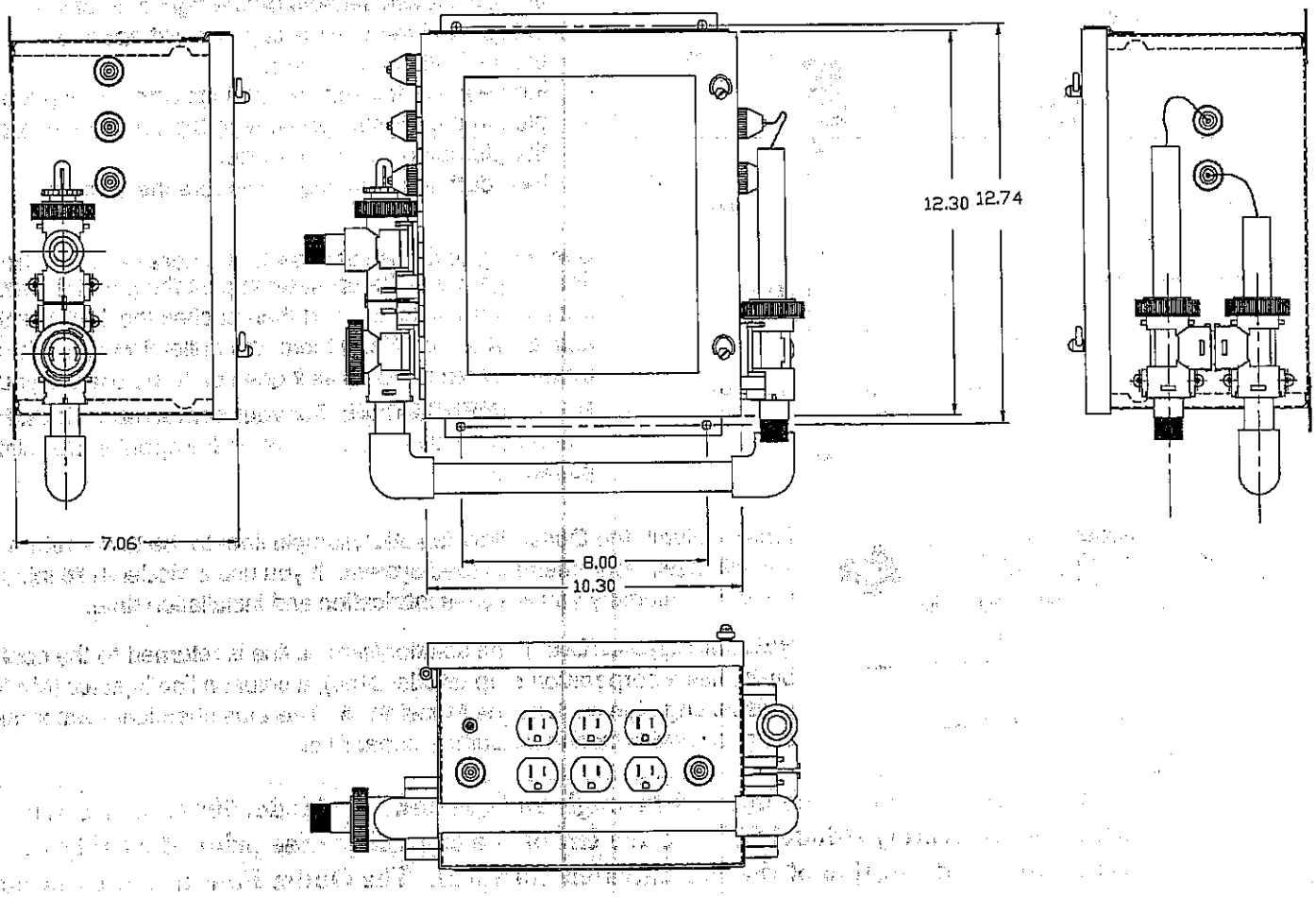
Inspect the shipping carton for obvious external damage. Note on the carrier's Bill of Lading the extent of the damage and/or notify the carrier.

Save the shipping carton until the controller is started up. If there was shipping damage, return the controller to the factory in the original carton.

MOUNTING

Mount the controller or prefabricated system on a FLAT, NON-VIBRATING wall.

Avoid drilling or punching additional holes in the controller enclosure. Stray metal chips can ruin the circuit board components.



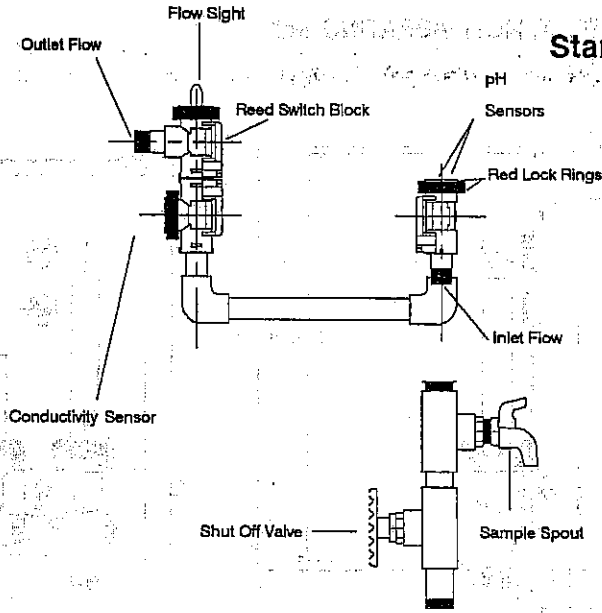
WARNING: Do not remove the pH sensor caps until ready for installation and operation. Glass electrodes must remain moist at all times!! Avoid sensor exposure to freezing temperatures.

MODEL 412
INSTALLATION

PLUMBING

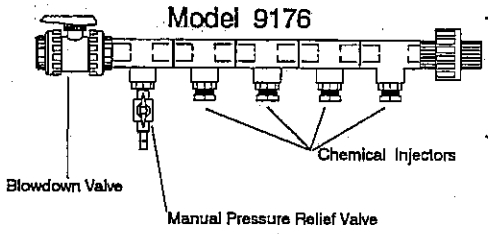
Plumbing materials

- Inlet plumbing can be 3/4" PVC, iron, or copper pipe.
- Provide at least 1 GPM to the controller. A 4 psi differential from take off to injection is sufficient. If flow is marginal, consult your LAKEWOOD INSTRUMENTS Factory Representative.
- Outlet plumbing must be 3/4" PVC or CPVC. **Use schedule 80 ONLY** because the acid and water mixing will generate some heat which requires a thick wall pipe.



Standard 412 Controller Plumbing (Refer to print A-5100739)

- **First**, connect the pH Sensors:
  - untape the two sensors on the right side of the box
  - untape and remove the cap and wet sponge
  - unlock both red lock rings
  - lube each of the sensor "O" rings with "O" ring lube only
  - plug in the pH sensors--match the sensor with a sticky dot to the plumbing with a sticky dot
  - lock both red lock rings to secure the sensors
- **Second**, plumb the inlet flow to the right of the controller. This line brings the make-up water in past the pH and conductivity sensors for evaluation and then pushes the flow switch float up to activate the unit. From there, the outlet flow water is chemically treated (when needed) as it goes on to be used in your system.
- **RECOMMENDATION:** For your convenience, include a sample line shut off valve and a sample valve spout in the inlet flow plumbing.



- **Finally**, plumb the Outlet Flow (solution/sample line) to the tower return line where you will insert your chemical feed system. If you use a Model 9176 Injection Manifold Assembly you will save fabrication and installation time.
- **RECOMMENDATION:** If the solution/sample line is returned to the cooling tower basin, use a corporation stop (Model 9160), a solution line injector (Model 9006), or a dispersing pipe such as the Model 9175. This aids chemical - water mixing and enhances water treatment control capabilities.

IMPORTANT! Chemical should be injected through an injection tee (Model 9007) or a Chemical Injection Manifold Assembly (Model 9176) to the left of the controller (See print B-5103195). This gives partial mixing and dilution of the concentrated chemical. The Outlet Flow line then becomes a solution line of diluted chemical.

WARNING: Do not remove the pH sensor caps until ready for installation and operation. Glass electrodes must remain moist at all times!! Avoid sensor exposure to freezing temperatures.

Injecting chemical into the system

- See IMPORTANT note above. **DO NOT** attempt to feed acid directly into steel pipe. Instead, use a solution line for partial mixing and a corporation stop for solution injection into the center of the tower return line.
- The Outlet Flow should be connected to the tower return or condensor water return line. Make sure you **DO NOT** plumb the controller across the circulating water pump. This "short circuits" the acid mixing and will cause poor pH control.
- If your piping layout does not allow you to plumb the controller properly (i.e. to the tower return line or to the tower basin), contact the LAKEWOOD INSTRUMENT Customer Service Dept.--(602) 272-5100. A phone call can save a lot of construction time.

Prefabricated Chemical Pump and Controller Assemblies

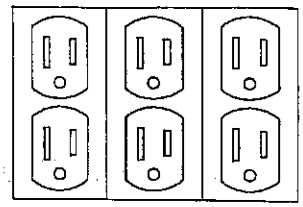
- These units follow the same instructions given for the Standard 412 Controller listed above.

Blowdown Valve

- If you have a way to accurately measure your blowdown flow rate and pressure range (psi), you can use the chart below to determine the correct valve size. If not, consult your Water Treatment Engineer.
- Adjustable flow rate diaphragm valves require at least 5 psi differential pressure to close. If your water pressure is marginal, use a supply water pressure actuated diaphragm valve or a valve designed to work with 0 differential pressure.
- Extremely dirty cooling water will plug diaphragm valves. In such cases, use a motorized ball valve with a globe valve for flow control. If your flow lines are above 2" (for large systems), use a pneumatically operated butterfly valve.
- Be sure to provide isolation and bypass valves (See print 5100739). If your blowdown valve ever fails you need to be able to bypass it in order to replace it.
- Remember on occasion to purge your "Y" strainer screen to maximize the life of your blowdown valve.

BLOWDOWN VALVE SIZING CHART

Pressure Range (psi)	Blowdown Flow Rate Range (GPM)	Suggested Valve Size
10 - 50	1 - 5	3/4"
50 - 150	5 - 10	3/4"
10 - 50	5 - 10	1"
50 - 150	10 - 15	1"
10 - 50	10 - 15	1 1/2"
50 - 150	15 - 20	1 1/2"
10 - 50	15 - 20	2"
50 - 150	20 - 30	2"
10 - 50	30 - 100	3"
10 - 50	100 - 300	4"

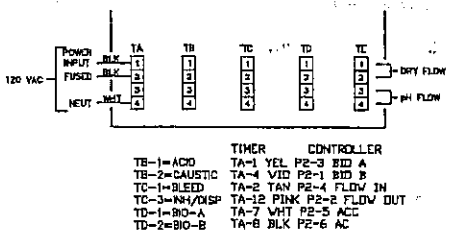


WIRING

Standard 412 Controller With Power Cord And Outlets.

The Model 412 has a variety of available options. The standard unit comes with outlets for your pumps and a power cord. The number of outlets and the way they are set up on your particular unit will depend on which options you select. Follow the wiring procedure in the order it is stated below:

- Make sure the AUTO-OFF-MANUAL switches are both on OFF.
- Plug the blowdown solenoid valve into the outlet marked BLEED OFF. This may not be consistent with local electrical codes. If local codes require conduit and internal wiring, do the following:



- Remove the two acorn nuts on the right hand side of the front panel. Swing open the panel to expose the terminal blocks on the back panel for wiring connections. Wire the blowdown solenoid valve through conduit to the 1/2" conduit knockout provided in the bottom of the enclosure. Connect the hot (black) wire to the top lug on the TC Terminal (OPEN). The ground wire (green) should be wired to the ground screw under the TA Terminal. The neutral (white) wire goes to the SERVICE outlet lug with the other neutral wires. After you are done, make sure there are no loose connections and that all tools and debris are removed. Close the panel. Tighten the two acorn nuts and continue the wiring process. (Refer to print B-5103582)

- Plug the inhibitor chemical pump into the INH PUMP outlet. This outlet is set up to feed inhibitor proportional to blowdown. The inhibitor pump may also be plugged into the ACID PUMP outlet. This will feed inhibitor proportional to make up in some instances--consult your Water Treatment Engineer.
- Plug the remaining chemical pumps into the outlets as marked.
- If your unit has an outlet marked SERVICE, it is a general utility outlet. For your convenience it will remain operational whenever the POWER light is on, even if the flow switch is not activated by the inlet flow. **Do not** plug your chemical or blowdown pumps into this outlet.
- Plug in the power cord to a convenient 115 VAC outlet. If your unit has an OFF/ON switch, turn it ON to make sure the unit is properly powered. The POWER light and the SERVICE outlet should be on.

WARNING: DO NOT plug in chemical pumps that are larger than 1/6 HP. The control relays are intended for electronic or small motor driven chemical pumps. Large pumps require the -HR option with 25 amp rated interposing relays. Contact LAKEWOOD INSTRUMENTS for special instructions.

Weatherproof Enclosure (WP Option) Without Outlets.

Instead of having outlets to plug pumps into, the WP Option provides conduit knockouts so you can bring all the wiring into the unit through conduit. You then wire the pumps directly to the terminal blocks as shown in the wiring diagram (See Print B-5103582).

WARNING: Punching or drilling more knockouts may allow stray metal chips to ruin circuit board components.

Water Meter Option.

Wire water meter with normally open dry contacts to TF 9 & 10 on rear PCB. See print A-5100841.

Prefabricated Chemical Pump and Controller Assemblies.

The chemical pumps, biocide timers, and other options are already prewired with prefabricated systems. You only need to wire the power source and the solenoid blowdown valve (See Print B-5103582). DO NOT use less than 16 guage wire because the system is fused for 10 amps.

- 21-412 Prefab: All external power connections are made to a junction box with terminal blocks located on the left hand side of the controller.
- 25-412 Polyethylene Shelf Prefab: All external power connections are made to the controller terminal blocks located on the rear of the enclosure.

Biocide Timer And Other Custom Options.

Many options are available. Refer to the attached prints for wiring details.

MAINTENANCE

In every case below, make sure you have shut off the sample flow and the power to the controller before you do anything.

CONDUCTIVITY SENSOR

- Clean the electrode end of the conductivity sensor at least once a month.
- Unlock the red lock ring and remove the sensor.
- Gently use a coarse cloth to clean the carbon tips.
- In cases of extreme neglect, use a soft brass brush to burnish the carbon tips.
- Replace the sensor and secure the red lock ring.

pH SENSORS

pH GLASS SENSOR

This is the one with the glass ball at the end. Be careful when handling the sensor as the glass at the end is thin and fragile. Unlock the red lock ring and remove the sensor.

- Clean the sensor at least once a month.
- Use muriatic acid or 10% HCl to clean the sensor. If this is too dangerous or otherwise unacceptable, simply use tap water.
- In cases of extreme neglect, acid must be used for cleaning.
- **Do not** try to wipe the glass with a rag or paper. Any grit will scratch the glass and ruin the sensor.
- Expected life is from one to two years. **Replace after two years.**

pH REFERENCE SENSOR

- Clean the tip with a clean untreated cloth or paper.
- After one or two years, refill the reference with #8042 refill solution.
  - Remove the 1/4" PVC plug and empty the contents. Flush the reference with tap water then refill it with reference solution. Shake out any air bubbles before you very slowly screw in the PVC plug until it is finger tight. Then replace the sensor and lock the red lock rings.
  - If refilling is a problem, simply replace the sensor.

WARNING: Do not remove the sensor cap until ready for installation and operation. Glass electrodes must remain moist at all times!! Avoid sensor exposure to freezing temperatures.

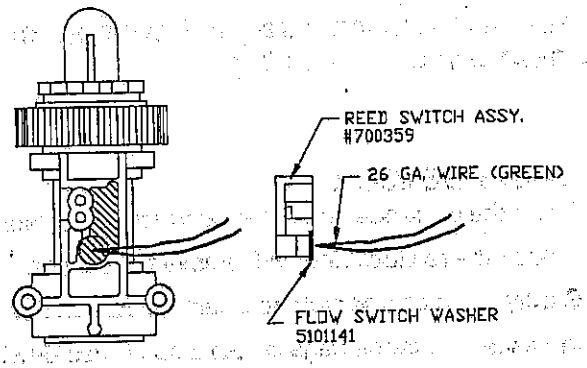
FLOW SWITCH CLEAN OUT

- Unlock the red lock ring and remove the flow sight.
- Then remove the float with your fingers.
- Bottle brush the float, flow sight and the flow switch assembly to remove any residue.
- Make sure you lock down the red lock ring after you replace the components.
- After you turn the flow back on, check for leaks.

MAINTENANCE (Cont.)

Flow Switch Replacement

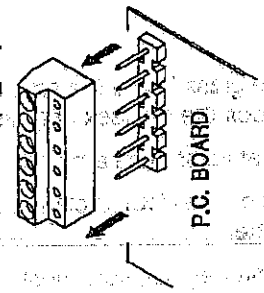
INSTALL / REMOVAL PROCEDURES
A. REMOVE 3 SCREWS HOLDING FLOW SWITCH.
B. REMOVE SCREWS HOLDING OTHER PLUMBING COMPONENTS.
C. PULL HARD ON THE GREEN WIRES TO REMOVE THE REED SWITCH.
D. INSTALL AND WIRE NEW REED SWITCH.
E. RE-INSTALL PLUMBING.



Terminal Block Replacement

Easy low power wiring.

1. Pull terminal block with longnose pliers.
2. Install wires.
3. Push back onto pin header.



REPLACEMENT PARTS LIST

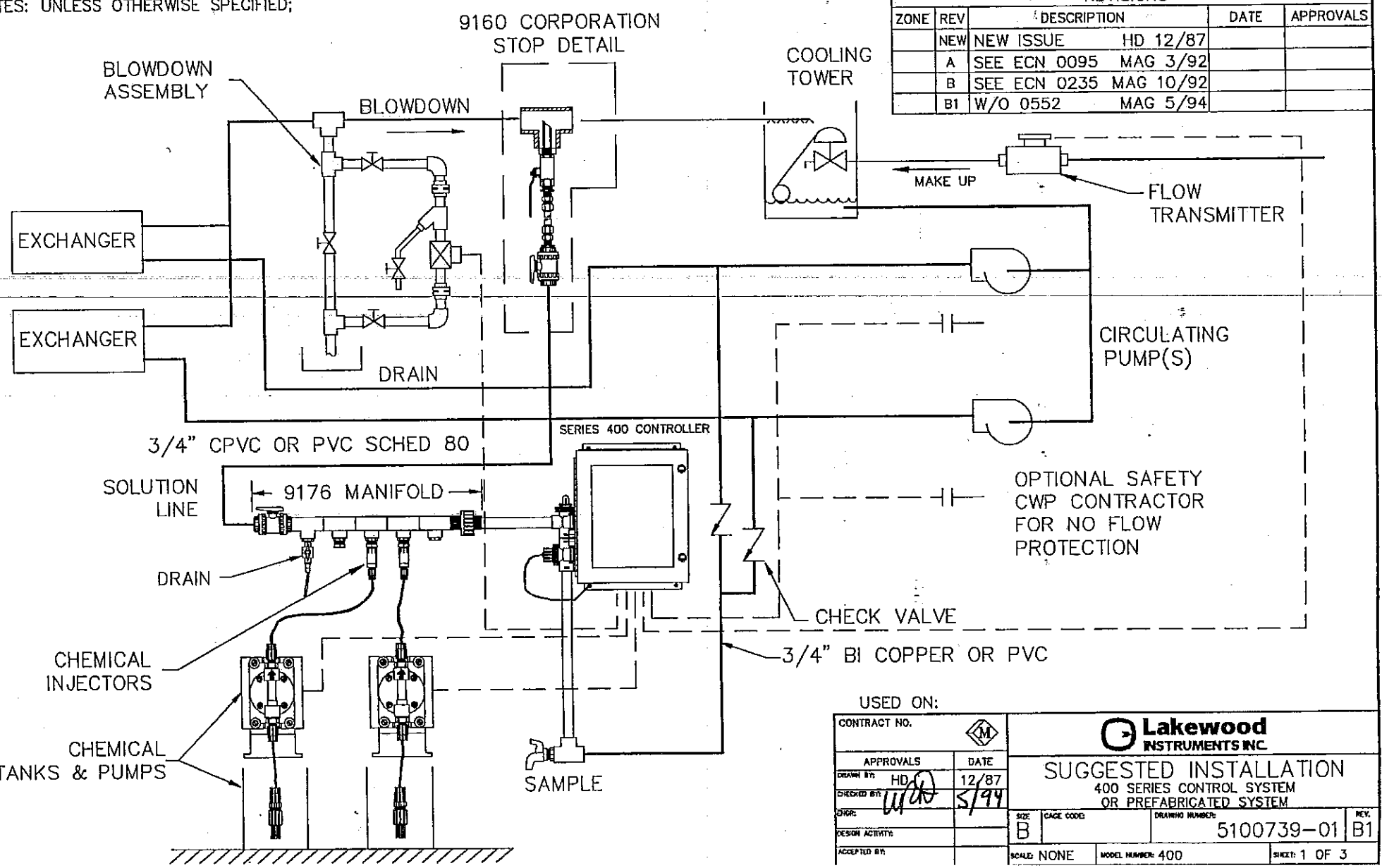
PART NUMBER	DESCRIPTION
700002	Model 412 front panel and circuit board
700025	Model 412 rear circuit board
700181	pH glass sensor
700182	pH reference sensor
700185	Conductivity sensor
7000316	Plumbing Assembly
7000358	Flow switch float
7000359	Flow reed switch block
7000449	Flow switch flow sight
3260001	Spare relay
WA1/2	Chart paper -- Single channel
WD1/2	Chart paper -- Dual channel

TROUBLE-SHOOTING CHART

PROBLEM NOTED	CHECK		CORRECTIVE ACTION
No power to solenoid valve or chemical pump.	1. SYSTEM light is off.		
	A. Is the flow switch float in the sight glass?	NO	Increase sample flow. Need 1 GPM minimum. Clean the flow switch.
		YES	Replace flow relay. Replace reed switch block. Replace float.
	B. Is the fuse blown?	YES	Check for 24 V solenoid. Should be 115 VAC. Check chemical pump.
	2. SYSTEM light is on.		
	A. Are A-O-M switches OFF?	YES	Turn to AUTO.
	If all of the above checks out OK but you still don't have power to the outputs, return the rear circuit board to LAKEWOOD INSTRUMENTS for repair.		
No power to acid pump only.	pH ALARM lamp on?	YES	Turn A-O-M to OFF then to AUTO to reset alarm.
		NO	Check outlet for 115 VAC.
Conductivity not working or reading too low. Out of calibration range.	1. Is sensor clean?		Clean with emery paper.
	2. Is one electrode eaten away?	YES	Replace front panel.
	3. Can now calibrate OK?	YES	Proceed to #4.
		NO	Replace sensor.
	4. Does set point work OK?	NO	Replace front panel.
Water pH way off from set point.	1. Glass pH sensor broken?	NO	Replace anyway for test.
	2. Reference electrolyte discolored? It should be white or clear.	NO	Replace anyway for test.
	3. Still can't calibrate?	NO	Replace BNC feed-through then front panel if it is still a problem.
pH ALARM light on.	1. Acid pump lost prime and timed out?	YES	Increase pump rate. Repair chemical pump. Use A-O-M to reset timer.
	2. Out of acid?		
	3. Other source of low pH water?		
	4. All OK but pH is very high and alarm times out?		Set acid pump at maximum rate. Manually reset until pH is near set point. Then lower the pump rate.
	5. Can't reset alarm?		Replace front panel.

NOTES: UNLESS OTHERWISE SPECIFIED;

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVALS
	NEW	NEW ISSUE HD 12/87		
	A	SEE ECN 0095 MAG 3/92		
	B	SEE ECN 0235 MAG 10/92		
	B1	W/O 0552 MAG 5/94		



USED ON:

CONTRACT NO.		
APPROVALS		DATE
DRAWN BY:	HD	12/87
CHECKED BY:		5/94
ENGR:		
DESIGN ACTIVITY:		
ACCEPTED BY:		

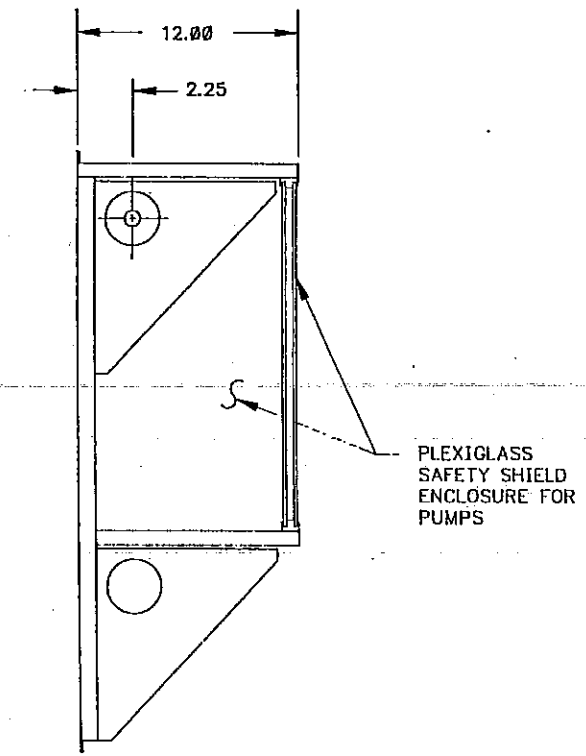
Lakewood INSTRUMENTS INC.

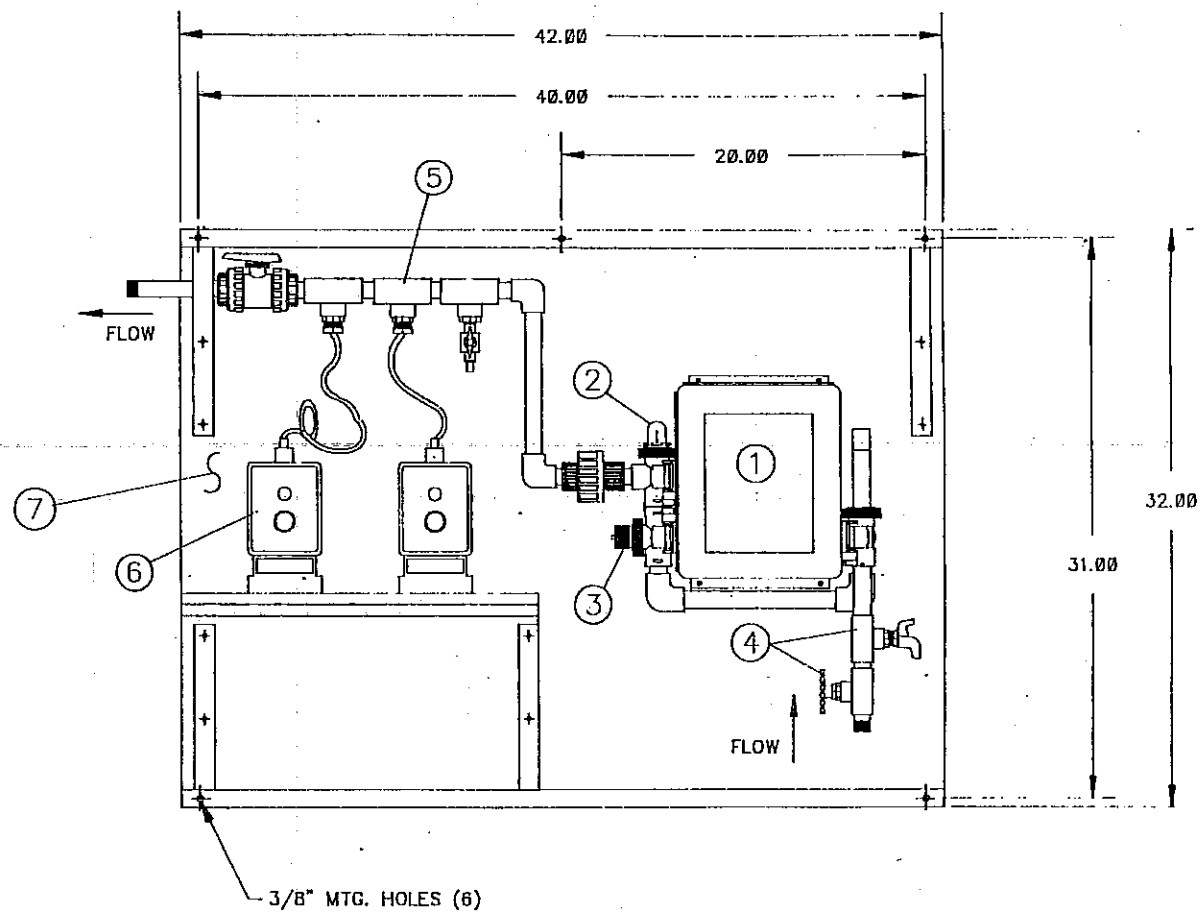
SUGGESTED INSTALLATION

400 SERIES CONTROL SYSTEM
OR PREFABRICATED SYSTEM

SIZE	CAGE CODE:	DRAWING NUMBER:	REV.
B		5100739-01	B1

SCALE: NONE | MODEL NUMBER: 400 | SHEET: 1 OF 3





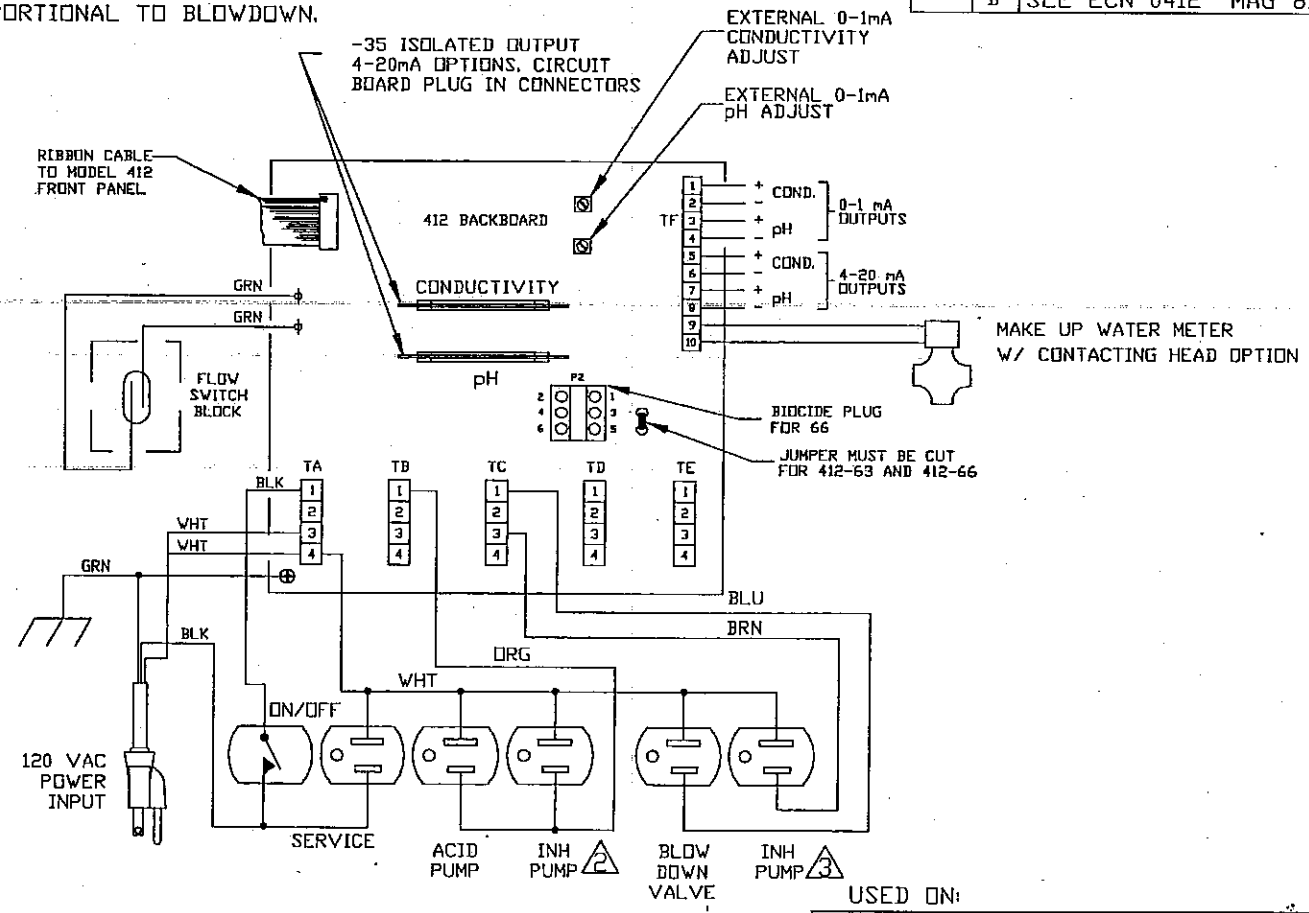
NOTES:

1. MODEL 412.
2. FLOW SWITCH FLOW SIGHT AND BACK CHECK VALVE.
3. CONDUCTIVITY SENSOR.
4. SAMPLE VALVE AND GATE SHUT-OFF VALVE.
5. INJECTION MANIFOLD WITH PRESSURE RELIEF VALVE INJECTION TEES AND DOUBLE UNION BALL VALVE.
6. CHEMICAL PUMPS.
7. H.D. POLYETHYLENE MOUNTING PLATE. SHELF AND BRACKETS.

DATE 2-13-91	LAKEWOOD INSTRUMENTS			
DRAWN DH	PREFABRICATED CHEMICAL FEED SYSTEM	LET.	REVISION	BY DATE
CHECKED				
APPROVED				
SCALE NTS	MODEL NUMBER 25-412	DWG. NO. B-5103195		

NOTES: UNLESS OTHERWISE SPECIFIED,
1. FOR "WP" OPTION NEMA 4 ENCLOSURE, WIRE DIRECT TO TERMINALS.
2. TO FEED INHIBITOR PROPORTIONAL TO ACID.
3. TO FEED INHIBITOR PROPORTIONAL TO BLOWDOWN.

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVALS
	A	REVISED HD 1/84		
	B	SEE ECN 0412 MAG 8/93		



USED ON:

CONTRACT NO.		
APPROVALS		DATE
DRAWN BY:	HD	1/84
CHECKED BY:		
ENG:	DR	8/93
DESIGN ACTIVITY:		
ACCEPTED BY:		

Lakewood INSTRUMENTS INC.

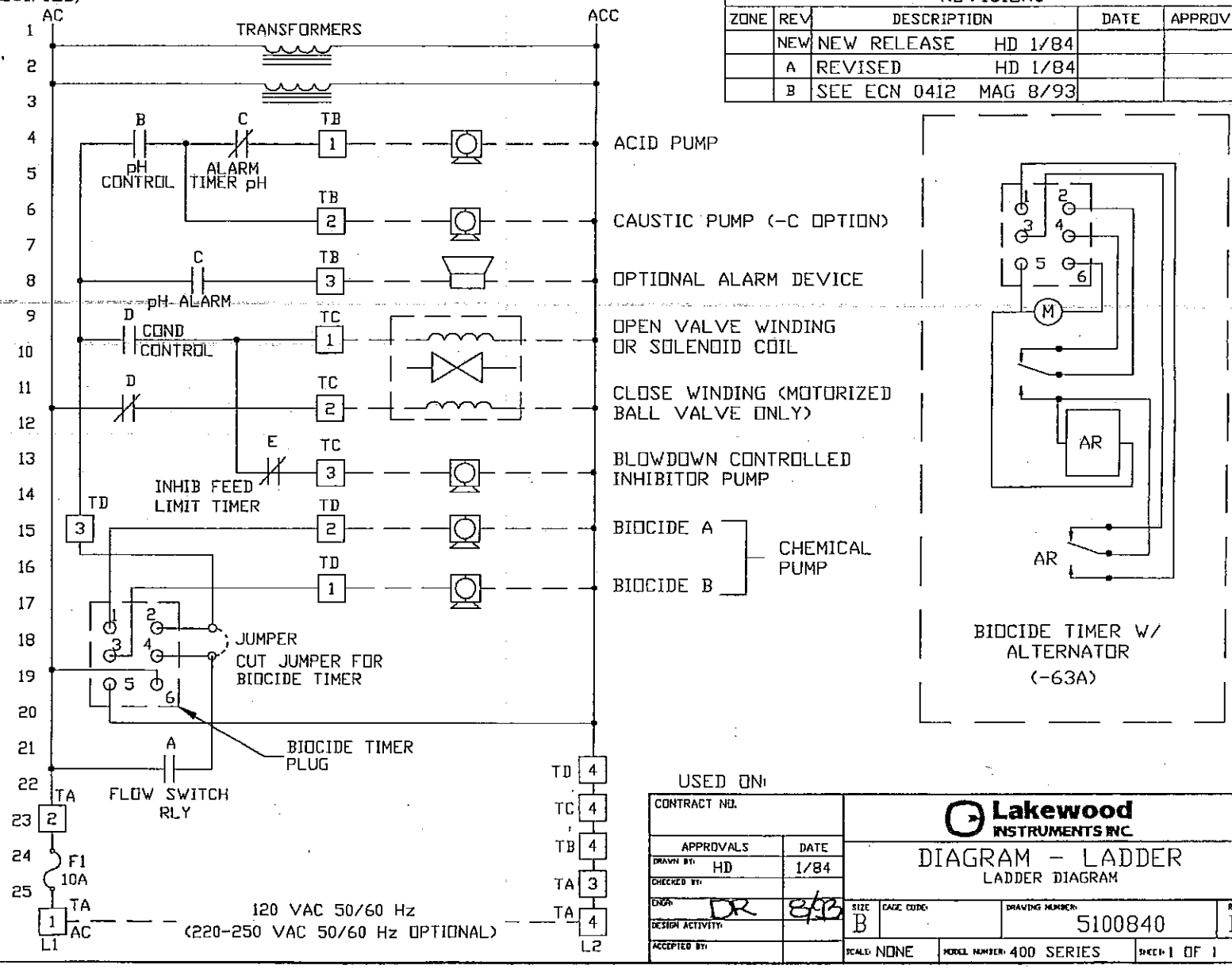
DIAGRAM - WIRING
EXTERNAL WIRING AND OPTIONS

SIZE	CAGE CODE	DRAWING NUMBER	REV.
B		5100841	B

SCALE: NTS | MODEL NUMBER: 400 SERIES | SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED
1. MAX CURRENT EACH CUICUIT 3 AMPS.
2. "TE" FOR OTHER OPTIONS.
3. WIRING BY LAKEWOOD
4. WIRING BY OTHERS

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVALS
	NEW	NEW RELEASE HD 1/84		
	A	REVISED HD 1/84		
	B	SEE ECN 0412 MAG 8/93		



USED ON:

CONTRACT NO.		
APPROVALS		DATE
DRAWN BY:	HD	1/84
CHECKED BY:		
ENGR:	DR	8/93
DESIGN ACTIVITY:		
ACCEPTED BY:		

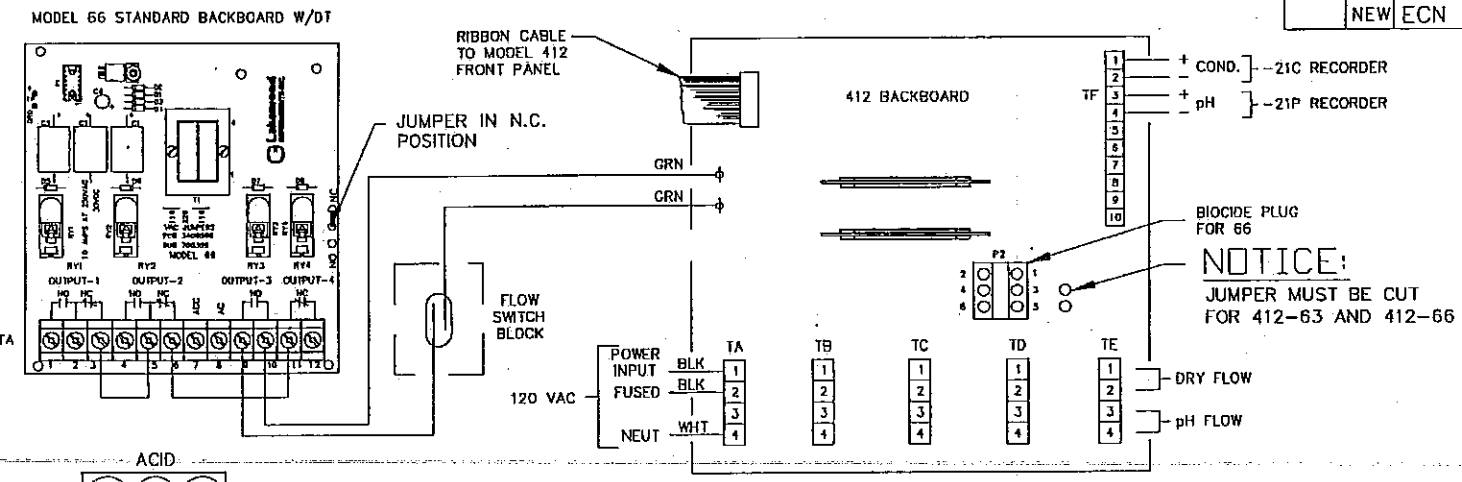
Lakewood INSTRUMENTS INC.

DIAGRAM - LADDER
LADDER DIAGRAM

SIZE	CAGE CODE:	DRAWING NUMBER:	REV.
B		5100840	B

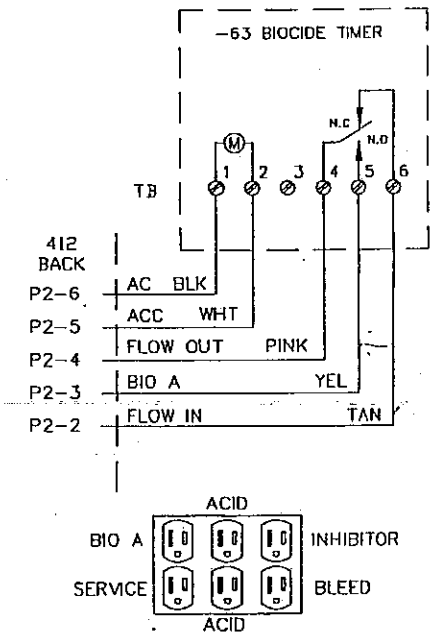
SCALE: NONE | MODEL NUMBER: 400 SERIES | SHEET 1 OF 1

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVALS
	NEW	ECN 0185 MAG 9/92		



412-66

	TIMER	CONTROLLER
TB-1=ACID	TA-1 YEL	P2-3 BIO A
TB-2=CAUSTIC	TA-4 VIO	P2-1 BIO B
TC-1=BLEED	TA-2 TAN	P2-4 FLOW IN
TC-3=INH/DISP	TA-12 PINK	P2-2 FLOW OUT
TD-1=BIO-A	TA-7 WHT	P2-5 ACC
TD-2=BIO-B	TA-8 BLK	P2-6 AC



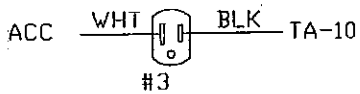
NOTE: FLOW SWITCH WIRE RUNS STRAIGHT TO 412 BACK-BOARD.

412-63

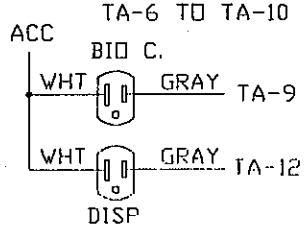
-99 OPTIONS

NOTE: FLOW SWITCH WIRE RUNS STRAIGHT TO 412 BACKBOARD.

1. 110 VOLTS NEEDED ON RELAY #3 OF THE 66 BOARD AND FLOW IS NOT CONTROLLING FUNCTION.
   JUMPERS FROM TA-8 TO TA-9
2. 110 VOLTS NEEDED ON RELAY #3 OF 66 BOARD, FLOW CONTROLS FUNCTION.
   JUMPERS FROM TA-9 TO TA-12



3. BIO C AND DISPERSANT (ADDITION TO BIO A AND BIO B)
   JUMPER FROM TA-3 TO TA-5
   TA-6 TO TA-10



TIMER	CONTROLLER
TA-2 TAN	TO P2-4 FLOW IN
TA-11 PINK	TO P2-2 FLOW OUT
TA-7 WHT	TO P2-5 ACC
TA-8 BLK	TO P2-6 AC
TA-4 VIO	TO P2-1 BIO B
TA-1 YEL	TO P2-3 BIO A

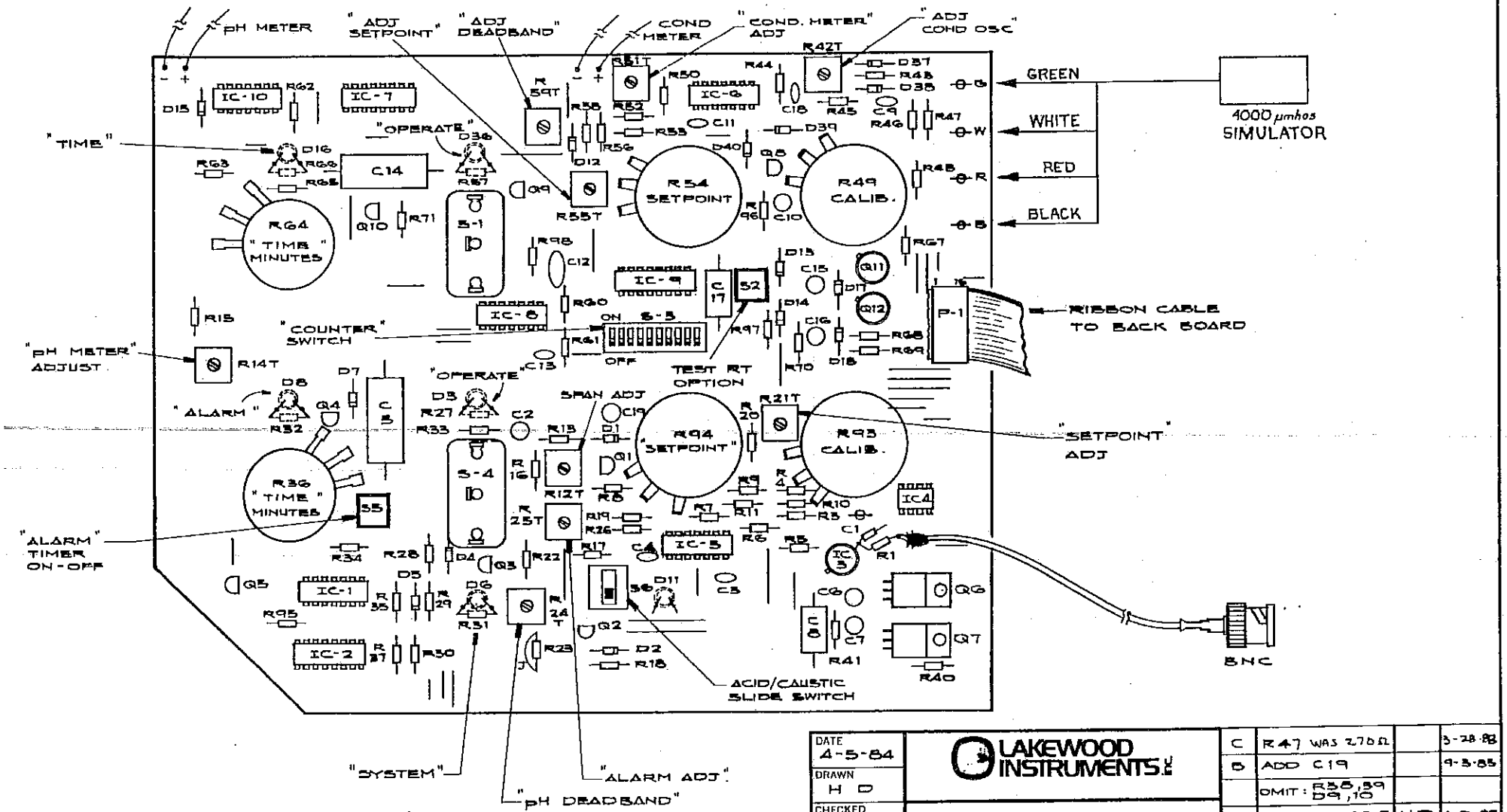
USED ON:

CONTRACT NO.	
APPROVALS	DATE
DRAWN BY: MAG	9/92
CHECKED BY:	
ENGR:	
DESIGN ACTIVITY:	
ACCEPTED BY:	

Lakewood INSTRUMENTS INC.

DIAGRAM — WIRING
412 OPTIONS

SIZE	CAGE CODE:	DRAWING NUMBER:	REV.
B		5103582	
SCALE: NONE	MODEL NUMBER: 412-66/412-63	SHEET: 1 OF 1	



DATE 4-5-84	LAKEWOOD INSTRUMENTS	C	R47 WAS 270Ω — 3-28-88
DRAWN H D		B	ADD C19 — 9-3-85
CHECKED			OMIT: R56,59 D9,10
APPROVED	MODEL 400 FRONT PCB COMPONENT LAYOUT	A	CHANGED Q6,7 — H D — 1-8-85
SCALE FULL		LET.	REVISION — BY — DATE
	MODEL NUMBER 400		DWG. NO. B-5100909

BISHOP GRAPHICS/ACCUPRESS