HyDAC®

MODU-MAX®

BOILER CONTROL MANUAL
(INTERMITTENT SAMPLING VERSION)

Use With Bargraph Models Only.
HI821-1-3

parts list
trouble shooting
method of operation
installation instructions
checkout guide and calibration

INSTRUCTION MANUAL
AUTOMATIC BOILER BLOW DOWN SERVICE

CONTENTS

SYSTEM DESCRIPTION

Continuous/surface blowdown is frequently used to control the concentration of dissolved solids in a steam boiler. The HyDAC Modu-Max enables the boiler operator to automate surface blowdown. Continuous surface blowdown results in "peaks and valleys" in the TDS concentration. Automation smooths out the "peaks and valleys" resulting in a high, but safe, level of TDS. Modu-Max periodically opens an electric valve in the surface blowdown line. A sensor (upstream of the valve) then compares the boiler water conductivity to the preselected set point. If the two values are close, the valve shuts and remains shut until the next sample period. If the conductivity is high with respect to the set point, the valve remains open until the make-up water reduces the conductivity and the controller is satisfied. Modu-Max features front panel adjustments for both the sample interval and sample duration timers as well as the conductivity set point. Modu-Max prevents excessive blowdown which wastes water, chemicals and energy. It also prevents insufficient blowdown which can result in harmful scale deposits. Scale wastes energy and can also cause damage to the boiler.

Figure I shows a typical installation. The Modu-Max is not recommended for heating boilers or boilers rated at less than 50 H.P. For boilers rated at less than 50 H.P., use the Modu-Max Meter-Matic II system, and one water meter, properly sized to system.

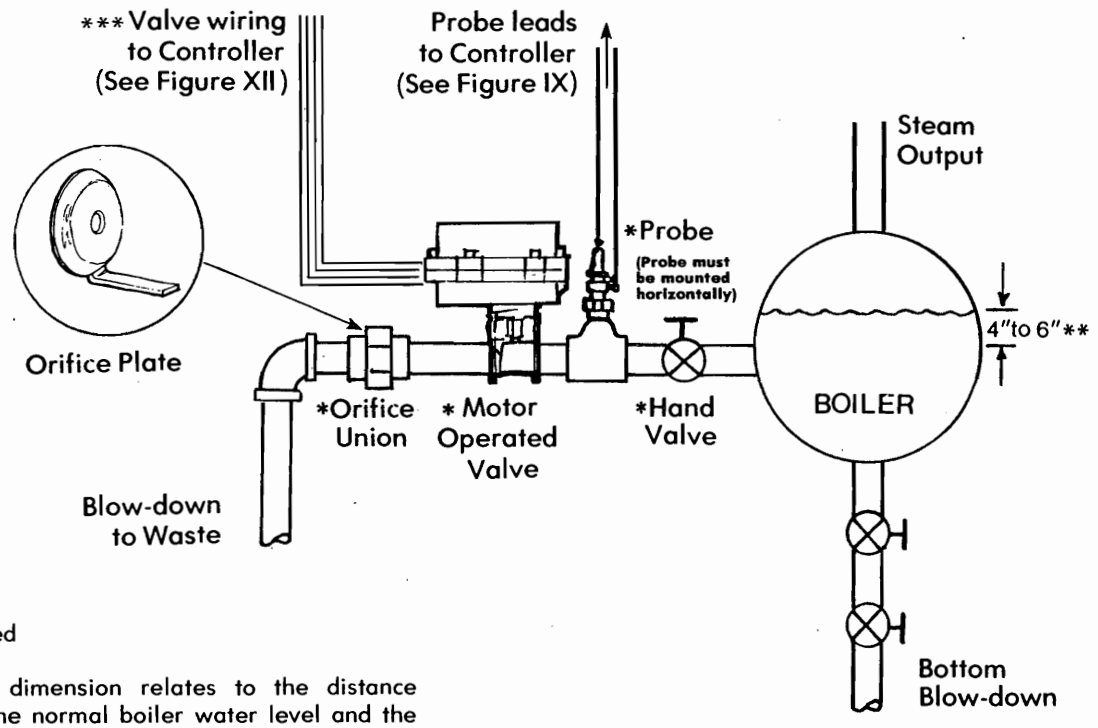
INSTALLATION PREPARATION

Survey the boiler; a suitable surface blowdown point should be located (typically 4-6 inches below the normal water level). If no line exists, see Figure II for a suggested method of installation.

Caution: The surface blow-down line must discharge to a safe place (e.g., a flash tank).

Avoid a true "skimmer" blowdown line; these are sometimes found on old boilers. If you must use a skimmer line, it will have to be modified with a bushing and internal "dip-tube" to get below the surface of the water.

Install a hand valve in the blowdown line upstream of the sensor, control valve and throttle. It should be close to the boiler. The valve should be rated at boiler operating pressure (or higher) and is normally full open. It provides a shut-off so the control valve can be serviced without shutting down the boiler. See Figure I.

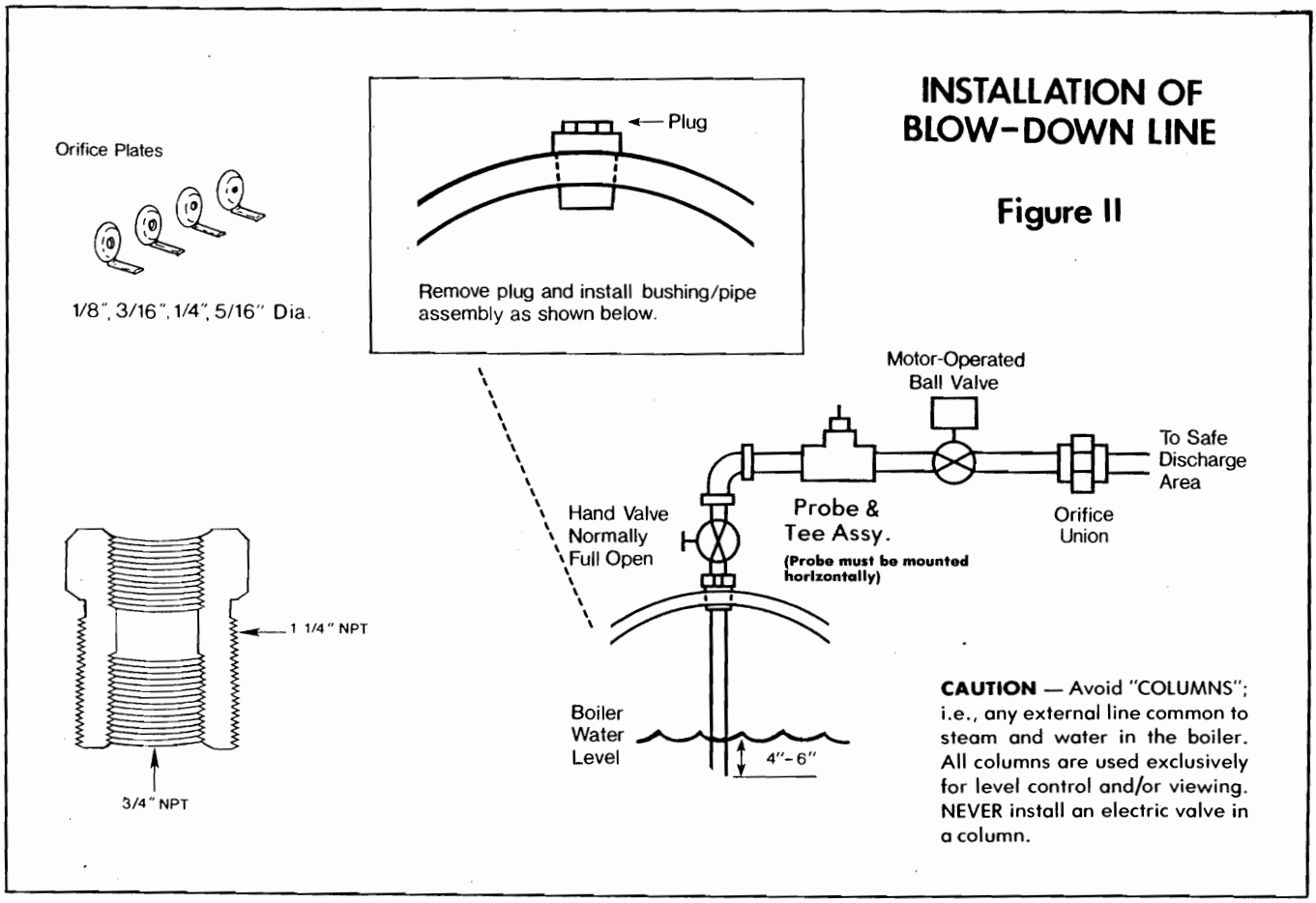


* Not included

** The 4"-6" dimension relates to the distance between the normal boiler water level and the top of the surface blow-down pipe line.

*** If a spring-return valve (e.g.: Solenoid Valve) is used, use the OPEN and COMMON terminals in Controller. Do not use CLOSE. Be sure to include Ground.

Figure I



EQUIPMENT/PARTS SUPPLIED

Since Modu-Max uses a "Building Block" concept, the equipment necessary will depend on the boiler and its installation. A typical Modu-Max system, using an "A"-size enclosure, will be covered throughout this text, although mounting dimensions and spare parts have been included for the "B"-size and "C"-size enclosures also. This manual will cover the basic A-size enclosure (with transformer assembly), P/N 301225; one Boiler Blowdown Control Module with Bargraph Display, P/N 301238-1 (0-10,000 micromhos), or P/N 301309 (0-5,000 micromhos), and one Relay Module, 20 amp, P/N 203072. "Add-on" modules such as Hi-Lo Conductivity Alarm, P/N 202412, have separate instruction sheets.

ADDITIONAL EQUIPMENT/PARTS NEEDED FOR BOILER INSTALLATION

This section covers items which can be ordered initially with the basic Modu-Max controller. As with the "add-on" modules, separate instruction sheets apply.

1. Hand valve called for in the installation preparation section.
2. Probe assembly, P/N 300966-1.
3. Electric valve assembly. A proper rated valve must be used (temperature and pressure). See Figure VI to determine rating. Valves are available from CSI as follows:

Description	Pressure	Part No.
½" solenoid valve	125 WSP	903549
¾" motor-operated valve	250 WSP	300519-1
¾" electro pneumatic valve (20# to 150# air supply required)	600 WSP	301322
Note: Special valves are available on request.		

4. Throttle. A properly rated throttle must be installed downstream of the electric valve. CSI can supply an orifice kit with 4 plates; order P/N 3015. See Figures VII and VIII for plate selection. A Hancock-type valve can be used as an alternate means of throttling. Note: P/N 3015 is included with the 300519-1 and 301321 valve assemblies listed above.

5. Strainer. If the solenoid valve is used, it is recommended that a strainer be installed upstream of the solenoid valve. CSI can supply a strainer rated at 125 WSP (compatible with valve P/N 903549). Order P/N 500294.

INSTALLATION - PLUMBING CONSIDERATIONS

1. If there is an existing surface blow down line, it should be broken at a point not more than 4 feet from the boiler. The first item to be installed (if not already there) is a gate or globe valve which is rated at or above the boiler operating pressure. Check the HyDAC pressure/temperature chart to obtain the proper temperature rating for this hand valve which is normally left in the **full** open position; should the valve/sensor assembly need service, the hand valve can be conveniently closed. Size of the hand valve should be the same as the existing blow-down piping.

2. If there is not an existing surface blow down line, the most convenient method of installing one is shown in Figure II. The optimum pipe size is ¾" which will handle boilers up to 6000 H.P. (200,000 lbs. of steam per hour). The double-tapped bushing is available from HyDAC and is rated at 600 WSP. All piping should be rated at or above the boiler operating pressure. As mentioned in Step One, a hand valve is the first item to be installed in the blow-down line.

3. Downstream of the hand valve comes the sensor, electric valve and throttle (orifice union/plate or "Hancock" type valve) in that order. It is good practice to install a by-pass system, see Figure III. This allows the operator to select a continuous blowdown mode whenever the sensor or valve requires service.

As mentioned in Step 1, all hand valves should have proper ratings; this includes all associated piping.

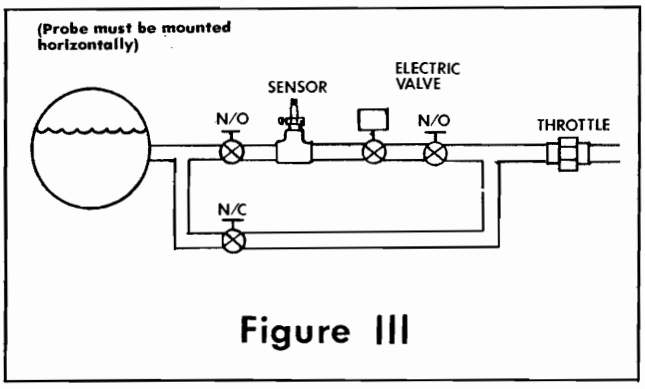


Figure III

Generally, threaded connections are acceptable up to 600# WSP; higher pressures require flanged connections. HyDAC sensors are available for pressures up to 600# WSP only, therefore, service for higher ratings necessitate the use of a sample cooler.

4. The probe must be installed in a ¾" tee. The probe and tee should be installed so that probe body is in the same plane as the horizon (sideways). DO NOT deviate from this configuration. (Catalog #300966-1 sensor assembly is built specifically for this application). Run 2-conductor wire from controller to sensor assembly. Recommend 18 gauge insulated copper wire, maximum run of 200 feet.

Install the sensor assembly in the skimmer blowdown line. The assembly must be mounted in a horizontal pipeline within 4 feet from boiler outlet to allow sensor to come up to temperature. Note: If pipe used is longer than 4 feet, it should be insulated. The probe must be mounted so that the insulator points toward the horizon. A hand valve should be installed between this assembly and the boiler outlet to facilitate the installation and servicing of this assembly. **Warning:** Do not run probe wiring in same conduit as valve wiring.

NOTE: Columns and feedwater points on the boiler should be avoided as locations for any part of the blowdown system. A column is a length of pipe which connects to both the water side and the steam side of the boiler, see figure IV.

A column is used for level detection and control as well as visual observation of water level.

Feedwater points are usually too low (too far below the water level), see Figure V.

Figure IV

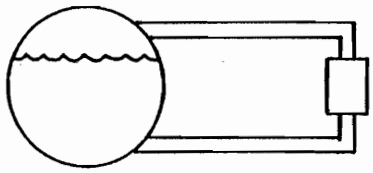
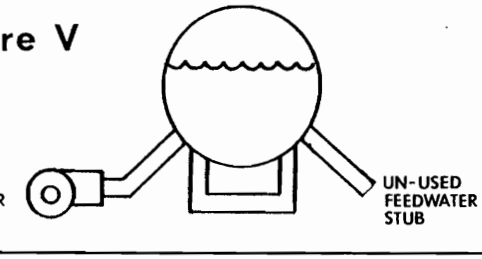


Figure V



Whether it comes in from the side or the top of the boiler, the blowdown line must be 4-6 inches below the normal water level of the boiler. Wildly fluctuating water levels can result in steam entering the blowdown line. This will cause a deposit buildup on the sensor and render the Modu-Max control system inoperative.

Boiler Water Temperature Pressure Curve

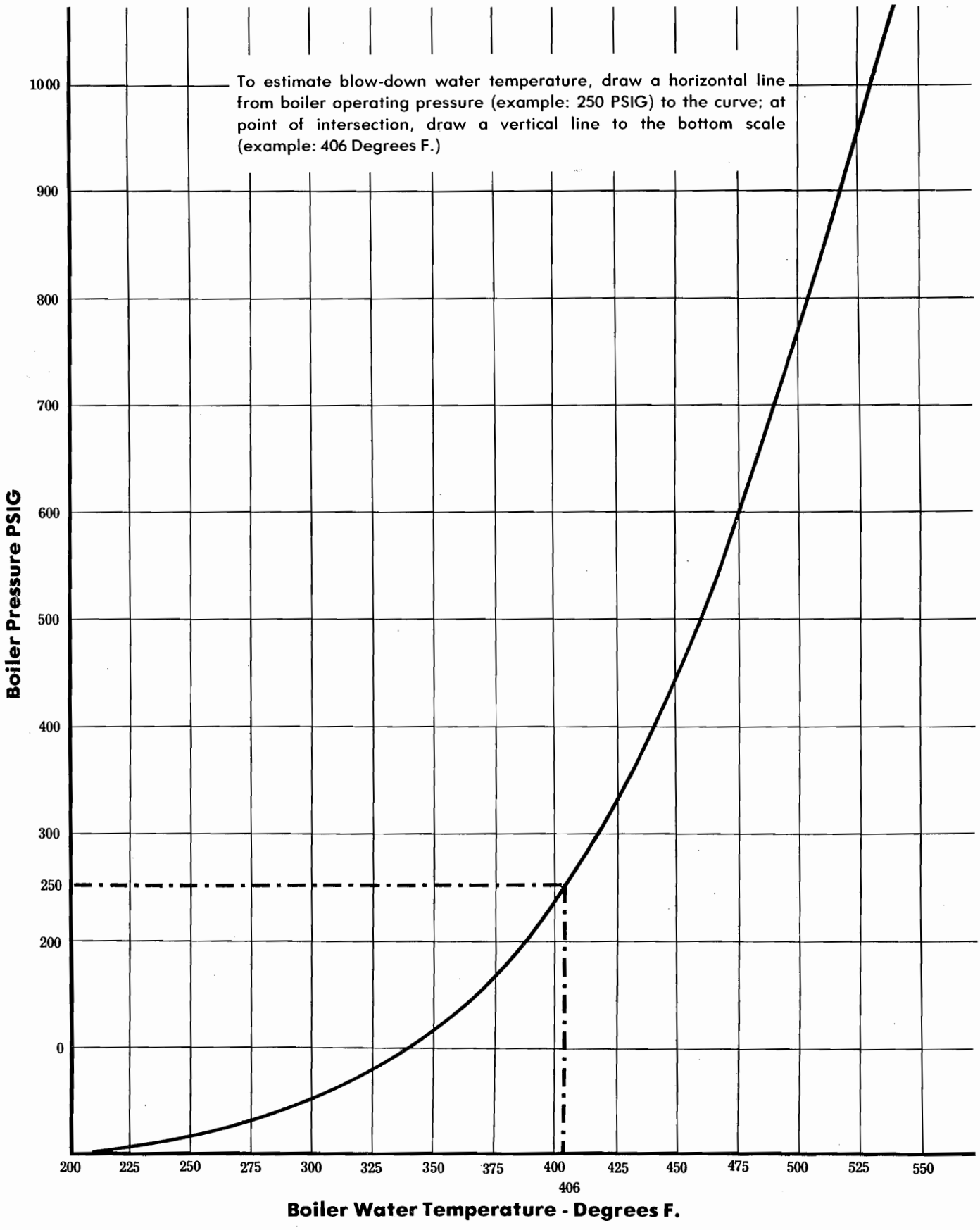


Figure VI

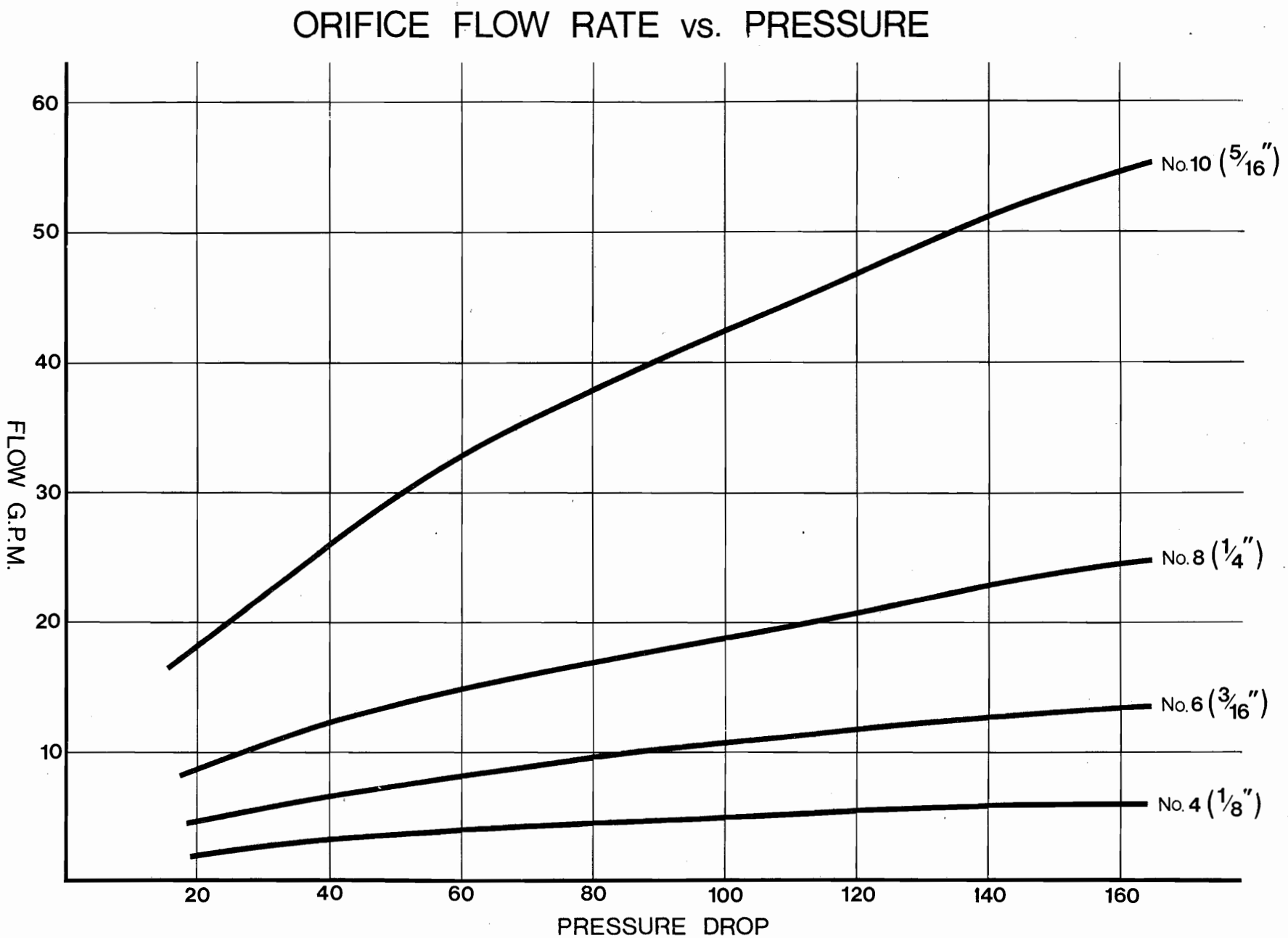

ORIFICE FLOW RATE vs. PRESSURE
FLOW G.P.M.
60
50
40
30
20
10
20
40
60
80
100
120
140
160
PRESSURE DROP
No. 10 (5/16")
No. 8 (1/4")
No. 6 (3/16")
No. 4 (1/8")

Figure VII

Calculations Chart

The orifice flow rate curves do not take into consideration the length of blowdown pipelines, pipe diameter or other variables such as back pressure created by flash tanks, heat exchangers, etc.

The curves should be used as follows:

I. Calculate Blowdown Flow Rate

Step 1 — Calculate boiler make-up based on no condensate return

$$\frac{\text{Horse Power}}{15} = \text{Make-up in Gallons per minute}$$

$$\frac{\text{Pounds of Steam Per Hour}}{500} = \text{Make-up in Gallons per minute}$$

Step 2 — Determine if any condensate is being returned

$$\frac{\text{*Chlorides in the Feedwater} \times 100}{\text{**Chlorides in the Make-Up Water}} = \%\ \text{Make-Up}$$

*Obtain water sample from the condensate receiver

**Obtain water sample from the water supply which maintains the water level in the condensate receiver

NOTE — Conductivity measurements may be substituted for Chloride residual measurements. If chemicals are being added to the condensate receiver, conductivity measurements will give erroneous results; use chloride test only.

Step 3 — Calculate actual Make-Up

$$\text{Worst Case (Step 1)} \times \frac{\%\ \text{Make-Up (Step 2)}}{100} = \text{Actual Make-Up in Gallons per minute}$$

Step 4 — Determine desired cycles of concentration. This is beyond the scope of this paper; however, 10 is typical with good quality make-up water (low calcium and magnesium content).

Step 5 — Calculate Blowdown Rate

$$\frac{\text{Make-Up (Step 3)}}{\text{Cycles of Concentration}} = \text{Blowdown Rate in Gallons per minute}$$

EXAMPLE:

Step 1 — $\frac{3000\ \text{Horse Power}}{15} = 200$ Gallons per minute, Worst Case Make-Up

Step 2 — $\frac{\text{Conductivity of Feedwater}}{\text{Conductivity of Make-Up}} = \frac{100}{300} = .33 \times 100 = 33\%$ Make-Up

Step 3 — $200 \times \frac{33}{100} = 67$ Gallons Per Minute Actual Make-Up

Step 4 — Selected 10 cycles of concentration based on Water Treatment consultant's recommendation

Step 5 — $\frac{67}{10} = 6.7$ or 7 Gallons per minute Blowdown

II. Refer to the Orifice flow rate curves.

Step 1 — Determine Boiler operating pressure
Step 2 — Factor in blowdown rate from I. Step 5 (above)
Step 3 — Select the first orifice size which lies above the crossing lines (coordinates)

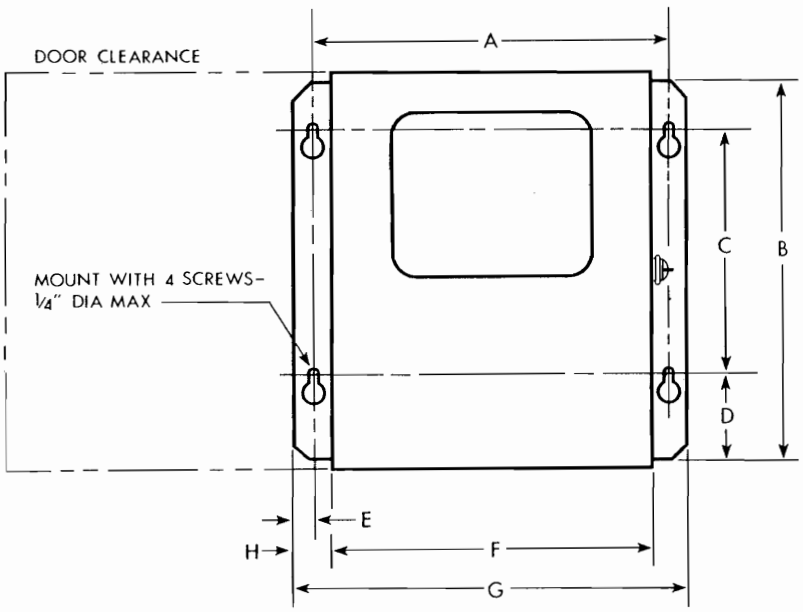
EXAMPLE:

Step 1 — 150 PSIG
Step 2 — 7 Gallons per minute (from Step 5, Part I)
Step 3 — Select #6 (3/16") Orifice Plate

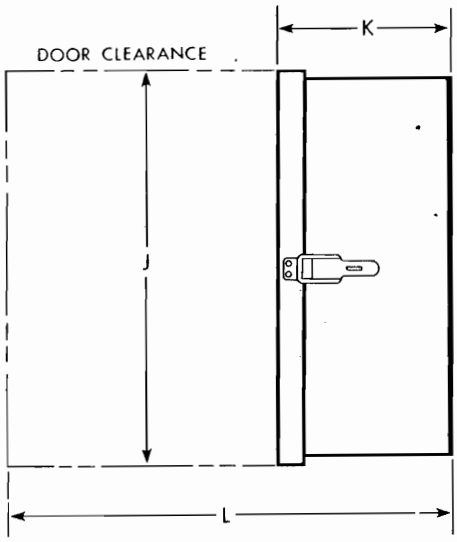
III. Try the Selected Plate for several days. If TDS slowly increases beyond the set point, go to next larger size orifice plate.

Figure VIII

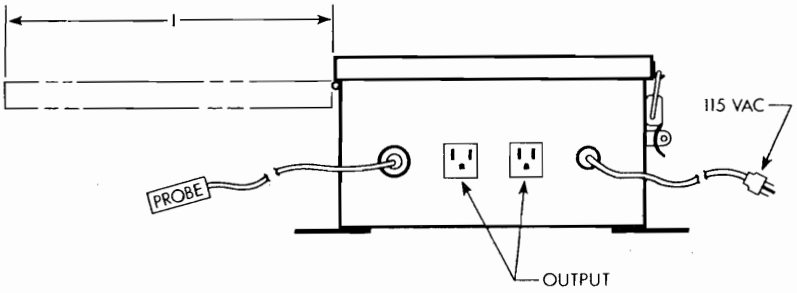
Mechanical and Mounting Dimensions



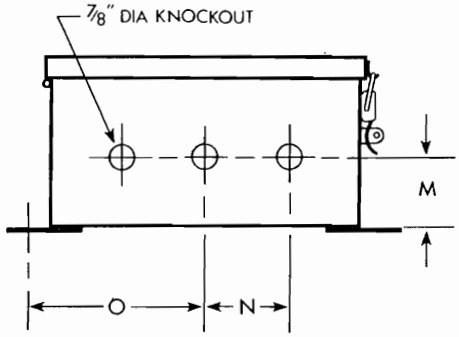
FRONT VIEW



SIDE VIEW



BOTTOM VIEW
(Receptacle Model)



BOTTOM VIEW
(Conduit Model)

A-size box	B-size box	C-size box
A=10-5/8"	A=13-3/4"	A=16-1/4"
B=11-3/8"	B=14"	B=17"
C=7-3/8"	C=10"	C=10"
D=2-17/32"	D=2-17/32"	D=4"
E=5/8"	E=5/8"	E=5/8"
F=9-3/4"	F=12-7/8"	F=15-3/8"
G=11-15/16" (max.)	G=15-1/32" (max.)	G=17-17/32"
H=1-5/32"	H=1-5/32"	H=1-5/32"
I=10" (max.)	I=13-1/8" (max.)	I=15-5/8"
J=12" (max.)	J=14-1/2" (max.)	J=17-1/2"
K=5-3/8" (max.)	K=5-3/8" (max.)	K=5-3/8"
L=14-1/4" (max.)	L=17-3/8" (max.)	L=19-7/8"
M=2-1/16"	M=2-3/16"	M=2-3/16
N=2-1/16"(typ.)	N=3" (typ.)	N=3 (typ.)
O=5-5/16"	O=6-7/8"	O=8-1/8"

Figure IX

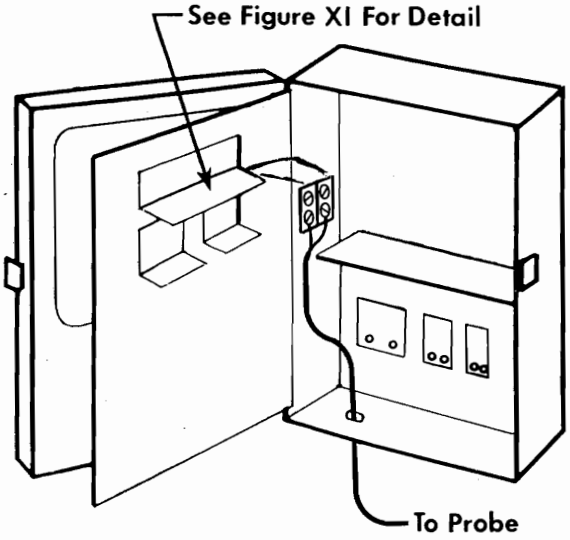


Figure X

ELECTRICAL INSTALLATION

Power wiring to the Controller, and between the Controller and the blow-down valve, should be 18 gauge or larger. The wiring to the probe should be stranded, copper wire. 18-gauge is adequate, and is recommended for ease of wiring within the controller. All line voltage connections are made inside the connection box in the lower part of the controller. Be sure to replace cover before applying power to the controller. For personal safety, be sure to install ground wires.

The line voltage connections inside the connection box are shown schematically on Fig. XII. Fig. X shows the connection box with the cover removed. This figure also shows the routing of the probe wiring along the left side of the connection box, Fig. XI shows the probe connection to the control module.

If the probe wiring is run in conduit, it is important that no other wiring run in that conduit.

MECHANICAL AND MOUNTING DIMENSIONS

(See Figure IX)

See Figure I; for controller mounting, refer to Figure IX. Most HyDAC valve assemblies include an orifice union and 4 orifice plates. Refer to Figures VII and VIII for orifice size selection. Do not operate the system without an orifice plate or some other throttling device (e.g., Hancock valve).

Never install the blowdown valve assembly on a column!

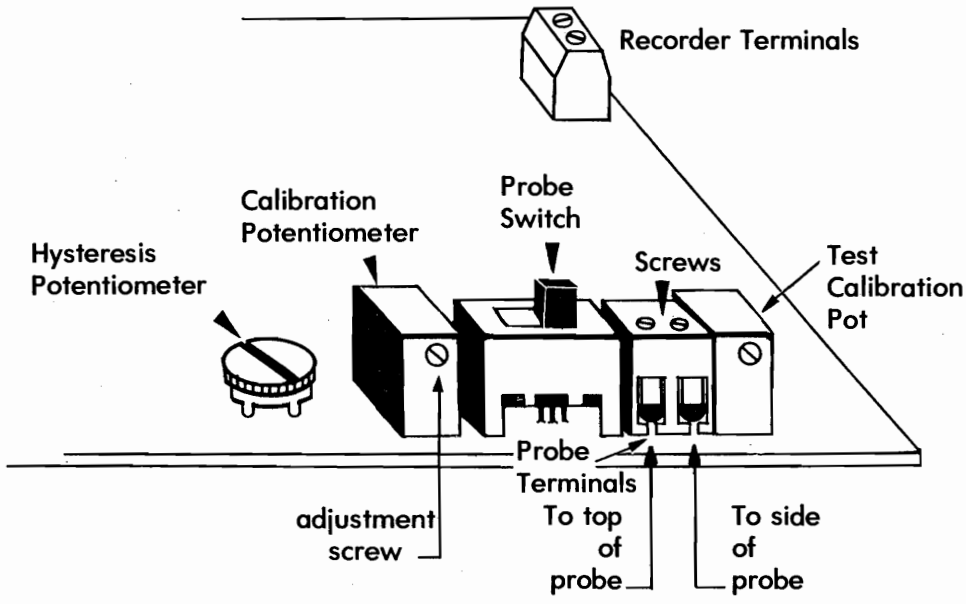
ADDITION OF CHEMICAL TREATMENT

Chemical Treatment can be added to a boiler based on conductivity; however, the accuracy is poor due to the volume of bottom blowdown. Bottom blowdown, since it must be manual, basically amounts to "uncontrolled" blowdown, as far as the conductivity controller is concerned. The ideal way to add treatment to the boiler is with a counter-timer system. This requires a Meter-Matic II System and one Water Meter, properly sized to system. It may be possible to add a counter-timer module to your existing Modu-Max conductivity controller. Contact the factory for more details.

ADDITIONAL INFORMATION

Additional information is available. Request Bulletin HB794-1, "Practical Considerations on the Application of Automatic Blow-Down Systems."

Figure XI



CONTROLLER CHECK-OUT AND ADJUSTMENT

CAUTION: Make sure that personnel are clear of the blowdown discharge point

1. Open the windowed door and turn Modu-Max POWER switch to the "ON" (upward) position. At this point, the LED display and the "VALVE OPEN"/ "OPERATE" lights may or may not be illuminated.
2. Place valve switch (Open-Closed-Auto) on "CLOSED". Check to make sure that the blowdown valve is closed.
3. Place valve switch on "OPEN". Valve should open and blowdown should occur. Place valve switch on "CLOSED".
4. Open the inner (white) door by pulling on the latch (black) with an outward motion.
5. Push the probe switch to the left. See Figure XI
6. The Bar Graph readout should be indicating 5,000 micromhos (0-10,000 model) or 2,500 micromhos (0-5,000 model). EXCEPTION: If the controller has been previously calibrated with the boiler, the readout point will probably be different. If it is, open the inner door and adjust the calibration potentiometer (See Figure XI) until the readout is 5,000 (2,500 on the 0-5,000 model) micromhos. If the readout is low (e.g. 4,000), turn the calibration screw counterclockwise. If the readout is high, turn the screw clockwise.
7. Select a hysteresis (dead-band) operating point. This is a relative setting, i.e. maximum, minimum, and in-between. If you want the least amount of dead-band, turn the hysteresis adjustment potentiometer completely counterclockwise. (See Figure XI).
   Some dead-band may be desirable, depending upon individual situations. Since this is not a critical adjustment, you may want to gain some operating experience before changing it from the factory setting.
8. Place valve switch on "AUTO".
9. Hold the "READ-SET" switch down while adjusting the "SET" potentiometer until the Bar Graph readout is 4,000 micromhos (2,000 on the 0-5,000 model). Release the "SET" switch to the "READ" position. If the "VALVE & OPERATE" lights are not on, momentarily depress the "TEST" switch; the "VALVE" and "OPERATE" lights should come on and stay on indefinitely.
10. Hold the "READ-SET" switch down while adjusting the "SET" potentiometer until the Bar Graph readout is 6,000 micromhos. (3,000 on the 0-5,000 model). Release the "SET" switch to the "READ" position. If the "VALVE & OPERATE" lights are not on, momentarily depress the "TEST" switch and they should come on for the length of time indicated by the "DURATION" timer set point potentiometer.
11. This is a good time to set the sample interval and duration timers. A recommended starting point is 30 minutes interval, and 1 minute duration. Since the markings are relative, watch the controller and make sure that it is sampling at the proper interval and for the proper duration; readjust as required. The duration timer can be manually activated by momentarily depressing the "TEST" switch on the front panel.
12. The valve should be open and blowdown should be occurring whenever the "VALVE OPEN" legend is illuminated. NOTE: The "OPERATE" & "VALVE OPEN" lights are normally on together (HOA switch in the "AUTOMATIC" position). EXCEPTION: When the valve switch is in the "OPEN" or "CLOSED" position, the "OPERATE" light will come on periodically in accordance with the sampling program.
13. Push the probe switch to the right (See Figure XI)
14. Make sure that the boiler water chloride and chemical residuals are within recommended limits. Do not proceed until this has been accomplished.
15. Measure the conductivity of the water right out of the boiler. Do not neutralize the sample. Use a HyDAC portable conductivity tester with temperature compensation or a manual tester and a thermometer.
16. Depress & hold the "READ-SET" switch in the "SET" position while turning the "SET" potentiometer (front panel) so that the Bar Graph display indicates the conductivity of the measured boiler water.
17. Release the "READ-SET" switch.
18. Place valve switch in "ON".
19. Open the inner door and adjust the calibration potentiometer (See Figure XI) until the Bar Graph display indicates the same conductivity as set in Step 16. If the "apparent" conductivity is high, turn the screw clockwise; if low, turn the screw counterclockwise.
20. Close inner door.
21. Place valve switch in "AUTO".
22. **Set conductivity set point adjustment (Step 16) to desired boiler operating conductivity (if different than measured conductivity). For example, if the measured boiler water conductivity is 5,000 the controller must be calibrated to read 5,000 (Steps 16-19). Then you may readjust the set point to a lower or higher value as desired, but do not disturb the calibration adjustment. Place the probe switch in the left hand position (test position), then adjust the test calibration potentiometer to the desired mid-scale value. (See Figure XI). Don't forget to return the probe switch to the right hand position.**
23. Allow the system to stabilize for 24 hours before making further adjustments to the set point. Additional flexibility is achieved by varying the Internal and Duration timers.

MODU-MAX TROUBLE SHOOTING GUIDE
REFER TO CONTROLLER CHECKOUT AND ADJUSTMENT PROCEDURE

CHECK-OUT STEP	SYMPTOM	POSSIBLE CAUSE	REMEDY
2	Valve is open	Defective valve	Repair or replace valve
		Valve wiring is reversed	Correct wiring
3	"Valve Open" light is out	Blown fuse in the controller	Replace fuse. P/N 904256 (Buss GLH 10 or equivalent)
		No power to the controller	Check switches, circuit breakers/fuses and wiring
		Defective controller	Repair or replace controller (factory repair recommended)
		Defective "Valve Open" light	Replace light P/N 102701
		Defective transformer board	Replace transformer board
	Valve does not open	Defective valve	Repair or replace
6	No display	Previous calibration change	Complete Step 6
		Defective control module	Replace module P/N 301238-1 (0-10,000) or P/N 301309, (0-5,000)
9	Unable to adjust display	Defective control module	Replace module P/N 301238-1, (0-10,000) or P/N 301309, (0-5,000)
9 or 10	Controller doesn't sample	Defective control module	Replace module P/N 301238-1, (0-10,000) or P/N 301309, (0-5,000)
12	No blowdown occurring	Closed hand valve	Open hand valve
19	Unable to calibrate the unit	Defective probe wiring	Check wiring
		Fouled probe	*Clean probe
		Defective probe	*Replace probe, P/N 300966
		Water conductance is too low	Incorrect orifice plate or too frequent sampling or too long a sample duration

*IMPORTANT: Controller must be re-calibrated each time probe is cleaned/replaced. Proceed with Controller Check-Out and Adjustment, Steps 11 - 22 to re-calibrate unit. Test calibration potentiometer may require adjustment at this time also.

"A" BOX WIRING FOR
BALL VALVE

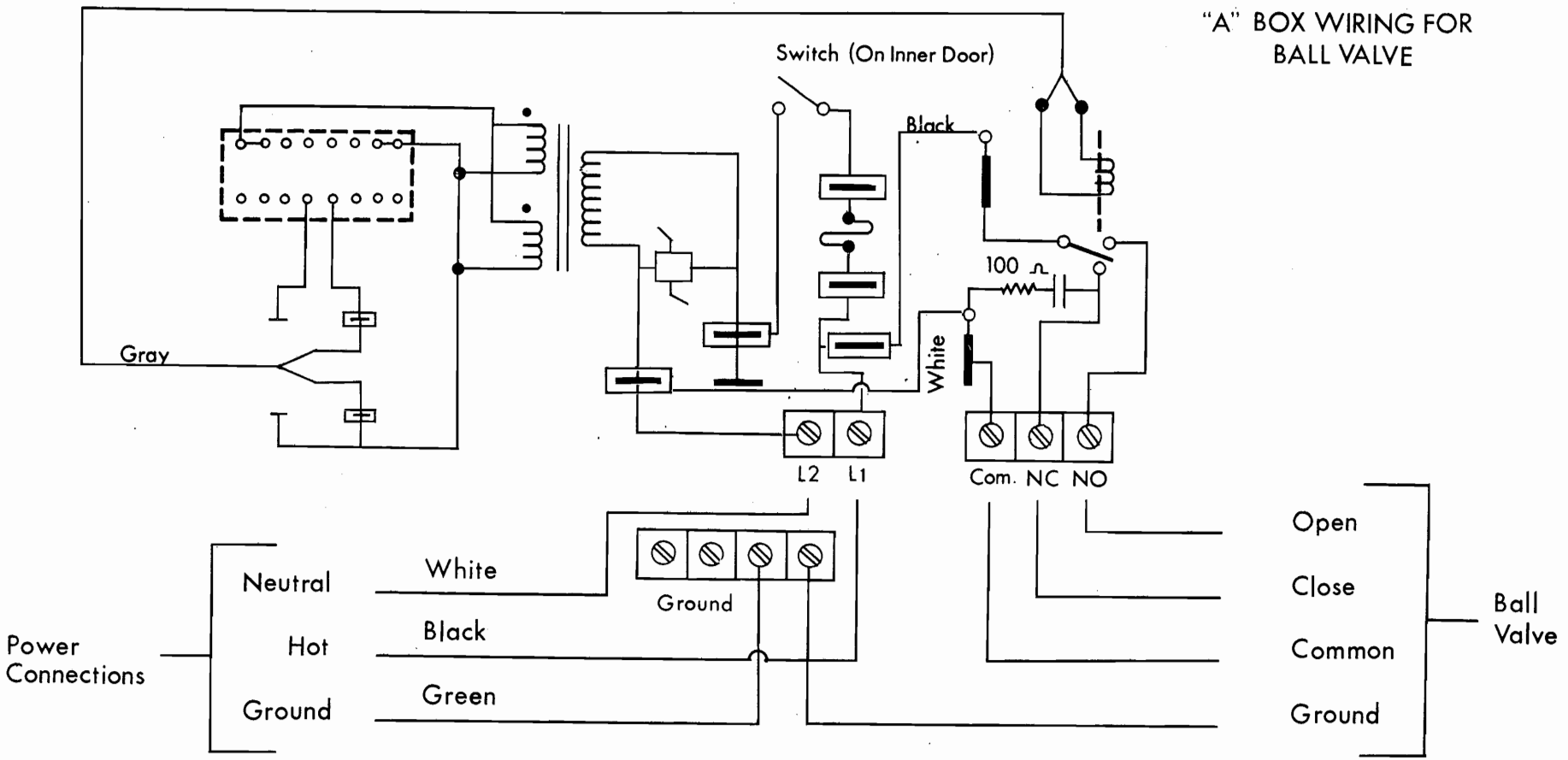
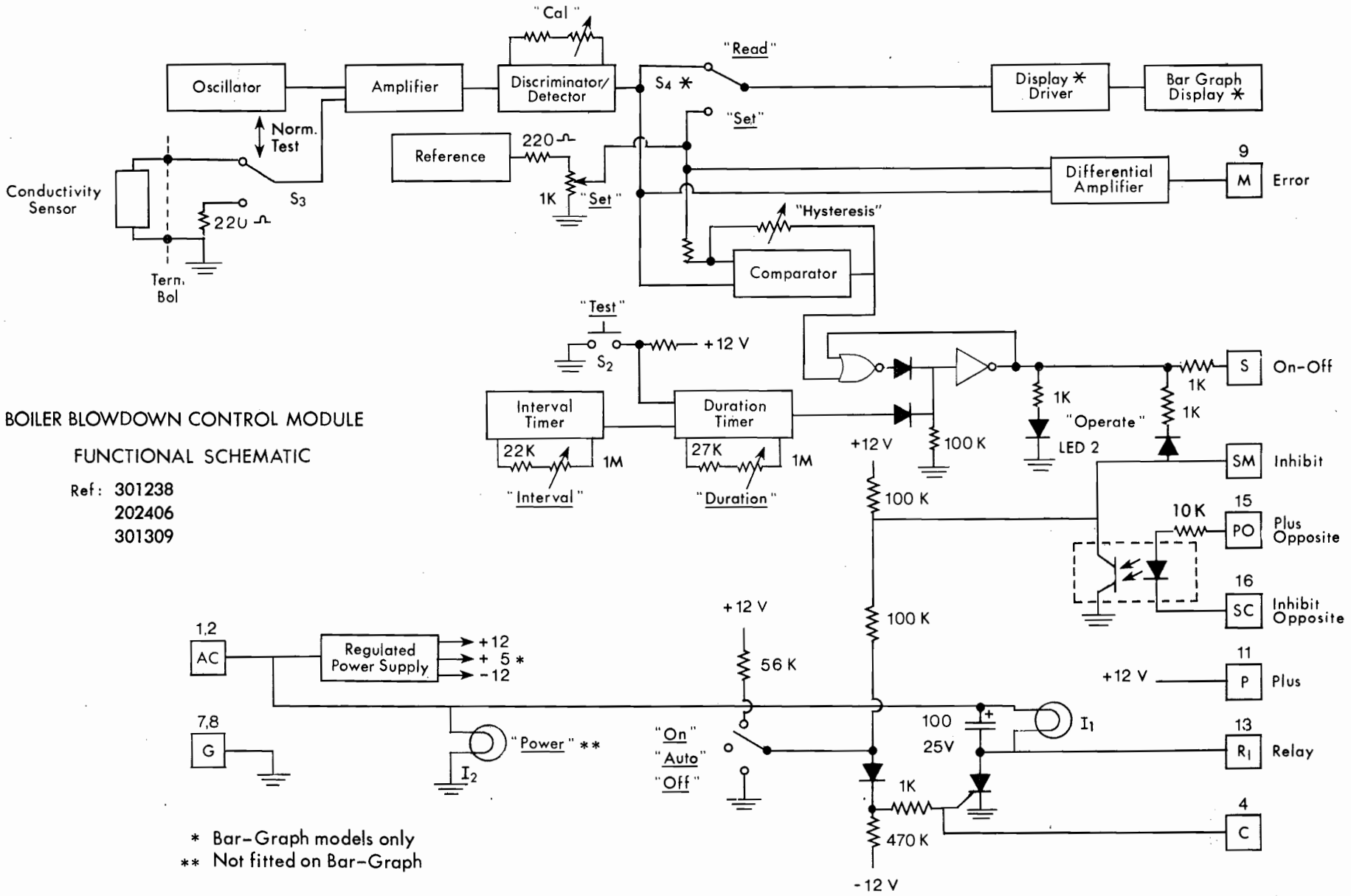


Figure XII



BOILER BLOWDOWN CONTROL MODULE

FUNCTIONAL SCHEMATIC

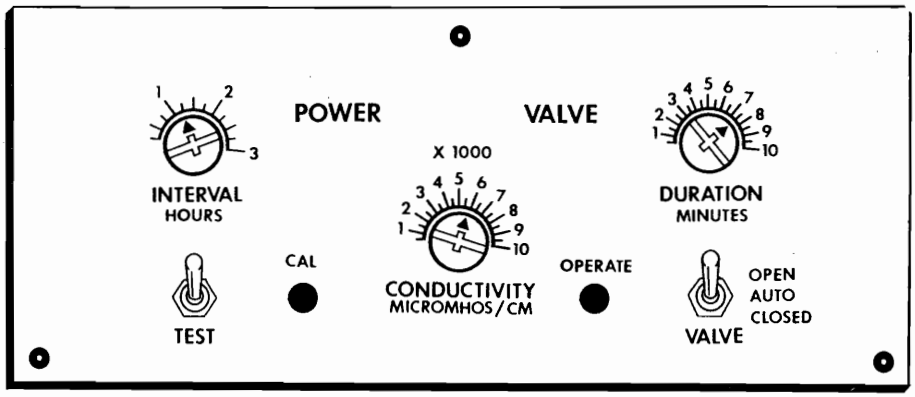
Ref: 301238
202406
301309

* Bar-Graph models only
** Not fitted on Bar-Graph

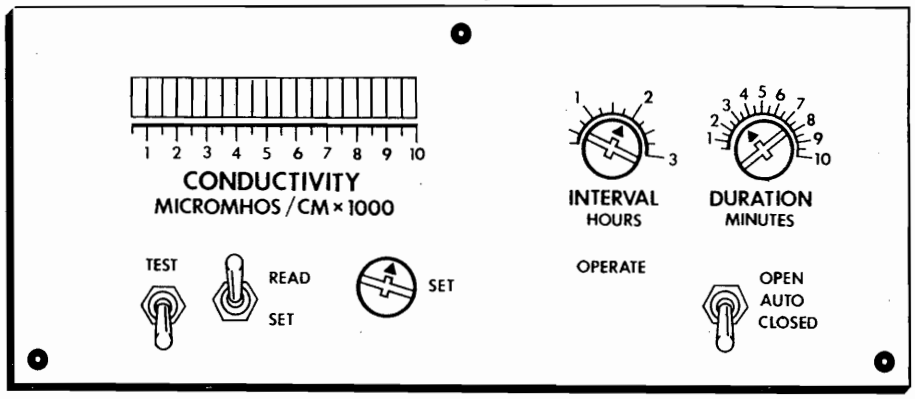
PARTS LIST

P/N 202406	Boiler Blow-Down Control Module with Indicating Dial
P/N 301238-1	Boiler Blow-Down Control Module with Bar Graph Display (0-10,000 micromhos range)
P/N 301309	Boiler Blow-Down Control Module with Bar Graph Display (0-5,000 micromhos range, not shown)
P/N 203072	Relay Module, 20 amp
P/N 202429	Cable Assembly
P/N 202771	Transformer Assembly
P/N 102700	Power Valve Light Bulb Assembly
P/N 904256	Fuse, Bussman # GLH 10
P/N 102706	Power Switch
P/N 300966	Probe Assembly
P/N 300519-1	Valve Assembly (optional)
P/N 301323	Valve and Probe Assembly (optional)

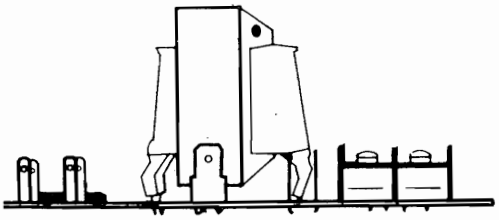
P/N 202406



P/N 301238-1
0 - 10,000
micromhos



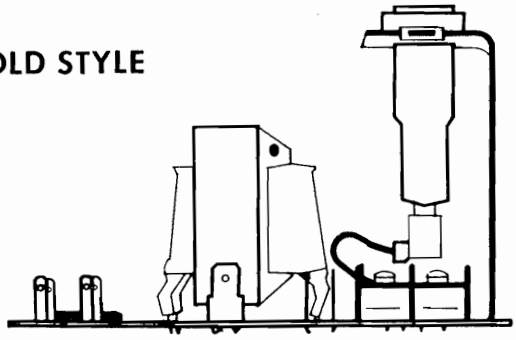
NEW STYLE



Transformer Assembly

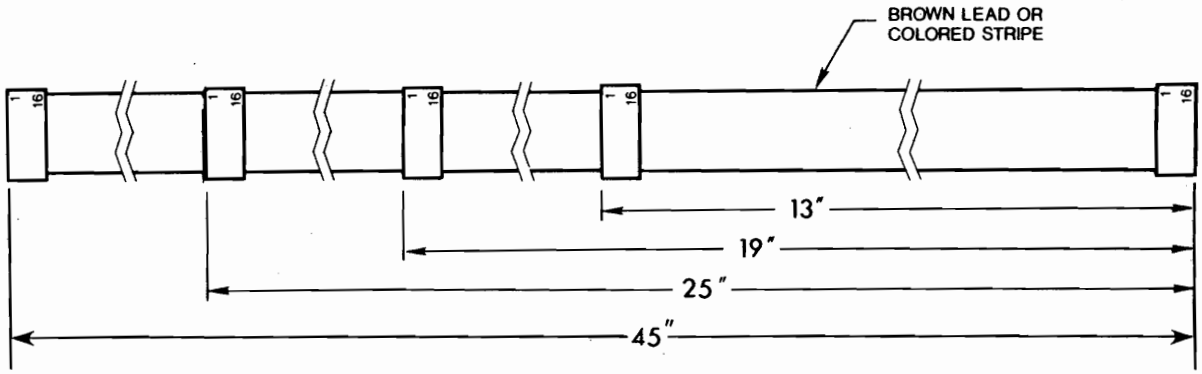
(Shown) P/N 202771 – A Enclosure
P/N 202787 – B Enclosure
P/N 202788 – C Enclosure

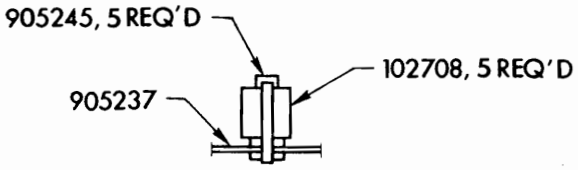
OLD STYLE



Transformer Assembly

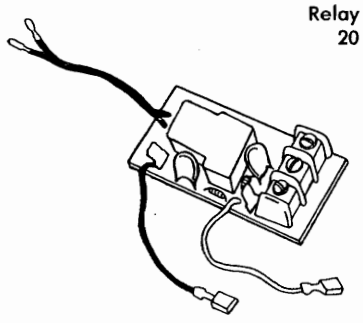
(Shown) P/N 202427 – A Enclosure
P/N 202491 – B Enclosure
P/N 202549 – C Enclosure



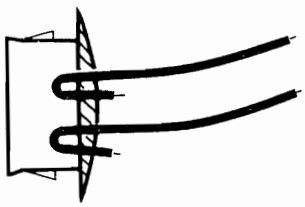


Cable Assembly

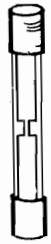
P/N 202429 – 4 connectors (A enclosures)
P/N 202490 – 5 connectors (B or C enclosures) – shown
P/N 202642 – 6 connectors (B,C or AR/BR enclosures)



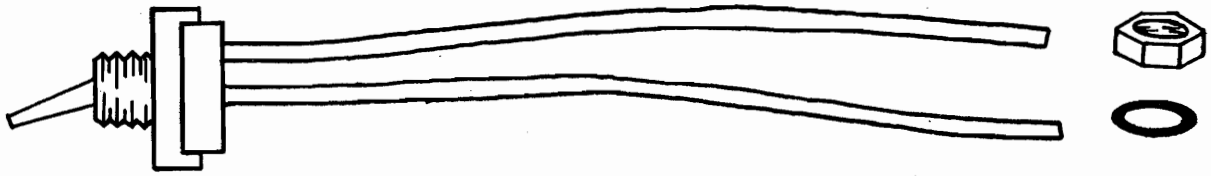
P/N 203072



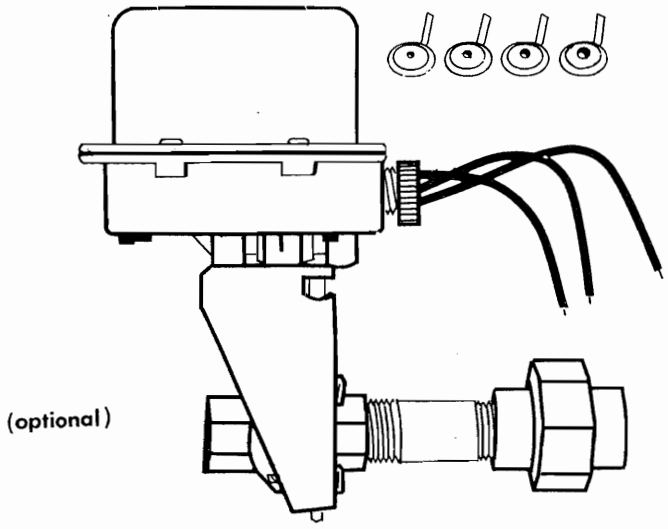
P/N 102700



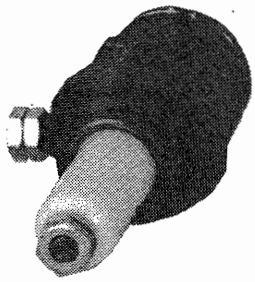
P/N 904256



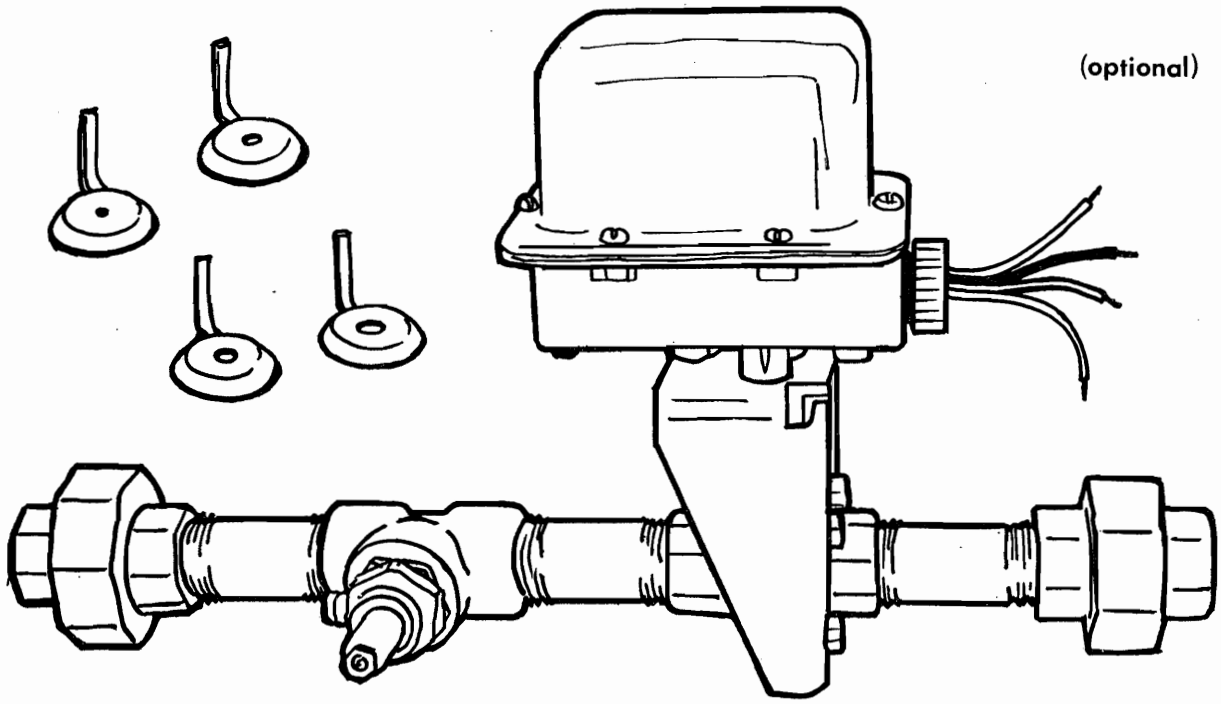
P/N 102706



P/N 300519-1



P/N 300966



P/N 301323

HyDAC® LIMITED TWENTY-FOUR MONTH WARRANTY

Cambridge Scientific Industries ("CSI") warrants each new item of HyDAC brand equipment manufactured and sold by CSI to be free from defects in materials and workmanship under normal use and operation in accordance with CSI instructions and use directions for a period of twenty-four (24) months from date of delivery to the original purchaser. Exception: pH probes are only guaranteed to be operational at the time of delivery. All claims must be submitted in writing within 30 days from the date of shipment from C.S.I.

CSI's obligations under this warranty are limited to the repair or replacement of any such item of equipment (or part thereof) shown to be defective or, at CSI's option, to refunding the purchase price of any such defective item of equipment less a reasonable allowance for prior use. Each item of equipment for which a warranty claim is asserted shall, at the request of CSI, be returned on a prepaid basis to CSI's factory at the expense of the purchaser. Replacement parts furnished by CSI shall be warranted as stated above for the unexpired portion of the original twenty-four (24) month warranty. This warranty does not extend to any item or part subjected to misuse, accident, improper installation, maintenance or application, improper packing by purchaser in return shipment to CSI, or to any item or part repaired or altered outside of CSI's factory without the express prior authorization of CSI.

THE FOREGOING WARRANTY IS IN LIEU OF ANY OTHER WARRANTY, EXPRESS OR IMPLIED, IN FACT OR IN LAW, INCLUDING WITHOUT LIMITATION THE WARRANTY OF MERCHANTABILITY OR THE WARRANTY OF FITNESS FOR PARTICULAR PURPOSE. IT IS EXPRESSLY UNDERSTOOD THAT PURCHASER'S SOLE AND EXCLUSIVE REMEDY IS LIMITED TO ENFORCEMENT OF CSI'S OBLIGATION AS SET FORTH ABOVE AND CSI SHALL NOT BE LIABLE TO PURCHASER OR OTHERS FOR LOSS OF USE OF THE EQUIPMENT OR FOR OTHER DIRECT, SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES.

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