Boiler-Matic 3000
Boiler Controller
Installation and Operating Manual

PREFACE

This manual describes how to use the Boiler-Matic 3000, a boiler controller / intermittent conductivity sampling system.

Material in this manual is subject to change without notice. Manual revisions will be made on an as needed basis. Special circumstances involving important design, operation or application information will be released via Technical Services Bulletins.

GENERAL INFORMATION

GENERAL DESCRIPTION

The HyDAC Series Boiler-Matic 3000 is a solid state device which automates surface blowdown in boilers, allowing operation at the maximum cycles of concentration with regards to Total Dissolved Solids (TDS).

The Boiler-Matic 3000 is an easy to use, automatic boiler blowdown controller with a periodic sampling schedule. The sampling interval is user selectable from every 15 minutes to once every 3 hours. The sample duration is also user selectable from 30 seconds to 10 minutes. The Boiler-Matic 3000 will periodically open an electric valve located in the skimmer blowdown line to sample the boiler water conductivity. If the system conductivity is below the setpoint, the valve will close after the sample duration. If the conductivity is above the setpoint, the valve will remain open until the desired conductivity level is obtained. The periodic sampling schedule will repeat to maintain the desired system conductivity level.

A complete system would include (minimum requirements):

- HyDAC Series Boiler-Matic 3000 Boiler Conductivity Controller
- Boiler Conductivity Probe
- Electric Blowdown Valve
- Properly Sized Throttling Device

STANDARD SPECIFICATIONS

Control Range

0-7,000 microsiemens/cm

Blowdown Output

2 wire or 3 wire

Sample Frequency

Adjustable – 15 minutes to 3 hours

Sample Duration

Adjustable – 30 seconds to 10 minutes

Calibration

Field Adjustable

Net Weight

5.89 lb.

Enclosure Type

NEMA 4X Thermoplastic

Dimensions (overall)

10 H x 8 W x 4 D in.

Power Requirements

115 VAC, 50/60 Hz

Ambient Temperature

140°F (60°C) Max

Humidity

0-100% RH Non-Condensing

Power Output

115 VAC, 50/60 Hz, 10 Amperes Combined Maximum Load)

INSTALLATION

MOUNTING

The HyDAC Series Boiler-Matic 3000 Boiler conductivity controller should be installed in an accessible, well lit, dry location. The enclosure may be bolted to a wall or any flat surface by means of four flange holes.

If installed outside it should be protected from direct sunlight and rain. In cold weather climates provisions must be made to prevent freezing.

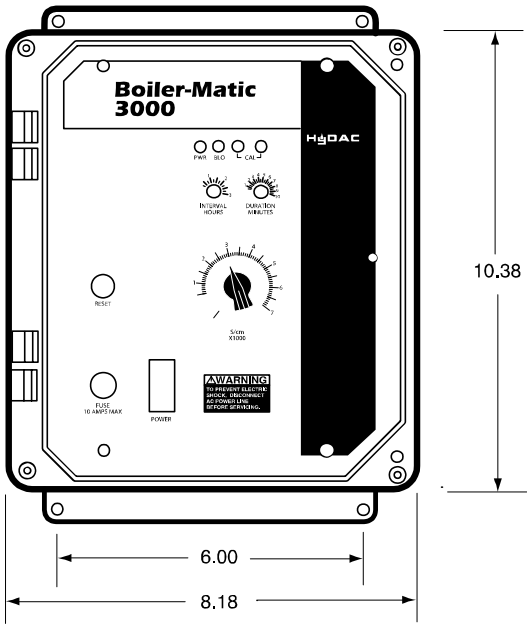


Figure 1.

ELECTRICAL REQUIREMENTS

- A dedicated AC power source free of noise, transients and voltage sags is needed for proper operation.
- Input power is 115 VAC, 60 cycle at 10 Amperes
- Electrical installation must conform to all applicable electrical codes and regulations.

ELECTRICAL CONNECTIONS

- All connections are made inside of the enclosure.
- Each controller is shipped with a removable connection panel with conduit knockouts. Water tight conduit is recommended if the controller will be exposed to rain, splashing water or spray.
- Do not route high voltage (115 VAC) and signal (probe) wiring in the same conduit. Always run them separately.
- All power wiring must be wired according to local electrical codes.
- Wiring to the probe should be 2-conductor stranded, shielded 18 gauge wire.
- Distance from probe to controller should not exceed 50 feet (15.2 meters).
- Refer to the **Boiler-Matic 3000/4000 Wiring Detail** on the next page for electrical connections.

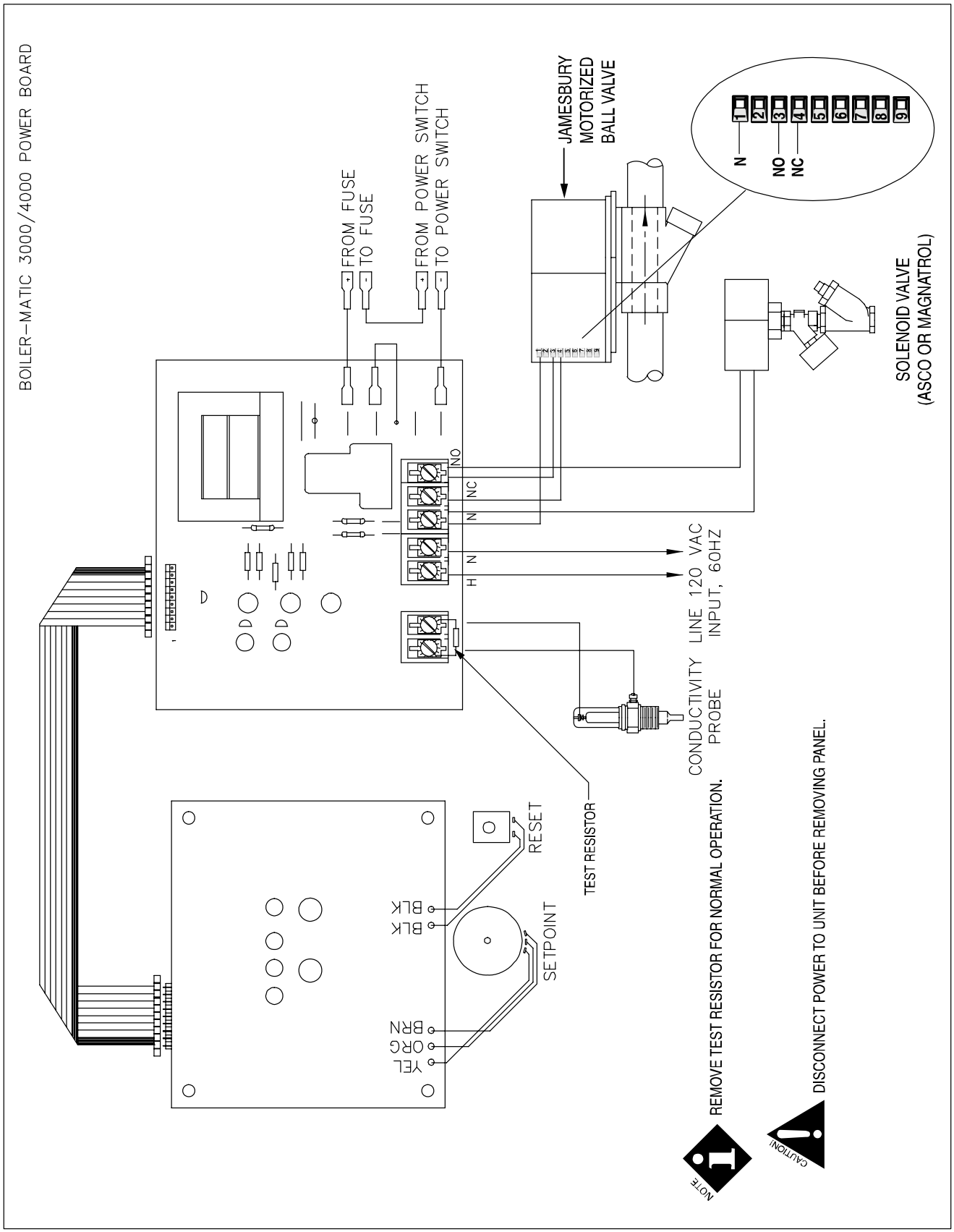

BOILER–MATIC 3000/4000 POWER BOARD
FROM FUSE
TO FUSE
FROM POWER SWITCH
TO POWER SWITCH
JAMESBURY
MOTORIZED
BALL VALVE
N
NO
NC
SOLENOID VALVE
(ASCO OR MAGNATROL)
NO
NC
N
H N
LINE 120 VAC
INPUT, 60HZ
CONDUCTIVITY
PROBE
TEST RESISTOR
RESET
SETPOINT
BLK
BLK
BRN
ORG
YEL
NOTE
REMOVE TEST RESISTOR FOR NORMAL OPERATION.
CAUTION!
DISCONNECT POWER TO UNIT BEFORE REMOVING PANEL.

Figure 1.1

BLOWDOWN PIPING ASSEMBLY

Blowdown piping assembly consists of a blowdown valve, throttling device, probe, probe tee and manual shutoff valve.

*Installation of the blowdown piping assembly and probe are critical to the operation of the Boiler-Matic 3000. Refer to the **Boiler-Matic 3000 Piping Outline** on the next page and **Appendix B**.*

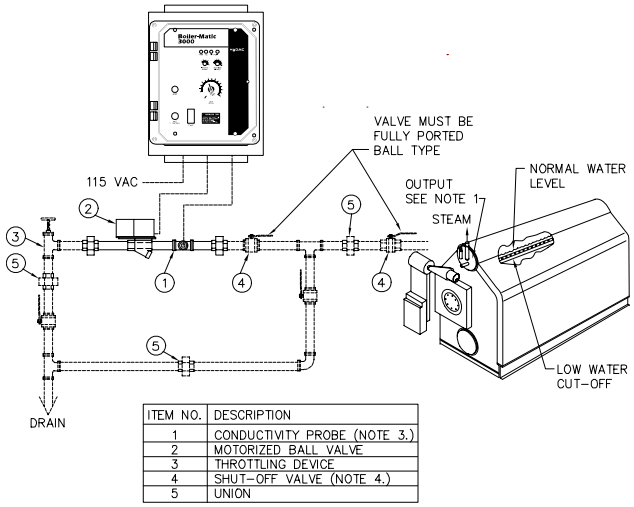
- Maintain pipe sizing throughout the blowdown piping assembly, while minimizing the use of tees, elbows, unions, etc. This is done to limit stream flashing.
- Recommended throttling device is a needle type flow control valve. Orifice plates such as in Beta's blowdown valve assemblies can also be used.
- Recommended blowdown valve is a motorized ball valve.
- Remove any existing throttling valves or devices.
- The skimmer blowdown line extending into the boiler must be installed below the normal water level but above the low water level cut-off point.

The skimmer pipe must be capped at both ends to insure that samples are drawn through the sample holes. The sample holes, located along the length of the skimmer line, must be drilled in the pipe horizontally. These 3/8" holes must have a combined area equal to 2 times the internal area of the skimmer pipe.

A cross sectional piece of 3/4" Schedule 40 skimmer line has an area of .53 square inches. The total area of the 3/8" holes must be equal to 2 times .53" or 1.06". Since the area of a 3/8" hole is 0.11", then there should be a minimum of 10 holes drilled in the skimmer blowdown pipe.

Consult boiler manufacturer's drawings for details and / or contact a certified inspector for further information.

Do not install the blowdown piping assembly on the bottom blowdown line, nor off any other lines not intended for this specific use. SURFACE BLOWDOWN LINE ONLY!



ITEM NO.	DESCRIPTION
1	CONDUCTIVITY PROBE (NOTE 3.)
2	MOTORIZED BALL VALVE
3	THROTTLING DEVICE
4	SHUT-OFF VALVE (NOTE 4.)
5	UNION

Figure 2. Typical Boiler-Matic 3000 Piping Outline

1. Skimmer blowdown line should be installed 6" below normal water level, but must be located above low water cut-off point. Consult boiler manufacturer for proper installation.
2. Only piping drawn in full detail is available from Beta. Dotted components are custom-supplied.
3. The conductivity probe must remain in horizontal position. Probe tee can be rotated 180° in the fitting if not easily serviceable.
4. All shut-off valves before the probe must be fully ported.
5. If a spring-return valve (e.g., solenoid valve) is used, use the open and common terminals in the controller. Do not use the closed terminal. Be sure to include the ground.
6. Probe tee must be mounted within 7 to 10 feet of a horizontal pipe. The probe must be mounted horizontally.
7. Items 3 and 4 are not included.
8. If using Beta-sourced motorized valve (Jamesbury) the maximum ambient temperature for the actuator is 150°F (66°C). Temperatures over this limit may cause thermal cutout of the valve operation.

BOILER CONDUCTIVITY PROBE MOUNTING

The standard Conductivity Probe is usable for pressures up to 300 psig at temperatures up to 425°F. For applications exceeding these parameters, please consult your local Beta Representative.

The boiler Conductivity Probe should be mounted in the surface blowdown piping.

Install the probe horizontally within 7 to 10 feet from the boiler, with 24" of straight pipe before the probe.

The probe should be mounted close to the boiler so that the representative samples will occur rapidly with minimum blowdown and heat loss.

The Conductivity Probe must remain in the horizontal position in a horizontal section of the blowdown piping. To minimize the causes of steam flashing, use as few elbows and tees before the probe as possible. The probe tee may be rotated 180° to make it accessible for servicing. Refer to **Appendix B** for details.

PRE START-UP PROCEDURE

SYSTEM CHECK

Before placing system into operation, check the following:

- All piping is installed correctly and checked for leaks.
- Lines have been flushed and strainer is clean.
- Wiring is correct and terminals are tight.
- Blowdown discharge point is clear and safe with no splashing, etc.

START-UP AND OPERATING PROCEDURES

PRELIMINARY ADJUSTMENTS

The following adjustments are a starting point and should be rechecked after several days of operation. Readjustment for optimum conditions will conserve water and fuel.

- Ensure the throttling valve is open enough to satisfy blowdown requirements without causing steam flashing. See **Appendix A.**
- With a screwdriver, adjust the SAMPLE DURATION potentiometer to 1 minute.
- With a screwdriver, adjust the SAMPLE INTERVAL potentiometer to 30 minutes.

INITIAL CALIBRATION

The “CAL” LED simply indicates whether boiler conductivity is higher than setpoint value. If it is “ON” conductivity is higher, if it is lower, it is “OFF”.

The following adjustments are a starting point and should be rechecked after several days of operation. Readjustment for optimum conditions will conserve water and fuel.

- Measure the boiler water conductance using a portable conductivity tester. Do not neutralize the sample.
- Note the present boiler water conductivity reading.
- Turn the setpoint knob to the present boiler water conductivity reading.
- With the Boiler-Matic 3000 power on, press the red RESET button.
- Wait 30 seconds to allow the blowdown line to clear. Blowdown light must remain illuminated. If it extinguishes, press the red RESET button again and continue.
- With a screwdriver adjust the CALIBRATION potentiometer until the light just extinguishes. Rotate adjustment clockwise and counterclockwise until the calibration light just illuminates and then extinguishes.

This is your initial adjustment. Return the black setpoint knob to desired control setpoint. Final calibration adjustment should be performed as close to operative setpoint as possible.

If you notice any flickering of the “cal” LED while performing the initial calibration, this is an indication of steam flashing. Refer to Appendix B and Troubleshooting section (“High TDS” symptoms) of this manual.

ONGOING ADJUSTMENTS

After several days of operation adjustments may be necessary to fine tune control for optimum water and fuel savings. Described below are the possible adjustments and their affect on control.

Sample Interval

Controls how often a boiler water sample is taken and measured. It is adjustable from 15 minutes to 3 hours. Use a 30-minute sample for boilers that cycle quickly due to a high load. Adjust higher for boilers with a lower load.

Sample Duration

Controls the minimum time of sampling. Adjustable from 30 seconds to 10 minutes. For optimum control this setting should be as low as possible and yet long enough for the blowdown line to purge old stagnant water, come to temperature and pass a representative sample of fresh boiler water. Typically 30 seconds to 1 minute is adequate.

Blowdown Throttling

Adjusting the throttling device determines the rate of blowdown. **Appendix A** lists blowdown flow for various devices. Throttling must allow for adequate flow to satisfy the boiler blowdown requirement while small enough to prevent the water from flashing to steam. See **Appendix B**.

MAINTENANCE

CONDUCTIVITY PROBE

The Boiler-Matic 3000 is made with state-of-the-art, solid- state electronics and requires scheduled maintenance only for the Conductivity Probe. The need for cleaning the Conductivity Probe is usually indicated by frequent readjustment of the setpoint knob to hold the setpoint or Conductivity level.

- Before removing the Conductivity Probe, close the manual shutoff valve between the probe and boiler. Depress the RESET switch which opens the blowdown valve and relieves the pressure.
- The probe can be cleaned with a clean cloth; use steel wool if there is scale buildup. A mild acid solution can also be used to dissolve stubborn scale.
- After replacing the probe, open the manual shutoff valves, check all switches for position and recalibrate the Conductivity Controller.

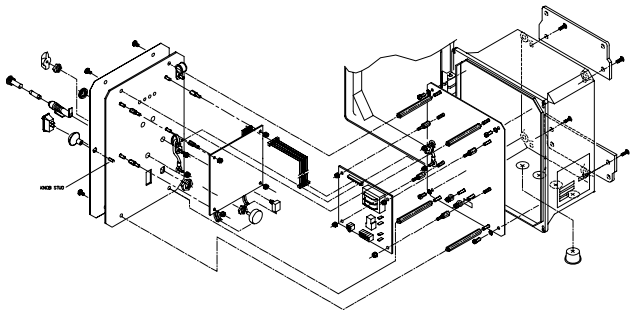
TROUBLESHOOTING

SYMPTOM	OBESERVATION	CHECK
System dead	Power lamp out	External power source Main fuse blown External power wiring
High TDS	Power lamp lit Blowdown lamp lit Blowdown pipe cold	Manual shutoff valve closed Blowdown line plugged Throttling valve closed or not properly sized
High TDS	Power lamp lit Blowdown lamp lit Blowdown valve open Blowndown line hot	Throttling valve not open enough Controller setpoint to high Fouled probe Sample length setting too short Too many throttling valves (See Appendix B)
High TDS	Steam flashing “Cal LED flickers” of ten while sampling	Surface blowdown line drawing steam due to low water level in relation to pipe elevation inside boiler (See Appendix B)
High TDS	Boiler pressure too low	Make sure probe tip is submerged during sampling. If keeping probe tip submerged is a problem, try adding a ¾” nipple and coupling to the probe tee to provide more area for probe tip to sense.
Low TDS	Blowdown time short	Sample length too long Throttling valve opening too large Freshly clean boiler water (See Appendix B) Excessive bottom blowdown (See Appendix B) Bypass valve settling (See Appendix B)

Testing PCB

A test resistor (220 ohm, 1/4 watt 5%) is included with unit and installed in the probe connection input when shipped from the factory. Remove this resistor for normal operation. If PCB or probe is suspected faulty, this test resistor can be connected in lieu of the probe. It represents 2,500 micromho when connected. Follow calibration procedure using this test resistor to determine if PCB is functioning properly. (See Figure 1.1 for hook-up).

REPLACEMENT PARTS



Surface Blowdown Piping Assembly Parts

Item Number	Description
051642	Boiler probe (stainless steel/Teflon)
059849	Boiler probe w/tee and bushing
031211	Jamesbury valve and actuator, complete
031213	Actuator for valve (Jamesbury)
031215	Valve, ball only (Jamesbury)
031216	Valve repair kit (Jamesbury)
027042	Asco solenoid valve
034669	Strainer
015300	Orifice union kit

PCB's and Other Parts:

Item Number	Description
069387	PCB, Power kit (for older units with mounting channels pre-1994)
099532	PCB, Power
015871	PCB, Main
031740	Test resistor
011028	Reset switch
020942	Fuse, 10A

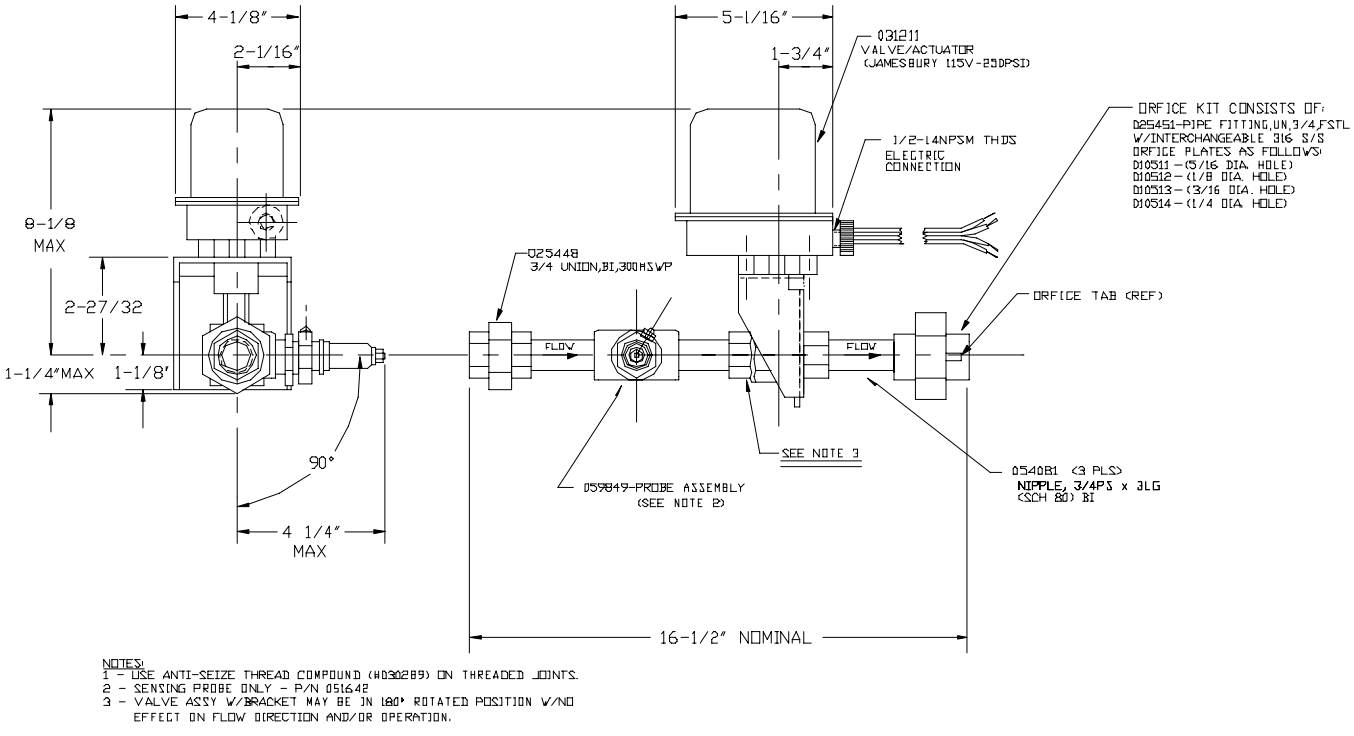


Figure 2.1 Jamesbury Motorized Valve Assembly

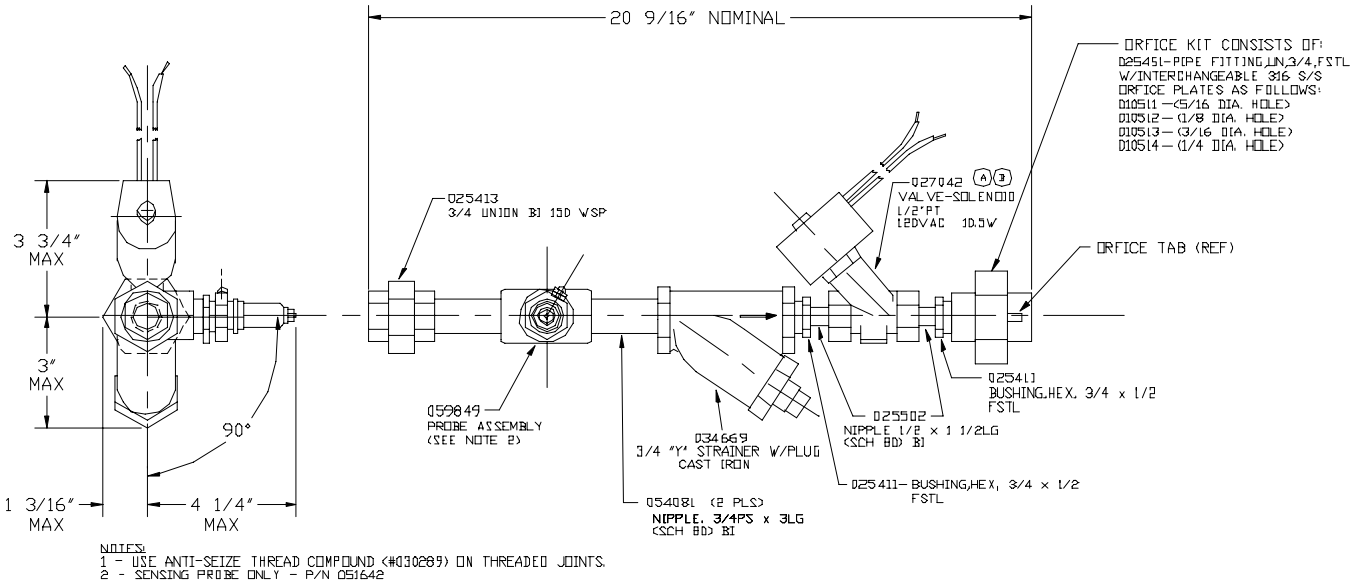


Figure 2.2. Asco Solenoid Valve Assembly

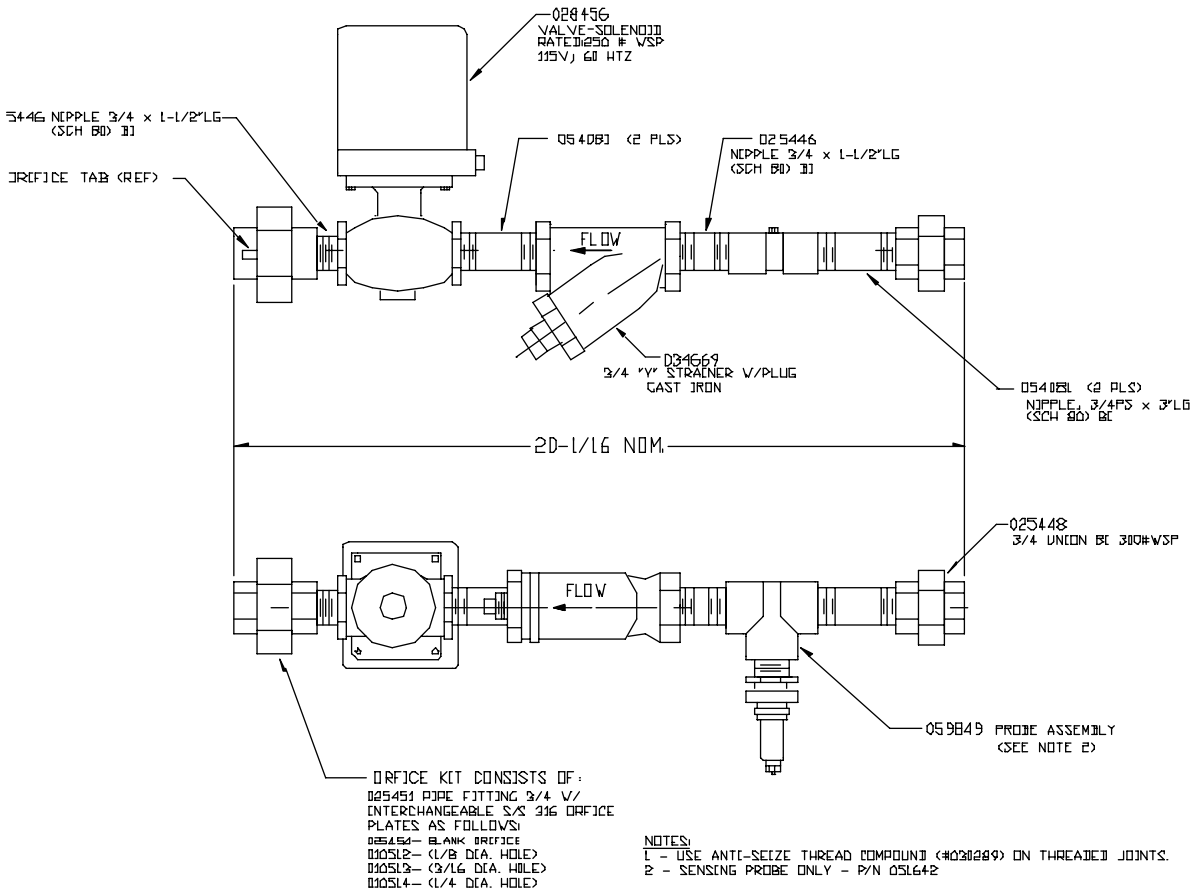


Figure 2.3 Magnetral Solenoid Valve Assembly

APPENDIX

A. THROTTLING VALVE/ORIFICE DISK SIZING CHART

Note: Tasco valve size indicates inlet and outlet thread size.

BOILER OPERATING PSIG	TASCO VALVE 150 PSIG RATING				TASCO VALVE 300 PSIG RATING				3/4" ORIFICE UNION WITH		
	3/8' 150#	1/2" 150#	3/4" 150#	1" 150#	3/8" 300#	1/2" 300#	3/4" 300#	1" 300#	1/8" Orifice	3/16" Orifice	1/4" Orifice
	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PPH	PPH
15	475	1,450	2,350	5,000	570	1,750	4,250	7,500	570	1,420	2,350
20	550	1,600	2,750	5,900	720	1,975	4,725	8,500	660	1,600	2,750
25	610	1,800	3,050	6,500	860	2,200	5,200	9,500	740	1,800	3,050
30	660	1,990	3,300	7,000	990	2,375	5,570	10,500	810	1,990	3,300
35	700	2,100	3,550	7,500	1,360	2,550	5,940	11,500	870	2,100	3,550
40	760	2,250	3,750	8,000	1,420	2,725	6,310	12,000	940	2,250	3,750
45	800	2,400	4,000	8,500	1,650	2,825	6,680	12,500	990	2,400	4,000
50	850	2,500	4,170	9,000	1,900	2,950	7,150	13,000	1,050	2,500	4,170
60	900	2,800	4,500	9,800	2,000	3,180	7,490	14,000	1,150	2,800	4,500
70	1,000	3,000	4,800	10,600	2,150	3,420	7,850	15,000	1,250	3,000	4,800
80	1,070	3,200	5,100	11,250	2,400	3,600	8,400	16,000	1,340	3,200	5,100
90	1,120	3,400	5,400	11,750	2,600	3,800	9,200	17,000	1,420	3,400	5,400
100	1,200	3,500	5,720	12,250	2,800	4,000	10,000	18,000	1,500	3,500	5,720
110	1,250	3,600	6,000	12,750	2,950	4,180	10,600	18,800	1,580	3,600	6,000
120	1,300	3,750	6,200	13,250	3,100	4,350	11,200	19,600	1,650	3,750	6,200
130	1,350	3,900	6,400	13,750	3,250	4,510	11,700	20,400	1,720	3,900	6,400
140	1,400	4,100	6,600	14,250	3,400	4,630	12,100	21,200	1,790	4,100	6,600
150	1,450	4,250	6,800	14,700	3,600	4,750	12,500	22,000	1,860	4,250	6,800
175					4,000	5,000	13,500	23,500	2,020	4,530	8,050
200					4,350	5,500	14,500	25,000	2,160	4,860	8,630
225					4,600	5,850	14,900	26,500	2,300	5,170	9,190
250					4,900	6,050	15,500	28,000	2,430	5,470	9,730
275					5,200	6,400	16,000	29,000	2,560	5,750	10,230
300					5,600	6,700	16,800	30,000	2,680	6,030	10,270

Figure 4. Calculated Blowdown Based on Feedwater for Sizing Throttling Valves

CONTINUOUS BLOWDOWN

$$\frac{\text{PPH}}{\text{Cycles}} \quad \frac{(\quad)}{(\quad) - 1} = (\quad)\text{PPH}$$

AUTOMATIC (INTERMITTENT) BLOWDOWN

$$\frac{\text{PPH}}{\text{Cycles}} \quad \frac{(\quad)}{(\quad) - 1} \times 3 = (\quad)\ \text{PPH}$$

Converts to Boiler HP - One Boiler HP = 34.5 PPH Steam
EXAMPLE: 10000 PPH (Pounds per Hour) Steam, 8 Cycles, 120 psig

FOR CONTINUOUS BLOWDOWN USE

1/2" 150 psig Tasco Valve

$$\frac{10000}{8\text{-}1} = 1429\ \text{PPH}$$

FOR AUTOMATIC BLOWDOWN USE

3/4" 150 psig Tasco Valve

$$\frac{10000}{8\text{-}1} = 1429\ \text{PPH X3} = 4287\ \text{PP}$$

B. TERMS

Steam Flashing

In a steam boiler, the water exists as steam and liquid. The blowdown piping in the boiler should pull water and only water, NOT STEAM. As the water flows through the piping, the pressure will drop without a corresponding reduction in temperature, which will cause the water to flash to steam. Restrictions in the blowdown will cause a pressure drop, leading to flashing. As the flow through the line is increased, the restriction causes more pressure drop and more flashing.

The electrical conductance of steam is very low. If steam flashing occurs, the Boiler-Matic 3000 will read a false low reading or fluctuate dramatically.

Skimmer Pipe Drawing Steam

If the boiler water level drops below the skinner pipe in the boiler, steam will enter the blowdown line. Steam appears as low Conductivity and will cause the blowdown to close, even though the TDS may be high. To prevent this, the skimmer pipe elevation should be lowered but kept above the low water cut-off. Refer to Boiler Manufacturer Instructions.

Bypass Valve Setting

If a bypass valve is piped around the motorized valve, it must remain closed unless it is used with a heat recovery unit, when approximately 50% of the required blowdown should be taken through the bypass.

Throttling Devices

The throttling device specified with the Beta control has been sized to control the blowdown rate based on boiler size, pressure and cycles of concentration. Any restrictions or secondary throttling valves will decrease the blowdown rate and may cause high TDS,

Skimmer Pipe Configuration

A series of holes drilled along the length of the header pipe inside the boiler permits even withdrawal of the boiler water. If these holes are partially plugged or scaled, there may an excessive pressure drop, which will cause the boiler water to flash to steam inside the boiler blowdown pipe.

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