SUBMITTAL DATA
FOR
SAMPLE
SUBMITTAL
Thank you for purchasing this fine Superior Boiler Works product. Our quality products are unmatched anywhere in the marketplace today and in an effort to maintain that leadership, we have put together this submittal for your review.

We ask that you review this document carefully and promptly as it will become final after approval of this submittal and authorization to release. Any changes that are requested after that time will carry substantial re-work, re-engineering and/or restocking charges.

If you have questions, or need to make changes to this unit, please contact your distributor as soon as possible.

Thank you for choosing Superior Boiler Works.
### Model: CR-ST-2000-W80-PF-G

**Input:** 2000 MBH  
**Output:** 1920 MBH  
**Design Pressure:** 80 PSIG  
**Operating Pressure:** 65 PSIG  
**Nameplate:** Superior Paint Red/Black  
**Safety Valve(s):** CONBRACO

1. 10-606  
   **Size:** 1.25" x 1.25"  
   **Set at:** 80 PSIG  
   **Operator:** L4006A 1959  
   **Limit:** L4006E 1125  
   **Firing Rate:** w/Burner  
   **Low Fire Hold:** N/S

**Pressure Gauge:** THERICE 600CB-45-02-L-A-130  
**Dial:** 4 1/2"  
**Range:** 0-200 PSI  
**Temperature Gauge:** WEKSLER AF04-4-4-FS-X  
**Dial:** 5.00"  
**Range:** 50/400 °F  
**Troubicator:** N/S  
**Dial:**  
**Range:**  
**Drain Valve:** N/S  
**Condesate Drain Valve:** N/S  
**Fig. No.:**  
**Size:**

**Instrumentation Spool:** Not Supplied

**All Controls Field Installed and Wired.**

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**Burner Information:**

**Mfg.:** POWER FLAME  
**Model:** FDM 300  
**Voltage:** 120 Volt  
**Motor:** 3/4 HP

**Burner Operation:** Modulation  
**Control Panel:** MOUNTED  
**Burner:** REMOTE

**Fuels:** Natural Oil  
**Firing Rate:** gas 2000 CFH of 1000 BTU/CF

**Blower Motor:** 3/4 HP

**Available Gas Pressure:** 7"-14" WC  
**GAS TRAIN:** MOUNTED  
**Pressure Atomizing Oil Pump:** X

**Codes:** UL, CSD-1, IRI, FM, NFPA 85  
**Special Instructions:**

**Mount & Wire Burner & Gas Train Only.**

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**Completed By:**  
**Date:** 7/9/14  
**Sales:** SH  
**Eng.:** TLT  
**Date Req'd:** __________  
**Manuals Req'd:** 2  
**Revisions:**

<table>
<thead>
<tr>
<th>Rev.</th>
<th>Date</th>
<th>By</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>8/20/14</td>
<td>SH</td>
</tr>
<tr>
<td>B</td>
<td>11/10/14</td>
<td>JB</td>
</tr>
</tbody>
</table>

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**Anticipated Codes:**

**UL**  
**CSD-1**  
**IRI**  
**FM**  
**NFPA 85**

**Electrical Test Only:** Full Firetest

**Not applicable:**

- N/A
- N/S
- CF

**Customer Furnished:**

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**Additional Information:**

- R&D Sheet
- Spec Sheet - Creek
- S.O. No.: 15A90547
- Nat. Board No.: __________
- Date Received: 7/2/14
- Rev.: __________
- Status: Wa&R
- Job: NYC - PS 163
- Location: New York, NY
- Sold To: Alstrom Heat Transfer LLC
- 1408 Seabury Ave
- Bronx NY 10461

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**Burner to Meet the Following Codes:**

- CSD-1
- UL Label
- Electrical Test Only
- Full Firetest
- M
- L
- P
- Shipped Mounted
- Shipped Loose
- Prepiped/Shiped Loose
- Not Applicable
- Not Supplied
- Customer Furnished
CREEK ST
CONDENSING BOILER

High Efficiency Condensing Boiler
<table>
<thead>
<tr>
<th>Model</th>
<th>ST-300</th>
<th>ST-500</th>
<th>ST-750</th>
<th>ST-1000</th>
<th>ST-1400</th>
<th>ST-2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUT (btu/hr)</td>
<td>300,000</td>
<td>500,000</td>
<td>750,000</td>
<td>1,000,000</td>
<td>1,400,000</td>
<td>2,000,000</td>
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<tr>
<td>FUEL CONSUMPTION NG (ft³/hr)</td>
<td>300</td>
<td>500</td>
<td>750</td>
<td>1,000</td>
<td>1,400</td>
<td>2,000</td>
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<tr>
<td>FUEL CONSUMPTION #2 OIL (GPH)*</td>
<td>2.1</td>
<td>3.6</td>
<td>5.4</td>
<td>7.1</td>
<td>10</td>
<td>14.3</td>
</tr>
<tr>
<td>OUTPUT (btu/hr)</td>
<td>285,000</td>
<td>475,000</td>
<td>712,500</td>
<td>950,000</td>
<td>1,330,000</td>
<td>1,900,000</td>
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<tr>
<td>WATER CONTENT (gal)</td>
<td>40</td>
<td>55</td>
<td>81</td>
<td>75</td>
<td>104</td>
<td>148</td>
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<tr>
<td>DRY WEIGHT (lbs)</td>
<td>975</td>
<td>1140</td>
<td>2200</td>
<td>2300</td>
<td>3200</td>
<td>3940</td>
</tr>
<tr>
<td>OPERATING WEIGHT (lbs)</td>
<td>1310</td>
<td>1600</td>
<td>2875</td>
<td>2925</td>
<td>4065</td>
<td>5175</td>
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<tr>
<td>WIDTH (in)</td>
<td>28 1/2</td>
<td>28 1/2</td>
<td>32 5/8</td>
<td>32 5/8</td>
<td>36 3/4</td>
<td>36 3/4</td>
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<tr>
<td>HEIGHT (in)</td>
<td>71 3/8</td>
<td>71 3/8</td>
<td>77 1/2</td>
<td>77 1/2</td>
<td>80 1/2</td>
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<tr>
<td>DEPTH (in)</td>
<td>36 1/2</td>
<td>49 5/8</td>
<td>60 5/8</td>
<td>60 5/8</td>
<td>71</td>
<td>91 3/8</td>
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<tr>
<td>STACK CONNECTION O.D.</td>
<td>6</td>
<td>7 1/4</td>
<td>8</td>
<td>8</td>
<td>10</td>
<td>10</td>
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<tr>
<td>WATER INLET/OUTLET DIA.</td>
<td>2</td>
<td>2</td>
<td>2 1/2</td>
<td>2 1/2</td>
<td>4</td>
<td>4</td>
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<tr>
<td>MIN CLEARANCE TO CEILING</td>
<td>20</td>
<td>20</td>
<td>20</td>
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<tr>
<td>MIN SIDE CLEARANCE</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
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<tr>
<td>SYSTEM FILLING/DRAINAGE</td>
<td>1 FPT</td>
<td>1 FPT</td>
<td>1 FPT</td>
<td>1 FPT</td>
<td>1 FPT</td>
<td>1 FPT</td>
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</tbody>
</table>

**PRESSURE DROP vs GPM**

+ Sizes range from 300,000 - 2,000,000 btu/hr
+ High water volume w/ low waterside pressure drop reducing system pump HP
+ Twin water return for maximum efficiency
+ Complete heat exchanger made w/ 316Ti
+ Available w/#2 fuel oil
+ Available w/ low emissions < 9ppm technology

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Model Number
ST-300 & 500
ST-750 & 1000
ST-1400 & 2000
### BOILER CONNECTIONS

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>4&quot; 150# Flg</td>
<td>4&quot; 150# Flg</td>
<td>4&quot; 150# Flg</td>
<td>1 1/2&quot; NPT</td>
<td>1&quot; NPT</td>
<td>3/4&quot; NPT</td>
<td>1/2&quot; NPT</td>
<td>Ø10&quot;</td>
<td>1&quot; NPT</td>
</tr>
</tbody>
</table>

### RATINGS & CAPACITIES

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
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<tbody>
<tr>
<td>Design Pressure</td>
<td>80 PSIG</td>
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<tr>
<td>Design Temperature</td>
<td>210°F</td>
</tr>
<tr>
<td>Gross Output</td>
<td>1900 MBH</td>
</tr>
<tr>
<td>Rated Input</td>
<td>2000 MBH</td>
</tr>
<tr>
<td>Heating Surface (ASME)</td>
<td>254.03 Soft</td>
</tr>
</tbody>
</table>

### LYR DATE

- A 4-H REMOVE BURNER CONTROL PANEL. ADD BURNER J'BOX

### COMPANY

- ALSTROM HEAT TRANSFER LLC

### PROJECT

- NYC PS 163

### NOTES

1. ALL CONTROLS MOUNTED AS PER SPECIFICATION SHEET.
2. SPECIFICATION SHEET TAKES PRIORITY OVER R & D SHEET.
3. BOILER DESIGN CODE ASME SECTION IV.
4. ALL DIMENSIONS ARE 1"=1' UNLESS OTHERWISE NOTED.
5. ALL PARTS IN CONTACT WITH COMBUSTION GASES MANUFACTURED WITH 316Ti.
6. SINGLE PASS LARGE FURNACE DESIGN
7. VERTICAL CONDENSING FLUE GAS PASHAGES
8. DUAL-HINGED/REVERSIBLE DOOR

### SCALE

- 1/31 15A90547 & 15A90548
TOTAL FLOODED WEIGHT = 5174 LB
= 285 LB/LINEAL FEET
DEFINITIONS

Where the context permits, the following words shall have the meanings indicated:

"Buyer" means the person, partnership, company, or corporation or entity procuring the Products from the Company.

"Company" means Superior Boiler Works, Inc., a Kansas corporation, or the subsidiaries, affiliates, or assigns thereof it may designate from time to time.

"Products" means all goods, materials, chattels, equipment, and machinery to be provided pursuant to this Proposal.

"Proposal" means the proposal in which these Terms and Conditions are incorporated by reference and in which specific Products, prices and other details are provided.

SALES TERMS

A. PAYMENT TERMS. The Company's normal payment terms are Net thirty (30) days from date of invoice. The Company may, in its sole judgment, require such other payment terms as it deems appropriate, including full or partial payment in advance of shipment or by letter of credit. Sales orders in excess of Seventy-five Thousand Dollars ($75,000) require a payment of seventy percent (70%) prior to shipment. International Buyers will provide Company an Irrevocable Letter of Credit acceptable to Company for payment of one hundred percent (100%) of the contract price in US funds at sight upon presentation of clean on board bill of lading.

B. PAST DUE ACCOUNTS. A finance charge of the lesser of one and one-half percent (1.5%) per month (eighteen percent (18%) APR) or the highest rate permitted by law will be assessed on all past due accounts. The parties intend to comply with all relevant usury laws. Should the finance charge paid exceed the legal limit, any excess will be deemed a payment of principal. An invoice is past due if the net amount is not paid within thirty (30) days from date of invoice. Interest charged on a past due invoice will be assessed from the date on which that invoice was due. The above charges will be billed on the date that the invoice becomes thirty (30) days past due and on each monthly period thereafter.

C. BREACH. In the event of failure of Buyer to make any payment to the Company when due, the Company shall be entitled, at its sole option, to suspend shipment of any or all goods to such defaulting Buyer, whether or not the contract covering said goods has been accepted by the Company; cancel any contracts then outstanding for the sale of goods to such defaulting Buyer; and to the extent permitted by law, receive all expenses incurred by it in the collection of said payment, including reasonable attorneys' fees.

D. PRICES. Prices quoted by the Company herein are firm for thirty (30) days from the date of quotation and are subject to adjustment as stated in the Company's Proposal. After thirty (30) days from the date of Proposal, all quoted prices are subject to change by the Company without prior notice to Buyer.

SALES CONDITIONS

A. OFFER. The Proposal and these Terms and Conditions constitute an offer by the Company to sell the Products specified upon the terms and conditions and at the price(s) and with the delivery date(s) stated herein and is not an acceptance of an offer by Buyer to buy Products. Buyer shall indicate its acceptance of this offer by written acceptance, confirmation or conforming Purchase Order, by making full or partial payment for the products, or by accepting delivery of part or all of the Products.

The Proposal, together with these Terms and Conditions and the documents attached thereto or incorporated therein by reference, shall constitute the entire agreement of the parties and may not be modified unless specifically agreed to by the Company in writing. No terms stated by Buyer in its proposal, request for proposal, bid, purchase order, acknowledgment or other form shall be binding upon the Company except as specifically approved in writing or expressly incorporated herein by the Company. Buyer is hereby notified of the Company's objection to and rejection of any additional or different or conflicting terms in Buyer's proposal, request for proposal, bid, purchase order, acknowledgment, or other forms. THE COMPANY'S PROPOSAL IS EXPRESSLY LIMITED TO ACCEPTANCE UPON THE TERMS AND CONDITIONS CONTAINED HEREIN.

B. EQUIPMENT SELECTION. The selection of sizes, types, capacities, and specifications of Equipment purchased by Buyer and the suitability thereof for Buyer's specific application shall be the sole responsibility of Buyer and/or Buyer's representative or consultant.

C. CANCELLATION AND MODIFICATION OF ORDERS. Orders are not subject to change or cancellation by Buyer. Orders may be canceled by Buyer only upon (1) written notice to the Company subsequently accepted in writing by the Company and (2) payment to the Company of reasonable cancellation charges for costs, losses and anticipated profits to be solely determined by the Company. Company shall have the right to cancel a contract for an order without any liability on its part.

D. CREDIT APPROVAL. All orders by Buyer are subject to credit investigation and approval prior to acceptance by the Company. Company reserves the right to withdraw credit and require full payment before production, shipment, delivery or installation if Company, within its sole discretion, determines Buyer's financial condition does not merit Company's extension of credit.

E. TAXES AND CHARGES. Federal, state and local taxes are not covered in the Company's price unless expressly stated on the Proposal and will be added to the purchase price, where applicable.

F. FREIGHT. Unless otherwise stated on the quotation form, prices are F.O.B. shipping point.

G. SHIPPING DATES. Shipment dates are approximate. All shipment dates are subject to strikes, accidents, shortages of material or labor, delays of carriers or causes that are unavoidable or beyond the control of Company.

H. TRANSPORTATION RISK. Title to Products and risk of loss passes to Buyer at the shipping point. Buyer assumes all risks of loss of damage upon the Company's delivery of the Products to the initial carrier. All Products are shipped at Buyer's risk.
I. DELAYS IN DELIVERY. The Company has no obligation to deliver Products against any order by Buyer unless and until the order has been accepted by issuance of the Company's acknowledgement of order. In any event, the Company shall not be liable for any delay or failure in the delivery or shipment of Products against any accepted order, or for any damages suffered by reason thereof, in the event that such delay or failure is, or such damages are, directly or indirectly due to either accident in manufacture or otherwise, fire, flood, riot, war, embargo, labor stoppages, inadequate transportation facilities, shortage of materials or supplies, delay or default on the part of Company's vendors, regulation by any governmental authority, or any cause or causes beyond Company's control. The Company shall have no liability whatsoever for any direct, indirect, special, consequential, and incidental or liquidated damages or penalties. Buyer shall reimburse the Company for any additional cost to the Company resulting from delays caused by Buyer.

J. STORAGE. If shipment is delayed due to any cause within Buyer's control, the Products may be placed in storage by the Company for Buyer's account and risk and regular charges therefore and expenses in connection therewith shall be paid by Buyer. If, in the sole opinion of the Company, it is unable to obtain or continue such storage, Buyer will, on request, provide or arrange for suitable storage facilities and assume all cost and risk in connection therewith.

K. CLAIMS. The Company shall not be liable to Buyer for loss or damages to Products while in transit or after acceptance of delivery by Buyer. Shortages or damage of Products must be brought to the attention of the carrier at the time of delivery and stated in writing on the delivery papers in order to initiate a claim.

L. WARRANTIES AND LIMITATION OF LIABILITY. Superior warrants all equipment manufactured by it and bearing its nameplate to be free from defects in workmanship and material, under normal use and service within one (1) year from the date the equipment is first placed in use for any purpose, temporary or otherwise, or eighteen (18) months from the date of shipment, whichever shall be less. (See current warranty.) Buyer must provide written notice to Company within the warranty period of any defect in workmanship or material. Except where a different expressed written warranty has been issued, no warranty of any kind, express or implied, is extended by Superior to any person or persons other than its direct buyer.

Superior shall have no responsibility for the performance of any product sold by it under conditions varying materially from those under which such product is usually tested under existing industry standards, nor for any damage to the product from abrasion, erosion, corrosion, deterioration or the like due to abnormal temperatures or the influences of foreign matter or energy, nor for the design or operation of any system of which any such product may be made a part or for the suitability of any such product for any particular application. Superior shall not be liable for any cost or expense, including without limitation, labor expense, in connection with the removal or replacement of alleged defective equipment or any part or portion thereof, nor for incidental or consequential damages of any kind. Any substitution of parts not of Superior’s manufactures or not authorized by Superior, or any modification, tampering, or manipulation of Superior's product shall void any and all warranties. Alteration of any parts without express written permission of Superior for a purpose other than that intended shall void any and all warranties.

The foregoing warranties shall not apply to products or parts not manufactured by Superior.

Warranty Validation: Superior Boiler Works, Inc. Field start-up reports must be completed, dated and signed then returned to Superior Boiler Works, Inc., P.O. Box 1527, Hutchinson, KS 67504-1527, ATTN: Sales Secretary to validate warranty.

M. DISCLAIMER OF IMPLIED WARRANTIES AND LIMITATION OF REMEDIES. The foregoing warranties are in lieu of all other warranties, expressed or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose, and such implied warranties are expressly disclaimed. In no case shall Company be liable for any special, incidental, indirect or consequential damages, whether based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory. No event shall Company be liable for more than the purchase price of the Products in this contract.

N. SECURITY INTEREST. The Buyer hereby grants to the Company and the Company hereby retains a security interest in all Products furnished by the Company and the proceeds thereof, until the purchase price therefore is fully paid. Buyer appoints Company its attorney in fact to execute any security agreement requested by Company and authorizes Company to file financing statements evidencing such security agreement.

O. RETURNS. Products may not be returned by Buyer for credit unless and until the company has agreed in writing to accept them. A minimum charge of twenty percent (20%) of the price of the returned Products shall be paid by Buyer for re-handling, restocking and/or reconditioning. All transportation costs for the returned Products must be paid by Buyer.

P. ASSIGNMENT. Any assignment of the rights accruing hereunder shall be void without the prior written consent of the Company.

Q. WAIVER. The Company’s waiver of any breach by Buyer of any of the provisions of these Terms and Conditions or the Proposal shall not constitute a waiver of any other breach of the same or any other provision. The Company’s rights and remedies under any provision of these Terms and Conditions or the Proposal shall be in addition to and not in substitution of any other rights and remedies available to the Company under applicable law.

R. GOVERNING LAW AND ARBITRATION. This Proposal is to be interpreted in accordance with, and its administration and performance governed by, the laws of the State of Kansas. The parties hereto agree that Reno County, Kansas, shall be the exclusive forum for any cause of action filed in any court of law or equity arising out of the execution of or performance under this Proposal. Notwithstanding the foregoing, in the event Buyer is located outside the United States of America and purchases Products pursuant to the terms hereof for use outside the United States of America, any dispute between such Buyer and the Company respecting the Products shall be finally resolved by arbitration in the English language in Hutchinson, Kansas, Reno County, U.S.A. in accordance with the rules then obtaining of the American Arbitration Association, and judgment upon the award rendered may be entered in any court having jurisdiction thereof.

S. HEADINGS AND SEVERABILITY. Any headings preceding the text of the several articles hereof are inserted solely for convenience of reference, shall not constitute a part of the Terms and Conditions or the Proposal and shall not otherwise affect the meanings, content, effect or construction of these Terms and Conditions or the Proposal. In the event that any provision contained herein is held to be invalid or unlawful, such provision shall be severable from the remaining provisions of these Terms and Conditions or the Proposal which shall remain in full force and effect.
CREEK CONDENSING BOILER

WARRANTY

GENERAL WARRANTY:
Superior warrants all equipment manufactured by it and bearing its nameplate to be free from defects in workmanship and material, under normal use and service within sixty (60) months after shipment for the boiler body flue gas side and twelve (12) months for all other parts and accessories of the boiler. Thermal shock is covered for the lifetime of the boiler. Except where a different expressed written warranty has been issued, no warranty of any kind, express or implied, is extended by Superior to any person or persons other than its direct buyer.

Superior shall have no responsibility for the performance of any product sold by it under conditions varying materially from those under which such product is usually tested under existing industry standards, nor for any damage to the product from abrasion, erosion, corrosion, deterioration or the like due to abnormal temperatures or the influences of foreign matter or energy, nor for the design or operation of any system of which any such product may be made a part or for the suitability of any such product for any particular application. Superior shall not be liable for any cost or expense, including without limitation, labor expense, in connection with the removal or replacement of alleged defective equipment or any part or portion thereof, nor for incidental or consequential damages of any kind. Any substitution of parts not of Superior’s manufacture or not authorized by Superior, or any modification, tampering, or manipulation of Superior's product shall void any and all warranties. Alteration of any parts without express written permission of Superior for a purpose other than that intended shall void any and all warranties.

GENERAL WARRANTY EXCLUSIONS:
Warranty will not cover the damaged, defective or not functioning parts due to:
- Normal wear and tear;
- Improper or inadequate use of the boiler;
- Installation or start up performed by unauthorized third parties;
- Failure to comply with the indication of Superior’s manual of use or improper modifications made by third parties;
- Tempering or improper adjustment of the boiler by third parties that are not included in the network of authorized representatives on behalf of Superior;
- Conditions of use not included in the instructions and warnings on the instruction manuals delivered with the boiler;
- Defects of elements of foreign origin;
- Incorrect electrical connections or input;
- Use of the product, after it has been taken out of service;
- Use of non-original spare parts;
- Faulty plant, installation errors or noncompliance with plant instructions, warnings, laws, regulations and applicable technical standards (i.e.: incorrect adjustment, boiler supply with specific fuel, use of the boiler outside of its certification range);
- Absence of a plate heat exchanger between primary and secondary circuit (when used in an open loop system);
- In case of improper installation, control and maintenance, that cause damage to the installed boiler, such as burner malfunction, absence of the safety parts provided by the Standards in force such as inadequate safety valves or expansion systems or improper chemical cleaning of the plant;
- Failure to remove the processing residues if the plant is new or deposits and subsequent cleaning of the pre-existing plant. In both cases the suggested operations must be performed before assembling the boiler;
- Events of force majeure (e.g.: lightning, floods, earthquakes) or vandalism;
- The warranty does not cover product maintenance;
- The warranty covers only the boiler body and excludes the accessories, electrical parts, and materials used for the construction of the plant; and not originally included with the boiler.

FLUE GAS SIDE WARRANTY EXCLUSIONS AND CONDITIONS:
- Any and all adjustments and inspections must be reported on a log with dates and signatures of the authorized technician.
- To make sure that there will be no cracks, the flame must be adjusted to prevent it from entering the heat exchanger passages. The adjustment of the burner must be checked every six (6) months of operation. Therefore, it is necessary to verify the content % of CO2 and NOx (Check the parameters according to the standards in force).
- The chimney draft must not impair the stability of the flame and should be checked before installation.
- Each component inside the combustion chamber should be checked before being ignited and at every heating season, as in the instructions given in the manual (e.g.: insulation between the burner nozzle and ceramic fiber door, deflector positioned correctly, visual inspection of the status of the internal boiler chamber and heat exchanger passages).
- The combustion chamber must be cleaned every year.
- Visual check of all the inner parts, and replacement if necessary.
- Cleaning of combustion chamber must not be performed using aggressive acidic or basic substances, but only the use of surfactants and water is permitted.
- The use of any fuel except natural gas (and/or LPG) is forbidden even for short periods of time, except for maximum five (5) days only in case of emergency backup fuel (light oil), with obligation of cleaning to be done by an authorized technician. Each type of gaseous fuel, although similar to natural gas and LPG, must be notified to and approved by the manufacturer.
- There must not be: aggressive gases, chemicals or halogens in the environment (combustion air).
- Any sealing operation, mechanical work, electrical engraving of any surface of the boiler is strictly forbidden.
WATER SIDE EXCLUSIONS AND CONDITIONS:
If any of the following occurs, the warranty shall not apply:
- Lack of water in the boiler;
- The supply water parameters must be in accordance with the limits indicated in the table annexed to the instruction manual;
- The plant and the boiler must be properly grounded;
- In case of limestone clogging, deposits and sludge, the presence of corrosion, overheating of the boiler body, corrosion caused by oxygen;
- Electrolysis caused by using dissimilar metals in the piping system;
- In a case where multiple boilers are connected in series which does not follow suggested piping diagrams in the manual;
- If the temperature goes below 410°F and the plant piping does not contain antifreeze, the boiler must be started and brought to the minimum temperature of 680°F, or the system must be completely drained;
- Use of improper product for water treatment inside the plant or incompatible antifreeze with system construction materials;
- The pressure must not exceed that indicated on the label;
- The boiler is used for direct production of domestic hot water; i.e. used in open system;
- The circulation inside the boiler exceeds the minimum and maximum range of the designed temperatures; 410°F minimum for hot water; 2100°F maximum; maximum 100°F delta T;
- The boiler must be connected to the plant piping according to the standards in force and should not be isolated from the plant piping through isolation valves that interrupt the connection with the expansion vessel;
- The water flow must not exceed the maximum values indicated in the technical diagrams.

The foregoing warranties shall not apply to products or parts not manufactured by Superior.

There are no express or implied warranties which extend beyond those contained herein.

NOTE: All new boilers must be boiled out or Superior Boiler Technologies, Inc. will void the warranty.

NOTE: WARRANTY VALIDATION: Field start-up report must be completed, dated and signed then returned to Superior Boiler Technologies, Inc., 3524 East 4th Avenue, Hutchinson, KS 67501, ATTN: Sales Secretary, to validate warranty.
CREEK ST BOILER MANUAL
Condensing Water Boiler
300 - 2000 MBtu/Hr.
Gas
Superior Boiler Works, Inc.
3524 E. 4th Avenue
Hutchinson, KS 67501
(620) 662-6693
www.superiorboiler.com

Manufactured in the USA
to the ASME boiler and
pressure vessel code.
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GENERAL
The boilers of the CREEK ST series have a horizontal through-flame combustion chamber and a vertical condensing section of a special design in stainless steel type AISI 316 Ti. These elements are immersed in water contained in a horizontal boiler drum with a vertical column to which the system inlet and outlet connections are fitted.

These boilers reach very high efficiency levels approaching 98%. The flue gases not only are released at a temperature little higher than that of the system return water but also a large part of the water vapor contained in the flue gases is condensed. This recovers the latent heat of condensation.

The particular flame path (through the combustion chamber without inversion) limits as much as possible the formation of Nitrogen Oxides (NOx) that form when the flame remains at high temperature in the combustion chamber for long periods.

The CREEK ST series boilers place no limit on the return water temperature. However the boilers reach the highest performance when used with floor panel heating systems in which the return temperature is lower than 135 °F. At higher temperatures, condensation does not occur and so the recovery of the latent heat contained in the water vapor, present in the flue gas, is impossible. The efficiency of the boiler remains high in any case (97%) even with traditional high-temperature heating systems (At 175/150 °F).

Thank you for purchasing a Superior Boiler Works Inc. (SBW) product. This manual is for the CREEK ST line of boilers. READ AND SAVE THESE INSTRUCTIONS FOR REFERENCE. These manual and associated documents are to be kept with the boiler and in legible condition for the life of the boiler.

This manual will refer to the burner’s manual when appropriate. A double asterisk (**) is used to indicate that your burner manual should also be checked for information on the topic being covered unless otherwise noted. In addition to the boiler and burner working together, there are controls, switches, valves, and other components on your boiler assembled specific to each end user. A list of exact components and information about them is appended to this manual. All of these documents and devices work together to safely operate your boiler.

Documents Unique to your boiler
There are many Superior Boiler Works Inc. (SBW) Documents created unique to each boiler. These documents are appended to this manual either directly before or after this structured manual.

<table>
<thead>
<tr>
<th>Document</th>
<th># of pages</th>
<th>Page #/Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cover page with your information</td>
<td>Pages</td>
<td>Zero/First</td>
</tr>
<tr>
<td>• Specification sheets</td>
<td>4</td>
<td>Appendix 1</td>
</tr>
<tr>
<td>• Ratings and dimension drawing</td>
<td>1</td>
<td>Appendix 2</td>
</tr>
<tr>
<td>• Recommended spare parts</td>
<td>1 to 3</td>
<td>Appendix 3</td>
</tr>
<tr>
<td>• List of component manuals</td>
<td>1 to 4</td>
<td>Appendix 4</td>
</tr>
<tr>
<td>• ASME data reports</td>
<td>1 to 12 pages</td>
<td>Appendix 6</td>
</tr>
<tr>
<td>• Panel Casing installation</td>
<td>7</td>
<td>Appendix 7</td>
</tr>
<tr>
<td>• Firetest report (if tested)</td>
<td>0 to 4</td>
<td>Appendix 8</td>
</tr>
<tr>
<td>• MSDS Information (if supplied)</td>
<td>0 to 9</td>
<td>Appendix 9</td>
</tr>
<tr>
<td>• Miscellaneous unique paperwork for this boiler</td>
<td>Any</td>
<td>Appendix 10</td>
</tr>
<tr>
<td>• Wiring drawing(s)</td>
<td>can be large format</td>
<td>Last</td>
</tr>
</tbody>
</table>

Supplementary Manuals:
This manual is intended to be used in conjunction with other documents.
• Burner manual and manuals that come with the burner. Appendix 11
• Manuals for every major component supplied with the boiler. Appendix 12
The Warranty validation/Start-up report information sheet must be filled out and return to SBW within three weeks of when the burner is first turned on and within two months of shipment of boiler to maintain your warranty. Also note that boil-out procedures, a slow initial warm up, and proper water treatment are required to maintain your warranty.

⚠️ WARNING

The improper installation, adjustment, service, maintenance, or operation of this equipment can result in fire, explosion, serious injury, or death.

NOTICE!

Acronyms, Definitions, Standards, & Sources

SBW: Superior Boiler Works Inc.
ASME: American Society of Mechanical Engineers
ASME CSD-1: Controls and Safety Devices for Automatically Fired Boilers
BPVC: ASME boiler and pressure vessel code.
Section IV: Portion of BPVC that applies to water boilers not exceeding 160 PSIG or 250°F and Steam boilers not exceeding 15 PSIG
Heating boiler: hot water boiler
Water boiler: Boiler that supplies hot water
LWCO: Low-water cutoff, or Low-water fuel cutoffs
Aux LWCO: Auxiliary Low water cutoff
LWCO mark: Vertical position on boiler where the primary LWCO operates
ANSI: American National Standards Institute
150# class: ANSI standard of flanged piping connections,
NPS: Nominal pipe size
NPT: National pipe thread (tapered)
MAWP: Maximum allowable working pressure
Set point: A specific value of pressure or temperature used in a control where it will switch on or off.
Aquastat: Water temperature control device
BoHP: Boiler horse power is equivalent to 33,475 Btu/Hr.
PSI: Pounds per square inch
PSIG: PSI gauge reading.
In. WC: Inches of water column. Units of pressure where one (1) PSI = 28 In. WC (28” WC)
UL: Underwriters Laboratories Inc.
UL Mark: Signage on the boiler designating UL approval
UL 795: Commercial-Industrial Gas Heating Equipment
UL 353: Limit Controls
cUL: Verification to Canadian Requirements by Underwriters Laboratories Inc.
CSA: Canadian Standards Association
CSA 22.1: Canadian Electrical Code Part 1
CSA B149: Natural Gas & Propane Code
NFPA: National Fire Protection Agency
NFPA 54: National Fuel Gas Code
NFPA 70: National Electric Code, AKA: NEC
IFGC: International Fuel Gas Code
R&D drawing: Ratings and Dimensions drawings. AKA: General Arrangement.
Introduction to safety

Refer to this manual and the burner manual. For assistance or additional information consult a qualified installer, service agency, or fuel supplier as appropriate.

**WARNING**
The improper installation, adjustment, service, maintenance, or operation of this equipment can result in fire, explosion, serious injury, or death.

DO NOT STORE OR USE GASOLINE OR ANY OTHER FLAMMABLE LIQUIDS IN THE VICINITY OF THIS OR ANY OTHER APPLIANCE.
DO NOT USE GASOLINE, CRANKCASE DRAININGS, OR ANY OIL CONTAINING GASOLINE.
NEVER BURN GARBAGE OR PAPER IN THE UNIT, AND NEVER LEAVE COMBUSTABLE MATERIAL AROUND IT.

All personnel involved with the startup, maintenance, or adjustment of this boiler must read and understand the entire contents of this manual prior to any startup or adjustment being made to the boiler and related components. Installation and service must be performed by a qualified installer, service agency, or the fuel supplier.

Safe and reliable operation is dependent to a large extent upon the skill and attentiveness of the operator and of the maintenance personnel. Operating skill implies the following:
- Knowledge of fundamentals
- Familiarity with equipment
- Suitable background of training and experience

Full and effective use should be made of manufacturer's instruction books on operation and maintenance. Of special importance are written procedures prepared expressly for each installation by the manufacturers' service engineers and qualified personnel from the operating organization before and during the commissioning period. These procedures are based on actual experience and often include invaluable information on what the equipment is expected to do. Limitations critical to safe and reliable operations are also given. Control systems vary in complexity from computer control to manual operation. Regardless of the type of system used, the operators should be thoroughly trained so that they can maintain safe and continuous operation during changeover from automatic to manual control as well as to continue operation by manual control if the automatic systems are out of service. The operator should have instrumentation at the point of manual operation to permit him to be aware of operating conditions at all times. Regularly scheduled auto-manual changeover, manual operation, and emergency drills to prevent loss of these skills are recommended.

**What to do if you smell gas:**
- Do not try to light any appliance
- Do not touch any electrical switch
- Do not use any phone in your building
- Immediately call your gas supplier from a neighbor’s phone
- Follow the gas supplier’s instructions
- If you cannot reach your gas supplier, call the fire department.

**NOTICE!** This is used to point out warranty issues
Approvals & Recordkeeping

All SBW boilers are designed, manufactured, and stamped to the ASME BPVC. Refer to the signage information section to determine the approvals that have been applied to your boiler.

THE INSTALLATION OF THIS BOILER SHALL BE IN ACCORDANCE WITH THE REGULATIONS OF AUTHORITIES HAVING JURISDICTION.

BOILERS SHALL BE OPERATED BY QUALIFIED PERSONNEL. BOILERS SHALL BE INSTALLED AND SERVICED BY QUALIFIED PERSONNEL ONLY.

Boilers intended for Canadian markets, refer to the following regulations as applicable:

The equipment shall be installed in accordance with the current Installation Code for Gas Burning Appliances and Equipment, CSA B149, and applicable Provincial Regulations for the class; which should be carefully followed in all cases. Authorities having jurisdiction should be consulted before installations are made.

Wiring shall be in accordance with the CSA 22.1 Canadian Electrical Cod, Part I.

The installation of the unit shall be in accordance with the regulations of the authorities having jurisdiction.

Boilers intended for American markets, refer to the following regulations as applicable:

NFPA54: National Fuel Gas Code
NFPA70: National Electrical Code
IFGC: International Fuel Gas Code

All drawings, wiring diagrams, schematic arrangements, manufacturers’ descriptive literature, spare parts lists, and written operating instruction should be kept permanently in the boiler room or other suitable location so it will be available to those who operate and maintain the boiler. Where space permits, drawing and diagrams should be framed or sealed in plastic and hung adjacent to the related equipment. Other materials should be assembled and enclosed in a suitable binder. When change or additions are made, the data and drawings should be revised accordingly.

READ AND SAVE THESE INSTRUCTIONS FOR REFERENCE.

Some states and municipalities require licensing or certification of personnel who operate or maintain heating equipment. Also, some authorities require posting of inspection certificates in the boiler room. The supervisor in charge of a given installation should make sure such requirements are met.
GENERAL WARNINGS

Each generator is provided with a data plate that can be found in the envelope with the boiler documents. The plate lists:
- Serial number or identification code;
- Rated thermal output;
- Furnace thermal output;
- Types of fuels that can be used;
- Maximum operating pressure.

A manufacturer's certificate is also provided which certifies the hydraulic test pressure.

The installation must be performed in compliance with the regulations in force by professionally qualified personnel. The term “professionally qualified personnel” means persons with specific technical skills in the sector of heating system components.

Incorrect installation may cause damage to persons, animals or objects for which the manufacturer cannot be held responsible.

At the first start up, all regulation and control devices positioned on the control panel should be checked for efficiency. The guarantee shall be valid only upon compliance with the instruction given in this manual.

IMPORTANT: This boiler has been designed to heat hot water to a temperature lower than the boiling point of water at atmospheric pressure and must be connected to a heating plant and/or a domestic hot water plant within the limits of the boiler performance and output.

⚠️ WARNING

THE BOILER MAY ONLY BE INSTALLED IN A ROOM WHICH COMPLIES WITH THE APPROPRIATE VENTILATION REQUIREMENTS. READ THE INSTALLATION AND USER INSTRUCTION BEFORE INSTALLING AND LIGHTING THE BOILER.
1 BOILER SIGNAGE
SBW boiler signage map front view: Figure 1
The Serial No. or National Board No. is useful when contacting SBW for spare parts or support.

Location B. Warning plate: Figure 3
Every boiler includes this warning mounted on the front door of the boiler close to eye level.

Location C. UL and cUL boiler stickers: Figure 4
**Location D.** cUL and UL boiler rating plates: **Figure 5**

![Boiler Rating Plate](image)

<table>
<thead>
<tr>
<th>TYPE OF FUEL:</th>
<th>GAS NO.</th>
<th>OIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firing Rate Max</td>
<td>MBTU/HR.</td>
<td>US GAL./HR.</td>
</tr>
<tr>
<td>Firing Rate Min</td>
<td>MBTU/HR.</td>
<td>US GAL./HR.</td>
</tr>
<tr>
<td>Input Pres. Max</td>
<td>IN. WC</td>
<td>PSIG</td>
</tr>
<tr>
<td>Input Pres. Min</td>
<td>IN. WC</td>
<td>PSIG</td>
</tr>
<tr>
<td>Noz. Spray Angle</td>
<td>Deg.</td>
<td></td>
</tr>
<tr>
<td>Noz. Spray Pattern</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volts</th>
<th>Amps</th>
<th>Hertz</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Circuit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burner Motor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil Pump Motor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Comp. Motor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auxiliary Heater</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Creek ST Boiler Manual**

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Revision 2013.07
SBW boiler signage map side view: **Figure 6**

---

**Location E. Logo Sticker: Figure 7**
**Location F.** Handling options sticker: **Figure 8**
This is to make clear how the boiler can be handled.
(Alternate location is F*)

**Location G.** Load Bearing Point sticker: **Figure 9**
Besides the lifting lug, this shows the only locations the boiler should be lifted from.
SBW boiler signage map top view: **Figure 10**

**Location H. Supply water sticker: Figure 11**
Clear identification of supply water nozzle

**Location J. LWCO mark: Figure 12**
Used to determine the correct elevation of the LWCO switch. Line this up with the primary level mark on the LWCO. This is located on the centerline of the pipe on the instrumentation spool.
SBW boiler signage map rear view: **Figure 13**
Location L. Low temperature return water sticker: Figure 14
Clear identification of the low temperature return water nozzle

Location K. Medium temperature return water sticker: Figure 15
Clear identification of the medium temperature return water nozzle

Location M. ASME Drum stamping: Figure 16
The ASME “H” Stamp is riveted directly to the boiler frame above and to the left of the medium temperature return nozzle. This stamping will be covered by the insulation and casing during normal boiler operation.
2 BOILER COMPONENT IDENTIFICATION

Figure 17
### 2.1 Boiler Specifications and Dimensions

#### CREEK ST

**CONDENSING BOILERS**

**DIMENTIONAL DATA**

- **WATER BOILERS**
  - 80 PSIG

---

#### Figure 18

---

#### Table: Boiler Specifications and Dimensions

<table>
<thead>
<tr>
<th><strong>BOILER MODEL</strong></th>
<th><strong>DIMENSION (IN) APRX</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>LENGTH Overall</td>
<td>256 x 39 x 150 x 140 x 71 x 109 x 109 x 109</td>
</tr>
<tr>
<td>Diameter Overall</td>
<td>14 x 14 x 14 x 14 x 14 x 14 x 14 x 14</td>
</tr>
<tr>
<td>Front of Shell to Outlet</td>
<td>6 x 6 x 6 x 6 x 6 x 6 x 6 x 6</td>
</tr>
<tr>
<td>Front of Shell to SV</td>
<td>2 x 2 x 2 x 2 x 2 x 2 x 2 x 2</td>
</tr>
<tr>
<td>WIDTH Overall</td>
<td>31 x 31 x 31 x 31 x 31 x 31 x 31 x 31</td>
</tr>
<tr>
<td>Depth Overall</td>
<td>7 x 7 x 7 x 7 x 7 x 7 x 7 x 7</td>
</tr>
<tr>
<td>REAR SPEC</td>
<td>8 x 8 x 8 x 8 x 8 x 8 x 8 x 8</td>
</tr>
<tr>
<td>REAR SPECS</td>
<td>8 x 8 x 8 x 8 x 8 x 8 x 8 x 8</td>
</tr>
<tr>
<td>RATING SPEC</td>
<td>8 x 8 x 8 x 8 x 8 x 8 x 8 x 8</td>
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</table>

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#### Ratings:

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<tr>
<th><strong>UNIT MODEL NUMBER</strong></th>
<th><strong>300</strong></th>
<th><strong>500</strong></th>
<th><strong>750</strong></th>
<th><strong>1000</strong></th>
<th><strong>1400</strong></th>
<th><strong>2000</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>GROSS INPUT W/H</strong></td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
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<tr>
<td><strong>OUTPUT W/H</strong></td>
<td>285</td>
<td>375</td>
<td>712</td>
<td>950</td>
<td>1330</td>
<td>1900</td>
</tr>
<tr>
<td><strong>INPUT CAS (1,000 BTU)</strong></td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td><strong>OIL (18,000 BTU)</strong></td>
<td>N/A</td>
<td>3.6</td>
<td>5.1</td>
<td>7.1</td>
<td>10.0</td>
<td>11.3</td>
</tr>
</tbody>
</table>

---

#### Data:

<table>
<thead>
<tr>
<th><strong>HEATING SURFACE</strong></th>
<th><strong>45.37</strong></th>
<th><strong>67.81</strong></th>
<th><strong>95.3</strong></th>
<th><strong>127.55</strong></th>
<th><strong>201.07</strong></th>
<th><strong>254.83</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>FURNACE VOLUME</strong></td>
<td><strong>3.94</strong></td>
<td><strong>6.13</strong></td>
<td><strong>10.48</strong></td>
<td><strong>10.48</strong></td>
<td><strong>17.66</strong></td>
<td><strong>24.18</strong></td>
</tr>
<tr>
<td><strong>WATER VOLUME</strong></td>
<td><strong>40</strong></td>
<td><strong>55</strong></td>
<td><strong>81</strong></td>
<td><strong>75</strong></td>
<td><strong>104</strong></td>
<td><strong>148</strong></td>
</tr>
<tr>
<td><strong>WATER WEIGHT</strong></td>
<td><strong>333</strong></td>
<td><strong>456</strong></td>
<td><strong>675</strong></td>
<td><strong>625</strong></td>
<td><strong>866</strong></td>
<td><strong>1233</strong></td>
</tr>
<tr>
<td><strong>SHIPPING WEIGHT</strong></td>
<td><strong>975</strong></td>
<td><strong>1440</strong></td>
<td><strong>2200</strong></td>
<td><strong>2300</strong></td>
<td><strong>3200</strong></td>
<td><strong>3940</strong></td>
</tr>
<tr>
<td><strong>SHIPPING WEIGHT</strong></td>
<td>N/A</td>
<td><strong>2225</strong></td>
<td><strong>2750</strong></td>
<td><strong>3250</strong></td>
<td><strong>3950</strong></td>
<td></td>
</tr>
</tbody>
</table>

---

**STANDARD FEATURES:**

1. Units Designed And Fabricated To ASME Boiler And Pressure Vessel Code Requirements
2. Section II, Part D- Pressure Vessel Code
3. Insulated With 3" Glass Wool Blankets
4. Joints Material: 21 Gauge Painted Steel
5. 1 LED Lighting
6. Sealed For Forced Draft Furnace
7. Door Hinge/Revelable Door Swing
8. All Parts in Contact with Combustion Products Are Stainless Steel
9. Gas Train to either Left or Right Side

---

**NOTE:**

- Dimensional data based on Standard Units For Natural Gas or 300 F Combustible Gas.
- All dimensions are approximate and may be used for layout.
- All dimensions are approximate and may be altered forbof performance.
- All dimensions are approximate and may be altered for performance.

---

**SUPERIOR BOILER WORKS, INC.**

RESERVES THE RIGHT TO CHANGE DIMENSIONS DUE TO PRODUCT MODIFICATIONS OR REQUIREMENTS.
2.1 Boiler Specifications and Dimensions

Figure 18

NOTE:
1. Manufactured with ASME Section III, all parts in contact with combustion gases.
2. Single-pass, large furnace design.
3. Vertical condensing flue gas passages.
4. High water volume.
5. Twin water return.

<table>
<thead>
<tr>
<th>BOILER CONNECTIONS</th>
<th>RATINGS &amp; CAPACITIES</th>
<th>LOW PRESSURE</th>
<th>DESIGN TEMPERATURE</th>
<th>HEATING SURFACE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A(1) WATER OUTLET</td>
<td>2&quot; IPS FLG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B(1) WATER INLET</td>
<td>2&quot; IPS FLG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C(1) WATER OUTLET</td>
<td>2&quot; IPS FLG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D(1) SAFETY VALVE</td>
<td>1&quot; NPT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E(1) BOILER FILL/DRY</td>
<td>1&quot; NPT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F(1) CONDENSATION DRAIN</td>
<td>3/4&quot; NPT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G(1) BLOW DOWN</td>
<td>1/2&quot; NPT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H(1) LWG PROBE</td>
<td>1/4&quot; NPT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J(1) FLUE OUTLET</td>
<td>67 1/2&quot;</td>
<td></td>
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<table>
<thead>
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<th>RETURN</th>
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</table>

| WATER CAPACITY | 10.0 GPM | ASME |
|               |         |      |

| SHIPPING WEIGHT | 855 Lbs |
|                |        |

NOTES:
1. All controls mounted as per specification sheet.
3. Boiler design data as per section.
4. All dimensions are ±1/2" unless otherwise noted.

S. CANNON 11/12/13
T. THURSTON 11/12/13

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Figure 23

NOTE:
1. Manufactured with ARI 315TR ALL PARTS IN CONTACT WITH COMBUSTION GASES
2. Single Wall Large Furnace Design
3. Vertical Condensing Flue Gas Passages
4. High Water Volume
5. Twin Water Returns
6. Dual-Hinged/Reversible
7. Substrate approx. 2" from width with jacket removed
2.2 Cross Sections

Figure 24

Figure 25
### 2.3 Typical Instrumentation Spools

- **Low water cutoff probe connection**
- **2” Spool piece from boiler outlet.**
- **High Limit control connection**
- **Firing Rate control connection**
- **Operating control connection**
- **Temperature connection**
- **Pressure gauge connection**
- **High Limit control connection**
- **Firing Rate control connection**
- **Operating control connection**
- **Temperature connection**
- **Pressure gauge connection**
- **2.5” Spool piece from boiler outlet.**

**Example of Instrumentation spool on Creek ST 300 and 500, Figure 26.**

**Example of Instrumentation spool on Creek ST 750 and 1000, Figure 27.**
Example of Instrumentation spool on Creek ST 1400 and 2000, *Figure 28.*

### 2.4 Burner Mounting

*Figure 29*

**KEY:**
1. Burner
2. Thermo-insulating material
3. Burner Draft Tube
4. Gasket

### 2.5 Gas Train

*Figure 30:* Example gas train. Exact mounting location will depend on job specifications.
2.6 Standard Junction Box Location

Figure 31

4” x 4” x 2 1/8” Junction box on the same side as the instrumentation spool

Figure 32 - Wired Junction Box
2.7 Miscellaneous Images

Fig 33 – Condensate Drain

Fig. 34 – Door clamping arm

Figure 35 - Furnace Drawer
3 SPECIFICATIONS

Superior Boiler Works Inc. (SBW) Creek ST series boilers are condensing water boilers with a horizontal furnace section and a vertical condensation section. Sizing is available in the six sizes shown in the boiler specification (Section 2.1). The boiler is mounted on a structural steel base with a forced draft burner and burner controls.

The boiler is designed, constructed, and tested in accordance with the latest edition and addenda of the ASME boiler and pressure vessel code. The boiler is registered with the National Board of Boiler and Pressure Vessel Inspectors. The boiler is completely pre-assembled and tested at the factory to check construction, controls, and combustion characteristics of the unit. All Creek ST boilers are constructed to meet CSD-1.

Creek ST boilers are equipped with one lifting lug located below the casing capable of supported the packed boiler’s weight during lift operations. This lug will be covered by the casing during normal boiler operation.

The furnace is located at the top of the boiler. The outside of the furnace is a plain cylindrical shell. Inside the furnace there is a drawer with baffles to increase the heat transfer area. There are several slits in the bottom of the furnace which lead to the condensing section.

The condensing section is a series of vertical plates surrounded on both sides by water. The plates have a pattern of indentations to increase the heat transfer area. The plates are located at the bottom of the boiler near the return water inlet. This counterflow arrangement leads to lower stack temperatures and higher efficiencies.

Opening of the access points are not to be impeded by any fuel lines, door plates, baffles, linkages, or electrical connections. The front door is secured by bolts at the four corners of the door. The door is sealed gas tight gaskets. The entire boiler shell is insulated with 3” of high density glass wool slabs. The entire boiler is then covered with painted steel panels.

Two washout plugs are provided to ease waterside inspection and cleaning on either side of the heat exchanger near the top of the condensing section. These plugs are covered by the steel casing during normal operation. A flue gas connection is located at the back of the boiler at the bottom centerline above the condensate drain. The flue gas connection is slip on. The flue gas connection is not designed for support.

Safety relief valves (SRV) are selected and sized to the ASME boiler and pressure vessel code. Connections for SRV(s) are provided along the top centerline of the boiler. Connection 1” and larger not slated for use have an appropriate pipe nipple and cap installed.

Locations and sizes of many components are specified in the dimensional data and drawings.

An instrumentation cluster is provided in the outlet spool as detailed in section 2.2. These connections are typically used for three aquastats, a temperature, and a pressure gauge. The low water cutoff will be a probe connection in this spool. The temperature and pressure gauge may be replaced with a tridicator.
The High limit, Operating, and Firing rate controls are installed as individual components in the boiler outlet spool instrumentation cluster. Stop valves are not to be installed between the boiler and any of these controls. These controls occupy three of the connections of the instrumentation cluster with aquastats. The Firing rate controller can be replaced with a temperature sensor that is incorporated into the burners controls. The operator and firing rate controls can be incorporated into the same device.

The water supply nozzles are ANSI class 150# flange. Creek ST boilers come with a medium and a low temperature water return nozzle along the centerline above the flue gas outlet. If only one nozzle is used always use the low temperature return. Recirculation pump connections and re-circulating pumps may be added to one or both sides of the boiler to isolate the boiler from the hot water system and reduce temperature differential across the boiler. The boiler shall have a drain connection.

4 BOILER INSTALLATION

4.1 Receiving the Boiler

During the construction of your new boiler, over one hundred (100) separate inspections were made of the unit. These inspections started with your unit’s engineering drawings and ended with the signing of the bill of lading by the freight carrier. These inspections were made by our Quality Control Department and our Insurance Inspection Agency. At the time the freight carrier signed the bill of lading at our factory, he acknowledged that the unit was received by him in an undamaged condition. It is good practice for you, prior to signing the freight carrier’s delivery receipt, to examine your boiler in detail to be sure that the unit has not been damaged in transit. If damage is evident, make a notation on the freight bill of the damage and file a claim against the carrier for the cost of replacement or repair. In the event your boiler-burner unit should have sustained concealed damage (damage which is not outwardly evident), you have up to fifteen (15) days after receipt of the unit to file a claim covering repair or replacement of the concealed damage. Most of our units are shipped with certain fragile and easily damaged parts packaged in a separate box. The freight bill will describe the number of pieces shipped. Be sure that all pieces noted on the freight bill are received.

Boilers are typically shipped with the main boiler burner package assembled with fuel train(s), mounted switches, and wiring that is practical before placement. Electrical components are wrapped in plastic and the boilers internals are closed off from the elements. The shipped condition is only intended to protect the boiler from weather during transport, not additional long term storage. Some parts are shipped loose with the boiler. Boil out chemicals, if purchased from SBW, are shipped separately.

4.2 Unloading the Boiler-Burner Unit

Your new boiler-burner unit is equipped a single lifting lug, located on the top of the boiler along the centerline. This is to be used for unloading. A crane is the best means of unloading and setting the new unit in place. A forklift can also be used to unload and set the boiler. When a forklift is used, be certain that it is only lifted from the designated points. DO NOT USE A LIFTING CABLE AROUND THE UNIT. See Figures 8 & 9
4.3 Boiler Unloading Instructions

- Before the boiler is shipped, employ a firm that is experienced in the unloading and moving of equipment of this size and weight.
- Confirm with the supplier of the crane that is being used to unload the boiler that it is of sufficient capacity to lift and unload the boiler. The boiler’s dimensions and weights are found on the R&D drawing supplied with your submittal.
- Upon arrival, inspect the boiler and any parts shipped with the boiler. If any damage is found, notify Superior Boiler Works Inc. and note damage on the bill of lading and any other receiving papers.
- The boiler is designed to be lifted by the lifting lug only. The use of tow motors, etc., is not acceptable and can damage the boiler. See Figure 8
- Before lifting the boiler, check all of the transport tie downs to insure that they have been removed and will not interfere with the lifting of the boiler.
- Check the lifting cables to insure that they are positioned properly and will not cause any damage to the boiler.
- Check all electrical enclosure doors and attached piping to insure that they are firmly secured.
- Carefully lift the boiler off the trailer, lower it, and transport it to its installation location.
- Lower the boiler onto its foundation and disconnect the lifting cables.
- Once the boiler is in position, verify that required clearances are satisfied. Clearances need to be provided from combustible materials. See dimensional data included in Appendix. This should be checked while the boiler can still be easily moved.
- The boiler should now be in position for the attachment of all the connecting piping and electrical wiring.
- If the boiler cannot be moved into position by the crane, a forklift may be used. The forklift must be of sufficient size for the boiler. The forks must only be under the marked locations.
- After the boiler has been located, the top staves will need to be installed. Please follow the instructions in section 4.6
4.4 The Boiler Room

Local building codes and insurance requirements usually dictate the type of construction and the material to be used in the boiler room. The boiler room floor should be non-combustible and of adequate strength to support the weight of the boiler full of water. The boiler room floor should include a floor drain See the “Drains” section. It is advisable to provide, when possible, wall and floor surfaces that permit the use of water hoses. Space should be provided in the boiler room to accommodate boiler water treatment equipment and any other equipment that may be required in the boiler room. Adequate space should be provided around each boiler to permit cleaning and inspection of all piping supplied with the boiler. After the boiler has been set in place, ensure it is level.

Fresh & Ventilation Air

The boiler room must have an adequate air supply to permit clean, safe combustion and to minimize soot formation. An unobstructed air opening should be provided. It may be sized on the basis of 1 sq in. free area per 1000 Btu/hr. maximum fuel input of the combined burners located in the boiler room, or as specified in NFPA 54 or IFGC as applicable to your installation. The boiler room air supply openings must be kept clear at all times. Also review the ventilation requirement of your burner.

Lighting

The boiler room should be well lit and it should have adequate emergency lighting for use in case of power failure. If a flashlight is used for this purpose, it should be maintained in usable condition and it should be protected against removal from the boiler room.

4.5 Extended Storage Procedure for Boilers not yet installed.

**NOTICE!** If a newly delivered boiler is to be placed outdoors for more than two weeks, the following steps shall be taken:

- The boiler should be placed on crossties under the legs, preferably on a flat surface of concrete or asphalt.
- Make certain that any moisture from weather has been removed
- Remove the washout plugs and place desiccant inside.
- The electrical enclosures and panels will also require desiccant to protect against condensation. A handful’s worth of desiccant in a cardboard lid will do.
- Close the unit up tight to exclude all moisture and air.
- Desiccant should be checked weekly. When the desiccant has changed color, it is used up. Replace as required.
- The entire boiler should be covered with a tarp, with emphasis on protection for the gas train, air compressor, low water cutoff, junction boxes, burner control panels, and boiler control panels.

For the water side of a boiler, SBW recommends a desiccant product called boiler lizards. These tubes of desiccant can be opened and placed in the water side of a boiler. The boiler lizards can remain in the water side of the boiler to be dissolved by water. The desiccant and tubular bags are water soluble; dissolving the first time water is added to the boiler. Desiccant placed in other locations should be removed prior to placing the boiler in service. Even if the extended storage is inside, this extended storage procedure is recommended.
4.6 Casing Panel Installation

The Creek ST boiler is shipped with the top casing panels removed so that the lifting lug is exposed. After the boiler is set, these remaining panels should be installed. The panels will need to be secured by screws on each end. For more details on panel installation see the installation details in the Appendix.

4.7 Installation of Loose Shipped Items

After the final staves are attached, loose shipped items can be installed and the boiler can be connected to your systems. It is preferable to delay installation of any items with glass like gauges until after the piping has been completed to avoid glass breakage.

Items that typically ship loose are:
- Touch up paint
- Safety relief valve(s)
- Pressure gauge
- Water temperature gauge or tridicator
- Stack thermometer
- Gaskets and bolts between any hot water outlet parts

Many components like gauges and gaskets will have their own manuals. Please refer to the appropriate documentation for installation.

At least one small parts box will be supplied with your boiler for small items like pressure gauges, thermometers, and any other small loose items you ordered. Larger and heavier items are typically shipped on pallets.

For water boilers, an appropriate pressure and temperature gage or a tridicator is provided. Install them in the instrumentation cluster as instructed by the manufacturer’s cut sheet. See Figure 26-28

An appropriate stack thermometer is provided. Install into a 1/2” coupling on the instrumentation spool.

The safety relief valve(s) shall be installed at connections provided on the top of the boiler. Often this takes place after the boil-out procedure. The safety relief valve(s) provided for your boilers are documented in the ASME data reports provided with this manual. See the safety relief valve installation section.
4.8 Electrical Installation

**WARNING**

The improper installation, adjustment, service, maintenance, or operation of this equipment can result in fire, explosion, series injury, or death.

ELECTRICAL INSTALLATION SHALL BE IN ACCORDANCE WITH THE REGULATIONS OF AUTHORITIES HAVING JURISDICTION. THE FOLLOWING CODES SHALL BE FOLLOWED AS APPLICABLE. CSA 22.1: CANADIAN ELECTRICAL CODE PART 1, NFPA 70: NATIONAL ELECTRIC CODE (NEC)

A wiring diagram for the boiler and burner will be inside the burner control panel. The wiring diagram, in conjunction with this manual and O&M manuals for the burner and electrical components, should provide an electrician with everything required to properly install the electrical components. Before installing, modifying, or servicing system, the main electrical disconnect switch must be in the OFF position. There may be more than 1(one) disconnect switch. Lock out and tag switch with a suitable warning label.

The exact configurations of electrical panels vary. The most common configuration is at the front of the boiler on the same side as the instrumentation spool. See Figures 31 & 32. The junction box will be secured to the panels by sheet metal screws. Additional small junction boxes are used when needed. If for repair purposes wiring is run to any probes, that wiring shall be sufficient for 150°F. Grounding of some components is conducted through the boiler and the mounting of burner to the boiler. Electrical power requirements are listed on placards for the respective components. Wiring from any boiler mounted controls and any fuel train controls is pulled into the burner control panel. Wiring for sensors tends to be specific to the manufacture of the burner management system. If maintenance is performed on this wiring, ensure the appropriate wire is used. Wires are mounted on terminal strips for ease of trouble shooting and maintenance.

**Power for Electrically Operated Controls**

All controls are powered with a potential of 150 V or lower with one side grounded. A separate equipment ground conductor should be brought to the control panel frame with ground continuity assured to the fuel valve. All operating coils of control devices should be connected to the neutral side of the control circuit, and all control limit switches or contacts should be in the ungrounded (hot) side of the control circuit. If an isolating transformer is used, it should be bonded to the control panel frame. The equipment ground is not required when the isolating transformer is used. Do not fuse control transformers above their rated current value because these devices are current limiting and an oversize fuse may not blow under short circuit conditions.

**Remote Emergency Shutdown Switches**

A manually operated remote shutdown switch or circuit breaker shall be located just outside the boiler room door and marked for easy identification. Consideration should also be given to the type and location of the switch to safeguard against tampering. If the boiler room door is on the building exterior, the switch should be located just inside the door. If there is more than one door to the boiler room, there should be a switch located at each door. Where a boiler is located indoors in a facility and not in a boiler room, a remote emergency shutdown switch shall be located within 50 feet of the boiler along the primary egress route from the boiler area. The installer shall be responsible to install the remote emergency shutdown switch(s) and to verify that it is suitably marked.
4.9 Miscellaneous Installation Guidelines

Software & Safety

Programming controls, when used, shall provide proper sequencing of the above controls to insure that all conditions necessary for proper burner operation are satisfied. Included in a programmed control are pre-purge and post-purge cycles to remove accumulated gases.

Flame Safeguard

When installation is complete, safety controls will stop fuel flow in the cases of ignition failure, main flame interruption, mechanical draft failure, and circuit failure as appropriate for your installation. The controls on the burner and boilers are designed to prevent fuel flow when any of the boiler conditions are outside intended limits of pressure, temperature, and water level as is appropriate for your system.

Venting of Gas Controls

Venting of gas controls should conform to recognized installation standards. It is best to check with the authorities having jurisdiction to determine your specific requirements.

4.10 Furnace Drawer

A drawer has been fitted inside the furnace in order to increase thermal exchange and efficiency of the boiler. If removed, it is necessary to refit it making sure that the open side with fin supports (labeled “1” in figure 35) must stay in the front part close to the door in order to allow a complete reverse flame inside the furnace. The distance from the front edge of the furnace must correspond to the dimension indicated on the baffle warning label.

4.11 Boiler Stack Connection

A flue gas connection is located at the bottom centerline at the back, just above the condensate drain of your boiler. The stack connection is slip-on. The flue gas connection is not designed for support. The breaching and chimney shall at minimum be the size of the boilers stack connector. The exhaust must be pitched a minimum of a 1/4 inch per foot back to the boiler to allow drainage of condensate. When installing a boiler where the exhaust is tied into other systems, a professional should be consulted.

INSTALLATION AND MAINTENANCE OF THE STACK SHALL BE IN COMPLIANCE WITH THE AUTHORITIES HAVING JURISDICTION.

Furnace pressure: The pressure drop between the burner and the stack connector at high fire.
Draft: The difference between the “stack effect” of your stack and the pressure drop of your stack.
Stack effect: Flue gasses are hotter & buoyant compared to ambient air.

Both draft & furnace pressure are measured at the stack connector. However it should be evident that the two terms have completely different meanings. This is typically measured with a manometer (Supplied by others).

Your new boiler-burner unit is supplied with a forced draft burner capable of supplying all the air for combustion when operating at reasonable amount of draft. The boiler shall be connected to a vent having
sufficient draft at all times to ensure safe and proper operations of the unit. For details on the relationship between draft and burner operation, refer to your burner manual or consult a professional. The furnace pressure (negative gauge value) should be between 0.03” and 0.6” WC at the stack connector.

Stack installation and adjustment are the responsibility of the installer. The installation of your venting system should be conducted by a professional installer who can properly balance the draft of your system with the tuning of your burner. Draft can dramatically impact the adjustment of your burner on a seasonal basis. Draft values and draft control vary depending on the configuration of your stack, weather conditions, firing rate of your boiler, and many other variables. The stack draft must not impair the stability of the flame and should be checked before installation.

4.12 Vent Material Selection

SBW recommends the use category IV UL 1738 listed ducting systems for positive pressure condensing boilers installed by a professional contractor. The ducts should be double wall construction with at least one inch between the liner (inside wall) and a shell (outside wall). Single wall construction can be used, but the heat losses, potential fire hazards, and risks to people become problematic. A properly insulated ducting system minimizes heat losses that can vary draft due to changing weather conditions and minimize heat risks to personnel. Please see UL 1738 for more information.

Materials:
- Liner for gas: stainless steel AL294C
- The shell can be made from any corrosion resistant steel including: stainless 304, stainless 316, or aluminized carbon. Specific selection is determined upon your environment, preferences, and local practices.

Thickness:
- Liner should be 20 gauge.
- Shells can vary from 26 gauge to 18 gauge depending on diameter, construction style, and structural installation choices. The UL listing process specifics an amount of incidental contact protection that is a good recommended standard.

Clearance:
- Single wall ducts require up to 18” of clearance from any flammable material
- Each manufacture of ducting will have a rating that specifies a require clearance to flammable material ranging from one (1) to six (6) inches.

⚠️ WARNING

The flue gas temperatures produced by CREEK ST boilers are considerably lower than in the case of non-condensing boilers, and have therefore very high relative humidity. For these reasons the chimney must be completely watertight, able to withstand corrosion attack by acid condensate, and adequately heat-insulated to guarantee sufficient draft.
5 Plumbing your Boiler

**WARNING**
The improper installation, adjustment, service, maintenance, or operation of this equipment can result in fire, explosion, serious injury, or death.

THE INSTALLATION OF THE UNIT SHALL BE IN ACCORDANCE WITH THE REGULATION OF THE AUTHORITIES HAVING JURISDICTION. INSTALLATIONS SHALL BE IN ACCORDANCE WITH CSA B149, NFPA 54, AND IFGC AS APPROPRIATE.

5.1 Fuel Supply & Connections

Gas piping shall be of adequate pressure at capacity for your applications in accordance with NFPA 54.

UL/cUL listed boilers have the required fuel pressures and flow rates on the rating plate.

5.2 Boiler Connections, General

- The configuration of the supplied piping is documented on your R&D drawing.
- The piping on a boiler should be kept leak proof. A small leak, if allowed to continue, soon becomes a major problem.
- Discharge from all blowdowns, safety relief valves, and venting shall be plumbed to a safe point of discharge. Please consult the authorities having jurisdiction to determine your discharge requirements.
- All plumbing installation of the boiler shall be in accordance with the regulation of the authorities having jurisdiction.
- Provisions shall be made for the expansion and contraction of hot water mains connected to boilers so there will be no undue strain transmitted to the boilers.

5.3 Water Connections

A proper and convenient water fill connection should be installed and provisions should be made to prevent boiler water from back-feeding into the service water supply. Provision should also be made in every boiler room for a convenient water supply which can be used to flush out the boiler and to clean the boiler room floor.

5.4 Hot Water Boilers Supply & Return Connections

Makeup water shall only be introduced to the boiler though the water inlet. The makeup water pipe shall be provided with a check valve or a backflow preventer containing a check valve near the boiler and a stop valve or cock between the check valve and the boiler or between the check valve and the return piping system. Some jurisdictions may require installation of a backflow preventer in the feedwater connection.

Stop valve(s) shall be placed in the supply and return pipe connections of a single hot water heating boiler installation to permit draining the boiler without emptying the system. When stop valves over two (2”) inches are used, they shall be of the outside and screw yoke rising spindle type, or of such other type as to indicate at a distance by the position of its spindle or other operating mechanism whether it is closed or open. The wheel may be carried either on the yoke or attached to the spindle. If the valve is of the plug cock type, it shall be fitted with a slow opening mechanism and an indicating device. The plug shall be held in place by a guard or gland. The design pressure of all valves used in water headers should equal or exceed the design pressure of the boilers they are attached to.
5.5 Drains

Unobstructed floor drains, properly located in the boiler room, will facilitate proper cleaning of the boiler room. Floor drains that are used infrequently should have water poured into them periodically to prevent the entrance of sewer gasses and odors. If there is a possibility of freezing, an environmentally safe antifreeze mixture should be used in the drain traps. Drains receiving blowdown water should be connected to the sanitary sewer by way of an acceptable blowdown tank, separator, or air gap that will allow the blowdown water to cool to at least 140°F and reduce the pressure to 5 PSIG or less.

5.6 Drain connections

The discharge piping shall be full size to the point of discharge. The minimum pressure rating of valves and cocks used for drain purposes shall be at least equal to the pressure stamped on the boiler but in no case less than 30 psi. The temperature rating of such valves and cocks shall not be less than 250°F.

5.7 Condensate Drain Connection

The condensate drain is located at the rear of the boiler below the flue connection. Slope the condensate tubing down and away from the boiler into a drain or condensate neutralizing filter. Do not expose the condensate line to freezing temperatures.

A condensate removal pump is required if boiler is below the drain. When installing a condensate pump, select one approved for use with condensing boilers and furnaces. The pump should have an overflow switch to prevent property damage from condensate spillage. The switch should be wired to the auxiliary device proving switch terminals on the low voltage connection board.

Condensate from the CREEK ST will be slightly acidic (typically with a pH from 3 to 5). Install a neutralizing filter if required by local codes. If the boiler is not supplied with acid condensate neutralizer, a siphon loop must be fitted on the condensate drain in order to avoid flue gas leakage.

5.8 Safety relief valves (SRV)

See the operation instructions for more details on SRV

SRV need to be installed so that no significant loads are placed on the outlet. Testing and occasional weeping can create condensate. Drip pan elbows are recommended to handle these issues during installation. Safety valves are shipped loose because they are vital to safe operation and can be damaged during transport.

SRV are installed to prevent operation of the boiler above maximum allowable working pressure. It is good practice to manually open the safety relief valves on your boiler monthly. This is done by lifting and releasing the handle provided on the valve. Refer to the maintenance section for details on use of these valves.
5.9 SRV Discharge Piping

A discharge pipe shall be used. Its internal cross sectional area shall be not less than the full area of the valve outlet or of the total of the valve outlets discharged therein. It shall be as short and straight as possible and so arranged as to avoid undue stress on the valve or valves. A union may be installed in the discharge piping close to the valve outlet. When an elbow is placed on a safety or safety relief valve discharge pipe, it shall be located close to the valve outlet downstream of the union.

The discharge from safety relief valves shall be so arranged as to minimize the danger of scalding attendants. The safety or safety relief valve discharge shall be piped away from the boiler to a safe point of discharge and there shall be provisions made for properly draining the piping. The size and arrangement of discharge piping shall be independent of other discharge piping and such that any pressure that may exist or develop will not reduce the relieving capacity of the relieving devices below that required to protect the boiler.

The discharge piping should be supported so that loads (piping weights and dynamic forces during operation) transmitted to the relief valves are minimized. The weight supported by the valve should not exceed the weight of a short elbow and drip pan or comparable weight of a direct connected free hanging discharge pipe. Installations requiring long discharge piping runs should not have those discharge piping runs directly connected to the valve. The valve manufacturer should be consulted if the weight to be loaded on a valve outlet exceeds a short elbow with a drip pan.
6 Boiler Start-up

The design, manufacture, and assembly of your new unit is the result of years of engineering work and field testing. It is a sophisticated piece of equipment to be serviced only by qualified people. If you don’t already have a qualified operator, we recommend that you contact your SBW representative for the name of experienced service personnel in your area.

Each burner can vary in details, but the following should help outline the steps involved with first time startup. The following section and your burner manual will provide many details for safe first time startup.

6.1 Operating Data

Whenever a new boiler is placed in service, operating data should be recorded, compared to predicted performance, and saved for future reference. This information is extremely valuable for diagnosing problems if abnormal operation occurs. Record all operating parameters such as pressures, temperatures, flows, draft losses, motor amps, turbine speeds, damper positions, and interlock set points.

This data assists operators to spot trends and take corrective action. Maintenance plans can be made by comparing the routine logs to the base data. For operating data to be meaningful, the instruments and controls must be well maintained and properly calibrated.

A new or relocated power boiler should not be put into operation until it has been inspected by an Authorized Inspector for the authorities having jurisdiction or insurance company and the required certificates have been issued.

6.2 Start-up Guidelines

- Start-up and testing of new unit is a SERIOUS matter.
- Take time to become familiar with the equipment you will be working with.
- Review the burner manual.
- Review the wiring diagrams, operating sequence, piping schematics, installation drawings, and any other pertinent information for the particular pieces of equipment.
- Before applying electrical power to the unit, check all electrical connections to ensure they are secure and properly connected
- Before applying fuel to the unit, check all piping to ensure it is arranged per the drawings and that all connections are tight
- DO NOT START THE BURNER UNLESS ALL CLEANOUT DOORS ARE SECURED IN PLACE.
6.3 Tools & Gauges

Before you begin, check that the following tools & gauges are installed or available:

- Stack thermometer, 50-500°F
- Temperature gauge appropriate for your size of boiler
- Flue gas analyzer
- U-tube inclined type manometer to measure stack draft and furnace pressure
- U-tube or calibrated gauge for gas pressure
- Multi-meter
- Meter to measure flame signal
- A stack velocity meter, if you need to verify stack flow

6.4 Fuel Guidelines

- Do not attempt to relight the pilot or start burner with the combustion chamber full of gas or with a very hot combustion chamber.
- Do not use gasoline, crankcase drainings, or any oil containing gasoline.
- NEVER BURN GARBAGE OR PAPER IN THE UNIT, AND NEVER LEAVE COMBUSTIBLE MATERIAL AROUND IT.
- Review all safety guidelines

6.5 Cleaning and Filling a New Boiler

Prior to starting a new boiler an inspection should be made to insure that no foreign matter such as tools, equipment, rags, etc., is left in the boiler.

Before putting water into a new boiler, make certain that the firing equipment is in operating condition to the extent that this is possible without actually lighting a fire in the empty boiler. This is necessary because raw water must be boiled [or heated to at least 180°F)] promptly after it is introduced into the boiler in order to drive off the dissolved gases, which might otherwise corrode the boiler.

In a hot water heating system, the boiler and entire system (other than the expansion tank) must be full of water for satisfactory operation. The red, or fixed, hand on the combination altitude gage and thermometer is normally set to indicate the amount of pressure required to fill the system with cold water. Water should be added to the system until the black hand registers the same or more than the red hand. To insure that the system is full, water should come out of all air vents when opened.

The water must enter the system as slowly as possible, and in proportion to the rate of air purge from the components involved. In the case of a system with a closed expansion tank, water is injected until the pressure gauge reaches the static pressure for the tank. Then proceed to heat the water to the maximum allowed plant temperature. During this operation, the air in the system purges from the automatic or manual air separators fitted to the system. On completion of the air purge, bring the pressure to the set value and close the manual and/or automatic water supply valve.
6.6 Firing a New Boiler

Commissioning and firing a new boiler is to be conducted by your installer. This process is beyond the scope of this manual. This is to be conducted by qualified personnel only. Refer to the burner manual for more information about starting up the burner.

When tuning the flame in your new boiler, the flame should not be allowed to impinge upon the back of the furnace. If the boiler is tuned with flame continuously impinging upon the back of the furnace the warranty is void. Also see the boil out instructions and start up procedures for details on firing the boiler for the first time.

6.7 Boil-out Procedure

All new boilers must be boiled out or Superior Boiler Works will void the warranty!

Before introducing the boil-out chemicals to any drain system, check local environmental regulations to ensure you are in compliance.

It is necessary to clean the inside of the new boiler of oil and grease. Failure to remove these materials will result in your unit foaming, priming, and pulling over. These contaminants must be removed to provide clean heat transfer surfaces. Before boil-out procedures may begin, the burner must be ready for firing and the operator must be familiar with the procedure outlined under burner operation. SBT-710 is the chemical recommended for the cleaning of boilers. Dosage is one (1) gallon per fifty (50) gallons of water in the boiler. The operator must become familiar with the information in the SBT-710 technical data sheet and the MSDS.

1. Close off supply and return water valves and remove safety relief valves.
2. An overflow pipe should be attached to either the vent connection or a safety valve connection located at the top center of the boiler and routed to a safe point of discharge, in compliance with local environmental regulations. Use care in removing and reinstalling these valves. All other openings shall be closed off.
3. All valves in the piping leading to and from the boiler must be closed to prevent cleaning solution from getting into the system.
4. Fill pressure vessel with soft water to the normal water line. Add the SBT-710 and then fill to the top.
5. The boiler should then be fired intermittently at a low rate sufficient to hold the solution just at the boiling point. Maintain this temperature for a minimum of twelve (12) to twenty-four (24) hours to allow sufficient time for the removal of all dirt, oil, and grease from the internal boiler surfaces. Do not produce steam pressure.
6. Add a small amount of fresh water to the boiler to create a slight overflow that will carry off surface impurities.
7. Maintain temperature and overflow until water clears of impurities. Do not produce steam pressure.
8. Shut down the burner and permit the boiler to cool to 120°F then drain boiler. Use caution that the hot water is discharged with safety.
9. Remove washout plugs and wash the waterside surfaces thoroughly using a high-pressure water system.
10. Inspect internal surfaces and repeat steps four (4) through nine (9) if necessary.
11. All washout plugs and any other openings shall be closed except a vent line. Fill the boiler immediately to prevent flash corrosion. Fire boiler until water is heated to at least 180°F to drive off any dissolved gases that may corrode the metal.
12. Proper water treatment must be maintained at all times to prevent scale and corrosion in the boiler and condensate return lines. See your water treatment professional for the program that best fits your needs.
13. Connect a vent pipe to the safety relief valve port on the boiler and run this vent to a drain.
14. Fire the boiler at a low rate for three (3) to four (4) hours allowing the steam to discharge through the vent pipe (installed in place of the safety relief valve if necessary).
15. Drain the boiler while still warm. Remove washout plugs. Wash interior of boiler with tap water at full pressure through a nozzle. Wash until all evidence of dirt, mud, and impurities are removed through the washout plug opening. Clean any shell mounted probe holders.

16. When the boiler is so equipped, remove water level prove holder(s), and check for contamination that may have been caused by the boil-out chemicals. Clean the water side surfaces of the probe holder and the probe(s) to remove any contamination. Reinstall using appropriate pipe thread sealant to ensure a leak proof seal.

17. The boil-out procedure will be complete after replacing the safety valve and opening the outlet valve.

18. The above cleaning operation also serves to safely remove any moisture in the insulating refractory in your boiler.

6.8 Start-up of Hot Water Boilers

If you know that the system is working safely, start-up can be simplified to the following:

1. Review the burner manual for startup recommendations.
2. Fill boiler and system; vent air at high point in system
3. Check altitude gage and expansion tank to assure system is properly filled.
4. Set control switch in “OFF” position.
5. Make sure fresh air to boiler room is unobstructed and manual dampers are open.
6. Check availability of fuel.
7. Vent combustion chamber to remove unburned gases (integral to burner operation).
8. Clean glass on both the burner’s view port, and the boiler’s sight glass.
9. Observe proper functioning of water pressure regulator and turn circulator pumps on electrically.
10. Check temperature controls for proper settings.
11. Check manual reset button on low-water fuel cutoff and high-limit temperature control.
13. Place circuit breaker or fused disconnect switch in “ON” position.
14. Place all boiler emergency switches in “ON” position.
15. Place boiler control start switch in “ON” or “Start” position. Do not stand in front of boiler access doors. This is a precautionary measure should a combustion explosion occur.

Notes: Once main flame has been established, visually check the flame and note its appearance. The flame should be relatively small to achieve a slow warm-up. The main use is stable combustion and slow even heating of the boiler to minimize structural stresses.

16. Do not leave boiler until it reaches the established cutout point to make sure the controls shut off the burner

17. During the temperature and pressure buildup period, walk around the boiler frequently to observe that all associated equipment and piping is functioning properly. Visually check burner for proper combustion. Note: Remain fully aware of water temperature and flow rate or steam pressure and water level while operating the boiler at higher capacities.

18. Immediately after burner shuts off, inspect water pressure and open the highest vent to determine that system is completely full of water.

19. Enter into log book: Time and date of startup, any irregularities observed and corrective action taken. Time when control shut off burner at established pressure/temperature, tests performed, etc…

20. Check safety relief valve(s) for evidence of leaking. Perform try lever test. See safety relief valve section under the operation section.
6.9 Good practice recommendations for hot water boilers

Use of this hot water boiler for temporary heating of an unfinished building is not recommended by SBW. Use of the boiler prior to closing the building and balancing of the heating system may lead to thermal shock and leakage. Use of the boiler for temporary heat will render the warranty void against leakage.

1. Do not put into service for any purpose without properly balancing the heating system and properly adjusting the burner.
2. The burner must be adjusted to avoid short term cycling. This will help eliminate the problems connected with rapid expansion and contraction associated with short cycling when the burner is not modulating continuously.
3. The firing rate of the unit must not be exceeded.
4. A circulation flow switch (when a circulation pump is provided) must not permit the burner to fire unless water from the heating system is circulating through the boiler.
5. Prior to initial start-up, the entire heating system must be cleaned of all foreign matter such as rust, oil, etc.
6. Proper water treatment must be used.
7. Boiler operating personnel should be properly trained in maintenance and operating procedures.

6.10 Guidelines for hot water boiler heating system.

**Condition: Boiler Warm – System Warm**

- Start burner on low fire only.
- Open supply and return headers and start system pump.
- After boiler and system temperature are equal, release burner to automatic.

**Shut down of hot water boiler heating system**

- Put manual low fire hold switch in low fire hold position.
- After burner is at low fire, open burner control switch and let burner cycle to off position.
- Shut pump system off.
- Close supply and return header valves.
7 Operation

7.1 Safety Relief Valves

Safety relief valves are used to relieve excessive pressure generated within a boiler. The safety relief valve (or valves) is the final line of protection against overpressure in the boiler. They discharge a volume of hot water when relieving. This is the most important single safety device on any boiler.

**Safety Relief Valves:** A safety relief valve is an automatic pressure relieving device actuated by the pressure generated within the boiler. It is used primarily on water boilers. Valves of this type are spring loaded without full-opening pop action and have a factory set nonadjustable pressure setting.

Safety relief valves should be try lever tested every 30 days of boiler service and after any period of inactivity.

All personnel concerned with conducting a safety relief valve test should be briefed on the location of all shutdown controls in the event of an emergency, and there should be at least two people present. Care should be taken to protect those present from hot water. All safety relief valve tests are to be documented including the date into your log book. Excessive hand lifting will shorten the life of the valve.

**Try Lever Test:**

a. Check the safety relief valve discharge piping to determine that it is properly installed and supported.

b. Check and log the system operating pressure and temperature.

c. Lift the try lever on the safety relief valve to the full open position and hold it for at least 5 sec or until clean water is discharged.

d. Release the try lever and allow the spring to snap to the closed position. If the valve leaks, operate the try lever two or three times to clear the seat of any foreign matter that is preventing proper seating. As safety relief valves are normally piped to the floor or near a floor drain, it may take some time to determine if the valve has shut completely.

e. If the safety relief valve continues to leak, it must be replaced before the boiler is returned to operation.

f. Check that system operating pressure and temperature have returned to normal.

g. Check again to assure the safety relief valve has closed completely and is not leaking.

**Safety Relief Valve Test:**

a. Check that safety relief valve discharge piping is properly installed and supported.

b. With the circulating equipment in operation, turn the fuel burning equipment off and allow the boiler water to reach a temperature approximately 80% to 85% of its normal operating temperature.

c. After the boiler water temperature has been reduced, turn off the water circulating equipment. On some boilers, it may be necessary to jumper out the circulating pump flow switch to allow the burner to come on during the test.

CAUTION: On boilers requiring water flow to prevent damage to the boiler, do not jumper out the flow switch. It may be necessary to isolate the boiler and hydrostatically test the safety relief valve or have the safety relief valve removed and sent to a nationally recognized testing agency for testing.

d. Turn off the system supply and return valves, and isolate the expansion tank from the boiler.

e. Install a calibrated test gage.

f. After assuring that all personnel are clear of the safety relief valve discharge piping, turn on the fuel burning equipment.
CAUTION: On boilers with small water storage capacity, very little heat will be required to raise the pressure to the opening pressure of the safety relief valve.

g. If the temperature at the start of the test is below the normal operating temperature, as recommended in (b), it will not be necessary to change or jumper out the operating or high limit temperature controls. If the water temperature is at normal operating temperature, it may be necessary to readjust these limits upward to allow the burner to remain on long enough to reach the opening pressure of the safety relief valve.

h. The safety relief valve should open* within an acceptable range above or below the set point. This range is ±3 psi for valves set to open at or below 60 psig.

i. There will be a discernible point when the valve opens and provides water flow with no significant rise in pressure. At this point log the pressure and turn off the fuel burning equipment.

j. If the safety relief valve does not open at the set pressure plus the allowable tolerance, shut off the fuel burning equipment and do not operate the boiler until the safety relief valve has been replaced.

k. If the safety relief valve opens at a pressure below the allowable tolerance, this is not necessarily a dangerous condition but it can indicate a deteriorating condition or improper spring setting. The valve should be replaced.

l. After the safety relief valve has closed, open the valve to the expansion tank, the system return line, and the supply line to allow the boiler to return to its normal operating pressure.

m. If applicable, remove the flow switch jumper and return the operating and high limit temperature controls to normal.

n. Start the water circulating equipment.

o. Start the fuel burning equipment. Observe the pressure and temperature until the system returns to normal operating conditions and the operating control has cycled the burner on and off at least once.

p. Check again to assure that the safety relief valve is not leaking

* In the absence of flow metering equipment, opening of the valve can be considered to have been achieved when a steady fast drip or stream of approximately 40 cc/min is observed at the discharge opening of the valve.

7.2 Gauges

7.2.1 Pressure Gauges
A proper pressure gauge was shipped loose with your boiler and installation at a location indicated in the installation section of this manual. If your gauge needs to be replaced, the following information is helpful to specify its replacement. Pressure gauges are used on both steam and hot water boilers. Gauges can be damaged by overpressure or corrosion. See Figures 26-28

7.2.2 Pressure Gauge range
The gauge range should be selected so that the gauge will normally operate in the middle of the scale. For example, if the operating pressure is 50 psi, then a 100 psi gage should be used. For hot water boilers, the gauge should have a range of not than 1 1/2 times nor more than 3 1/2 times the safety relief valve setting.

7.2.3 Pressure Gauge Accuracy
The gauge accuracy is expressed in percent of full scale reading. For example, if a 100 psi gauge is 2% accurate, then it will be within ±2 psi of the actual pressure. A gauge is usually more accurate at mid-scale and should be calibrated at that point. Most gauges used on boilers have an accuracy of 1 % to 1 1/2%. An inspector gauge is usually 1/2% accurate and a laboratory gauge may have an accuracy of 1/4%.
7.2.4 Pressure gauge calibration:
The gauge used on a boiler should be calibrated at least once per year. This can be accomplished by comparing it to an inspector gauge or using a deadweight tester. If an inspector gauge is used, the accuracy of that gauge should be verified with a deadweight tester at least once every 2 years. If the gauge is damaged or cannot be calibrated to provide consistent readings, it should be discarded and replaced with a new gauge.

7.2.5 Temperature gauges
Water boilers are supplied with a proper temperature gauge installed at a location indicated in the installation section of this manual. The temperature gauge is located so that it shall at all times indicate the temperature of the water in the boiler at or near the outlet. The temperature gauge’s range shall be such that it is capable of reading the water temperature of your water boiler at all times.

7.2.6 Pressure or altitude gauges
Each hot water boiler shall have a pressure or altitude gauge connected to it or its flow connection in such a manner that it cannot be shut off from the boiler except by a cock with a tee or lever handle, placed on the pipe near the gauge. The handle of the cock shall be parallel to the pipe in which it is located when the cock is open. The scale on the dial of the pressure or altitude gauge shall be graduated approximately to not less than 1-1/2 nor more than 3-1/2 times the pressure at which the safety relief valve is set. See Figure 26-28

7.2.7 Stack thermometers
All boilers are supplied with a proper stack thermometer good for at least 200°F installed near the stack outlet.

7.3 Temperature controls
Water boilers are protected from over-temperature by two temperature-operated controls. The high limit and operator temperature controls are installed as aquastats in the boiler’s outlet water spool. See Figures 26-28

7.3.1 High limit: Water boilers have a high temperature limit control that cuts off fuel supply to prevent water outlet temperature from exceeding its maximum fixed set point. This control is constructed to prevent a temperature setting above the maximum design temperature. Operation of the high limit will cause a safety shutdown requiring a manual reset. The manual reset button is on the controller itself to make the user aware of what has happened.

7.3.2 Operator: Hot water boilers have a control that will cut off the fuel supply when the system water temperature reaches a preset operating limit, which shall be less than the maximum water temperature.

7.3.3 Firing rate control: Hot water boiler have a control that will modulate the burner between the firing rate set point and its differential. On hot water boilers, both the operator and firing rate control typically have a single user setting of temperature and a fixed subtractive differential determined at the factory during the time of manufacture.

7.4 Maintenance on temperature limiting controls
Maintenance on temperature limiting controls is generally limited to visual inspection of the device for evidence of wear, corrosion, etc. If the control is defective, replace it. Do not attempt to make field repairs. Also see the maintenance section for operational check of temperature limiting devices.
7.5 Example of control set point adjustment procedure

Given that the approximate desired plant operating water temperature is known, review the factory firetest temperature control set points (shown on the Firetest Report) and make the appropriate adjustments on each set point. In the initial phase of adjustment, the original factory set spreads between set points should be maintained. For specific setting available on your set points, refer to the appendix portion of your manuals for your burner or controls as appropriate.

Turning the larger main scale adjusting screw CW will raise the temperature while CCW rotation will decrease it. The same convention also pertains to the smaller differential adjusting screw. The manual reset high limit control has no differential screw.

After the boiler has been started, the burner adjusted, and the safety devices checked out, the boiler should be put on line to carry a normal water load. Note that control adjustment will be difficult to complete accurately if the load is either too high or too low. Control settings are determined by observing the water temperature gauge at the point of switch function as opposed to relying on the pointer indication on the scale plate.

There is no benefit in adjusting the manual reset high limit and operating control set points too close to each other. This practice can lead to nuisance tripping and lockout of the high limit.

7.6 Water level controls

Water level controls are provided on every boiler. The most important function they provide is low-water fuel cutoff. Low-water fuel cutoffs are designed to provide protection against hazardous low-water conditions in boilers. History indicates that many boiler failures result from low-water conditions. Low-water fuel cutoffs may be generally divided into two types, float and probe. Only probe type controls will be used on the Creek ST boilers See Figure 26-28.

7.6.1 Electric probe type low-water fuel cutoffs
The electric probe type low-water fuel cutoff is located in the instrumentation spool. It consist of one electrode (probe) that under normal conditions is immersed in the boiler water with a small current being conducted from the electrode to ground to energize a relay. If the water level drops sufficiently to uncover the probe, the current flow stops and the relay operates to shut off the burner.

7.6.2 Low-water fuel cutoff and water feeder maintenance
Low-water fuel cutoffs and water feeders should be dismantled annually, by qualified personnel, to the extent necessary to insure freedom from obstructions and proper functioning of the working parts. Inspect connecting lines to boiler for accumulation of mud, scale, etc., and clean as required. Examine all visible wiring for brittle or worn insulation and make sure electrical contacts are clean and that they function properly. Complete replacement mechanisms, including necessary gaskets and installation instructions are available from SBW. After re-assembly test as required.

7.6.3 Low-water cutoff (LWCO)
Creek ST boilers are equipped with a probe type LWCO with a manual reset. In the event this device is activated to shut off the burner, the operator must reset the device. This ensures the operator is aware that the LWCO is not operating as designed. The reset button is located on the burner control panel usually located on the burner.
7.7 Water level operations

Every effort should be made to place feedwater control on automatic operation as soon as possible during startup because they require constant operator attention otherwise. Operating without sufficient water to cool pressure parts is the most common way to destroy a boiler. Maintenance of water at a safe level in the boiler is of vital importance. It must not be allowed to go low enough to endanger the boiler through overheating. Automatic level control devices and low and high level alarms should be considered solely as operating aids and should not be relied upon entirely. Water level, as indicated by two or more devices, should be frequently compared. Significant (more than 1/2”) differences in level indications should be promptly investigated and reconciled.

Other indications of low water conditions include higher than normal water or stack temperature. Operation of the unit can be maintained provided immediate action is taken to restore the water level to normal level. This should be done with care, using all indicators available, such as feedwater flow meter, and all other instruments that properly sense the operating conditions of the boiler.

The best, safest advice is: IF IN DOUBT - SHUT DOWN THE BURNER, CONTINUE TO FILL WITH WATER UNTIL THE BOILER IS FLOODED.

If a complete shutdown occurred, let the boiler cool until the exposed drum is at hand touch temperature, and then add water. Do not put the boiler back into service until the condition responsible for the low water has been identified and corrected.

If there is any possibility that the boiler has been damaged, it should be cooled down and thoroughly inspected for damage due to overheating.

7.8 Water Treatment

Water treatment starts with the boil-out procedure and the quality of your feedwater. Boiler feed water, regardless of the type of treatment program used, will still contain measurable concentrations of impurities. To maintain reliable boiler operation, the concentrations of each component of the boiler’s water must be limited to certain maximums. Feedwater treatment and chemicals are the typical means used to maintain water quality inside your boiler.

Maximum trouble free boiler life is in most cases tied directly to proper boiler water treatment. The exact chemistry of water varies greatly from one area to another so there is no such thing as one treatment being effective in all areas. Treatment must be provided to prevent scale formation, oxygen corrosion, excess acidity, control of total dissolved solids, prevent caustic embrittlement, and so forth. We, therefore, recommend that you contact a reputable boiler treatment company operating in your area for advice in this field.

If the boiler is to be installed in an existing system where there could be frequent losses from the system or if the hardness of the water is greater than 10 F, it will be necessary to use a filter and a softener for system water and control the pH above 8-9.
The most common phenomena in heating systems are:
- **Furring (calcareous deposits of Calcium Carbonate)**

  Furring impedes heat exchange between the flue gases and the water, thereby increasing the temperature of parts exposed to the flame and reducing considerably the boiler life. Furring concentrates where the boiler wall temperature is higher, and the best defense against this phenomenon is a boiler design that eliminates high temperature spots.

  Furring represents an insulation layer that decreases heat exchange, penalizing boiler efficiency. This means that a large part of the combustion heat is not transferred to the water, but leaves the system via the chimney.

**Calcium Carbonate Diagram**

<table>
<thead>
<tr>
<th>Legend</th>
<th>% unused fuel</th>
<th>mm furring</th>
</tr>
</thead>
</table>

![Calcium Carbonate Diagram](image)

- **Water-side corrosion**

  Corrosion of metallic boiler surfaces, waterside, is due to Iron dissolving to form ions (Fe+). In this process, the presence of any dissolved gas plays a major role, in particular oxygen and carbon dioxide. Often there are corrosion phenomena with softened and demineralized water, which are by their nature aggressive to iron (acid water with pH < 7): in these cases though clearly there will be no furring, corrosion remains a risk and it will be necessary to condition the feedwater with corrosion inhibitors.

### 7.8.1 Heating boilers

Water treatment in a heating boiler is usually not a problem because the same water is used over and over. Treatment’s primary purpose is to eliminate corrosion and pitting cause by alkalinity and oxygen. It is usually necessary to treat the water in a heating boiler once a year at the beginning of the heating season. SBW recommends you consult a competent water consultant to determine your water treatment. The appearance of scale, corrosion, or pitting is definite evidence that water treatment is needed.

### 7.8.2 Water treatment guidelines

**Get professional help**

Detailed instructions, prepared by a competent feedwater chemist, for feedwater treatment should be followed. It is inadvisable to experiment with "homemade" treating methods or compounds. Representative samples of feedwater and boiler water need to be analyzed frequently to ensure they are within specifications.

**Oil & water don't mix**

Every effort should be made to prevent oil from getting into the water side of boilers. Oil causes foaming or combines with suspended matter to form a sludge that, in turn, can cause overheating of pressure parts through its insulating effect. If oil does get into a boiler, the boiler should be taken out of service immediately and thoroughly cleaned.
Heating boilers should not breathe

Use every practical means for excluding oxygen from boiler water. One source of oxygen is makeup water; therefore, hold makeup to a minimum. If a water boiler in a closed loop system loses more than 3 in. of water per month, this indicates there probably is a leak in some part of the system. The leak should be found and corrected.

7.9 Access openings and Combustion Chamber

7.9.1 Burner mounting

IMPORTANT: Check that the spaces between the burner sleeve and the boiler door are filled with thermal insulation (Figure 2). A piece of ceramic fiber insulation rope is provided with the boiler. If this is not suited to the specific burner fitted, use a rope of another diameter, of the same type of material.

All details on the draft tube length, the diameter of the burner hole, and the pressurization are included in the part Technical Specifications.

7.9.2 Door Aperture

For the models CRST-300 and CRST-500 models, the door can be opened in either direction (RH or LH). For the larger models if the door is to be opened to the opposite side, take the following steps.
1. Switch the outside nut (or bush) of one hinge with the diametrically opposite closure bush; then at the hinge side, fasten the cone to the door with the inside nut.
2. Repeat the operation for the other hinge.
3. For any adjustment needed, act on the specific hinge nuts.

For the door height adjustments see Fig. 34.


8 MAINTENANCE

With proper operation and maintenance you can expect years of trouble-free service from your new boiler. The next few pages give guidelines for typical boiler maintenance. Cover plates, enclosures, and guards shall be maintained in place except during maintenance.

Periodically, the waterside surfaces of the boiler should be visually checked for scale formation, pitting, and corrosion. Scale collection should not be thicker than an eggshell as scale is a good insulator and can considerably lower your boiler’s overall efficiency. When lowering the water level or draining the boiler for inspection, caution must be used. DO NOT DRAIN A HOT BOILER QUICKLY. Good practice dictates draining the boiler only after it has been out of service at least twenty-four (24) hours.

IN NO CASE EVER FILL A WARM BOILER WITH COLD WATER. THIS WILL CAUSE LEAKAGE. If you want to reduce the time it takes to cool off the boiler, the burners fan can run cool air through the boiler. This is not a recommended practice, however in some cases the downtime cannot be afforded to allow the boiler to cool down slowly.

8.1 Spare Parts.

Spare parts for controls, including electronic components which require time for procurement, should be maintained in stock supply. Spare parts should be kept in the boiler room or close by in a cool, dry place. In case you need to open up your boiler unexpectedly, it is a good idea to keep spare gaskets on hand. Many locations require that boilers are inspected once a year. Typically the yearly maintenance is conducted at the same time as this inspection. A full set of gaskets will be needed to reseal all access openings. Documenting the start-up is required to activate your warrantee. Keeping records of all boiler activities can be helpful in troubleshooting if you have a problem with operations.

8.2 Maintenance schedule

The suggested maintenance schedule has been broken down into daily, weekly, monthly, semi-annual, and annual procedures. While the exact frequency of your inspections may vary, the schedule presented here is a good place to start. Over time you can determine exactly how often each item needs to be checked. Examples of maintenance logs are provided at the end of the manual. However the end user is responsible to create log sheets that match with the specifics of your system.

A permanent log book should be provided in each boiler room to record maintenance work, inspection, certain tests, and other pertinent data. Brief details of repairs or other work done on a boiler plant (including time started, time completed, and signature of person in charge) should be recorded. Performance and results of test, inspections, or other routines required by codes or laws, insurance company inspection reports, and initial acceptance test data should be recorded.

A double asterisk (**) is used to indicate that your boiler manual should also be checked for information on the topic being covered.
8.2.1 Daily procedure, also reference the burner manual’s procedures.

1. All water level controls should be tested for proper operation.
2. All gauges, monitors, and indicators should be checked for proper operation.
3. Observe burner starting sequence and flame characteristics to verify normal behavior. Check furnace for debris and sooting, also inspect refractory through flame.
4. If an operating log is kept, enter reading; otherwise, conduct visual check of all pressure and temperature gauge readings.
5. Check safety relief valves and washout plugs for signs of leakage.
6. Check stack temperature. If temperature is higher than normal, check burner operation for over-firing or improper combustion.
7. Check water sample readings for proper chemical treatment.
8. Check the condensate trap

8.2.2 Weekly procedure, also reference the burner manual’s procedures.

1. Check the temperature limit shutdown. During this check, observe the operation of the primary safety to make sure that the operation is as described in the sequence of operation section of the burner manual.
2. Wipe the entire unit, particularly the operating parts, so that oil and dust do not accumulate.
3. Check combustion control operation as outlined in check list section of burner manual. Investigate and correct any failure at once. **
4. Check flame safety control’s response to lack of flame with main gas off. **
   - Interrupted Pilot – Start burner with pilot gas on, verify lockout.
   - Determine that alarms are reacting to lockout.
5. Details about your lockout system timing should be provided with the burner manual. **
6. During and after flame failure test, observe ignition spark and pilot flame for abnormalities. **
7. Record pilot and main flame signals if proper meter is available. **
8. Verify that main fuel valves are closing within specified timings; check valve position indicators. **
9. If boiler is equipped with modulating burner, verify that adequate differential exists between operating and modulating controls to prevent short cycling. **
10. If you have chemicals being introduced directly into the boiler, check chemical feed equipment against the check list supplied by your water treatment professional.
8.2.3 Monthly procedure, also reference the burner manual’s procedures.

1. Clean combustion air fan and air inlet assembly.
3. Clean scanner lens.
4. Test low draft, combustion fan air flow switches mechanically and electrically. Disconnect wire, start burner, verify that pilot does not light. Reconnect wire when finished.
5. Check low fire switch, proving switch circuit mechanically and electrically. Terminal must not be powered until motor returns to low fire position. If wire is disconnected, verify that pilot does not light. Reconnect wire when finished.
6. Check “open damper proving switch circuit” mechanically and electrically. Terminal must not be powered until motor reaches high fire position. If wire is disconnected, verify that motor remains at high position. Reconnect wire when finished.
7. Check door interlock switch electrically. If wire is disconnected, verify that pilot does not light. Reconnect wire when finished.
8. Test main gas valves for leakage. Close checking cock, connect hoses to open leak test valves, submerge hose ends in water, and watch for bubbling.
9. Test fuel pressure interlock switches. With burner in normal operation (preferably at high fire), raise low gas pressure switch set point above available fuel pressure. Burner must shut off when visual indicator trips. Test high gas pressure switch by reducing set point below existing manifold pressure. Again, burner must shut off when indicator trips. After returning to normal set point, burner must not restart until switches have been manually reset.
10. Manually lift safety valve with test lever momentarily while boiler is at normal operating pressure. You should see flow out of this valve. If the valve does note flow when opened, or properly close afterwards, refer to the safety relieve valves manual for further details.
11. Check the flue gas connector, vent connector (breaching), and stack for leaking and or corrosion. All vent system components and draft controls shall be check per their manuals or instructions provided by the installer.
8.2.4 Semi-Annual procedure, also reference the burner manual’s procedures.

1. Cool boiler slowly to room temperature. NOTE: Failure to cool boiler slowly can cause plates to leaks. This is very important! To assist cool down, use the Test/Run or Check/Run switch located on the programmer to run the blower.
2. Remove all the nuts from the front door, pry the door loose from the boiler, and swing it away on the davit arm.
3. Clean the combustion chamber.
4. Clean the sight port glass, replace if required.
5. Rinse the condensate drain pipe with soft water.
6. Clean & adjust pilot assembly. This will be covered in the burner manual. **
7. Re-calibrate all indicating and recording devices
8. Check flame failure detection system components. Refer to the burner manual for additional instructions.
9. Check firing rate control. **
10. Check piping and wiring of all interlocks and shut off valves. **
11. Inspect burner components; refer to the burner manual for additional instructions. **
12. Check wire insulation for brittleness, cracking, or missing patches.
13. Disassemble and clean all safety control related piping
14. Check boiler pressure gauge against calibrated master gauge or with dead weight tester. New gauges are built to one percent (1%) accuracy.
8.2.5 Annual procedure, also reference the burner manual’s procedures.

1. Follow steps 1 through 6 listed under Semi-Annual Procedure.

2. Clean water side of boiler as follows:
   - Cool and drain the boiler.
   - Wash down the inside (water side) of the boiler with a hose, making sure to get all sludge and scale out of bottom of boiler.
   - Remove the washout plugs.
   - Inspect the shell surfaces for signs of corrosion or scale formation. If scale is forming (to any degree) on internal surfaces, chemical treatment is not correct. Consult your water treatment professional.
   - Disconnect the piping on the discharge side of the feedwater pump and inspect for scale build up. Check stop and check valves for proper operation and replace if necessary.
   - Test the safety relief valves. If the safety relief valves fail to properly operate, they shall be replaced with new safety valves of proper pressure and capacity rating. Old valves may be refurbished by a reputable valve repair company with a VR stamp and kept as spares.
   - Fill the boiler by means of the feedwater pump and reset the low water cutoff.

3. At the time of this yearly inspection and cleaning, it is recommended that the local state or insurance inspector, in addition to the SBW distributor, or agent, be called in to check the condition of the equipment. Water treatment professional should also be present.

4. Jumper operating control and run boiler under manual control at reduced load to determine if high limit control functions correctly. Remove jumper wire when finished.

5. Bypass both operating and high limit controls under manually controlled low load condition. Gradually bring boiler pressure up to safety relief valve set point. Valves rated at 15# valves must open at 15#, valves rated 15 to 69# are permitted two percent (2%) tolerance, and 70 to 300# valves may vary by three percent (3%).

6. Remove gas line strainer basket and clean.

7. Flame failure detection system, pilot turn down test. **

8. Replace scanners or flame rods in accordance with manufacturer’s instructions. **

9. Conduct a combustion test. **

10. Check all coils and diaphragms; test other operating part of all safety shutoff and control valves. **

11. Test fuel valve interlock switch in accordance with manufacturer’s instructions. **

12. Perform leakage test on pilot and main gas valves. **

13. Test purge air switch in accordance with manufacturer’s instructions. **

14. Test low fire start interlock in accordance with manufacturer’s instructions. **

15. As required. **
   - Recondition or replace lower water fuel cutoff device
   - Check drip leg and gas strainers.
   - Flame failure detection system, pilot turn down test.
   - Test safety relief valves in accordance with SRV tests.
8.3 Detailed Empty inspection

Before commissioning, and as required the boiler can be drained and inspected in detail. The following checklist is what most inspectors will be looking for.

Safety Checklist for Inspection
1. Notify the person in charge at the site when beginning and upon completion of the inspection.
2. Inspect with another person so if assistance is required help will be close at hand.
3. Always be aware of the nearest escape routes.

Water Side Checklist
1. The water side should be free of extraneous material such as dirt, tools, rags, wood, or trash.
2. All internal fittings should be in serviceable condition and securely installed in the correct position.
3. Look for evidence of corrosion on pressure parts.
4. Look for erosion at mating surfaces of washout plugs and flanges
5. Note location and type of deposits in boilers that have previously been in operation and collect samples for analysis.

Fire Side Checklist
1. All combustion air and flue gas passages such as the furnace, ductwork, and fans should be free of extraneous material.
2. It is especially important to remove all combustible material that might ignite, burn, and trigger the explosion of unburned fuel if ignition is lost or interrupted at the burners.
3. Dampers and burner registers should be operated to confirm that they are free to travel from fully closed to wide open. (Canadian boiler vent damper may have a stop preventing full closure)
4. Check to verify that the refractory is correctly located and properly installed. Burner orifices, over fire air nozzles, observation ports, and instrument taps must not be covered or plugged. Repairs should be made if refractory is missing or significantly damaged. Slag should not be removed from the surface of the refractory unless it interferes with normal operation. It is very likely that chunks of refractory will be removed with the slag.
5. Look for daylight shining through holes that indicate air or flue gas leaks.
6. Always carry a note pad and pencil and make notes of conditions found to avoid reliance on memory. Sometimes a photograph or sketch will be valuable as a reference base for future inspections.

Look for corrosion of pressure parts:
1. under deposits;
2. at joints;
3. where the flue gas may have been below its dew point;
4. under refractory or insulation if it has been water soaked for a period of time.

Look for erosion:
1. of draft fan housings and wheels handling dirty gas
2. at sharp turns or points where dirty gas flow may concentrate
3. in areas near where any water leaks have occurred
External Checklist:
1. Free access should be provided to the burner front, observation ports, and operating valves.
2. All instrumentation and controls should be complete, operational, and checked for proper calibration and action.
3. External indicators permanently marked or installed on damper shafts and registers are necessary for positive determination of position while the boiler is in service.
4. Personnel protection from hot surfaces should be provided by restricting access or by covering the hot surfaces with insulation.
5. Find potential air or flue gas leaks in the furnace of out of service boilers operated with positive furnace pressure by operating the forced draft fan at high flow rates. Leaks that can be felt or heard should be repaired before returning the boiler to service.
6. Safety relief valve outlets should be piped so they cannot discharge on people or any property that may be damaged. The discharge piping should be supported so that loads (piping weights and dynamic forces during operation) transmitted to the relief valves are minimized. The weight supported by the valve should not exceed the weight of a short elbow and drip pan or comparable weight of a direct connected free hanging discharge pipe. Installations requiring long discharge piping runs should not have those discharge piping runs directly connected to the valve. The valve manufacturer should be consulted if the weight to be loaded on a valve outlet exceeds a short elbow with a drip pan.

8.4 Limit control tests

All limit controls should be tested periodically. Refer to the maintenance schedule as a starting point and discuss the details with your installer. A test gauge should be used to check the operation of all pressure controls. In general, the tests are to be performed as follows. Some tests may not apply to your specific installation.

8.4.1 High & Low gas pressure switch limit test & adjustment

The maximum and minimum pressure range of the gas train is on the rating plates on the front of the boiler. If any readings are above this range, or if adjustments can’t be consistently made within this range, then other issues like pressure regulators or line pressure need to be addressed first.

For setting and testing the gas pressure switches:

Close the main manual gas shutoff valve and install a manometer or calibrated gauge in a test port that will see the same pressure as the switch. Reopen the main manual gas shutoff valve. When finished, close the main manual shutoff valve, remove calibrated gage or manometer, and restore the test plug. Restore the main manual gas valve to full open.

Setting and testing the low gas pressure switch:

Cycle the burner to high fire and a gas pressure reading. Using the main manual gas shutoff valve, throttle down the gas flow to a point there the reading is approximately 10% below the full open reading. Then adjust the low gas pressure switch until it breaks and shuts down the burner. Restore main manual gas shutoff valve to full open.

Set the burner to high fire and use the main manual gas shutoff valve to throttle the gas flow. The low gas pressure switch should immediately break and shut down the burner at about 10% reduced pressure.
For setting and testing of the high gas pressure switch:

If the high gas pressure switch (HGPS) is located downstream of the metering valve, adjustment and testing of the HGPS is performed at high fire. If the HGPS is located upstream of the metering valve, then adjustment and testing is performed at low fire.

Cycle the burner to firing rate, and take gas pressure reading. Slowly adjust the switch until it breaks and shuts down the burner, then reverse the adjustment so that setting is approximately 10% greater than the reading at which the switch broke.

8.4.2 Electrical Limit Controls.

All electrical current limiting or overload devices, including fuses and thermal overload elements, should be inspected to determine that they are properly sized and in good condition. Switches, starters, and relays should be checked for proper operation.
9 TROUBLESHOOTING

If burner does not start, check the controller fault code in the burner manual.
1. Check all electric fuses.
2. Check water level in boiler.
3. Check limit controls to make sure they are making circuit.
4. Check the door interlock switch to make sure it is making circuit.
5. Push motor or starter reset button.
6. Push reset button on the programming control.
7. Push reset on high and low gas pressure switches.
8. Push reset button(s) on LWCO and temperature devices.
9. If burner then fails to start, call a qualified service technician.
Refer to your burner manual, look for sections about start up, flame sensors, flame safe guard, etc...

To stop burner
1. Switch off burner control switch or push emergency door switch.
2. Do not kill the feedwater pump until boiler is cooled or boiler is full.

Burner adjustments
The burner manual should be used for reference on burner adjustment.
1. The flame should not be impinging on the walls of the furnace.
2. If you are having problems adjusting the flame using the burner controls, draft controls may need to be adjusted, or added if not present.

Switch problems
1. Probe style switches (common LWCO) can give a false closed switch signal because of contamination. Clean water side of probe holder.

Leaking
If water starts coming out of the smoke box door, this is common during initial cold start up. If this does happen during start up, but stops after the boiler has warmed up, this is ok. If this happens during normal operation when the boiler is warm, then you may have a leak. This could also just be the result of condensation if the boiler room is humid. If you believe you have a leak, call your local boiler service technician.

Fan rotation
Even when factory tested, the fan motor can be wired backwards in the field. Observe the fan rotation indicator marked on the fan. The diagram below shows how the three phase wiring can control a fan going clockwise (cw) vs. counterclockwise (ccw). In general, incorrect fan rotation is corrected by switching the position of two wires.

Figure 37
Fan rotation wiring
10 Out of service operations

10.1 Shutdown

When shutting down a boiler, switch the burner to manual, set the burner to low fire for a few moments, and then turn the burner off. As the boiler flow drops toward zero, it will probably be necessary to close the main feedwater isolation valve and manually regulate drum water level with the bypass valve. Most flow control valves will not shut off tightly. When the drum level stabilizes with no water flowing, the boiler may be isolated. When the non-return valve, if any, on the water outlet has closed, close inlet valves and outlet valve. Run down the stem on the non-return valve to hold the disk on its seat. Where two stop valves are used, open the drain between them and see that it is clear and bleeds off the pressure in the line. After pressure falls, slowly open the drum vents to prevent formation of a vacuum that might cause subsequent leakage at gasketed joints.

10.2 Boiler taken out of service

When a boiler is taken out of service, it should be laid-up using either the wet or dry procedure.

SBW does not warranty boilers out of operation that are not properly laid up for extended periods of time. If the boiler could be subject to freezing temperatures when out of service, the boiler must be laid up dry.

If draining the boiler is not practical, the laid up wet procedure may be used. Wet boiler layups are not recommended for periods longer than 30 days. SBW does not Warranty boilers laid up wet for more than 30 days.

ALWAYS KEEP THE FUEL SUPPLY VALVE(S) SHUT OFF IF THE BURNER IS SHUT DOWN FOR AN EXTENDED PERIOD OF TIME.

10.3 Boiler laid up dry

1. Allow the boiler to cool and shut of the water supply.
2. Drain, clean, and dry the boiler thoroughly (both fire and water sides)
3. Fuel and electricity to the unit shall be shut off. Use proper tag and lock out procedures.
4. An oil coating of fire side metal surfaces is beneficial when the boiler is not used for extended periods of time. This will prevent oxidization of the metal. Care should be taken to avoid putting oil on the firebox thermal blankets.
5. Place desiccant inside the boiler, primary junction box, and burner control panel
6. Close up all opening to the boiler preventing leakage of humid air into the boiler.
7. When the lay-up time is finished, see the re-commissioning section
10.4 Boiler laid up wet procedure

1. Fill the boiler to overflowing with the highest quality water available. Steam condensate, soft water, or filtered fresh water all generally acceptable. Raw city water should not be used.

2. While maintaining boiler water temperature at 120°F minimum to remove oxygen, drain off boiler water from boiler drain until it runs clear.

3. Add enough caustic soda to the hot water to maintain approximately three hundred fifty (350) parts per million of alkalinity and also add enough sodium sulfite to produce a residue of sixty (60) parts per million of this chemical.

4. When all the dissolved gases are released and chemicals mixed into the water (approximately 1 hr)

5. Completely close up the water side of the boiler so that open air does not come into contact with the water.

6. Dry the flue gas side of the boiler.

7. Fuel and electricity to the unit shall be shut off. Use proper tag and lock out procedures.

8. The fire side should then be cleaned. An oil coating of fire side metal surfaces is beneficial when the boiler is not used for extended periods of time. This will prevent oxidization of the metal. Care should be taken to avoid putting oil on the firebox thermal blankets.

9. Place desiccant on wooden or plastic trays in the fireside of the boiler. Do not fill the trays more than half way. Also place small amount of desiccant in the junction box and burner control panel.

10. Close up all opening to the boiler preventing leakage of humid air into the boiler.

11. When the lay-up time if finished, see the re-commissioning section.

12. When the boiler is done with a laid-up wet period of time, make sure blowdown is conducted during start up.

10.5 Re-commissioning

1. When approaching the end of your lay-up time, review the operator logs for any items that may need to be replaced. Some items can take time to procure.

2. Check that you have gaskets/seals to replace any that have been opened. This likely includes gaskets for: Smoke box doors, washout plugs, and sight glass. Your spare parts list will be helpful in determining exactly what is needed. SBW or SBW representative can supply you with spare parts.

3. Remove all desiccants placed within the boiler except boiler lizards placed in the water side of the boiler can be left inside.

4. If the boiler was laid up dry, rinse out the water side of the boiler

5. Remove your tag and lock outs

6. See the start-up section of this manual. Boil-out procedures do not need to be repeated unless inspection finds oil buildup inside the water side.
# MAINTENANCE, TESTING, AND INSPECTION LOG

**DAILY**

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Log maintained by: Operator: 
Operator: 

**DAILY BOILER READINGS:**

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## Maintenance, Testing, and Inspection Log

**Weekly & Monthly**

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<td>Operator:</td>
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### Weekly Boiler Readings:

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Note: Any necessary information or observations should be recorded in the "Notes" section.
CREEK ST BOILER MANUAL
Condensing Water Boiler
300 - 2000 MBtu/Hr.
Gas
Installer
NOTICE OF COMPLETION  
AND  
AUTHORIZATION TO APPLY THE UL MARK

Superior Boiler Works Inc  
ADRIAN ASPINALL  
3524 E 4th Ave  
Hutchinson Ks 67501-1960, Us

Our Reference: File MP3156-Vol. 1  
Project Number 4786074919

Your Reference: Adrian Aspinall 09-24-13

Project Scope: Alternate Construction - Gas Burner Model NP3

Dear ADRIAN ASPINALL:

Congratulations! UL's investigation of your product(s) has been completed under the above Reference Number and the product was determined to comply with the applicable requirements. This letter temporarily supplements the UL Follow-Up Services Procedure and serves as authorization to apply the UL Mark at authorized factories under UL's Follow-Up Service Program. To provide your manufacturer(s) with the intended authorization to use the UL Mark, you must send a copy of this notice to each manufacturing location currently authorized under File MP3156-Vol. 1.

Records in the Follow-Up Services Procedure covering the product are now being prepared and will be sent in the near future. Until then, this letter authorizes application of the UL Mark for 90 days from the date indicated above.

Additional requirements related to your responsibilities as the Applicant can be found in the document "Applicant responsibilities related to Early Authorizations" that can be found at the following web-site: http://www.ul.com/EAResponsibilities

Any information and documentation provided to you involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL.

We are excited you are now able to apply the UL Mark to your products and appreciate your business. Feel free to contact me or any of our Customer Service representatives if you have any questions.

Very truly yours,  
Reviewed by:

John Cronin  
Staff Engineer  
John.Cronin@ul.com

William R. Carney  
Chief Engineer Director I  
William.R.Carney@ul.com

NBKB593-474B34
Certification Agreement for Applicants and Manufacturers

THIS AGREEMENT made the 27th day of January, 2015, by and between:

INTERTEK TESTING SERVICES NA, INC. having offices at

545 E. Algonquin Rd, Arlington Heights, IL 60005 USA ("Intertek")

and "Company", having principle place of business at

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<th>Company Legal Entity Name</th>
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</tr>
<tr>
<td>City, State/Province, Postal Code</td>
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Company is entering the Certification Agreement as a(n):  ■ Applicant*  ■ Manufacturer*.

*See definitions below. If the entity is both the Applicant and Manufacturer, please check both boxes.
If the Applicant and Manufacturer are different, please check the box that is applicable.

RECITALS

Intertek provides a service for evaluating whether products provided by the Applicant comply with designated standards or specified requirements. Subject to the terms of this Certification Agreement, products found to be in compliance by Intertek may be eligible for inclusion on a list maintained by Intertek for Products to display a Certification Mark owned by Intertek.

The Applicant desires to submit or has submitted certain devices, equipment, materials, or systems manufactured by the Applicant or the Manufacturer if different, to Intertek for evaluation in order that the product may be considered for Listing and Labeling by Intertek.

If the submitted product is found to be eligible for Listing, Labeling, and Follow-up Service, this Certification Agreement shall be executed by Intertek and the Applicant (and the Manufacturer, if applicable) setting forth the terms and conditions to which the parties hereto must adhere.

NOW THEREFORE, for and in consideration of the mutual covenants herein expressed and other lawful and valuable consideration, the parties hereto agree as follows:

1. DEFINITIONS

1.1 Applicant. The term Applicant shall mean the company who submitted the product for evaluation and certification and owns rights to Listing Reports.

1.2 Manufacturer. The term Manufacturer shall mean the company who carries out or controls certain stages in the manufacture, assessment, handling, and storage of a product that enables it to accept responsibility for continued compliance of the product with the relevant requirements and undertakes all obligations to apply the certification labels.

1.3 Company. The term Company shall mean both Applicant and/or Manufacturer.

1.4 Authorization to Mark. The term Authorization to Mark ("ATM") shall mean a written document from Intertek that authorizes the Manufacturer to apply an Intertek certification mark to a specific product.

1.5 Certification Mark. The term Certification Mark ("Mark") shall refer to any common law or registered trademark owned by Intertek, or its affiliates, used in the certification of Product.

1.6 Follow-up Service. The term Follow-up Service shall refer to the process of monitoring the Company’s compliance with the Intertek Requirements.

1.7 Intertek Requirements. The term Intertek Requirements shall mean (a) the
Certification Agreement for Applicants and Manufacturers

requirements contained in the Listing Report; (b) the standard(s), if any, applicable to the Product; (c) the terms of this Certification Agreement; and (d) any third party requirements separately applied as a condition of the Listing.

1.8 Labeling. The term Labeling shall refer to the process of applying the Mark to the Product, whether the Mark is applied to the Product by a separable label, directly on the product, or by other media as authorized by Intertek.

1.9 Listing. The term Listing shall mean the process of preparing and including the Product in the published directory of Intertek certified products.

1.10 Listing Report. The term Listing Report shall mean the document prepared by Intertek, also known as Constructional Data Report (CDR), which identifies the Company, the Product, the requirements specific for the Product, including but not limited to, identification of standard(s), test protocols and the type and form of Mark which must be used on or in connection with the Product and related information.

1.11 Product. The term Product ("Product") shall mean an Applicant's device, equipment, material, or system that has been submitted for testing or evaluation, and found to be in compliance with Intertek Requirements and approved for Listing.

2. CERTIFICATION

2.1 Testing and Evaluation. Intertek is an independent laboratory providing testing and evaluation services to determine whether representative samples of a product comply with designated national and international standards, specifications, and/or codes. Intertek does not publish standards, specifications, and/or codes, or warrant to the Company that the standard used for the evaluation is adequate. Company understands and agrees that Intertek has only tested or evaluated the submitted Product samples and does not guarantee or warrant the quality or compliance of all units of the Product manufactured or produced by the Applicant and/or the Manufacturer. Company further acknowledges that as an independent laboratory, Intertek assumes no responsibility for the design of the Product.

2.2 Company Obligations. Company understands its obligations pursuant to this Certification Agreement in order to maintain eligibility for Listing, and warrants that it shall comply with the following provisions:

(a) Company agrees that if the Company wishes to modify or change the Product such that the Product no longer meets the requirements of the Listing Report for the Product, Company must first either obtain the approval of Intertek or discontinue use of the Mark. The Product may no longer be eligible for Listing if it has been modified or changed by the Company after Intertek's testing or evaluation.

(b) Upon request, the Company agrees that it shall retain or make available a sample of the certified Product from the most current production.

(c) Company agrees to notify Intertek in writing of any product recall or reports that it receives of serious personal injury or property damage involving the Product.

(d) Company shall notify Intertek of any labeled Product which has left the control of the Company that does not comply with Intertek Requirements.

(e) Company warrants that a quality control program is, or will be, established and maintained to ensure Product compliance with the Intertek Requirements.

(f) If re-evaluation and/or investigation of the product is required as a result of modification to the Product without prior notification by the Company and approval by Intertek, the Applicant shall be subject to applicable fees for these services.

(g) If the company provides copies of the certification documents to others, the documents shall be reproduced in their entirety.

2.3 Reservation of Rights. Intertek reserves the right, upon reasonable written notice to the Applicant, to reevaluate the Product at the Applicant's expense. This re-evaluation may be the result of Follow-up Service (Variation Notice), a revision of the applicable standard (Standard Update Notice ("SUN")), new information regarding the characteristics of the material used in the Product, or other information (including administrative changes) that raises a question
Certification Agreement for Applicants and Manufacturers

concerning the conformance of the Product to Intertek Report Requirements. Such reevaluation may require Intertek to review the Listing Report, reevaluate the product and update our records and be subject to applicable fees.

2.4 Revision or Withdrawal of the Intertek Requirements. Intertek reserves the right, upon reasonable notice to the Applicant, to revise or withdraw the Intertek Requirements to the extent required by applicable statutory guidelines or standards. If the Intertek Requirements are revised, the Company shall be entitled to continue Listing and Labeling of the Product upon a demonstration to the satisfaction of Intertek that the Product complies with the revised Intertek Requirements. If the Intertek Requirements are withdrawn, the Company's right to the Listing and Labeling of the Product shall terminate pursuant to the terms of Article 6 of this Certification Agreement. In the case of a revision or withdrawal of Intertek Requirements, Intertek shall provide a notice specifying a reasonable date by which the Product must meet the revised Intertek Requirements or for such termination.

2.5 Third Parties. Applicant agrees that Intertek has entered into a contractual relationship with the Applicant to perform testing or evaluation services on the Product. Intertek agrees to perform such services with due care. Intertek does not guarantee or warrant that third parties will accept or recognize the results obtained by Intertek or the Intertek certification of the Product.

3. LISTING AND LABELING

3.1 Ownership of the Mark. Ownership of the Mark and all trademark rights in the Mark remain in Intertek, even if it is used on the Product. The Mark shall only be applied to a Product that complies with the Intertek Requirements and such Mark shall be applied as specified in the Listing Report. The Mark may be applied only to those models and brands that are specifically named in the Listing Report at the factory receiving active Follow-up Service and as noted on the Authorization to Mark. Except as provided herein and as indicated in Article 3.2, any other use of the Mark, or the Intertek name, on the Product is expressly prohibited.

3.2 Advertising. Intertek shall allow the Company to refer to Intertek and the Mark in advertising and promotional material for the Product, contingent upon the Company obtaining the prior, express, written approval of Intertek.

3.3 Follow-up Service. As a part of the Listing and Labeling of the Product, the Company shall cooperate with the Intertek representatives who conduct Follow-up Service. Follow-up Service may include factory audits at any time during business hours and such Intertek representatives shall have free, unannounced, and immediate access to the Company's premises wherein the Product, or components thereof, may be fabricated, processed, finished, stored, or located. Intertek representatives shall comply with factory policies as required while on premises. Follow-up Service is intended to allow Intertek to monitor the Company's compliance with maintaining continuing conformity of the Product to the Intertek Requirements, and to control the use of Intertek's Marks. The factory audits are not intended to satisfy or otherwise replace Company's responsibility to maintain its quality control program and to ensure that the Product remains in compliance with the Intertek Requirements. Follow-up Service may also include Company questionnaires, and/or the Company's warranty of conformity.

4. INDEMNIFICATION AND LIABILITY

4.1 Indemnification. Company agrees to hold Intertek harmless and to defend and indemnify Intertek against any liability, loss, or damage from claims, demands, costs (including legal fees), or judgments arising out of any negligent or intentional acts of the Company, or claims from third parties relating to the Product or arising from the use of the Mark.

4.2 Liability. Intertek will not, under any circumstances, be liable to the Company for any indirect, special, punitive, or consequential damages, or any third party claims which may arise as a result of the services provided in this Certification Agreement. The maximum aggregate liability of Intertek for damages in connection with this Certification Agreement shall not exceed the latest annual fee paid to Intertek by the Company.
Certification Agreement for Applicants and Manufacturers

5. **FAILURE TO COMPLY WITH INTERTEK REQUIREMENTS**

5.1 **Remedial Action.** In the event that Intertek detects any deviation or variance in the Product from Intertek Requirements, or improper or unauthorized use of the Mark or Intertek name, Intertek will notify the Applicant and require the Company, at its own expense, to undertake corrective action to ensure that the Product complies with Intertek Requirements. Intertek reserves the right, in its sole discretion, to take additional actions as it deems necessary, including but not limited to:

(a) Suspension or revocation of the Listing and the right to label the Product;
(b) Withdrawal of the supply of labels and removal of the Mark from non-conforming or unauthorized products;
(c) Payment of penalty fees (as defined in general information package) and any costs associated with the product investigation by the Applicant;
(d) Removal of the Product from the published directory of Intertek certified products;
(e) Termination of this Certification Agreement pursuant to Article 6;
(f) Notification of regulatory authorities and the public;
(g) Compliance with any applicable statutes, rules, or regulations.

5.2 **Injunctive Relief.** Company acknowledges that the manufacture, sale, delivery, shipment, distribution, or promotion of the Product utilizing a Mark would mislead or endanger the public if such Product is not eligible to use the Mark or does not comply with the Intertek Requirements. Company further acknowledges that a breach of this Certification Agreement cannot be adequately compensated by money damages. Company agrees that in the event of a breach of the Certification Agreement, Intertek shall have the right to seek a temporary restraining order to the Company, together with an action for a preliminary and permanent injunction, and such other and further relief as may be provided by law.

5.3 **Suspension.** Upon Company’s failure to comply with any of the requirements of this Certification Agreement or Listing Report, Intertek may issue a letter of suspension which shall notify the Applicant of the nature of the failure and the period of suspension of the Company’s right of Labeling. The Applicant is obligated to notify its Manufacturer of the suspension and insure both the Applicant and Manufacturer adhere to all requirements in the letter of suspension including remedial actions. A reinstatement fee may be applied. In the event that the Company fails to take corrective action to resolve the cause of suspension, this Certification Agreement shall be terminated pursuant to Article 6.

5.4 **Public Notice.** In the event that Intertek has confirmed evidence that the Product in the marketplace has a significant non-conformity, Intertek will contact the Applicant and act in support of remedial steps taken by the Company to address the non-conformity, including, if necessary, public notification and/or a product recall undertaken by the Company. In the event that the Company does not take action to address a significant non-conformity related to the Product, Intertek reserves the right to contact appropriate government agencies, other parties in the supply chain and/or issue public notifications advising of the non-conformity pursuant to Article 5.1(f) above.

6. **TERMINATION OF THE AGREEMENT**

6.1 **Termination By Either Party.** Either party may, for any reason, terminate this Certification Agreement, as to any Product, upon not less than sixty (60) days written notice to the other party. Such notice shall designate a termination date and the notice period shall be deemed to commence upon the date of mailing of the notice to the other party by registered or certified mail, return receipt requested or by courier with confirmed delivery.

6.2 **Intertek Right To Terminate.** Intertek may terminate this Certification Agreement, as to any Product, without prejudice to any other rights or remedies that Intertek may have, upon either of the following:

(a) Immediately upon written notice, if Intertek determines that the Product fails to comply with the Intertek Requirements and such defect was not cured within a reasonable period of time;
(b) Company is in default pursuant to Article 7.3;
(c) Thirty (30) days after the Company receives written notice in the event of: (i) the filing of a
Certification Agreement for Applicants and Manufacturers

voluntary or involuntary petition in bankruptcy by the Company; (ii) the making of any arrangement or composition with creditors by the Company; (iii) the appointment of a receiver for the Company; or (iv) the voluntary or involuntary liquidation of the business of the Company. The Company will notify Intertek within seven (7) days of notice of one of these events.

6.3 Company Obligations Upon Termination. Upon termination of this Certification Agreement, Company shall:

(a) Discontinue the use of the Mark on the Product or Company's promotional material or advertising.

(b) Allow Intertek to perform a final factory inspection to record final production status and to recover all unused Intertek Certification Marks upon notification of termination of the Authorization to Mark. Fees for a final inspection will be billed in accordance with Article 7.3 of this Certification Agreement.

(c) Promptly return to Intertek all Marks, Labeling material, and the Listing Report, and warrant in writing the date of last use of the Mark.

(d) Continue to honor the terms of Article 4 of this Certification Agreement concerning indemnification and liability, which terms shall survive the termination of this Certification Agreement.

(e) Pay any remaining outstanding charges owing to Intertek immediately.

(f) Applicant is obligated to notify its Manufacturer of the termination and insure both the Applicant and Manufacturer comply with all requirements in this section.

7. ADMINISTRATIVE PROVISIONS

7.1 Confidentiality. Without written authorization from the Applicant, Intertek will not voluntarily disclose to third parties confidential and proprietary information which Applicant provides to Intertek. This obligation shall not apply to information which is already available to the public, or acquired from other sources without confidentiality restrictions, or is required to be disclosed by Intertek to Regulatory Authorities responsible for the acceptance of the Product. Intertek agrees that this obligation to maintain confidentiality shall survive the termination of this Certification Agreement.

7.2 Subpoena. If Intertek is served with a Subpoena, Court Order, or similar document requesting the disclosure of confidential or proprietary information supplied to Intertek by the Company, Intertek shall promptly notify the Applicant. In the event that the Applicant chooses to contest the request, Intertek shall cooperate with the Applicant. The responsibility for contesting the request shall rest solely with the Applicant. If the Applicant declines to contest the request or is not successful in contesting the request, Intertek will provide the requested information. Any costs incurred by Intertek in responding to the request, including reasonable attorney's fees, shall be reimbursed by the Applicant immediately upon invoicing by Intertek.

7.3 Fees. Certification fees for maintaining the Listing, conducting the Follow-up Service, and licensing of the Certification Mark will be prepaid or billed to the Applicant or a designated payor. Payment shall be due upon presentation of Invoices and the Applicant shall be considered in default if the charges are not paid within thirty (30) days. Intertek reserves the right to adjust the billing rate for listing, labeling, and Follow-up Service, and to issue reasonable charges in the event additional costs are incurred by Intertek as a result of Company's failure to adhere to the Intertek Requirements. Additional costs include, but are not limited to, penalty fees for misuse of Mark and costs associated with the product investigation. Certification fees are non-refundable.

7.4 No Assignment. The rights running to the Company under this Certification Agreement may not be assigned to or acquired by any other person or corporation without Intertek's written authorization.

7.5 Term. This Certification Agreement shall continue in effect for a period of one (1) year from the date first above written and shall automatically be renewed thereafter for periods of one (1) year, unless the termination rights provided for in this Certification Agreement are exercised.

7.6 Jurisdiction. This Certification Agreement shall be interpreted in accordance with and governed
Certification Agreement for Applicants and Manufacturers

by the laws of the jurisdiction within which the Intertek office stated in the opening paragraph is located. If the Client is located in China, any dispute or claim arising from or in connection with this Certification Agreement, its breach, its performance or non-performance shall be submitted to the China International Economic and Trade Arbitration Commission ("CIETAC") Beijing Office for arbitration which shall be conducted in accordance with the Commission's arbitration rules in effect at the time of applying for arbitration. The arbitral tribunal shall consist of three (3) arbitrators. Intertek on the one part and the Client on the other part shall each appoint one arbitrator. The parties shall appoint the third arbitrator. If the parties fail to agree on the third arbitrator within fifteen (15) days from the date on which the respondent receives the notice of arbitration, the parties hereby designate the Chairman of CIETAC as the appointing authority hereunder provided that the Chairman shall select an arbitrator who satisfies the qualifications in the preceding sentence. The language to be used in the arbitral proceedings shall be Chinese and English. Each version shall have the equal validity and legal effect. The arbitral award is final and binding upon both parties.

This Agreement is accepted and duly executed by:

<table>
<thead>
<tr>
<th>Intertek Testing Services NA, Inc.</th>
<th>Company Superior Boiler Works, Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Print Name</strong></td>
<td><strong>Print Name</strong></td>
</tr>
<tr>
<td>Thomas J. Patterson</td>
<td>Doug Wright</td>
</tr>
<tr>
<td><strong>Title</strong></td>
<td><strong>Title</strong></td>
</tr>
<tr>
<td>Director, Certification</td>
<td>President &amp; CEO</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td><strong>Date</strong></td>
</tr>
<tr>
<td>2/17/2015</td>
<td>February 17, 2013</td>
</tr>
</tbody>
</table>

Authorized Intertek Signatory

Proprietor, Partner or Authorized Officer - Signature
Certification Agreement for Applicants and Manufacturers

ADDENDUM A

Certification and Follow-Up Service Program Fees

Acceptance, by signature, of the Certification Agreement further signifies acknowledgement of the ongoing fees for the program. Invoicing will commence upon Certification being granted, and will thereafter occur at the beginning of each Quarter. If a Purchase Order is required in order to secure payment, please enter your PO number below.

The fees for our Certification Program are as follows, and are per Manufacturing Location:

ONE TIME SET-UP FEE: $150.00 USD

QUARTERLY CERTIFICATION FEE (includes Certification, Inspection* and expenses):

- United States: $600.00
- Central/South America (including Mexico): $980.00
- Asia Pacific, Australia, New Zealand: $1005.00
- Middle East: $1,290.00
- Europe, Russia, Africa: Please inquire

*NOTE: For locations having more than Quarterly Inspections, the following fees will apply for additional Inspections and will be invoiced separately (includes expenses):

- United States: $340.00
- Central/South America (including Mexico): $720.00
- Asia Pacific, Australia, New Zealand: $745.00
- Middle East: $1,030.00
- Europe, Russia, Africa: Please inquire

QUARTERLY DIRECT IMPRINT FEE (if applicable): $125.00 USD

Multiple Listee arrangements, if applicable, are charged $257.00 annually per Multiple Listee. ($475/yr if unique Control Number requested).

Should our Engineering Services determine there are non-certified components deemed critical in the product meeting test requirements, ongoing (annual) Component Evaluation may be required. This is determined during the Testing and Listing Development process, and will be specifically noted in the Listing Report. These fees will be quoted separately (annually).

Any Administrative or Minor Technical changes to Reports by our SVN Center to address Variance/Variation items or Standard Updates may incur additional charges. These fees will be quoted separately, upon instance.

*Certification fees are subject to slight annual increases.

For further clarification on Fees, or to determine total costs, please contact the ETL Certification Group at:

Email: etcert.helpdesk@intertek.com
Phone: 312-906-7801

PO#____________________

This Information is for the exclusive use of Intertek’s Client and is provided pursuant to the Certification Agreement between Intertek and its Client. Intertek’s responsibility and liability are limited to the terms and conditions of the Agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the Agreement, for any loss, expense or damage occasioned by the use of this information.
CBLR Test Sheet  
December 17, 2013  
Rev 1.0  
Lam Duong

CBLR Unit General Information

<table>
<thead>
<tr>
<th>Date</th>
<th>Fuel Type:</th>
<th>Heating Medium:</th>
<th>Unit Type:</th>
<th>Draft Type:</th>
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<tbody>
<tr>
<td>July 22, 2014</td>
<td>Natural Gas</td>
<td>Water</td>
<td>Condensing</td>
<td>Forced Draft</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>Heat Exchanger Material:</td>
<td>Control Type:</td>
<td>Installation:</td>
<td>Test Location:</td>
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<tr>
<td>Stain Steel</td>
<td>Step-Modulating</td>
<td>Indoor</td>
<td>Intertek Plano</td>
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<th>Gas Burner Type:</th>
<th>Sample Received Date</th>
<th>Sample Tested Date(s)</th>
<th>Report Date</th>
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</thead>
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<tr>
<td>Power Burner</td>
<td>6/25/14</td>
<td>7/22/14</td>
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CBLR Unit Certification and Test Information

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<thead>
<tr>
<th>Client</th>
<th>Project Number</th>
<th>Report Number</th>
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</thead>
<tbody>
<tr>
<td>Superior Boiler</td>
<td>G101617160</td>
<td>101617160DAL-001</td>
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<table>
<thead>
<tr>
<th>Combustion Efficiency, %</th>
<th>Thermal Efficiency, %</th>
<th>Rated CO2, %</th>
<th>Rated Flue Draft, in w.c.</th>
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<tr>
<td>N/A</td>
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CBLR Unit Nameplate and Component Information

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<tr>
<th>Manufacturer</th>
<th>Nameplate Model</th>
<th>Nameplate Serial</th>
<th>Nameplate Voltage</th>
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<tbody>
<tr>
<td>Superior Boiler</td>
<td>Creek XL-5500</td>
<td>100016271</td>
<td>208/120</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nameplate Input, Btu/hr.</th>
<th>Nameplate Manifold Pressure, in. w.c.</th>
<th>Gas Meter #</th>
</tr>
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<tbody>
<tr>
<td>5,000,000</td>
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<td>T-18 MK2/ SN 7746913</td>
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<tr>
<th>Gas Meter Correction Factor</th>
<th>Burner Make</th>
<th>Burner Model</th>
<th>Burner Serial</th>
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<tr>
<td>1.000</td>
<td>Weishaupt</td>
<td>WM-GL20/3-a ZMT</td>
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<table>
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<tr>
<th>Venting Type:</th>
<th>Flue Size, inches</th>
<th>Min Vent Length, Feet</th>
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<tr>
<td>Direct Vent</td>
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<td>5</td>
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Miscellaneous Parameters

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<tr>
<th>Pressure and temperature corrected Gas Meter:</th>
<th>TP Corrected Gas Meter OFF</th>
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<tr>
<td>Recirculated outlet water loop:</td>
<td>Recirc Loop OFF</td>
</tr>
<tr>
<td>Water Data Collection Method:</td>
<td>Incremental</td>
</tr>
<tr>
<td>Condensate Data Collection Method:</td>
<td>Sum</td>
</tr>
<tr>
<td>Fuel Consumption Data Collection Method:</td>
<td>Incremental</td>
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</tbody>
</table>

Client Address

Superior Boiler Works, Inc  
3524 E 4th Ave  
Hutchinson, KS 67501

Reviewer

Craig Grider  
Engineer

Ramzi Amawi  
Review
**Indoor Step-Modulating Condensing Gas Commercial Boiler**

<table>
<thead>
<tr>
<th>Date</th>
<th>Manufacturer</th>
<th>Client</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 22, 2014</td>
<td>Superior Boiler</td>
<td>Superior Boiler</td>
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<table>
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<tr>
<th>Test Number</th>
<th>Report Number</th>
<th>Nameplate Model</th>
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<tr>
<td>G101617160</td>
<td>101617160DAL-001</td>
<td>Creek XL-5500</td>
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</tr>
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Nameplate Input, Btu/hr. | Nameplate Voltage | Nameplate Manifold, in. w.c. |
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<tbody>
<tr>
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<table>
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<tr>
<th>Draft Type</th>
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<th>Gas Meter Correction Factor</th>
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<tr>
<td>Forced Draft</td>
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<td>T-18 MK2/ SN 7746913</td>
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**Gas Input Verification**

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<thead>
<tr>
<th>Time (HH:MM)</th>
<th>P&lt;sub&gt;T&lt;/sub&gt;, in hg</th>
<th>P&lt;sub&gt;T&lt;/sub&gt;, in w.c.</th>
<th>HHV, Btu/ft&lt;sup&gt;3&lt;/sup&gt;</th>
<th>Manifold Pressure, in w.c.</th>
<th>Gas Consumed, Cubic Feet</th>
<th>Time, minutes</th>
<th>Time, seconds</th>
<th>Input, Btu/hr.</th>
<th>Ratio, %</th>
<th>Type</th>
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</thead>
<tbody>
<tr>
<td>08:45</td>
<td>29.61</td>
<td>27.0</td>
<td>991</td>
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<td>50.00</td>
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<td>5,035,554</td>
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**Gas Input Verification (Detailed Table):**

<table>
<thead>
<tr>
<th>Time (HH:MM)</th>
<th>Water</th>
<th>Water Delta</th>
<th>Condensate</th>
<th>Gas Consumption</th>
<th>Fuel Delta</th>
<th>Inlet</th>
<th>Outlet</th>
<th>Room Air</th>
<th>Test Air</th>
<th>Flue</th>
<th>CO</th>
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<td>02:00</td>
<td>2607823</td>
<td>1466</td>
<td>5834100</td>
<td>1270</td>
<td>79.7</td>
<td>179.7</td>
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<td>02:15</td>
<td>2609287</td>
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<td>157.1</td>
<td>99.9</td>
<td>3.25</td>
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**Total:** 11686.00 104.25 10100.0

**Average:** 1460.8 1262.5 79.7 180.3 84.0 83.6 156.6 0.0 10.60 3.47

<table>
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<th>00:30</th>
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<tr>
<td>Flue Draft, in w.c.</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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</tbody>
</table>

**Humidity, %** 61.4

**Barometric Start, in Hg** 29.61

**Barometric End, in Hg** 29.59

---

Craig Grider
Engineer

Ramzi Amawi
Reviewer
Report of a Performance Test of a Commercial Boiler
BTS-2000  Rev06.07

Manufacturer: Superior Boiler
Model Number: Creek XL-5500
Serial Number: 100016271
Test Number: G101617160
Report Number: 101617160DAL-001
Product Development Stage: N/A
Testing Location: Intertek Plano
Rated Input, High Fire; Btu/hr.: 5,000,000
Measured Input, High Fire Btu/hr.: 4,975,062

<table>
<thead>
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<th>Parameter</th>
<th>Measured</th>
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<tbody>
<tr>
<td>Combustion Efficiency, %:</td>
<td>92.75</td>
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<tr>
<td>Thermal Efficiency, %:</td>
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<td>Fuel Type:</td>
<td>Natural Gas</td>
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<tr>
<td>Test Firing Rate, Btu/hr.:</td>
<td>5,035,554</td>
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<tr>
<td>Heating Value, Btu/ft³:</td>
<td>991</td>
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<td>Inlet Temperature, ° F:</td>
<td>79.7</td>
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<tr>
<td>Boiler Water Temperature Rise, ° F:</td>
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<td>Flue Gas Temperature, ° F:</td>
<td>156.6</td>
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<td>Test Air Temperature, ° F:</td>
<td>83.6</td>
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<tr>
<td>Net Flue Temperature, ° F:</td>
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<td>Average Air Free CO, ppm:</td>
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<tr>
<td>Flue Loss, % (Lf):</td>
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<tr>
<td>Flue Draft, in w.c.:</td>
<td>0.00</td>
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<tr>
<td>Total Water Consumed, lbs.:</td>
<td>97184.0</td>
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<tr>
<td>Total Condensate, lbs.:</td>
<td>104.25</td>
</tr>
</tbody>
</table>

Comments:

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Creek XL is a high efficiency hot water condensing boiler manufactured in AISI 316 Ti stainless steel, with a true three pass water backed design. It is normally equipped with a thermostatic control panel (with control and safety thermostats) for a maximum working temperature of 100°C.
Main Features:

- **Boiler frame** is heavy duty vertical steel draw pieces on a base skid.
- **Patented boiler design** characterized by a horizontal combustion chamber and parallel second and third pass flue passages.
- **Large cylindrical and corrugated combustion chamber** with large size, entirely manufactured in AISI 316 Ti (rich in Chrome, Nickel and Titanium) TIG welded.
- **Heat transfer surfaces** are stainless steel AISI 316 Ti, TIG welded, composed by pressed plates characterized by tapered projecting parts which increase the turbulence and the heat transfer surface.
- **High water content** results in high circulation with larger waterways inside the boiler (lower risk of fouling and occlusions), no output division (lower thermal losses and higher efficiency).
- **Dual water return connections:**
  - Low temperature return (floor heating circuit, wide surface radiators, etc.)
  - Medium/high temperature (DHW circuit, radiators circuit)
- Rear **exhaust and condensate collection box** complete with stack connection made from stainless steel AISI 316 Ti
- **Double doors** for a quick and easy maintenance
- **Jacket of Horizontal Steel Slats**, entirely insulated with high density rock wool slabs
- **Compliance** to ASME Sect. IV, 311/06 (efficiency), 89/336/CEE (electromagnetic compatibility), 72/23/CEE (low voltage)

**COMPETITORS OVERVIEW:** AERCO - BENCHMARK
1) MANUFACTURING TECHNOLOGY

*Benchmark* is a single pass boiler where the flue gases develop inside the furnace and are driven to the exchanger with no inversion. The Creek XL is a **true Three Pass** design resulting in a boiler that is highly efficient when condensing, but also very efficient when not condensing.

The Creek is very rugged because all inner parts (in contact with water and flue gases) are manufactured in stainless steel Inox **AISI 316 Ti** (rich in Chrome, Nickel and Titanium), while *Benchmark* boiler is manufactured in stainless steel Inox **AISI 439**, similar to the 316 but without Nickel & Molybdenum.

*Benchmark* features two exchangers built with many small vertical **fire tubes**; The Creek features many **large condensing sections**, with corrugated surfaces, designed to increase turbulence and maximize the heat transfer.

The Creek’s **double return** connection is designed to obtain the best temperature stratification inside the boiler; thus increasing the condensation which increases efficiency. The Benchmark does not have a dual return.

2) MORE TECHNICAL FEATURES

Both products are technically high mass (large water content) boilers, but the Creek’s capacity is much larger. Moreover its **larger water ways** ensure better circulation with a lower risk of fouling and occlusions. The narrower water spaces in the Benchmark results in a slower circulation, higher pressure drop and water that has been treated perfectly.
High Capacity Safety Relief Valves for Hot Water Heating Boilers

High-capacity heating system valves with female inlet and standard or expanded female outlet. Elevated seat for drainage of water away from seat area. Entire pressure range is National Board capacity certified.

ASME Section IV
Inlet Sizes 3/4” to 2”
Factory set pressures from 15-160 psig
Maximum temperature service 250°F

APPLICATIONS:
Hot water heating boilers and hot water supply systems

FEATURES:
• High Btu capacity rating
• Silicone seat
• Fabric reinforced molded diaphragm isolates spring from water at all times
• Bronze body and spring cage
• Registered in Canadian provinces and territories CRN #0G8547.5C
• Protects against excessive water pressure due to failure of controls to regulate Btu input

DIMENSIONS AND WEIGHTS

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Size (in./mm.)</th>
<th>Certified Pressure Range psig</th>
<th>Wt./100 lbs./kg.</th>
<th>Dimensions (in./mm.)</th>
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<tbody>
<tr>
<td></td>
<td>Inlet NPT</td>
<td>Outlet NPT</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>10-614</td>
<td>3/4F 1 F</td>
<td>15-160</td>
<td>226</td>
<td>1.03</td>
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<tr>
<td>10-605</td>
<td>1F 1 F</td>
<td>15-160</td>
<td>410</td>
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<tr>
<td>10-615</td>
<td>1F 1-1/4F</td>
<td>15-160</td>
<td>390</td>
<td>1.25</td>
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<tr>
<td>10-606</td>
<td>1-1/4F 1-1/4F</td>
<td>15-160</td>
<td>795</td>
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<tr>
<td>10-616</td>
<td>1-1/4F 1-1/2F</td>
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<td>10-607</td>
<td>1-1/2F 1-1/2F</td>
<td>15-160</td>
<td>498.9</td>
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<td>10-617</td>
<td>1-1/2F 2F</td>
<td>15-160</td>
<td>1145</td>
<td>2.00</td>
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<td>10-608</td>
<td>2F 2F</td>
<td>15-160</td>
<td>2375</td>
<td>2.19</td>
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<td>10-618</td>
<td>2F 2-1/2F</td>
<td>15-160</td>
<td>2315</td>
<td>2.19</td>
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</tbody>
</table>

ORDERING CODE:
Use two-digit suffix number to indicate Inlet x Outlet size and set pressure.

EXAMPLES:
10-615-12
1” x 1-1/4” 10-610 set 60 psig
10-608-05
2” x 2” 10-600 set 30 psig

For additional information, submittal sheets and manuals, visit www.apollovalves.com
SAFETY & RELIEF VALVES

High Capacity Safety Relief Valves for Hot Water Heating Boilers

10-600 SERIES

ASME SECTION IV HOT WATER

British thermal units per hour (Kilocalories per hour) at 10% overpressure. National Board Certified. Ratings are 90% of actual.

US Customary Units Btu/Hr.  Metric Units Kcal/Hr.

<table>
<thead>
<tr>
<th>Model No.</th>
<th>10-604 3/4 x 3/4</th>
<th>10-605 1 x 1</th>
<th>10-606 1-1/4 x 1-1/4</th>
<th>10-607 1-1/2 x 1-1/2</th>
<th>10-608 2 x 2</th>
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</thead>
<tbody>
<tr>
<td>Set Pressure psig</td>
<td>15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160</td>
<td>541,000 636,000 732,000 827,000 923,000 1,018,000 1,113,000 1,209,000 1,304,000 1,399,000 1,495,000 1,590,000 1,686,000 1,781,000 1,876,000 1,972,000 2,067,000 2,162,000 2,258,000 2,353,000 2,449,000 2,544,000 2,639,000 2,735,000 2,830,000 2,925,000 3,021,000 3,116,000 3,212,000 3,307,000</td>
<td>876,000 1,030,000 1,185,000 1,339,000 1,493,000 1,648,000 1,802,000 1,956,000 2,111,000 2,265,000 2,420,000 2,574,000 2,728,000 2,883,000 3,037,000 3,192,000 3,346,000 3,500,000 3,655,000 3,810,000 3,965,000 4,120,000 4,275,000 4,430,000 4,585,000 4,740,000 4,895,000 5,050,000 5,205,000</td>
<td>1,515,000 1,782,000 2,049,000 2,316,000 2,583,000 2,850,000 3,117,000 3,384,000 3,651,000 3,918,000 4,185,000 4,453,000 4,720,000 4,987,000 5,254,000 5,521,000 5,788,000 6,055,000 6,322,000 6,589,000 6,856,000 7,123,000 7,390,000 7,657,000 7,924,000 8,191,000 8,458,000 8,725,000 8,992,000 9,260,000</td>
<td>2,061,000 2,424,000 2,788,000 3,151,000 3,514,000 3,878,000 4,241,000 4,604,000 4,968,000 5,331,000 5,694,000 6,058,000 6,421,000 6,784,000 7,148,000 7,511,000 7,874,000 8,238,000 8,601,000 8,964,000 9,327,000 9,691,000 10,054,000 10,417,000 10,781,000 11,144,000 11,507,000 11,871,000</td>
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<tr>
<th>Model No.</th>
<th>10-604 20 x 20</th>
<th>10-605 25 x 25</th>
<th>10-606 32 x 32</th>
<th>10-607 40 x 40</th>
<th>10-608 50 x 50</th>
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<td>Set Pressure barg</td>
<td>1.03 1.13 1.20 1.30 1.41 1.51 1.61 1.72 1.82 1.93 2.04 2.14 2.24 2.34 2.44 2.54 2.64 2.74 2.84 2.94 3.04 3.14 3.24 3.34 3.44 3.54 3.64</td>
<td>136 145 155 165 175 185 195 205 215 225 235 245 255 265 275 285 295 305 315 325 335 345 355 365 375 385 395</td>
<td>221 257 293 339 385 431 477 523 569 615 661 707 753 799 845 891 937 983 1,030 1,076 1,122 1,168 1,214 1,260 1,306 1,352</td>
<td>382 417 453 489 525 561 597 633 669 705 741 777 813 849 885 921 957 993 1,029 1,065 1,101 1,137 1,173 1,209 1,245 1,281</td>
<td>520 566 612 658 704 750 796 842 888 934 980 1,026 1,072 1,118 1,164 1,210 1,256 1,302 1,348 1,394 1,440 1,486 1,532 1,578 1,624</td>
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<th>Component</th>
<th>Material</th>
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<td>Body</td>
<td>Bronze Alloy C84400</td>
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<tr>
<td>Seat Insert</td>
<td>Brass ASTM B-16</td>
</tr>
<tr>
<td>Seat</td>
<td>Silicone</td>
</tr>
<tr>
<td>Disc</td>
<td>Brass ASTM B-16</td>
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<tr>
<td>Diaphragm</td>
<td>Fabric Reinforce EPDM</td>
</tr>
<tr>
<td>Stem Nut</td>
<td>Steel Plated</td>
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<tr>
<td>Spacer</td>
<td>Silicone</td>
</tr>
<tr>
<td>Cap</td>
<td>Bronze Alloy C84400</td>
</tr>
<tr>
<td>Spring</td>
<td>PLated ASTM A228</td>
</tr>
<tr>
<td>Spring Washer</td>
<td>AISI 12L14 Steel</td>
</tr>
<tr>
<td>Adj. Screw</td>
<td>Brass ASTM B-16</td>
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<tr>
<td>Nameplate</td>
<td>Aluminum</td>
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<tr>
<td>Lift Washer</td>
<td>Steel Plated</td>
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<tr>
<td>Handle Rivet</td>
<td>Steel Plated</td>
</tr>
<tr>
<td>Lift Handle</td>
<td>Steel Plated</td>
</tr>
<tr>
<td>Stem Nut</td>
<td>Steel Plated</td>
</tr>
<tr>
<td>Diaphragm Ret.</td>
<td>Steel Plated</td>
</tr>
</tbody>
</table>

ASME SECTION IV HOT WATER

British thermal units per hour (Kilocalories per hour) at 10% overpressure. National Board Certified. Ratings are 90% of actual.

www.apollovalves.com  Customer Service (704) 841-6000
This bulletin should be used by experienced personnel as a guide to the installation of the Series 26NM Control. Selection or installation of equipment should always be accompanied by competent technical assistance. We encourage you to contact Gems Sensors or a representative if further information is required.

### Specifications

**Control Design:** Solid-state components enclosed in a clear Lexan plug-in style housing. Not NEMA Rated.

**Contact Design:** 1 SPST (1 form A), N.O. Non-powered contact.

**Contact Ratings:** 10A @120/240-VAC resistive (120°F), 1A @120/240VAC resistive (150°F), 1/3 Hp @ 120/240-VAC (120°F).

**Contact Life:** Mechanical - 5 million operations

- Electrical - 100,000 operations minimum at rated load

**Supply Voltage:**
- Factory Configured: 24V, 120V, 220V, or 240V AC
- 208V/240V Model: 187V Min to 242V Max, VAC 50/60 Hz

**Power Consumption:** 24/120/220/240-VAC with relay energized ~ 4.4 VA.

**Secondary Circuit:** 2.3 VAC RMS voltage on probes, <1 milliampere source capability.

**Sensitivity:** Factory programmed to 4.7K, 10K, 26K, 50K, or 100K Ohms

**Operating Ambient Temperature Range:** -40°F to +150°F (-40°C to +65°C)

**Terminals:** All connections made with screw-clamp terminals.

**Time Delays:** Standard LLCO, 0.5 sec. on rising level, 3 sec. on falling level. Optional 0-90 sec. time delays in 1-sec. increments for rising and falling.

**Listings:** Control carries U.L. Limit Control Listing (UL-353) for 24VAC and 120VAC Line Powered units only (220VAC, 240VAC, 208/240VAC units not rated).

### Installation

1. Install octal socket in appropriate enclosure using two #6 or #8 screws.
2. Install rail mount socket on appropriate rail (DIN mount) in appropriate enclosure if applicable.
3. Wire control per wiring diagram following N.E.C and local codes.
4. Install control module in socket.

### Sensitivity vs. Maximum Probe Wire Distance*

<table>
<thead>
<tr>
<th>SENSITIVITY CHARACTER</th>
<th>SENSITIVITY (K-OHMS)</th>
<th>Distance (FT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.7</td>
<td>900</td>
</tr>
<tr>
<td>B</td>
<td>10</td>
<td>600</td>
</tr>
<tr>
<td>C</td>
<td>26</td>
<td>250</td>
</tr>
<tr>
<td>D</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>E</td>
<td>100</td>
<td>50</td>
</tr>
</tbody>
</table>

* Based on type MTW or THHN wire, #14 or #16 AWG

### Dimensional Drawing

Mount the octal socket (base) on rigid vertical or horizontal surface using #6 or #8 screws. The control should be mounted within an enclosure of proper NEMA integrity.

Torque all terminals and socket mounting screws to 7 in-lb max.
**Operation**

**AUTOMATIC RESET** (Reset Switch terminals not wired) When the liquid rises to the electrode on terminal LLCO, the control energizes, changing state of the load contacts. (LED will be lit) The control remains energized until the liquid level recedes below electrode on terminal LLCO. The control then de-energizes, (LED will not be lit) returning load contacts to original state. Unless otherwise specified, there is a three second time delay on decreasing level. Liquid must be below probe on terminal LLCO for full three seconds before control de-energizes.

**MANUAL RESET** (Normally closed pushbutton installed across reset terminals) When the liquid rises to the electrode on terminal LLCO, the control will remain de-energized until the pushbutton is depressed. Upon Reset Switch activation, the control will energize, (LED will be lit) changing the state of the contacts. The control remains energized until the liquid level recedes below electrode on terminal LLCO. The control then de-energizes, (LED will not be lit) returning load contacts to their original state. Unless otherwise specified, there is a three second time delay on decreasing level. Liquid must be below probe on terminal LLCO for full three seconds before control de-energizes.

**MANUAL RESET OPTIONAL POWER OUTAGE FEATURE** (Normally closed pushbutton across reset terminals) Control will auto-recover from a power loss. With liquid present on LLCO electrode at a power outage event, the control will de-energize and will automatically re-energize upon return of power with liquid present on the probe at power-up. However, if loss of liquid is sensed on power-up, the control will remain de-energized until liquid again rises to electrode and pushbutton is depressed. The control will not attempt to auto-recover from a power outage if no liquid was present on the probe at power loss.

**TEST FEATURE**

Allows LLCO circuit to be tested without the need to drop the water level in the boiler to create a dry probe condition. Holding down the reset button for 3 seconds will allow the LLCO circuit to trip, simulating a dry probe. The controller will return to normal operation once the reset button is pressed a second time.

---

**LED STATUS INDICATOR** In normal operation, the LED on the control will either be on or off depending on the controller state. On-board microprocessors continuously monitor for fault conditions. In the event a fault is detected, the LED will blink a pattern indicating the fault type. If you experience an inoperable control and the LED is blinking, attempt to leave the control in the blinking state and contact the factory for assistance.

**Time Delay Increasing Level:** 0-90 seconds, Blank = 0 seconds.

**Time Delay Decreasing Level:** 0-90 seconds, Blank = 3 seconds.

**Optional Character:** see Chart

**ENCLOSURE:** 0-None, 1-NEMA 1, 2-NEMA 4

**Socket Style:** A-11 Pin Octal, B-Din Mount, M-NONE, Module Only

**Supply Voltage:** 1-120VAC (+10%/-15%), 2-240VAC (+10%/-15%), 3-24VAC (+10%/-15%), 5-220VAC (+10%/-15%), 8-208/240VAC (187 to 242 VAC absolute range)

**Mode/Sensitivity:** A-4.7K, B-10K, C-26K, D-50K, E-100K

---

<table>
<thead>
<tr>
<th>N.C. Pushbutton</th>
<th>Power Outage</th>
<th>Test Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>A X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>B X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Y X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Z X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>X No Option</td>
<td></td>
<td></td>
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</tbody>
</table>
Series 3E – Pipe Thread Attachment
Series 3N – Flat Surface Mounting

- Up to 7 Probes
- Threaded Attachment (3E)
- CSA Approved
- FM Approved (3E)
- Flat Mounting (3N)
- Available in Various Body Metals
- U.L. Recognized (3E)

Series 3E fittings are cast metal, pressure-tight assemblies capable of handling 1-7 probes. Attachment to vessels is accomplished with external pipe threading. 3E Fittings require the use of 3R rigid or 3W wire suspended electrodes.

Series 3N fittings accommodate 1-3 probes operating at atmospheric pressure. The assembly mounts on a flat surface atop open tanks or closed vessels. 3N Fittings require the use of 3R rigid or 3W wire suspended electrodes.

Specifications

<table>
<thead>
<tr>
<th>Type of Connection</th>
<th>Series 3E</th>
<th>Series 3N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probes</td>
<td>Series 3E: 1 thru 7</td>
<td>Series 3N: 1 thru 3</td>
</tr>
<tr>
<td>Terminal Housing</td>
<td>Die cast aluminum, epoxy coated</td>
<td></td>
</tr>
<tr>
<td>Body Material</td>
<td>Series 3E: Cast iron, red brass, 316 stainless steel</td>
<td>Series 3N: PVC, red brass, 316 stainless steel</td>
</tr>
<tr>
<td>Pressure/Temperature</td>
<td>Series 3E: 125 psig @ 353°F (cast iron); 250 psig @ 406°F (brass, 316 S.S.)</td>
<td>Series 3N: 0 psig @ 150°F (PVC); 0 psig @ 500°F (brass, 316 S.S.)</td>
</tr>
<tr>
<td>Approvals</td>
<td>Series 3E: U.L. File # MP2489, Vol. 1, Sec. 2; CSA; FM</td>
<td>Series 3N: CSA File # LR11644</td>
</tr>
</tbody>
</table>

Dimensions

<table>
<thead>
<tr>
<th>Series</th>
<th>No. of Probes</th>
<th>Attachment to Vessel</th>
<th>Conduit Boss Thread Size</th>
<th>Terminal Housing Size (W” x D” x H”)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>3E</td>
<td>1</td>
<td>1” NPT</td>
<td>1/2” NPT</td>
<td>2-1/4 x 2-1/4 x 2-1/4</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2” NPT</td>
<td>1/2” NPT</td>
<td>3-1/4 x 3-1/4 x 2-3/8</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2” NPT</td>
<td>1/2” NPT</td>
<td>3-1/4 x 3-1/4 x 2-3/8</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>2-1/2” NPT</td>
<td>1/2” NPT</td>
<td>3-1/4 x 3-1/4 x 2-3/8</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>3” NPT</td>
<td>3/4” NPT</td>
<td>4 x 4 x 2-1/2</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>3” NPT</td>
<td>3/4” NPT</td>
<td>4 x 4 x 2-1/2</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>3” NPT</td>
<td>3/4” NPT</td>
<td>4 x 4 x 2-1/2</td>
</tr>
<tr>
<td>3N</td>
<td>1</td>
<td>2-1/4” square flat pad, 1-1/2” dia. hole in top of vessel secured with #10 machine screws at the corners of a 1-1/2” square</td>
<td>1/2” NPT</td>
<td>2-1/4 x 2-1/4 x 2-1/4</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2” NPT</td>
<td>1/2” NPT</td>
<td>3-1/4 x 3-1/4 x 2-3/8</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2” NPT</td>
<td>1/2” NPT</td>
<td>3-1/4 x 3-1/4 x 2-3/8</td>
</tr>
</tbody>
</table>

Applications
- Open Tanks
- Closed Vessels
- Water
- Diluted Corrosive Liquids

How to Order
Use the **Bold** characters from the chart below to construct a product code.

```
Series 3E  3N
Number of Probes 1 – One  5 – Five
2 – Two
3 – Three
4 – Four
7 – Seven

Body Material
A – Cast Iron (3E)
B – Red Brass (3N)
PVC (3N)
C – 316 Stainless Steel
```

Notes:
1. 3N features up to three probes only.
2. Special modifications available. Consult factory.
GENERAL

Aquastat® Controllers are immersion type devices for limiting or regulating the temperature of liquids in boilers, storage tanks, and other applications where temperature control is required.

FEATURES

- L4006, 7, and 8 provide Spst switching for high or low limit or circulator control.
- L4006G includes two Spst switches that provide high limit and circulator control.
- L4006,7; L6006,7 models are available for insertion in: vertical or horizontal immersion well, vertical or horizontal direct immersion, and surface mounting.
- L4008, L6008 include remote bulb for mounting controller at a location away from the sensing element.
- Totally enclosed Micro Switch™ snap-acting switches operate on temperature rise to set point.
- Models calibrated for high limit use are also suitable for low limit control if a separate high limit controller is used.
- Visible control point scale and external adjustment screw, permit easy setting.
- Remote bulb models may be used to sense air temperature in ducts and in outside air sensing applications.
SPECIFICATIONS

IMPORTANT
The specifications given in this publication do not include normal manufacturing tolerances. Therefore, this unit may not exactly match the listed specifications. Also, this product is tested and calibrated under closely controlled conditions, and some minor differences in performance can be expected if those conditions are changed.

SUPER TRADELINE®/TRADELINE MODELS
SUPER TRADELINE controls offer features not available on TRADELINE or standard models, and are designed to replace a wide range of Honeywell and competitive controls.

TRADELINE models are selected and packaged to provide ease of stocking, ease of handling, and maximum replacement value. Specifications of SUPER TRADELINE and TRADELINE controls are the same as those of standard models except as noted below.

SUPER TRADELINE Model: L6006A Aquastat Controller.

SUPER TRADELINE Features:
SUPER TRADELINE package with cross reference label and special instructions.
Factory-set stop at 240° F (116° C).
Vertical or horizontal mount.
Tube of heat-conductive compound.
Insulation: 1-1/2 in. to 3 in. (38 mm to 76 mm).

TRADELINE Models: L4006A,B,E; L4008E; L6006C; L6008A Aquastat Controllers.

TRADELINE Features Available:
TRADELINE package with cross reference label and special instructions.
Some TRADELINE models include immersion well.
Factory-set stops at 180° F, 240° F, or 250° F (82° C, 116° C, or 121° C).
Vertical or horizontal mount.
Tube of heat-conductive compound.
Insulation depths of 1-1/2 in. or 3 in. (38 or 76 mm).

NOTE: The following specifications are standard. Variances, available as options, are listed in Tables 1 and 2.

Electrical Ratings (A):
Models with 2° F (1° C) fixed differential:

<table>
<thead>
<tr>
<th></th>
<th>120 Vac</th>
<th>240 Vac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Load</td>
<td>2.6</td>
<td>1.3</td>
</tr>
<tr>
<td>Locked Rotor</td>
<td>15.6</td>
<td>7.8</td>
</tr>
</tbody>
</table>

Models with 5° F (3° C) fixed differential or 5° F to 30° F (3° C to 17° C) adjustable differential:

<table>
<thead>
<tr>
<th></th>
<th>110/120 Vac</th>
<th>200/240 Vac</th>
<th>277 Vaca</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Load</td>
<td>8.0</td>
<td>5.1</td>
<td>4.2</td>
</tr>
<tr>
<td>Locked Rotor</td>
<td>48.0</td>
<td>30.6</td>
<td>25.2</td>
</tr>
<tr>
<td>Millivoltage</td>
<td>0.25 at 0.25 to 12 Vdc</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a L6008G only.

Switching:
L4006, L4007, L4008: Spst.
L6006, L6007, L6008: Spdt (breaks R-B and makes R-W on temperature rise at setpoint).

Pressure Rating:
Capillary Bulb (Direct Immersion): 200 psi (1379 kPa).
Immersion Well: 255 psi (1758 kPa).

Sensing Bulb Material: Copper.

Sensing Bulb Fill: Liquid—toluene or silicone oil.

Sensing Bulb Dimensions: 2-7/8 in. (73 mm) long, 3/8 in. (10 mm) diameter.

Wiring: Screw terminals.

Maximun Ambient Temperature: 150° F (66° C).

ORDERING INFORMATION
When purchasing replacement and modernization products from your TRADELINE® wholesaler or distributor, refer to the TRADELINE® Catalog or price sheets for complete ordering number.

If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:
1. Your local Honeywell Automation and Control Products Sales Office (check white pages of your phone directory).
2. Honeywell Customer Care
   1885 Douglas Drive North
   Minneapolis, Minnesota 55422-4386
In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Scarborough, Ontario M1V 4Z9.
International Sales and Service Offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.
Approvals:
Underwriters Laboratories Inc:
Remote bulb devices and well-mounted devices shipped
without well are component recognized:
File No. MP466, Guide No. MBPR2.
L4006A shipped with well, L4006G, L4007A,B; L6006C for
surface mounting, L6006B for direct immersion mounting,
and L6007A are listed: File No. MP466, Guide No. MBPR.
L6008G is listed: File No. E4436, Guide No. XAPX.
Canadian Standards Association: File No. LR1620,
Guide No. 400-E-O.

ANSI Miswiring: Models with 1/4 in. (6.35 mm) tab terminal
meet ANSI Appliance Miswiring Standard.

Mounting:
Horizontal and vertical models mount directly to an immersion
well installed in a boiler fitting. L4006H and L6006C contain
a bracket and clamp for surface mounting on the pipe or
tank. Remote bulb models have three mounting holes
in rear of case for screw mounting to a vertical surface.
The L6006B direct immersion model also mounts directly to
a boiler fitting.

Finish: Gray.

Dimensions:
Installation: (See Figures 1, 2, and 3).
Immersion Well: (See Fig. 4).
Boiler Fitting and Bulb: (See Fig. 5).

Accessories and Parts:
137536A Scale Lock Assembly: Includes one 137536-767
Scale Lock and one 80844C-767 Screw, No. 3-48 x 3/16
(5 mm).
Q615A1004 Weatherproof Enclosure (for remote bulb devices
only).
107408 Heat-Conductive Compound (4-oz. can).
104488 Spring Clip (stainless steel).
124904 Well Adapter.
Immersion Well Assemblies and Compression Fittings:
See form no. 68-0040, Wells and Fittings for Temperature
Controllers, for list and ordering information.

Fig. 1. Approximate case installation dimensions
in inches (mm) for direct insertion models.

Fig. 2. Approximate installation dimensions
in inches (mm) for remote bulb models. Other
dimensions are the same as Fig. 1.
Fig. 3. Approximate installation dimensions in inches (mm) for surface mount models.

Fig. 4. Approximate immersion well dimensions in inches (mm) for all models except L4006C and L6006B.

Fig. 5. Approximate boiler fitting and bulb dimensions in inches (mm) for L4006C and L6006B.
Standard Models:
L4006,A,B,C,E,G; L4007,A,B; L4008A,B,E; L6006A,B,C; L6007A; L6008,A,G,H

Table 1. L4006, L4007, L4008 Controller (SPST Switching) Specifications.

<table>
<thead>
<tr>
<th>Model</th>
<th>Application</th>
<th>Range °F (°C)</th>
<th>Midscale Differential °F (°C)</th>
<th>Insertion&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Switching On Temperature Rise</th>
<th>Available Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>L4006A</td>
<td>High or low limit</td>
<td>40° F to 180° F (4° C to 82° C) or 100° F to 240° F (38° C to 116° C)</td>
<td>2° F or 5° F fixed (1° C or 3° C) or 5° F to 30° F adjustable (3° C to 17° C)</td>
<td>Horizontal Breaks</td>
<td>— TRADELINE models available. — NPT brass spud 1/2 in. or 3/4 in. (13 mm to 19 mm) — Special capillary assembly. — Insertion 3-3/8 in. or 5 in. (86 or 127 mm) — Celsius scale markings. — Factory-set stops at 160°, 180°, 185°, 200°, 220°, or 230° F (71°, 82°, 85°, 93°, 104°, or 110° C). — Insulation depths of 1-1/2 in., 3 in. or 4 in. (38 mm, 76 mm, or 102 mm). — Screw and mounting brackets. — Plastic tubing over well. — Modified dial with stop. — Special cover and knobs. — With ground screw.</td>
<td></td>
</tr>
<tr>
<td>L4006B</td>
<td>Circulator</td>
<td>100° F to 240° F (38° C to 116° C)</td>
<td>5° F (3° C) fixed or 5° F to 30° F (3° C to 17° C) adjustable</td>
<td>Horizontal Makes</td>
<td>— TRADELINE model available. — Insulation depth 1-1/2 in. or 3 in. (38 mm or 76 mm). — NPT brass spud 3/4 in. (19 mm) — Screw in front of case on dial suitable for Powerpile® control. — Factory-set stop at 240° F (116° C).</td>
<td></td>
</tr>
<tr>
<td>L4006C</td>
<td>High or low limit</td>
<td>65° F to 200° F (18° C to 93° C)</td>
<td>3-1/2° F (2° C) fixed</td>
<td>Horizontal direct immersion Breaks</td>
<td>— TRADELINE model available. — Less cover. — Capillary 10 in. (254 mm). — NPT brass spud 3/4 in. (19 mm).</td>
<td></td>
</tr>
<tr>
<td>L4006E&lt;sup&gt;b&lt;/sup&gt;</td>
<td>High limit</td>
<td>130° F to 290° F (54° C to 141° C)</td>
<td>Manual reset</td>
<td>Horizontal or vertical Breaks</td>
<td>— TRADELINE model available. — Insulation depth 1-1/2 in. or 3 in. (38 or 76 mm). — NPT brass spud 1/2 in. (13 mm) — Factory-set stop at 250° F (121° C). — Capillary 8 in. (203 mm).</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Some models include copper well or fitting; specify when ordering. Also specify boiler tapping size 1/2 or 3/4 in. (13 to 19 mm) NPT and insulation depth.  
<sup>b</sup> Manual reset (trip-free) switch breaks circuit and locks out when controlled medium reaches setpoint. Controlled temperature must drop 20° F (11° C) below setpoint before contacts can be manually reset.
<table>
<thead>
<tr>
<th>Model</th>
<th>Application</th>
<th>Range °F (°C)</th>
<th>Midscale Differential °F (°C)</th>
<th>Insertiona</th>
<th>Switching On Temperature Rise</th>
<th>Available Options</th>
</tr>
</thead>
</table>
| L4006G  | High limit and circulator control | 100°F to 200°F (38°C to 93°C) | 10°F (6°C) fixed              | Horizontal   | Two switches break simultaneously | — External adjustment knob.  
— Insulation depth 4 in. (102 mm).  
— Factory-set stop at 160°F (71°C).  
— Celsius scale markings.  
— Without well.                                                                 |
| L4007A  | High or low limit                 | 100°F to 240°F (38°C to 116°C) | 2°F or 5°F (1°C or 3°C) fixed, 5°F to 30°F (3°C to 17°C) adjustable | Horizontal or vertical | Breaks                        | — Insulation depth 1-1/2 in. or 3 in. (38 mm or 76 mm).                                                                                   |
| L4007B  | Circulator                        | 100°F to 240°F (38°C to 116°C) | 5°F (3°C) fixed or 5°F to 30°F (3°C to 17°C) adjustable | Vertical     | Makes                         | — Celsius scale markings.                                                                                                                   |
| L4008A  | High or low limit                 | 100°F to 240°F (38°C to 116°C) or 130°F to 270°F (54°C to 132°C) | 5°F (3°C) fixed, 5°F to 30°F (3°C to 17°C) adjustable | Remote bulb direct immersion | Breaks                        | — Remote capillary 5-1/2 ft (1.7 m), 8-1/2 ft (2.6 m) or 10 ft (3.0 m).  
— Factory-set scale stops at 120°, 170°, or 200°F (49°, 77°, or 93°C).  
— Celsius scale markings.  
— Front cover screw.                                                                                                               |
| L4008B  | Circulator                        | 100°F to 240°F (38°C to 116°C) | 5°F (3°C) fixed or 5°F to 30°F (3°C to 17°C) adjustable | Remote bulb direct immersion | Makes                         | — Capillary 5-1/2 ft (1.7 m).                                                                                                              |
| L4008Eb | High limit                        | 40°F to 80°F (4°C to 27°C) or 130°F to 270°F (54°C to 132°C) | Manual reset                 | Remote bulb | Breaks                        | — Factory-set scale stops at 140°, 200°, or 250° F (60°, 93°, or 121°C).  
— Capillary 5-1/2 ft or 20 ft (1.7m or 6.1 m).                                                                                         |

a Some models include copper well or fitting; specify when ordering. Also specify boiler tapping size 1/2 or 3/4 in. (13 to 19 mm) NPT and insulation depth.

b Manual reset (trip-free) switch breaks circuit and locks out when controlled medium reaches setpoint. Controlled temperature must drop 20°F (11°C) below setpoint before contacts can be manually reset.
### Table 2. L6006, L6007, L6008 Controller (SPDT Switching) Specifications.

<table>
<thead>
<tr>
<th>Model</th>
<th>Application</th>
<th>Range °F (°C)</th>
<th>Midscale Differential °F (°C)</th>
<th>Insertiona</th>
<th>Available Options</th>
</tr>
</thead>
</table>
| L6006A  | Circulator and low limit or high limit     | 100° F to 240° F (38° C to 116° C) or 100° F to 290° F (38° C to 143° C) | 5° F (3° C) fixed or 5° F to 30° F (3° C to 17° C) adjustable | Horizontal | — SUPER TRADELINE model available.  
 |         |                                            |                                                   |                              |            | — Modified dial with stop.  
 |         |                                            |                                                   |                              |            | — NPT brass spud 1/2 in. or 3/4 in. (13 mm to 19 mm)  
 |         |                                            |                                                   |                              |            | — 3-3/8 in. (86 mm) insertion.  
 |         |                                            |                                                   |                              |            | — Without well.  
 |         |                                            |                                                   |                              |            | — Adapter for horizontal or vertical mount.  
 |         |                                            |                                                   |                              |            | — Insulation depth 1-1/2 in. or 3 in. (38 mm or 76 mm).  
| L6006B  | Circulator and low limit or high limit     | 100° F to 240° F (38° C to 116° C)                 | 5° F (3° C) fixed or 5° F to 30° F (3° C to 17° C) adjustable or 30° F (17° C) fixed | Horizontal | — Direct immersion.  
 |         |                                            |                                                   |                              |            | — Insulation depth 1-1/2 in. (38 mm).  
 |         |                                            |                                                   |                              |            | — 3/4 in. (19 mm) brass compression fitting.  
| L6006C  | Circulator, low limit, and high limit      | 65° F to 200° F (18° C to 93° C)                   | 5° F (3° C) fixed or 5° F to 30° F (3° C to 17° C) adjustable | Horizontal or vertical surface mounted | — TRADELINE model available.  
 |         |                                            |                                                   |                              |            | — Strap-on, surface mount.  
| L6007A  | Circulator and low limit or high limit     | 40° F to 180° F (4° C to 82° C)                    | Fixed                         | Horizontal or vertical | — Insulation depth 1-1/2 in. or 3 in. (38 mm or 76 mm).  
| L6008A  | Circulator and low limit cooling           | 100° F to 240° F (38° C to 116° C) or -30° F to +70° F (-35° C to +21° C) | 5° F (3° C) fixed or 5° F to 30° F (3° C to 17° C) adjustable | Remote bulb | — TRADELINE models available.  
 |         |                                            |                                                   |                              |            | — Modified dial with stop.  
 |         |                                            |                                                   |                              |            | — Capillary 5-1/2 ft (1.7 m).  
| L6008G  | Two-stage Aquastat Controller to cycle two-stage gas valve. | 130° F to 230° F (54° C to 110° C) or 60° F to 160° F (16° C to 71° C) | 3-1/2° F (2° C) fixed | Remote bulb | — Capillary 6 ft (1.8 m).  
 |         |                                            |                                                   |                              |            | — Adjustable interstage differential; 5° F to 10° F (2° C to 6° C).  
| L6008H  | Low fire Aquastat Controller              | 150° F to 200° F (66° C to 93° C)                 | 15° F (8° C) fixed           | Remote bulb | — Capillary 33 in. (0.8 m).  

a Some models include copper well or fitting; specify when ordering. Also specify boiler tapping size 1/2 or 3/4 in. NPT and insulation depth.
INSTALLATION

When Installing This Product...
1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check product operation as provided in these instructions.

**WARNING**
Explosion Hazard.
Can cause serious injury, death or property damage.
This product is intended for use only in systems with a pressure relief valve.

**WARNING**
Electrical Shock Hazard.
Can cause serious injury or death.
Disconnect power supply before beginning installation to prevent electrical shock or equipment damage.

**CAUTION**
Equipment Damage Hazard.
Use of incorrect device or improper installation can damage the system.
1. Do not replace immersion-type Aquastat Controller with strap-on Aquastat Controller.
2. Do not secure draw nut so tightly that retainer clamp can collapse tubing.

**IMPORTANT**
1. Terminals on these Aquastat relays are approved for copper wire only.
2. Controller may be used with or without immersion well. If used, well must snugly fit sensing bulb for best thermal response. Insert bulb until it rests against the bottom of the well. Use well of correct length and bend the tubing, if necessary, to provide enough force to hold the bulb against the bottom of the well. Avoid making a sharp bend in the tubing as it can produce a break in the tubing and cause loss of fill. This condition causes the High and Low Limit controls to be made continuously.
3. If well does not snugly fit on bulb, use the heat-conductive compound, included with Super Tradeline and Tradeline models, as follows: Fold the plastic bag of compound lengthwise and twist gently. Snip the end of the bag and insert into the well. Slowly pull out the bag while squeezing firmly to distribute compound evenly in the well. Insert the bulb into the well. Bend the tubing, if necessary, to provide force to hold the bulb against the bottom of the well and to hold the outer end of the bulb firmly in contact with the side of the well. Wipe off excess compound.

The manufacturer usually provides a tapping for insertion of the controller sensing element. This tapping is located at a point where typical water temperature can be measured. Depending on the model, the element is inserted in an immersion well, through a boiler fitting, or directly immersed.

Installation should be made by a qualified service technician. Follow the instructions furnished by the system manufacturer, if available. Otherwise, refer to appropriate procedure listed below.

**Mounting Immersion Well and Direct Immersion Models (L4006A,B,C,E,G; L4007A,B; L6006A,B; L6007A)**

**Installing Immersion Well Models**
(L4006A,B,E,G; L4007A,B; L6006A; L6007A)
On an existing installation, shut off the power and remove the old control. If the old immersion well appears suitable, and if the adapter clamp on the Aquastat Controller fits the old well spud, this well does not need to be replaced.

To replace the well:
1. If the system is filled, drain the system to a point below the boiler tapping.
2. Remove the old well from the boiler tapping.
3. Install the immersion well included with the controller. If the boiler tapping is greater than 1/2 in. (13 mm), use a reduction fitting to adapt the boiler opening to the 1/2 in. (13 mm) threads that are standard with the well or fitting. Fittings with 3/4 in. (19 mm) threads are also available.
4. Fill the system. Make sure that the well is screwed in tightly enough to prevent leakage. Do not use the case as a handle to tighten the well after the controller is secured to the well.

To install the controller:
1. Loosen the screw (at the top of the case, above the scale setting), and remove the cover. Loosen the two screws that secure the adapter clamp. (See Fig. 6).
2. Insert the sensing element into the immersion well.
3. Fasten the case of the Aquastat Controller to the well with the adapter clamp. Make certain that the clamp is properly positioned over the groove of the well spud. Also, be sure the flange at the opening of the well fits snugly into the opening of the case. The sensing bulb must bottom in the well.

**NOTE:** Some models include up to 3 in. (76 mm) extra capillary tubing inside the case. In these models, pull out the extra tubing, if needed.
Installing Direct Immersion Models (L4006C, L6006B)
Models that provide for direct immersion of the sensing element into the boiler include a bulb compression fitting assembly instead of an immersion well. Install the fitting in the boiler tapping as follows:

1. Be sure the sealing washer is in place as shown in Fig. 7. Make sure that the spud of the bulb compression fitting is screwed in tightly enough to prevent leaking.

2. Insert the immersion sensing bulb through the bulb compression fitting. Adjust the adapter clamp so that the clamp fits over the groove at the opening of the bulb compression fitting.

3. Tighten the adapter clamp screws so that the Aquastat Controller is firmly attached to the bulb compression fitting.

Mounting Remote Bulb Models (L4008A,B,E; L6008A,G,H)
The remote temperature-sensing bulb can either be installed in an immersion well (See Fig. 8) that extends into the boiler or tank, or it can be directly immersed in the controlled medium (See Fig. 9). For installations that do not use a well, secure the remote bulb with a bulb compression fitting (See Fig. 10), or capillary compression fitting. (See Fig. 11).

Order well, well adapter, bulb compression fitting or capillary compression fitting separately. See form no. 68-0040, Wells and Fittings for Temperature Controllers. If used, well must snugly fit sensing bulb for the best thermal response. Insert bulb until it rests against the bottom of the well. Hold it there while tightening the tubing clamp. (See Fig. 8).

The boiler manufacturer usually provides a tapping for the insertion of the Aquastat Controller sensing element. This tapping should be located at a point where typical water temperature can be measured. Never locate the bulb or protecting immersion well close to a hot or cold water inlet or a steam coil.

If the system is filled, drain system to a point below the boiler tapping, or wherever the sensing bulb is to be installed.

The bulb can also be installed in the supply line of an indirect water heater, in the direct water heater itself, or in the feed riser, about 6 in. (153 mm) above the boiler. If the riser is valved, the bulb can be installed between the boiler and the valve.

NOTE: Do not make sharp bends or kinks in the capillary. Make bends no sharper than 1 in. (25 mm) radius.

After installing the controller, carefully coil the excess capillary at the bottom of the controller case.

Mounting Immersion Well

1. Screw the well into the boiler, tank, or pipe tapping.

2. Insert the bulb in the well, pushing the tubing until the bulb bottoms in the well.

3. Attach the retainer clamp to the end of the well spud. Loosen the draw nut and spread the jaws of the clamp with the screwdriver if necessary. (See Fig. 8).

4. With the retainer clamp attached to the well spud (be sure the jaws of the clamp hook over the ridge at the end of the spud, as shown at points A in Fig. 8), adjust the tubing to fit through the retainer clamp groove, as shown at point B in Fig. 8.

5. Tighten the draw nut so that the retainer clamp is firmly attached to the well spud and the tubing is held securely in place.
Mounting With Bulb Compression Fitting

1. Screw the fitting into the boiler or pipe tapping.
2. Slide the sealing washer onto the bulb.
3. Insert the bulb into the fitting until the bulb bottoms.
4. Slide the split sleeve into the fitting. (See Fig. 10).

5. Place clamps A and B on the assembly so that the sleeve is drawn into the fitting when the screws are tightened.

NOTE: Make sure that the nub on clamp A engages the space between the sleeve and the clamp.

6. Tighten the clamp screws evenly.

Mounting With Capillary Compression Fitting

1. Screw the fitting into the boiler or pipe tapping.
2. Place the packing nut on the tubing.
3. Slide the bulb completely through the fitting.
4. Place the composition disk and four slotted brass washers on the tubing in the order shown in Fig. 11. Turn the brass washers so the slots are 180 degrees apart.

5. Slide the seal assembly into the fitting and tighten the packing nut.

Duct Mounting

1. Drill a 3/4 in. (19 mm) hole in the duct wall large enough to admit the sensing bulb into the holder.
2. Using the holder as a template, mark and drill holes for the bulb holder mounting screws. (See Fig. 12).
Mounting Remote Bulb Models
For Outdoor Air Sensing
These models have a 5 ft (1.5 m) capillary that establishes the maximum distance between the case and the outdoor mounting.

Install the bulb on the outside of the building in the shield provided (See Fig. 15) where it can be exposed to representative air temperature, but not to direct sunlight. Mount the bulb high enough so that accumulated snow, leaves, or other debris cannot obstruct circulation of air around it, and where children cannot reach it. Avoid vents from the building.

Install the case at the indoor location selected, fastening the screws through holes in the back of the case. Bring out the bulb and tubing through a 3/4 in. (19 mm) hole in the outside wall, avoiding sharp bends or kinks. Leave excess tubing coiled near the case. Do not make sharp bends near the case or bulb.

Slip the bulb through the supports in the shield. Pinch the split supporting clip until it holds the bulb firmly in position. If the seal-off tube protrudes from under the shield, bend it under as shown in Fig. 15.

Hold the shield over the mounting position and form a small-radius bend in the tubing. Place the split plug around the tubing and move the shield into the mounting location as a unit. Push the split plug into the hole until it is wedged securely in place. Fasten the shield in place on the wall with the screws provided.

NOTE: If the tubing is properly shaped and the split plug installed as directed, the shield will cover the split plug, and the hole in the wall will be hidden from sight.

Mounting L6008A Remote Bulb Controller
Mounting with Guard Bracket
Mount the bulb in the guard bracket as shown in Fig. 16. Locate the bulb and bracket combination, in freely circulating air, in the controlled area. With screws provided, fasten the bracket in place.
Mounting on Suction Line
1. In cooling units with more than one suction line, place the sensing bulb on the common line.
2. Make certain the bulb is at least 2 ft (0.6 m) from the point at which the suction line leaves the cooler. This prevents the outside temperature from being transmitted to the remote bulb through the copper tubing of the suction line.
3. Place the remote sensing bulb on the side of the horizontal suction line between the coil and trap (not on the trap).
4. Attach the sensing bulb to the suction line with clips or straps. (See Fig. 17).
5. Coil the excess length of capillary tubing near the L6008A case.

Wiring
Disconnect power supply before beginning installation to prevent electrical shock or equipment damage.

All wiring must comply with local codes and ordinances regarding wire size, type of insulation, enclosure, etc.

Figures 19 through 28 show typical hookups.

When wiring a switch equipped with a 1/4 in. (19 mm) tab terminal connector, use 18 AWG to 22 AWG (0.8 mm² to 0.3 mm²) gauge wire with an AMP Inc. part no. 2-520129-2 fully insulated flag receptable connector or equivalent.

Mounting Surface Mount Models
The L4006H and L6006C are designed for surface mounting on piping or tanks. Mount the controller directly on the tank surface using the adjustable mounting bracket as shown in Fig. 18. The controller can be mounted in any position.

When mounting the L4006H or L6006C on piping, the pipe should be 1 in. (25 mm) diameter or larger for accurate temperature sensing. Remove any insulation from the pipe. Thoroughly scrape off all scale, rust, or paint. Mount the controller using adjustable bracket provided. Turn on power.
Fig. 20. Typical oil-fired gravity system.

Fig. 21. L6008A used to control cooling equipment and indicating light.

Fig. 22. Typical oil-fired hydronic system with domestic hot water.

Fig. 23. Typical oil-fired hydronic heating system that provides year-round domestic hot water using RA832A.

Fig. 24. Typical connection diagram for an oil-fired, hydronic heating system that provides year-round domestic hot water using RA817A.
**OPERATION**

For proper selection of settings, follow the boiler manufacturer recommendations.

**High Limit Controller**

R-B terminals provide high limit switching function (contacts open at set point on temperature rise). (See Figures 30 and 31). R-B terminals shut off burner if water temperature exceeds high limit setting. Burner restarts when temperature drops to high limit setting, less differential.

**NOTE:** On manual reset models, the reset button on the front of the case must be pushed in to allow the burner to operate after a high limit shutdown.

---

**Fig. 25. Typical wiring hookup using L6006 or L6007 with L8148A.**

**Fig. 26. Typical systems with 120 volt electric heat primaries.**

**Fig. 27. Typical Powerpile System wiring diagram.**

**Fig. 28. Typical oil burner installation using L4008G.**
Low Limit Controller

R-B terminals provide low limit switching function (contacts open at set point on temperature rise). Maintains minimum boiler temperature for domestic hot water. Turns on boiler at temperature setting, less differential.

Circulator Controller

R-W terminals provide circulation control function (contacts close at set point on temperature rise). Prevents circulation of water that is below the desired heating temperature. Breaks circulator circuit on temperature drop below setting less differential; remarks on rise to setting.

L6008G Adjustable Interstage Differential

When the temperature at the sensing element rises above the set point of the controller, the switch on the right makes R-W. If the temperature continues to rise through the preselected interstage differential of the controller, the switch on the left makes R-W.

Conversely, on a temperature fall, the switch on the left makes R-B, providing first step switching. If the temperature continues to fall, the switch on the right makes R-W to provide sequencing of equipment.

ADJUSTMENTS

Adjusting Differential

Set the differential to correspond with the boiler manufacturer recommendations. To adjust models with adjustable differential, rotate the wheel on the back of the snap switch, (See Fig. 32), until the desired reading is aligned with the V notch in the frame. The wheel provides an adjustment from 5° F to 30° F (3° C to 17° C). Replace the cover on the Aquastat Controller.
Adjust the control point to correspond with the boiler manufacturer recommendations. To adjust, insert a screwdriver in the slotted screw type head located beneath the window in the cover. Turn the scale to the desired control point.

Adjusting L6008G Interstage Differential

The L6008G Controller has an adjustable interstage differential. The set point adjustment knob determines the temperature at which the right switch operates. The left switch can be adjusted to operate from 3°F to 10°F (1.7°C to 5.6°C) above the point of operation of the right switch. See Figure 30 for the operation of the L6008G. The interstage differential is adjusted by turning the star wheel with a narrow screwdriver inserted into the rectangular hole in the chassis. (See Fig. 32).

Fig. 32. Interstage differential adjustment on an L6008G.

L6008A Location Differential Calibration

The L6008A1093 is calibrated for applications where the bulb and controller case are located in the same control space.

If the bulb and controller case are located in separate rooms, and if the temperature in the two rooms is different, an adjustment is required. Adjust the dial setting (control space temperature setting) to compensate for the difference in temperature.

1. If the L6008A case is located in a room with a higher temperature than indicated on the dial setting, raise the dial setting the number of degrees listed in Table 3.
2. If the L6008A case is located in a room with a lower temperature than indicated on the dial setting, lower the dial setting the number of degrees listed in Table 3.

Table 3. Temperature Adjustments.

<table>
<thead>
<tr>
<th>Difference Between Desired Room Temperature and Case Temperature</th>
<th>Reduce Dial Setting</th>
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<tbody>
<tr>
<td>°F</td>
<td>°C</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
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<td>5</td>
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<td>39</td>
</tr>
<tr>
<td>80</td>
<td>45</td>
</tr>
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</table>

EXAMPLE:

In the example shown in Fig. 33, the L6008A case is located in a room with a lower temperature than the controlled space. Adjusting the controlled space setting (dial setting) is necessary to compensate for the temperature difference of 35°F (20°C) between the two rooms. Table 3 indicates that the dial setting should be lowered 5°F (3°C) to compensate for the 35°F (20°C) temperature difference.

Manual Reset

If the device includes manual reset (L4006E, L4008E), be sure to press the (red) reset button on the front of the case to make sure that the controller is not locked out on safety. When checking the system, adjust the limit setting low enough so the temperature of the controlled medium reaches the high limit setting. When the limit setting is reached, the Aquastat Controller locks out and the burner shuts down. When the temperature of the controlled medium drops to the high limit setting, less the differential, push the manual reset button to make the system operative again. Reset the control to the proper high limit setting.

Fig. 33. L6008A calibration.
CHECKOUT

⚠️ WARNING

Explosion Hazard.
Can cause serious injury, death or property damage.
This product is intended for use only in systems with a pressure relief valve.

Check to make certain that the Aquastat Controller is properly installed and adjusted. Put the system into operation and observe the action of the controller through several cycles to make certain it provides proper control of the system as described in the OPERATION section. Make any additional adjustments necessary for assuring comfort requirements.
MATERIAL SAFETY DATA SHEET

Section 1. Product And Company Identification

Product Name: Heat Conductive Compound
MSDS ID: DS9021
Synonyms: MS1699
Product Use: Heat conductive material used to enhance contact and heat transfer in temperature sensor applications.

Manufacturer: Honeywell Inc., 1985 Douglas Drive North, Minneapolis, MN 55422.
Date Released: October 8, 1999
NFPA Ratings: Health 0; Flammability 1; Reactivity 0; Personal Protection B

Section 2. Composition, Information on Ingredients

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<th>Percent</th>
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<th>TVL</th>
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<td>Mineral Oil</td>
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<td>Aluminum Paste (30%):</td>
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<td></td>
<td></td>
<td></td>
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<td>Aluminum, as Al</td>
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<tr>
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<td>5 mg/m³</td>
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Additional Information: Part No. 120650 (0.5 oz tube); Part No. 107408 (4 oz can); Part No. 197007 (5 gallon container). May also contain minute amounts of lithium and molybdenum lubricant compounds.

Section 3. Hazard Identification

Acute Health Effects:
Skin: Excessive contact may cause skin irritation and dermatitis.
Eye: Direct contact with eye will cause irritation.
Inhalation: No adverse effects are expected.
Ingestion: Ingestion of product may cause nausea, vomiting and diarrhea.

Chronic Health Effects:
Existing skin rash or dermatitis may be aggravated by repeated contact.

OSHA Hazard Classifications: None.
Carcinogenicity: Not considered to be a carcinogen by either OSHA, NTP, IARC, or ACGIH.

Section 4. First Aid Measures

Eye Contact: Flush eyes with water for 15 minutes. Remove any contact lenses and continue to flush. Obtain medical attention if irritation develops and persists.
Skin Contact: Remove excess with cloth or paper. Wash thoroughly with mild soap and water. Obtain medical attention if irritation develops and persists.
Ingestion: Contact physician or local poison control center immediately.
Inhalation: Remove patient to fresh air and obtain medical attention if symptoms develop.

Section 5. Fire Fighting Measures

Material Flash Point: > 383° F (195° C). Will burn if exposed to flame.
Extinguishing Media: Carbon dioxide, dry chemical or foam.
Special Fire Fighting Procedures: None.
Explosion Hazards: None. Aluminum powder can react with water to release flammable hydrogen gas. In this form of the product, this reaction is not expected.
Section 6. Accidental Release Measures
Scrape up and dispose of as solid waste in accordance with state and federal regulations.

Section 7. Handling and Storage
Store in dry place. Keep container closed when not in use.

Section 8. Exposure Controls and Personal Protection.
Ventilation: No special ventilation is required when working with this product.

Respiratory Protection: None required.

Eye Protection: Not normally required. However, use chemical safety goggles or faceshield if potential for eye contact exists, especially if material is heated.

Hand/Clothing Protection: Not normally required. Protective gloves and clothing are recommended, as material is difficult to remove from skin and clothing.

Other Protective Equipment: None required.

Section 9. Physical and Chemical Properties
Appearance/Odor: Aluminum color, semi-solid material, pleasant odor.

Solubility in Water: Negligible.

Specific Gravity: 0.86.

Section 10. Stability and Reactivity
Stability: Stable.

Reactivity: Hazardous polymerization will not occur.

Incompatibilities: Strong oxidizing agents and halogens.

Hazardous Decomposition Products: Carbon dioxide, carbon monoxide.

Section 11. Toxicology Information.
No data available.

Section 12. Ecological Information
Chemical Fate Information: Hydrocarbon components will biodegrade in soil; relatively persistent in water.

Section 13. Disposal Consideration
Dispose of as solid waste in accordance with local, state and federal regulations.

Section 14. Transportation Information
DOT Classification: Not classified as hazardous.

Section 15. Regulatory Information
SARA Title III Supplier Notification: Include in Section 311/312 inventory reports if amounts exceed 10,000 pounds. Aluminum compounds are subject to the reporting requirements under Section 313 of Emergency Planning and Community Right-To-Know Act of 1986 (40 CFR 372). Ingredients listed in TSCA Inventory.

Section 16. Other Information
This information is furnished without warranty, expressed or implied, except that it is accurate to the best of our knowledge.
The 600CB Tрerice Contractor Gauge is among the most frequently specified HVACR gauges within the construction industry. This gauge offers high reliability at a moderate price. The 600CB is furnished with a cast aluminum case and an adjustable pointer.

- Optional features and case style variations available: Please consult the Options & Accessories Section for details.
- For correct use and application of all pressure gauges, please refer to: Pressure Gauge Standard ASME B40.100.

### Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Dial Sizes</th>
<th>Wetted Parts</th>
<th>Movement</th>
<th>Connection</th>
<th>Case</th>
<th>Ring</th>
<th>Window</th>
<th>Pointer</th>
<th>Accuracy</th>
<th>Maximum Temperature</th>
<th>Approximate Shipping Weight</th>
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<td>3½” &amp; 4⅛”</td>
<td>3½” Dial Size: Bronze tube, brass socket 4½” Dial Size: Bronze tube, brass socket</td>
<td>Brass</td>
<td>Lower male, 1/4” NPT</td>
<td>Cast aluminum, black finished, stem-mounted flangeless</td>
<td>3½” Dial Size: Friction type, steel, black finished 4½” Dial Size: Friction type, 304 stainless steel</td>
<td>Clear glass</td>
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### HOW TO ORDER

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<th>Connection Size</th>
<th>Connection Location</th>
<th>Units of Measure</th>
<th>Range Code</th>
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Sample Order Number: **600CB 35 02 L A 090**
### Standard Ranges

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<th>kPa Ranges (B)</th>
<th>kg/cm² Ranges (C)</th>
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<td><strong>Specific Range</strong> (psi)</td>
<td><strong>Figure Intervals</strong></td>
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<td>30° Hg to 0</td>
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<td>020</td>
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<td>180</td>
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For dual scale ranges, specify the appropriate Units of Measure: D (psi/kPa) or E (psi & kg/cm²) followed by the equivalent A (psi) Range Code. Other pressure ranges are also available including: Altitude, Ammonia, Refrigerant and Receiver. Consult Special Application Ranges section or factory for availability.

All dimensions are nominal. Dimensions in [ ] are in millimeters.
Adjustable Angle Type
3” and 5” Dial Size

**STANDARD RANGES**
- All Stainless Steel Construction
- External Recalibration Adjustment
- White dial with black markings
- Accurate to ±1% of Scale Range
- Gasketed Glass Face
- Case is sealed to exclude dirt, dust and moisture
- 3" and 5" dial sizes
- Angularly adjustable frame permits positioning of dial to accommodate viewing requirements

### 3” AND 5” DIAL SIZE CATALOG NUMBERS

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**NOTE:** Union connected types must be used with thermowells, longer length available on special order.

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<td>CN 0 to 50°C†</td>
</tr>
<tr>
<td>CR 0 to 150°C</td>
</tr>
<tr>
<td>CS 0 to 200°C</td>
</tr>
<tr>
<td>CU 0 to 300°C</td>
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<tr>
<td>CX 50 to 450°C†</td>
</tr>
<tr>
<td>CY 100 to 550°C†</td>
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### DUAL SCALE

<table>
<thead>
<tr>
<th>Fahrenheit</th>
<th>Celsius</th>
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<tr>
<td>DE -40/120°F and -40/50°C</td>
<td></td>
</tr>
<tr>
<td>DF 40/160°F and -40/70°C</td>
<td></td>
</tr>
<tr>
<td>DN 30/130°F and 0/55°C†</td>
<td></td>
</tr>
<tr>
<td>DJ 0/200°F and -20/94°C</td>
<td></td>
</tr>
<tr>
<td>DL 0/250°F and -20/120°C</td>
<td></td>
</tr>
<tr>
<td>DR 50/300°F and 10/150°C</td>
<td></td>
</tr>
<tr>
<td>DS 50/400°F and 10/200°C</td>
<td></td>
</tr>
<tr>
<td>DT 50/550°F and 10/230°C</td>
<td></td>
</tr>
<tr>
<td>DX 100/800°F* and 40/430°C†</td>
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</tr>
<tr>
<td>DY 200/1,000°F* and 100/550°C*†</td>
<td></td>
</tr>
</tbody>
</table>

*Not recommended for continuous service above 800°F (425°C). For such temperatures see pg. 63.
†Minimum stem length for these ranges 4”.

### OPTIONAL FEATURES

<table>
<thead>
<tr>
<th>CODE</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>EL</td>
<td>Liquid Filling for Catalog No’s AF, 3A, 5A only</td>
</tr>
<tr>
<td>PD</td>
<td>Plastic Window</td>
</tr>
<tr>
<td>SG</td>
<td>Shatterproof Glass</td>
</tr>
<tr>
<td>NN</td>
<td>Paper Tag</td>
</tr>
<tr>
<td>NH</td>
<td>Stainless Steel Tag</td>
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<tr>
<td>DM</td>
<td>Dial Markings</td>
</tr>
<tr>
<td>C4</td>
<td>Calibration Certificate</td>
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</tbody>
</table>

### HOW TO ORDER

1. Basic 4-digit Catalog No. From Table Above
2. Stem Diameter; “4” = .250” O.D. (Standard); “5” = .375” O.D. (Extra Cost)
3. Thread Size; “4” = ½ NPT Male (AF Series); “U” = ½ NPT Male Swivel Nut (AU Series)
4. 2 Digit Range Code from Range Tables Above
5. Option(s); “X” = None Required; “9” = Option(s) Required (Extra Cost)

If option(s) are required specify: Plastic Face, Shatterproof Glass Face, Paper Tag, Stainless Steel Tag

**SEPARABLE THERMOWELLS AVAILABLE**
SEE PAGES 59 - 63
"Re-Submittal -2" Burner Specification Sheet

Job Number: J083776-0  Qty: 2  Order Number: B060509  Line Number: 1
Customer: SUPERIOR BOILER WORKS  Purchase Order: 153002046
Job Name: NYC PS 163

Burner Model: FDM300  Burner Mode of Operation: MOD
Code: UL, CSD-1, IRI
UL Label: SUPERIOR BOILER
Combustion Chamber Type: Other
Job Site Altitude: 2000FT  Clearance Checked By: CG

Addl. Dwg.: G-J083776-2
Addl. Dwg.: PDGJ083776-1
Addl. Dwg.: FDM300_J085875

Gas High Fire Rate: 3000 MBH  Gas Type: NATURAL
Oil High Fire Rate: GPH  Fuel Oil Grade: Other
UL Group - Gas: 4D  UL Group - Oil: Ultra
High Fire Manifold Pressure**: 3.7 IN. WC  Side Orifice Drill Size: NONE
Gas Regulator Outlet Pressure: 4.9 IN. WC  RPTD Job Pressure: 7/14.0 IN. WC
Minimum Supply Pressure: 5.5 IN. WC  Max Design Pressure*: 14.0 IN. WC

Wiring Diagram: G-J083776-2  Gas Piping Diagram: PDGJ083776-1
Oil Piping Diagram: FDM300_J085875

Control Voltage: 115V Single Phase 60 HZ  Full Load Amps: 6.0
Blower Motor Voltage: 115V 1 PH 60 HZ  Full Load Amps: 3.3
Oil Pump Motor Voltage: PH HZ  Full Load Amps: 3.3
Compressor Motor Voltage: PH HZ  Full Load Amps: 3.3
Minimum Circuit Ampacity: 26.00  Gas Inlet Location: Gas PILOT SCANNER
Ignition System: GAS PILOT SCANNER
Diffuser Blade Setting: Blast Tube Flange Set

Comments:
9X10 HOFFMAN & 24" WALL MOUNT REMOTE
LEAVE AS MUCH SPACE IN THE 9X10 AS POSSIBLE FOR CUST. USE

**Approximate operating pressure at the Manifold Inlet for initial start-up. Final Pressure should be determined after checking actual flow with gas meter. Stack temperature, CO, CO2, O2, and Furnace Pressure will help in determining actual input when gas meter is not available for this unit.

*All components are rated for the Max Design Pressure specified, that pressure must not be exceeded.
<table>
<thead>
<tr>
<th>PFI Part No.</th>
<th>U/M</th>
<th>Qty</th>
<th>Material Description</th>
<th>Ship Loose</th>
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<tbody>
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<td>054210</td>
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<td>1</td>
<td>1 HP 3450 RPM 115/208/230/1 ODP 56C FR. Q56C34D1173 OR 5KC39RN44GX MARATHON MOTOR</td>
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<td>081050</td>
<td>EA</td>
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<td>7-5/8 X 3 X 5/8 S-HUB R762-300S 3450 CW REVCOR WHEEL SPEC 101343</td>
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<td>140020</td>
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<td>7990K10 4PDT CUTLER HAMMER GAS-OIL FUEL CHANGE-OVER SWITCH POSITIVE CENTER OFF</td>
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<td>140700</td>
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<td>CRTP1A9M9 OSLO SPST ROCKER SWITCH</td>
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<td>LGP-G 1-20 INCH ANTUNES LOW GAS PRESSURE SWITCH MANUAL RESET (VENTLESS)8103116202</td>
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<td>161100</td>
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<td>HGP-G 2-20 INCH ANTUNES HIGH GAS PRESSURE SWITCH, MANUAL RESET (VENTLESS) 8101111202</td>
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<td>171110</td>
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<td>SMD1206060 ANTUNES AIR SWITCH WITH COMPRESSION FITTINGS .17-12 INCH RANGE</td>
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<td>202450</td>
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<td>8040H007 1/4 INCH 120 VOLT 50/60 HZ. OR U-28-45-21-18 GAS PILOT VALVE</td>
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<tr>
<td>203065</td>
<td>EA</td>
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<td>V4295A-1155 HONEYWELL 2 INCH 5 PSI N.C. 120V NEMA 1 SOLENOID VALVE</td>
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<tr>
<td>273400</td>
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<td>501219-1 108BV 2 INCH ECLIPSE MANUAL BUTTERFLY VALVE</td>
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<tr>
<td>300100</td>
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<td>RV-20VL 3/8 INCH 1/2 PSIG INLET PRESSURE 2.8-5.2 INCH SPRING REGULATOR</td>
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<tr>
<td>300800</td>
<td>EA</td>
<td>1</td>
<td>RV-91 2 INCH MAXITROL REGULATOR WITH R9110-38 PINK 3-8&quot; SPRING USE INLET PRESSURE 0.5 PSI</td>
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<tr>
<td>320001</td>
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<td>1092-PF-G 6000 VOLT 50/60 HZ. ALLANSON GAS IGNITION TRANSFORMER WITH GROUND WIRE</td>
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<tr>
<td>332180</td>
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<td>AT140B-1206 40 VA 120/24 HONEYWELL FOOT MOUNT STEPDOWN TRANSFORMER</td>
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<tr>
<td>391000</td>
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<td>2</td>
<td>ML7999A-2001/U HONEYWELL UNIVERSAL PARALLEL POSITION ACTUATOR (REV. 2)</td>
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<tr>
<td>391010</td>
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<tr>
<td>391020</td>
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<td>R7999A-1005/U HONEYWELL PARALLEL POSITIONING CONTROLLER</td>
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<tr>
<td>391052</td>
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<td>S7999D-1048 HONEYWELL CONTROL LINKS TOUCH SCREEN 5.313 X 7.75 CUTOUT</td>
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<tr>
<td>397521</td>
<td>EA</td>
<td>1</td>
<td>RM7840L-1075 HONEYWELL AUTOMATIC PROGRAMMING CONTROL WITHOUT DISPLAY</td>
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<td>50/60 HZ HONEYWELL UNIVERSAL WIRING SUBBASE-METAL BURNER MOUNT</td>
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<td>400910</td>
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<td>Q7800B-1003/B HONEYWELL UNIVERSAL WIRING SUBBASE-METAL BURNER MOUNT</td>
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<td>403200</td>
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<td>C7027A-1023 CUSTOM PAK UV 1/2&quot; NPT. MOUNTING 0-215DEG HONEYWELL FLAME SENSOR STD CNNDT CNNCT</td>
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<tr>
<td>406950</td>
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<td>R7849A-1023 HONEYWELL UV AMP 3 SECOND FLAME FAILURE RESPONSE TIME</td>
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<tr>
<td>407710</td>
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<td>1</td>
<td>ST7800A-1039 HONEYWELL 30 SECOND PURGE TIMER</td>
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<tr>
<td>440211</td>
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<td>T775M-2048 HONEYWELL MODULATING TEMPERATURE CONTROLLER, 2 RELAY OUTPUT, UNIV SELECTABLE ANALOG OUTPUS</td>
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<td>480030</td>
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<td>RV4NAYSD502A CLAROSTAT 5K 1-TURN POTENTIOMETER</td>
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<td>480560</td>
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<td>MPKES9081/4 APEM POTENTIOMETER KNOB 679-3545-ND</td>
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<td>576061</td>
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<td>CONTACOR 7.5/7.5/15/20HP 25A,120V 1NO/1NC AUX,SIEMENS 3RT2026-1AK60</td>
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<tr>
<td>610400</td>
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<td>2</td>
<td>SLU-35 ILSO GROUNDING LUG</td>
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<td>611880</td>
<td>EA</td>
<td>1</td>
<td>1 POLE CC FUSE BLOCK KIT (CONSISTS OF 30321R, DFC3LP, DRM)</td>
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<td>612010</td>
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<td>019904225 ENTRELEC D6/8.ADO 14-16 GAUGE ADO, SCREW TERMINAL BLOCK</td>
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<td>612130</td>
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<td>0199075.26 ENTRELEC D6/8.ADO 14-16 GAUGE AQO,TERMINAL RED (GAS VALVE)</td>
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<td>612200</td>
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<td>11511811 ENTRELEC M6/8 8MM TERMINAL BLOCK 50 AMP 8-22 GA. SCREW</td>
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<td>2 INCH STANDARD BLACK MALLEABLE IRON PIPE TEE</td>
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<tr>
<td>910770</td>
<td>FT</td>
<td>5</td>
<td>3/8 INCH O.D. X .035 3003-0 ALUMINUM TUBE (5 FT. LENGTHS)</td>
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<td>911530</td>
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<td>ORIFICE SPRING FOR 2 INCH PIPE TEE PER DWG NO. M-232S</td>
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<td>912796</td>
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<td>FDM LINKAGE ARRANGEMENT TAG, M390MC</td>
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<td>925020</td>
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<td>ATMR6 6 AMP 600V. CLASS CC NON-MOTOR RATED FERRAZ SHAWMUT FUSE</td>
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<td>931130</td>
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<td>AEBF (ANGLE EXTENDED BAKELITE FITTING)</td>
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<td>FD300 MOUNTING FLANGE GASKET</td>
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<td>980030</td>
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<td>1/4 INCH MODEL 740 BALL VALVE WITH TEE HANDLE</td>
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<td>A26858</td>
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<td>15.5 X 24 DOOR S7999D AND VIEW WINDOW</td>
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<tr>
<td>A27003</td>
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<td>FDM300 AIR INLET DAMPER</td>
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<td>C10651</td>
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<td>2 INCH SNAP IN SIGHT GLASS</td>
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<td>C10730</td>
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<td>C1 MOTOR PLATE</td>
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<td>C14004</td>
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<td>FD UV SCANNER ASSEMBLY</td>
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<tr>
<td>E10480</td>
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<td>1</td>
<td>10 X 9 COVER PLATE</td>
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<tr>
<td>E10631</td>
<td>EA</td>
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<td>WALL MOUNTED BOX BRACKET LEFT</td>
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<td>E10641</td>
<td>EA</td>
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<td>WALL MOUNTED BOX BRACKET RIGHT</td>
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<tr>
<td>E20020</td>
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<td>10 X 9 X 7.5 PANEL BOX ASSEMBLY</td>
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<td>E24024</td>
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<td>24&quot; PANEL TOP (9) RECT., POT., C/O &quot;09&quot;</td>
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<td>E80310</td>
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<td>15.5 X 24 CHASSIS &quot;01&quot; PC WHITE</td>
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<td>M10034</td>
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<td>EA</td>
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<td>FD SHIPPING BRACKET TALL</td>
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<td>M10072</td>
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<td>NP2 63-120 ML7999 AIR INLET DPR BRKT</td>
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<td>2 INCH #68 BALL VALVE CSD-1</td>
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<td>EA</td>
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<td>1/8 BRASS HEX NIPPLE 122-2</td>
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<tr>
<td>X02622</td>
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<td>1/4 BRASS HEX NIPPLE 122-4</td>
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<td>3/8 X 1/4 COMP-MP STR 68-64</td>
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<td>8</td>
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<td>Y08000</td>
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<td>NO. 3GTO-15 15000 GTO IGNITION CABLE</td>
<td></td>
</tr>
</tbody>
</table>
ControLinks™ Fuel Air Ratio
Commercial/Industrial Combustion Controls

The Honeywell ControLinks™ Fuel Air Ratio Control System helps you realize real Energy Savings, Increased Turndown, Reduced Emissions and System Reliability all in an easy to install, powerful and cost effective package. With traditional mechanical linkage systems, compromised fuel and burner efficiency is the reality. So Go Linkageless with Honeywell's ControLinks and start reaping the benefits to your bottom line. You have Everything to Gain and Inefficiencies to Lose!

<table>
<thead>
<tr>
<th><strong>Go Linkageless with ControLinks and get Ahead of the Curve</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy Savings</strong></td>
</tr>
<tr>
<td>• Prevents burner short cycling</td>
</tr>
<tr>
<td>• Reduces fuel usage from 2 to 6% and beyond</td>
</tr>
<tr>
<td>• Many utility companies offer rebates if linkageless fuel air systems are installed</td>
</tr>
<tr>
<td><strong>Maximize Burner Efficiency</strong></td>
</tr>
<tr>
<td>• Match load to appliance firing rate</td>
</tr>
<tr>
<td>• Combustion efficiency maximized throughout the curve instead of at only 1 point</td>
</tr>
<tr>
<td>• Up to 24 points on the Fuel/Air Curve</td>
</tr>
<tr>
<td><strong>Reduced Emissions and Reduced Excess Air</strong></td>
</tr>
<tr>
<td>• Reduce Thermal NOx (Nitrous Oxide) by employing the Flue Gas Recirculation (FGR) damper function</td>
</tr>
<tr>
<td>• Reduce unburned fuel &amp; products of combustion with 4th channel FGR</td>
</tr>
<tr>
<td><strong>Increased Equipment Life</strong></td>
</tr>
<tr>
<td>• Equipment cycles less frequently, reducing wear and tear and extending its useful life</td>
</tr>
<tr>
<td>• Integrated Thermal Shock Protection Algorithms offer advanced capability to extend equipment life</td>
</tr>
<tr>
<td><strong>System Reliability</strong></td>
</tr>
<tr>
<td>• No Fuel/Air Ratio curve erosion over time due to component wear and shifting as with mechanical linkage systems</td>
</tr>
<tr>
<td><strong>Flexibility</strong></td>
</tr>
<tr>
<td>• Flexible use 4th Channel, which may be used for FGR, Secondary Air Control or Secondary Modulating Fuel Valve</td>
</tr>
<tr>
<td>• Dual fuel flexibility, with two independent fuel curves, allowing maximum efficiency for both fuels</td>
</tr>
<tr>
<td><strong>Safety</strong></td>
</tr>
<tr>
<td>• Dynamic safety checks: Fail Safe Potentiometer Test, Anti-Swap of Actuators, Curve Tracking Verification &amp; Safety Relay Test</td>
</tr>
<tr>
<td><strong>Affordable</strong></td>
</tr>
<tr>
<td>• Payback typically less than 1 year versus the expense of O₂ trim with marginal fuel efficiency gain over Linkageless Fuel Air Ratio Controls. Generally, O₂ trim provides some additional fuel savings, but is usually cost prohibitive.</td>
</tr>
</tbody>
</table>
ControLinks Fuel Air Control System: 
The Linkageless Advantage

Typical Applications
Replaces traditional single point modulation of a mechanical cam and linkage assembly, which controls the relationship between fuel, airflow and flue gas recirculation (if used) on a power burner. Up to 4 independently controlled universal parallel positioning actuators (UPPAs) are commanded by the ControLinks™ Controller, which responds to load and firing rate demands. Honeywell’s ControLinks linkageless fuel air ratio control provides more accuracy and efficiency in actuator positioning and burner firing, which equates to less service and downtime.

May be used on single or combination fuel single burner applications, including power burners, boilers, process furnaces, ovens, smelting, kilns, paint drying booths, VOC burn-off, ceramics, make-up air heaters or any full modulating burner as part of a retrofit or new burner application where increased efficiency is desired. Particularly suited for hospitals, schools, universities, office complexes, commercial retail complexes, multi-unit housing dwellings and industrial process production facilities.

<table>
<thead>
<tr>
<th>Key Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Stand Alone Parallel Positioning Control System that is Designed for Easy Retrofit</td>
</tr>
<tr>
<td>• Dynamic Safety Checks including Fail Safe Potentiometer Checks, Anti Swap of Actuators &amp; Curve Verification Algorithms</td>
</tr>
<tr>
<td>• Dynamic Safety Relay Test for LCI-LCO (Limit Control Input/Output) Contact Set</td>
</tr>
<tr>
<td>• Integrated Shock Protection Algorithms: Water or Stack Temperature Low Fire Hold, FGR Hold, FGR &amp; Low Fire Hold</td>
</tr>
<tr>
<td>• Controller LEDs: Power, Alarm, Motor 1, 2, 3, 4 for Status and Fault Code Annunciation (60 Possible)</td>
</tr>
<tr>
<td>• 2 Independent Fuel Profiles with or without Flue Gas Recirculation (FGR)</td>
</tr>
<tr>
<td>• Programmable Positioning for Non-Selected Fuel Actuator, Standby, Purge, Light-Off, Minimum &amp; Maximum Modulation</td>
</tr>
<tr>
<td>• Up to 4 Universal Parallel Positioning Actuators: Combustion Air, Fuel 1, Fuel 2, FGR/Flexible Usage</td>
</tr>
<tr>
<td>• 4th Channel Actuator Flexible Usage: FGR, Secondary Air Control, Secondary Modulating Fuel Valve</td>
</tr>
<tr>
<td>• 7 to 24 Points Per Profile Curve with Quick Set-up Feature Providing Minimum 3-Point Profile Curve</td>
</tr>
<tr>
<td>• Auto/Manual Firing Rate Input</td>
</tr>
<tr>
<td>• External Indication of Actuator Position via Large Arrow</td>
</tr>
<tr>
<td>• Actuator CW &amp; CCW Switches for Manually Driving Hub — Useful for Installation &amp; Service</td>
</tr>
<tr>
<td>• Actuator LED Annunciation for Unconfigured, Configured and On-Line or Faulty Actuator States</td>
</tr>
<tr>
<td>• Actuator Direct Coupled Output</td>
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</table>

Product Overview
The ControLinks Fuel Air Ratio Control System is a microprocessor-based control that simultaneously controls from two to four actuators associated with a full modulation power burner. Actuators control the position of primary and secondary fuel valves, the combustion air damper and the FGR (Flue Gas Return) damper, if used. The system consists of the R7999 master controller and its Q7999A wiring subbase and the ML7999A actuators.

Two controller models, 100 – 120Vac and 200 – 240Vac, cover global applications. Controller non-volatile memory stores operating history and current lockout and alarm status and has 6 LEDs for Power, Alarm and 4 Actuator Status Lights. Fault annunciation via blinking power light, with 60 possible fault codes. Floating control output to UPPAs, auto/manual firing rate input, remote reset capability, 4 – 20mA stack or water temperature input and dual fuel input. Control from 2 to 4 UPPAs. Password required for parameter adjustment to prevent unauthorized access.

UPPAs have universal power input of 100 to 240 Vac, providing flexibility in application with direct coupled output. A large arrow on the actuator face provides instant visual indication of actuator position. Floating control input with 950 possible actuator positions, output hub position accuracy of ±0.1 angular degrees and CW and CCW switches for manually driving hub. A mechanical stop with a magnetic coupling between stepper drive motor and the gear train assures gears will not strip or burn out the motor in an overload condition. Actuator LED Annunciation for Unconfigured, Configured and On-Line or Faulty Actuator States.
Go Linkageless and Say Goodbye to the Jackshaft Forever

Mechanical cam and linkage systems used to control the fuel-air ratio of a fully modulating power burner represent a great disadvantage to the equipment operator in regard to fuel usage, burner efficiency, dual fuel usage and burner turndown. Because mechanical linkage systems have one foot-mounted actuator to position both the combustion air and the fuel at the same time, the result is compromised fuel-air ratio and dual fuel efficiency to obtain reliable combustion throughout the fuel-air curve. Typically mechanically linked systems utilize the same point for light-off and low fire, which reduces fuel efficiency because many burners are capable of operating at a lower firing rate than light-off. As with any mechanical system, what happens over time is loss of precision due to component wear and shifting, equating to erosion of the fuel-air curve and non-optimal performance as well as unnecessary fuel costs.

With the ever increasing price of fuel and emphasis on emissions, achieving optimal burner efficiency has never been more critical and requires a cost-effective and enduring solution. Enter Honeywell’s ControLinks Linkageless Fuel Air Control System, which provides consistent and reliable fuel-air ratio control thanks to precision microprocessor control and integral actuator position feedback potentiometers. Four separate Universal Parallel Positioning Actuators (UPPAs) replace the single actuator used with mechanical cam and linkage systems, providing independent control of the combustion air damper, the primary fuel, the secondary fuel and the FGR damper (if used). The UPPAs are commanded by the ControLinks Controller, which responds to load and firing rate demands. Further, ControLinks offers dual fuel flexibility, allowing two independent fuel curves, providing maximum efficiency for both fuels. Because the burner fuel to air ratio is adjusted independently, the result is maximized burner efficiency and reduced fuel consumption that typically pays for the ControLinks system within a year. See your ControLinks Authorized Representative to estimate your potential saving today!

One controller, four actuators and optimal burner efficiency. It all adds up to monumental savings you can’t afford to ignore! So go linkageless with Honeywell’s ControLinks and reap the benefits. You have everything to gain and inefficiencies to lose!

Reduced Emissions and FGR

Reducing emissions has become a spotlight issue for many facilities. Thermal NOx (Nitrous Oxide) is produced from the oxidation of nitrogen (N₂) at temperatures above 1500° F when burning natural gas and distillate oils.

Thermal NOx can be reduced by dropping the flame temperature, which can be accomplished by lowering the amount of oxygen in the combustion air. Such a task is achieved by utilizing Flue Gas Recirculation (FGR), in which a damper is placed in the flue gas piping, allowing recirculation of a portion of the flue gas.

FGR significantly reduces NOx emissions in industrial boilers by recirculating a portion of the flue gas into the main combustion chamber, thereby reducing the peak combustion temperature. The use of FGR also reduces emissions of unburned fuel and products of combustion.

The ControLinks Fuel Air Ratio Control System provides value, flexibility and efficiency in an easy to install, capable package while ensuring equipment safety. It is compatible with competitive and legacy full modulation burner primary safety controls. A step-by-step menu driven commissioning process with step-size enforcement via the S7999B System Display or the ZM7999A Configuration Software provides quick and effective system commissioning.

Capable of controlling from 2 to 4 UPPAs for Combustion Air, a Primary Fuel, a Secondary Fuel and a 4th Flexible Usage actuator. Allows two independent fuel air profiles with or without FGR. The ControLinks controller has the capability to prevent equipment thermal shock. The Integrated Thermal Shock Protection Algorithms include Water or Stack Temperature Low Fire Hold, FGR Hold or FGR and Low Fire Hold combined. Utilizing a scaleable 4-20mA stack/water temperature sensor input, the Water or Stack Temperature Low Fire Hold keeps the burner at light-off until the programmed temperature limit is exceeded. FGR Hold keeps the FGR damper closed until the stack temperature has reached its programmed threshold. FGR and Low Fire Hold combines both hold features, providing maximum equipment protection. The controller also has Fuel-Air-FGR profile download capability from a PC or the S7999B System Display via File Transfer Protocol (FTP). Other features include programmable behaviors for all actuators during Purge and Standby, a configurable Differential (reaction time) of 0.12 to 3.0mA and a configurable Dead Band of 0.1 to 0.5 angular degrees.

Flexible 4th channel Flexible Use Function, which may be used for Flue Gas Recirculation (FGR) damper actuation, Secondary Air Control or a Secondary Modulating Fuel Valve. The 4th channel operates in conjunction with the selected primary fuel and is hard programmed to drive fully closed at light-off, regardless of its selected function. The 4th channel may be programmed to follow the Fuel/Air curve or be configured flat or negative versus the Fuel/Air curve. Further 4th channel special operating functions can be selected via the System Parameters option during commissioning, invoking the Integrated Thermal Shock Protection Algorithms, which respond to the 4-20mA stack or water temperature sensor input.

Efficient operation is obtained by replacing old mechanical single point linkage systems with the ControLinks Fuel Air Ratio System, reducing fuel usage from 2% to 6% and beyond. By decoupling the fuel curves, maximum efficiency is achieved for both fuels. Further, there is no erosion over time of the Fuel Air Profile as with the inherent wear and tear of mechanical linkage systems, saving valuable fuel and maintenance costs. ControLinks allows optimization of the fuel/air mixture, which maximizes combustion efficiency throughout the curve. And with the ability to program up to 24 points per fuel/air curve, closer and more precise firing rate control is obtained over the entire firing rate of the burner for each fuel. Due to the inherent energy usage impact, many utility companies offer energy rebates if linkageless fuel air systems are installed. Inquire with your local utility.

Safe operation assured with built-in Self-Test and Safety Relay Circuits. Dynamic safety checks including Fail Safe Potentiometer Checks, Anti-Swap of Actuators and Curve Tracking Verification. At commissioning, the 8-digit hexadecimal actuator ID is entered for its respective channel and is tracked to ensure it is not swapped with an adjacent actuator, providing consistent operation. The curve tracking algorithm verifies the curve profile is within its programmed Dead Band of between 0.1 to 0.5 angular degrees and will lockout if the Dead Band is exceeded. Further safety is provided via the Dynamic Safety Relay Test for the LCI-LCO (Limit Control Input/Output) Contact Set, which verifies the contact integrity of devices installed in the limit string. Password protection for parameter changes, assuring no unauthorized re-adjustment of system occurs.
Boiler Application — ControLinks Fuel Air Ratio Control System

**More Reasons to Go Linkageless with ControLinks**

**Increased Turndown**
- Increase turndown up to 6:1 vs. a typical mechanically linked optimal turndown of 3:1
- Separate points for light-off and low-fire vs. a mechanically linked system

**Commissioning Time & Cost**
- Burner commissioning time reduced by 30% to build the fuel/air curves
- Fast burner setup via S7999B Display or PC/Laptop

**Design Considerations**
- Choose modulating component placement without consideration of common jackshaft linkage

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**Information/Options**

<table>
<thead>
<tr>
<th>Component</th>
<th>Installation Instructions</th>
<th>Product Data</th>
<th>Guide Spec</th>
<th>Technical Brochure</th>
<th>Sell Sheet</th>
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<tbody>
<tr>
<td>R7999A, B Controller, Q7999A Subbase</td>
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<td>65-0248</td>
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<td>63-9165</td>
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<td>ML7999A Parallel Positioning Actuator</td>
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<td>65-0239</td>
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<td>63-9165</td>
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<tr>
<td>S7999B System Display</td>
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<td>—</td>
<td>65-0293</td>
<td>63-9488</td>
<td>63-9165</td>
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<tr>
<td>V5197A Firing Rate Gas Valve, C6097 Pressure Switches, P7810C PressureTrol Controller, Flame Safeguard Controls</td>
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</tbody>
</table>

Download from: [http://customer.honeywell.com](http://customer.honeywell.com)  
The Honeywell Solution

Get the 4-20mA control advantage by using Honeywell’s V5197A Firing Rate Valve, the P7810C combination Firing Rate/Limit/On-Off Control and/or the UDC2500/3200 Control for Firing Rate or On/Off Control in conjunction with ControLinks for a powerful and accurate combination. ControLinks also accepts a scaled 4-20mA auxiliary sensor input as the tool to drive the Integrated Boiler Shock Protection Algorithms.

<table>
<thead>
<tr>
<th>Component</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>R7999A, B ControLinks Controller</td>
<td>Linkageless Fuel Air Controller, which controls 2 to 4 UPPAs for Combustion Air, Fuel 1, Fuel 2 &amp; a 4th Channel Flexible Use. Directs UPPAs based on input from Firing Rate Control, Limit &amp; Operating Controls, Primary Flame Safeguard Control and/or S7999B System Display. Maintains optimal burner Fuel Air Ratio to maximize burner efficiency and minimize fuel usage and emissions.</td>
</tr>
<tr>
<td>ML7999A ControLinks Actuator</td>
<td>Universal Parallel Positioning Actuator (UPPA) with direct coupled output and universal 100 to 240 Vac power input. Controls % open of Combustion Air Damper, Fuel 1 Valve, Fuel 2 Valve &amp; FGR damper (if used). Floating control input with 950 possible actuator positions, output hub position accuracy of ±0.1 angular degrees.</td>
</tr>
<tr>
<td>S7999B System Display</td>
<td>Commission • ControlLinks Fuel/Air Ratio Control System. Password protected. Configure • S7830 Expanded Annunciator Terminal Names (Global Feature) • Modbus Network (up to 99 nodes) &amp; Assign Names Monitor • Local Burner/Boiler System or up to 99 Systems/Nodes • Device status, fault codes &amp; history, diagnostic information and key process variables for each 7800 SERIES &amp; R7140 Burner Control, ControlLinks Fuel/Air Ratio Control, Expanded Annunciator and/or UDC controller. Control • Single (Local) Burner/Boiler System or up to 99 Systems/Nodes • Remote reset for each 7800 SERIES &amp; R7140 Burner Control. UDC device security password, control, demand &amp; alarm setpoints. Password protected.</td>
</tr>
<tr>
<td>V5197A Firing Rate Valve</td>
<td>Modulating valve comes with ML7999 mounting bracket and direct couple drive stem to facilitate set-up. Driven by ML7999A, which responds to firing rate commands provided to the R7999 Controller, the valve expertly helps you match the appliance load. 15psi maximum rating, visual position indicator. Accepts C6097 flange mounted pressure switch. Several pipe adapters are available for valve train installation. Provides turndown of up to 40:1 via its flow limiting adjustment.</td>
</tr>
<tr>
<td>C6097 Gas/Air Pressure Switch</td>
<td>Diaphragm-actuated Gas Pressure Limit Switch. Available in 1/4 inch NPT or flange mount models, which mount directly to the V5197A Firing Rate Valve. IP54 enclosure standard. Other variations include additive or subtractive differential, operating pressure range, maximum pressure, manual reset and break on pressure fall or rise.</td>
</tr>
<tr>
<td>P7810C PressureTrol® Controller</td>
<td>Combination Firing Rate/Limit/On-Off Control. Two separate sensors for Limit and On/Off/Firing Rate Control. Provides 4-20mA Firing Rate commands based on pressure to the ControLinks Controller for effective load matching. For use with steam, air or noncombustible gases. Various operating pressure and differential ranges available. Break on pressure rise. LED indicators for power, call for heat and lockout status. Manual reset and electronic maximum fixed stop limit.</td>
</tr>
<tr>
<td>RM7800 SERIES Primary Flame Safeguard Controls</td>
<td>Primary flame safeguard control family. Several variations available for standing, intermittent or interrupted pilots, on/off or programming, modulation, pre purge, post purge, proof of closure, valve proving system (VPS), and lockout or recycle modulation as well as many other options.</td>
</tr>
<tr>
<td>UDC2500 or UDC3200 Control</td>
<td>For Firing Rate and/or On/Off operation based on pressure or temperature, the UDC2500 or UDC3200 Controls are just the ticket, providing accurate command for your burner application. For Firing Rate, controls provide a 4-20mA output for the ControLinks Controller.</td>
</tr>
</tbody>
</table>
### Condensed Specifications

| Application | Linkageless Fuel Air Ratio Control System  
|            | 4 Channel Output Control: Combustion Air, Fuel 1, Fuel 2, Flexible Usage  
|            | 4th Channel Usage: FGR, Secondary Air Control, Secondary Modulating Fuel Valve  
|            | Integrated Thermal Shock Protection Algorithms for Low Fire Hold and/or FGR Hold |

| LED Indicators | Power / Alarm / 4 Motor Channels for Status and Fault Codes (60 Possible) |

| Protection Category | R7999: NEMA 1 (IP40)  
|                     | ML7999: NEMA 2 (IP31) or NEMA 3 (IP54) with Optional Weatherproof Kit |

| Hysteresis and Dead Band | Configurable from 0.12 mA to 3.0 mA and 0.1 to 0.5 Angular Degrees |

| Required Components | ML7999A Universal Parallel Positioning Actuator (quantity 2 to 4), R7999A,B Controller, Q7999A Wiring Subbase and S7999B System Display or ZM7999A Configuration Software (for commissioning and/or monitoring) |

| Optional Components and Accessories | Weatherproof Kit (NEMA 3 / IP54) for ML7999A, Shaft Adapters, A7999A Portable Combustion Analyzer & Port Expander RS-232/RS-485 (for commissioning) & ControlLinks Demo Tool: DSP3548 |

| Honeywell Compatible Components | V5197A Firing Rate Valve, with ML7999 Actuator Mounting Bracket & Drive Stem  
|                                | P7810C PressureTrol® 4-20mA combination Firing Rate/Limit/On-Off Control  
|                                | UDC2500/3200 Control for Firing Rate/On-Off Control  
|                                | RM7800 SERIES, R7140, R4140 Legacy & Other Primary Flame Safeguard Controls |

| Electrical Ratings | R7999A: 100 to 120 Vac (+10%, -15%), 50/60 Hz (±10%), 10VA maximum  
|                    | R7999B: 200 to 240 Vac (+10%, -15%), 50/60 Hz (±10%), 10VA maximum  
|                    | ML7999A: 100 to 240 Vac (+10%, -15%), 50/60 Hz (±10%), 15VA maximum |

| Vibration | 0.0 to 0.5 G continuous environment |

| Actuator Stroke | 95° nominal ±3°, mechanically limited |

| Actuator Timing | 24 to 30 seconds for 90° Travel |

| Actuator Torque | 100 lb-in (11.3 Nm) Lift and Hold Minimum, Breakaway Minimum, Stall Minimum |

| Actuator Accuracy | Output Hub Position Accuracy ±0.1 Angular Degrees. |

| Ambient Temperature Range | -40°F to +140°F (-40°C to +60°C) |

| Humidity Range | 5% to 95% Relative Humidity, Non-condensing |

| Dimensions | R7999A,B: 5-3/16 in. W x 7-3/16 in. H x 3 in. D installed (131mm W x 182mm H x 76mm D)  
|            | ML7999B: 4 in. W x 6 in. H x 3-1/2 in. D (102mm W x 153mm H x 89mm D) |

| Approvals | R7999A,B: UL/cUL Component Recognized (A only), CE Approved, CSD-1 & NFPA Acceptable, AGA Certified Product (Australian Gas Association)  
|           | ML7999A: UL/cUL Listed, CE Approved, AGA Certified Product |

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### To Learn More

For more information please contact your Honeywell Distributor. Or visit [http://customer.honeywell.com](http://customer.honeywell.com).

### Automation and Control Solutions

In the U.S.:

Honeywell  
1985 Douglas Drive North  
Golden Valley, MN 55422-3992

In Canada:

Honeywell Limited  
35 Dynamic Drive  
Toronto, Ontario M1V 4Z9  
www.honeywell.com

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ProtoNode is an external, high performance, low cost Building and Industrial Automation multi-protocol gateway providing OEMs instant multiprotocol deployment of field protocol, quickly enabling the OEM device to communicate to systems and devices using modern open protocols.

FieldServer Technologies pre-programs the ProtoNode solution to provide a virtual plug-and-play, easy, complete protocol package for the OEM including: BACnet MS/TP, BACnet/IP, Metasys N2 by JCI, Modbus TCP, KNX, M-Bus, Allen Bradley EtherNet/IP, LonWorks and many others. There are no configuration files to download in the field and all configurations are available to the user/installer simply by selecting the proper DIP switches. ProtoNode OEM users have access to the extensive FieldServer driver library.

ProtoNode is the instant answer to a manufacturer’s needs to meet customer demands. As an example, a manufacturer might have five different devices, each requiring a variety of protocols to meet their customer’s interoperability needs. They desire a single source solution, with multiprotocol, multi-configuration capability, and they need it now! A single ProtoNode Solution can be provided by FieldServer Technologies that has all pretested configuration choices preloaded.

ProtoNode Solution:

- Ability to automatically support multiple known controller profiles.
- Designed to be full featured, field programmable, and with multiple protocol support for any protocol translation between Serial, Ethernet, or LonWorks environments.
- Three methods of configuration: - Configuration Auto-Selector (via DIP switches)
  - Auto-Discover known devices
  - Profile selection via Web Configurator to load multiple configurations
- Multiple hardware solutions available interfacing with RS-232, RS-485, RS-422, KNX, M-Bus, Ethernet or LonWorks.
- Support one or multiple field protocols in single ProtoNode.
- Supports up to 10,000 Host and Field Protocol memory points depending upon model selected.
- Options available include USB2 port, Bluetooth, SD Card for data logging and collection, higher point counts.
- BACnet COV support provides fast data communication while reducing the traffic over a BACnet network.
- Supports virtual nodes allowing multiple OEM controllers to connect to a single ProtoNode and seen as separate controllers on the various field networks.
- Easily supports OEM’s custom proprietary host serial or Ethernet protocols.
- Multi-Client and Multi-Server support ensures interoperability between any Industrial and or Building Automation protocols.
- BTL Marked and LonMark Certified.

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## Specifications:

<table>
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<th>ProtoNode</th>
<th>Interface Connections</th>
<th>Point Count</th>
<th>Certifications</th>
</tr>
</thead>
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<tr>
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<td>RS-232</td>
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</table>

### Power Requirements
- **Power:** 9-30 VDC or 12-24 VAC (RS-422 = 15-30 VDC or 12-24 VAC)
- **Current draw @ 12V**
  - RER @ 12V = 240 mA
  - LER @ 12V = 250 mA
  - FPC-N36 @ 15V = 200 mA
  - FPC-N37 @ 15V = 210 mA
- **M-Bus**
  - Slave: 550 mA @ 12V
  - Master (1 Slave): 580 mA @ 12V
  - Master (64 Slave): 980 mA @ 12V

### Environmental
- **Operating Temp.:** -40°F to 167°F (-40°C to 75°C)
- **Relative Humidity:** 5-90% RH, non-condensing

### Enclosure
- **Dimensions:** 4.5 x 3.2 x 1.6 in. (L x W x H) (11.5 x 8.2 x 4.0 cm)

### Warranty
- **Warranty:** Two years return to factory

### Approvals
- BACnet Testing Labs (BTL) B-ASC
- LonMark 3.4 Certified - ProtoNode LER Series
- TUV approved to UL 916 EN 60950-1, EN 50491-3 and CSA C22-2 standards
- RoHS Compliant
- DNP3 Conformance Tested
- CE & FCC Approved

### BACnet Support
- Alarm & Event notification read properties multiples, and more (see PICS)
- BACnet COV's, 20,000
- Support up to 20,000 Host & Field points
- DIP switches are for setting MAC Address, Node-ID, Baud Rate on the RS-485 Field protocol

### LonMark Certification on the ProtoNode LER
- **SPID:** 80:00:95:46:00:84:07
- **Profiles:**
  - 0000 - Node object (1)
  - 0001 - Open Loop Sensor Object (5)
  - 0003 - Open Loop Actuator Object (5)

FieldServer Technologies has a library of over 100 drivers so check with ProtoCessor sales to determine what additional protocols are available to meet specific application needs.
Description:

• Sequences up to 4 Fully Modulating Stages for Temperature or Pressure Systems. The Multi-MOD Platinum is the perfect control whenever multiple fully modulating stages are required for heating or cooling applications. The Multi-MOD Platinum controls the on/off and the modulation of each stage to maintain precise set point control using PID type control logic.

• Controls 0-5V, 0-10V, 4-20mA, or 135Ω modulating motors. The Multi-MOD Platinum is designed to accurately control the output from 0 to 100% of modulation for each of these different types of motors. One Multi-MOD Platinum can even control two different types of motors.

• Digital Display of all System Settings. The Multi-MOD Platinum’s 80 character alphanumeric digital display names each system parameter in plain English and shows its precise value. The easy to follow menu system allows users to quickly make changes to any system setting without having to learn any specialized codes or keyboard commands. Password protection is available to prevent unauthorized users from making adjustments to control settings.

• Automatic Rotation among Stages. Rotating the first stage to be activated on a call for output promotes even wear on each stage. The Multi-MOD Platinum has three modes of rotation: Manual, First ON/First OFF, or automatically every selected time period from every hour to every 7 days.

• Outdoor Reset Capability. The Multi-MOD Platinum can be connected to existing or new Heat-Timer outdoor reset controls (HWR for hot water heat, or MPC for steam heat). The Multi-MOD Platinum also has built in hot water reset with adjustable reset ratios, offsets and outdoor cutoff.

• Connects to Energy Management Systems. All Multi-MOD Platinums can be disabled by an Energy Management System (EMS) or other controller when there is no output requirement. The Multi-MOD Platinum can also accept a 4-20 mA input signal from an EMS to adjust the set point according to outdoor temperature or other factors.

• Monitors Stage Status. The Multi-MOD Platinum is designed to accept Lockout inputs from each stage. If any stage is in Lockout, the Multi-MOD Platinum will automatically skip it when adding more capacity. If a stage goes into Lockout during normal operation, the next stage will be activated immediately to maintain the desired output capacity.

• Optional BACnet or Modbus Communication. With the BACnet or Modbus options, a Multi-MOD Platinum can act as node in a BMS network. A proprietary communication EMS/BMS can use their BACnet IP, MST/TP, or Modbus integration to place the Multi-MOD Platinum on their network.

• Optional Internet Remote Communication Add-On. Imagine being able to not just control your building heat from anywhere, but to be able to see boiler status, and temperature and pressure logs. In addition, you will be able to set and monitor wireless and hard wired sensors, configure and receive alarms and lockout status, configure and view histories, and more. Well, imagine no more. The Multi-MOD Platinum can be ordered with the Internet communication packages that fit your needs. With that you can configure, set alarms and monitor a variety of sensors ranging from wireless, water meter, oil level, temperature, pressure, switch, and stack sensors.

• Additional features include: A purge timer, a low fire adjustment, a firing point setting for the next stage based on the firing rate of the current stage, a lag stage timer, a last stage hold adjustment, and many others.

Ask About the Internet, BACnet, and Modbus Communication Options
Features:

- All the following stage signal outputs are available: 0-5 V or 0-10 V - 4-20 mA - 135 Ω
- The following are field selectable
  - Rotation type: Manual, first on/first off, or automatic every adjustable time period from every hour to every 41 days
  - Input type: Temperature, pressure, 4-20mA, or interface to outdoor reset controls HWR or MPC
  - Temperature display: °Fahrenheit or °Celsius
- Lockout inputs for each stage allow the Multi-MOD Platinum to automatically begin activating the next stage if a stage goes into Lockout
- Capability of connecting to Heat-Timer network sensors or Mini-MIG boxes to monitor temperatures, pressures, oil tank levels, water meters, etc.
- A System output relay is provided and is energized when output is required. It will remain on for an adjustable time delay after the last stage turns off
- System Prove input must be made before stages are activated
- Adjustable PID type logic or throttling range controls stage loading/unloading
- Parallel loading mode—used when boiler recommends higher efficiencies at lower firing points
- Remote enable/disable function
- Remote set back feature
- Adjustable purge, lag stage delay, system run-on delay, and standby timers
- Adjustable ignition and modulation start points
- Lead stage will not turn off until the system temperature or pressure exceeds an adjustable range from the set point value, preventing short cycling of the lead stage
- The Multi-MOD Platinum can be configured to accept a 4-20mA signal to remotely change the set point
- System sensor can be located up to 500’ from the control module
- System sensor reading, set point, and stage information are constantly shown on the 80 character display
- Menu system provides digital display and precise adjustment of all settings
- Built-in password protection
- LEDs show status of each output relay
- Plug in field replaceable relays are rated at 6A resistive 1/3HP
- All settings and operating modes are stored permanently in EE-Prom even if power is lost
- Remote communication packages are available either at the time of order or as a field upgrade (Internet, BACnet, or Modbus)
- Hot water reset operation

Benefits:

Easy to order, stock, or field upgrade

- The base Multi-MOD Platinum unit can accommodate temperature, pressure, or 4-20mA inputs, and 0-5V, 0-10V, 4-20mA and 135Ω modulating motors.
- When ordering, you only need to specify the input sensor type and the output modulating motor type.
- If the system changes in the future, both sensors and output modules can be upgraded in the field.

Easy to install

A single 13” x 13” enclosure contains all Multi-MOD Platinum hardware and software.

- Only one sensor is required and it can be installed in any convenient location up to 500’ from the Multi-MOD Platinum panel.
- Large, clearly marked 3/8” terminals facilitate wiring with standard screwdrivers.
- The 80 character display and easy to use menu system will guide you through all necessary settings.
- Every setting is displayed, eliminating guesswork about the precise value.

Easy to use

- After initial configuration, the Multi-MOD Platinum needs no further adjustment.
- Glancing at the 80-character display provides you with all the necessary operating information — system sensor value, setting, and output stage status.
- The PID algorithm will adjust for changes in load based on ambient conditions, outdoor conditions, or process demands.
- Lockout and System Prove inputs allow the Multi-MOD Platinum to quickly adjust to output stage or other system problems.
- The remote enable/disable function turns the Multi-MOD Platinum off automatically when no output is needed.

Fuel saving

- The Multi-MOD Platinum is unique among lead-lag systems in that its PID algorithm controls to precisely the desired set point. Unlike other systems, it does not bring all stages up to high modulation and then back them down until the desired set point is obtained. The Multi-MOD Platinum does not waste energy by activating unneeded stages and running them in the inefficient high modulation mode.
- The Multi-MOD Platinum has a built-in Setback capability that lowers the set point when less output is required. This can be enabled from an EMS, a remote controller, or a manual switch.
Prolong output stage life

- The automatic lead stage rotation evenly distributes the wear on all available stages.
- The available rotation options allow you to pick the optimum schedule for your output stages.
- The purge time sets the minimum run time for any stage, preventing harmful short cycling.
- Short cycling prevention tools are built into the Multi-MOD Platinum software. As described in the previous section, on a cold start, the Multi-MOD Platinum does not bring all stages up to high modulation and then back them down. Stages are only enabled when they are required.
- The Multi-MOD reduces Short cycling of the lead stage during low load conditions using the Last Stage Hold setting. It allows the system temperature or pressure to vary from the set point before turning the last stage off.
- Stages are never turned off in high modulation, which can be very harmful. The Multi-MOD Platinum backs the modulation down to low before stages are turned off.

Multi-MOD Platinum Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>120VAC</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>30VA</td>
</tr>
<tr>
<td>Operating Mode</td>
<td>Heating/Cooling</td>
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<tr>
<td>Lead Stage Rotation</td>
<td>Manual</td>
</tr>
<tr>
<td></td>
<td>First On/First Off</td>
</tr>
<tr>
<td></td>
<td>Automatically</td>
</tr>
<tr>
<td></td>
<td>Every hour to every 41 days</td>
</tr>
<tr>
<td>Output Types</td>
<td>0-5V, 0-10V, 420mA, 135Ω</td>
</tr>
<tr>
<td>Stage Modes</td>
<td>Off, Auto, On, Standby, Manual</td>
</tr>
<tr>
<td>Output Contacts</td>
<td>5 SPST</td>
</tr>
<tr>
<td>Output Rating</td>
<td>6A resistive, 1/3HP</td>
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<tr>
<td>Operating Ambient Temperature</td>
<td>20 to 120°F</td>
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<td>Enclosure</td>
<td>NEMA -1</td>
</tr>
<tr>
<td>Dimensions</td>
<td>13” x 13” x 5-1/2”</td>
</tr>
<tr>
<td>Weight</td>
<td>14 Lbs</td>
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<tr>
<td>Sensor Accuracy</td>
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</tr>
<tr>
<td>Temperature</td>
<td>+1°F (1°C)</td>
</tr>
<tr>
<td>Pressure</td>
<td>1%FS</td>
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<td>Temperature display</td>
<td>Field select °F or °C</td>
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<tr>
<td>Sensor Ranges</td>
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<tr>
<td>Temperature</td>
<td>-30 to 250°F (-35 to 120°)</td>
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<tr>
<td>Pressure</td>
<td>0 to 15, 30, 100, 200, or 300psi</td>
</tr>
<tr>
<td>Ignition Start Point</td>
<td>1 to 50%</td>
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<tr>
<td>Modulation Start Point</td>
<td>0% to 100%</td>
</tr>
<tr>
<td>Operating Mode</td>
<td>Normal or Process</td>
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<tr>
<td>Modulating Mode</td>
<td>Normal or Parallel</td>
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<tr>
<td>Purge Delay</td>
<td>1.0 to 10.0 minutes</td>
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<tr>
<td>Lag Stage Delay</td>
<td>0.0 to 60 minutes</td>
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<tr>
<td>System Run On Delay</td>
<td>0.0 to 30 minutes</td>
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<tr>
<td>Standby Time</td>
<td>0.0 to 60 minutes</td>
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<td>Setback</td>
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<td>Temperature</td>
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<td>Pressure (0-15 or 0-30)</td>
<td>0-7.5 psi</td>
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<td>Pressure (0-100)</td>
<td>0-75psi</td>
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<td>Pressure (0-200)</td>
<td>0-150psi</td>
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<td>Pressure (0-300)</td>
<td>0-200psi</td>
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<td>Last Stage Hold</td>
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<tr>
<td>Temperature</td>
<td>0 to 30°F (0 to 30°C)</td>
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<tr>
<td>Pressure (0-15 or 0-30)</td>
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<td>Pressure (0-100, 200, or 300)</td>
<td>0-10% of range</td>
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<td>Shutdown Input</td>
<td>Dry Contact Only</td>
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<tr>
<td>System Prove Input</td>
<td>Dry Contact Only</td>
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<tr>
<td>Lockout Inputs</td>
<td>Dry Contact Only</td>
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<tr>
<td>4-20mA External Input</td>
<td>Pressure or temperature</td>
</tr>
<tr>
<td>Reset Ratio</td>
<td>1-4, 4-1</td>
</tr>
<tr>
<td>Reset Offset</td>
<td>(+40°F) (-40°F)</td>
</tr>
<tr>
<td>Remote Communication Options</td>
<td></td>
</tr>
<tr>
<td>Internet (RINET) through <a href="http://www.htcontrols.com">www.htcontrols.com</a></td>
<td></td>
</tr>
<tr>
<td>BACnet IP or MSTP (BAC)</td>
<td></td>
</tr>
<tr>
<td>MODBUS RTU (BUS)</td>
<td></td>
</tr>
</tbody>
</table>
Multi-MOD Platinum Control

The digital display shows the system status, set point, lead stage (in brackets), and status of each stage. To view and adjust settings, press the Adjust/Select button.

Depress the knob to move forward through the menus and to accept changes, rotate the knob to change a setting's value.

Depress the button to go back through the menus or to view a setting value without changing it.

To Temp sensor mounted in common header
When closed, all stages are turned off*
Pressure terminals have polarity and source sensor power
To Heat-Timer network sensors**
Checks status of system componentor DHW input*
Optional sensor enables outdoor reset
If a unit is in Lockout, the MultiMOD will not consider it as active

Provides remote set point adjustment with a 4-20mA signal or provides a setback function

Extension panels DO NOT come with Output cards or relays. They must be purchased separately.

** DRY CONTACTS ONLY
** Only available with the Remote Communications package

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Part #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-MOD Platinum (0-135Ω)</td>
<td>926650-135</td>
</tr>
<tr>
<td>Multi-MOD Platinum (Current or Voltage)</td>
<td>926650-C/V</td>
</tr>
<tr>
<td>Multi-MOD Platinum - Internet</td>
<td>926650-135-RInet*</td>
</tr>
<tr>
<td>Multi-MOD Platinum - BACnet IP or MSTP</td>
<td>926650-135-BAC*</td>
</tr>
<tr>
<td>Multi-MOD Platinum - Modbus RTU</td>
<td>926650-135-BUS*</td>
</tr>
<tr>
<td>Extension Panel (8 Stages with Lockout)</td>
<td>926650-EXT</td>
</tr>
</tbody>
</table>

* All Multi-MODs can have either C/V or 135Ω modulating signal based on the output cards installed. Change the 135 in the Part # to C/V for Current or Voltage modulation option.

** Extension panels DO NOT come with Output cards or relays. They must be purchased separately.
CSI SPECIFICATION:  MULTI-MOD PLATINUM

SECTION:  230913   Instrumentation and Control devices for HVAC

PART 1 GENERAL

1.1 Summary
A. Section Includes:
   1. Multiple modulating boiler Heating Control.
B. Related Sections:
   2. Conforms to applicable building code requirements of all authorities having jurisdiction.

1.2 References
A. International Organization for Standardization (ISO)
B. Underwriters Laboratories, Inc. (UL):
   1. Tested per standard 916, Temperature Indicating and Regulating Equipment.
C. The City of New York, Department of Environmental Protection (DEP).
   1. The control shall be approved for installation in New York City by DEP.

1.3 Quality Assurance
A. Manufacturer’s Quality System:
   1. Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.
   2. The control must be UL tested and certified per standard 916, Temperature Indicating and regulating Equipment.

1.4 Control Operation
A. Description: The control shall operate on 120VAC, with a maximum power of 30 watts. The control shall be pre-engineered and programmed exclusively for the operation of multiple modulating steam/hydronic heating systems based on a PID logic. It shall be capable of controlling four modulating boilers without any additional extra modules. However, it shall be modular and capable of controlling a total of 20 modulating boilers using a maximum of two external modulating extension controls.
B. Modulating Outputs: The control shall have four normally open relay contacts that can be used to start/stop each burner. These relays shall be field replaceable. The control shall have four modulating outputs. Every two modulating outputs shall have the same modulating signal and be controlled by the same modulating output card. The control shall have the capability to operate modules having 0 – 5 volts, 1 - 5volts, 0 – 10 volts, 2 - 10 volts, 4 – 20 ma, and 135-ohm outputs. The control shall be capable of identifying the output module types and adjusting control output accordingly. Where practical, the output modules shall be protected from accidental incorrect connection. Should damage occur, where practical, damage shall be confined to the output module.
C. **Sequence of Operation:** When heat is required, the control PID shall activate the lead boiler and start its pre-purge cycle followed by the initiation of modulation at the Fire Start Percent. When additional heat is needed, the control shall start to increase modulation until the Modulation Start percent has been reached. That shall be followed by the lag boiler pre-purge cycle. Then, the lag boiler shall remain at the Fire Start percent and the lead boiler shall resume its modulation until it reaches full fire (100% modulation). Any additional requirements for heat shall trigger the control to increase the lag boiler. When the control PID requires reduced output, the control shall reduce the modulation of the lag boiler until it reaches its Fire Start percent. That shall be followed by the reduction of modulation of the lead boiler until it reaches 40% percent of its Modulation Start percent. This shall trigger the control to turn off the lag boiler.

D. **Features:**

1. **Outdoor Reset or Set Point:** The control shall provide an integral sensor set point adjustment. The set point shall be adjustable either through the control menu or remotely using a 4-20mA input signal. In addition, when in temperature mode and equipped with an outdoor sensor, the control shall be capable of varying the set point based on an outdoor reset curve. The outdoor reset curve parameters shall be field adjustable.

2. **Fire Start Percent:** Adjustable from 1 to 100%. This setting shall set the firing percent at which the burner shall start at when energized or de-energized. There shall be an independent adjustment of this setting for each burner.

3. **Modulation Start Percent:** Adjustable from 0 to 100%. This setting shall set the percent of modulation the lead boiler must achieve before the lag boiler is activated. There shall be an independent adjustment of this setting for each burner.

4. **Gain:** Adjustable from -10 to +10. This setting shall increase or decrease the amount of modulation based on the rate of change in system sensor reading and the set point.

5. **Purge Time:** Adjustable from 0-10.0 minutes. This setting shall set the delay time between a boiler being energized and the beginning of modulation.

6. **Last Stage Hold:** Adjustable from 0 to 30 minutes. The last stage hold shall keep the last boiler at low fire for an additional degrees/lbs of pressure to reduce short cycling of the lead boiler.

7. **Lag delay:** Adjustable from 0 to 60 minutes. The lag boiler in the rotation shall not be fired until the lead boiler has remained in high fire for the period of time set by the Lag Stage delay.

8. **Rotation:** The control shall be capable of rotating the boilers either based on an adjustable time period, Last-On/last-Off, or manually.

9. **Parallel Modulation:** The control shall have an option for parallel modulation where multiple boilers can modulate upward or downward together with increase or decrease modulation.

10. **Memory:** The control shall store all configuration and settings on EE-Prom. In case of power failure the control should be able to retrieve all of its latest settings.

11. **Display:** The control shall have a four line by eighty-character alphanumeric display capable of displaying both numbers and characters. The display shall be visible with no ambient light. All control operation information shall be available for display. During times of inactivity, or 10 minutes after last user entry, the display shall enter a lower power mode. In this mode the control should display date and time of day, cycle status, outdoor temperature, system temperature, and valve opening percentage. In this mode, the display shall reduce visible light output. The control shall exit this mode whenever button or digital encoder activity is sensed.

12. **Boiler Lockout Input:** The control shall have a dry contact input for boiler failure. The control shall not include failed boilers in its modulation sequence.

E. **Input Points:**

1. **Outdoor Temperature:** This shall be the value read from the outdoor sensor placed on the north side of the building at least 10 Ft. above the ground.

2. **System Temperature (Hydronic Systems):** This shall be the value read from the system sensor placed on the hot water system pipe to measure hot water circulating temperature.

3. **System Pressure (Steam Systems):** This shall be the value read from the system pressure sensor placed on the main header.

4. **External Shutdown:** The control shall be capable of accepting a dry closure type shutdown input. This shall prevent any boilers or pumps from activating when the contact is closed.

5. **Prove Input:** The control shall be capable of accepting a dry contact closure type for system prove input. This shall prevent any boilers from activating until the contact is closed.

6. **Lockout Input:** The control shall be capable of accepting dry contact closure for boiler failure.
7. **System Set Point (4-20mA Signal):** The control shall be capable of accepting a 4-20mA remote signal as a set point.

F. **Output Points/Relays:**
   1. Burner relay output
   2. Burner modulation output: 135 Ohm, 4-20mA, 0-5V, 1-5V, 0-1V, 2-10V
   3. System relay output

G. **Data Points:**
   1. **Burner Modulation Percent:** This shall indicate the percent of modulation status each boiler has.
   2. Fire Start Percent: This shall be the percent at which a boiler will start its modulation. Each boiler shall have a separate configurable value.
   3. **Last Stage Hold:** Adjustable from 0 to 30 minutes. The last stage hold shall keep the last boiler at low fire for an additional degrees/lbs of pressure to reduce short cycling of the lead boiler.
   4. **Lag Delay:** Adjustable from 0 to 60 minutes. The lag boiler in the rotation shall not be fired until the lead boiler has remained in high fire for the period of time set by the Lag Stage delay.
   5. **Modulation Speed** (for process applications only) This shall be adjusted the burner modulation motor speed for the control logic to match.
   6. **Modulation Start Percent:** Adjustiable from 0 to 100%. This setting shall set the percent of modulation the lead boiler must achieve before the lag boiler is activated. There shall be an independent adjustment of this setting for each burner.
   7. **Rotation Mode:** Auto, Manual, Last-On/Last-Off
   8. **Setback:** The control shall have a dry contact input to initiate a setback.
   9. **Standby Delay:** This shall be the set to the amount of time for all automatically controlled boilers to be at high fire before starting boilers set to standby.
   10. **System Run-On:** This shall be the value at which the system relay shall remain energized for after all boilers have turned off.
   11. **System Set Point/Target.** This shall be either set to the desired system design temperature / pressure. If the control is set to outdoor temperature reset, this value should change dynamically based on the outdoor temperature and other reset ratio parameters.

1.5 **Regulatory Approvals**
   A. Underwriters Laboratories, Inc. (UL):
      1. The control shall be tested per standard 916, Temperature Indicating and Regulating Equipment.
   B. The City of New York, Department of Environmental Protection (DEP).
      1. The control shall be approved for installation in New York City by DEP.

1.6 **Included Items**
   A. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application. Only one relay is included for the system output. Additional relays are required for each boiler and must be ordered separately.

1.7 **Optional Items**
   A. Outdoor Temperature Sensor shall be of the Thermistor type capable of measuring between –30°F to 250°F. It shall have a weather shield to protect it from moisture and direct sun.
   B. System Temperature Sensor shall be of the Thermistor type capable of measuring between –30°F to 250°F
   C. System Pressure Sensor shall be of the Transducer type capable of measuring between 0-30PSI, 0-100PSI, 0-200PSI, 300PSI.

1.8 **Communication (Select one of these Options)**
   A. Internet Communication: The control shall be capable of communicating to the Internet using a high-speed Internet connection to communicate to the manufacturer or manufacturer representative web servers to send or receive its information. Remote users of the control shall have the capability of the control remotely using an Internet Browser with built-in Java when provided with security logging.
information. The user shall be capable of viewing and changing control settings remotely. In addition, the web server shall offer customizable history reporting and graphing of all control and sensor data. The control and web system shall be capable of sending alarms to web viewers, several E-mails, and several cellular phones as text messages.

B. **BACnet IP Communication:** The control shall be BACnet IP capable. It shall provide the user with BACnet IP communication interface to an Energy Management System (EMS) or Building Management System (BMS) on the same BACnet network. The control shall be designed to be BACnet Application Specific Controller (B-ASC). The control shall manage the boilers and their modulation and the system pump through direct wiring to the equipment and not through the BACnet network.

C. **BACnet MSTP Communication:** The control shall be BACnet IP capable. It shall provide the user with BACnet MSTP communication interface to an Energy Management System (EMS) or Building Management System (BMS) on the same BACnet network. The control shall be designed to be BACnet Application Specific Controller (B-ASC). The control shall manage the boilers and their modulation and the system pump through direct wiring to the equipment and not through the BACnet network.

D. **MODBUS (RTU):** The control shall be MODBUS RTU capable. It shall provide the user with RS485 communication interface to an Energy Management System (EMS) or Building Management System (BMS) on the same BACnet network. The control shall be designed to be BACnet Application Specific Controller (B-ASC). The control shall manage the boilers and their modulation and the system pump through direct wiring to the equipment and not through the MODBUS network.

B. **Johnson Metasys, Johnson N2, LonWorks, Honeywell, Tridium, and other protocol communications:** The control shall be BACnet IP capable. However, will communicate to the other proprietary protocol through a BACnet IP or BACnet MSTP to the specified proprietary protocol through a gateway that is supplied by the control manufacturer at additional cost. It shall provide the user with proprietary protocol communication interface to an Energy Management System (EMS) or Building Management System (BMS). The control shall be designed to be BACnet Application Specific Controller (B-ASC). The control shall manage the boilers and their modulation and the system pump through direct wiring to the equipment and not through the BACnet network.

1.9 **Security**

A. **Control Local Security:**
   1. The control shall have a secure password to deter unauthorized users. The password shall be optionally activated.
   2. The control shall have a key-locked enclosure.

B. **Control Remote Internet Security**
   1. To access an Internet communication control remotely, the control, web server, or proprietary software shall deter unauthorized users by requiring a secure password for logging to the control interface.
GMB24-3-X1 Actuators, On/Off, Floating Point

Models
GMB24-3-X1
2*GMB24-3-X1

Technical Data

Control
On/Off, Floating Point

Power supply
24 VAC ± 20% 50/60 Hz
24 VDC ± 10%

Power consumption
running 4 W
holding 2 W

Transformer sizing
6 VA (Class 2 power source)

Electrical connection
❑ 3 ft [1m]
18 GA plenum rated cable
½” conduit connector

Overload protection
electronic throughout stroke

Angle of rotation
95°

Direction of rotation
reversible with √ switch

Position indication
reflective visual indicator (snap-on)

Running time
150 seconds, constant independent of load

Humidity
5 to 95% RH non-condensing

Ambient temperature
-22°F to 122°F [-30°C to 50°C]

Housing
NEMA 2/IP54 with cable entry down

Housing material
UL94-9V (flammability rating)

Agency listings
cULus acc. to UL 60730-1A/2-14,
CAN/CSA E60730-1, CSA C22.2 No. 24-93,
CE acc. to 89/336/EEC

Noise level
<45 dB(A)

Quality standard
ISO 9001

Dimensions with 2-Way Valve

Valve Nominal
Dimensions (Inches)

Size

Value Body COP Inches DN [mm] A B C D F H1 H2
B239VS 400 1½ 40 7.50 3.00 6.00 4.37 6.25 9.75 8.50
B249VS 200 2 50 7.50 3.00 6.00 4.96 6.25 9.75 8.50
B239VSS 1000 1½ 40 7.50 3.00 6.00 4.37 6.25 9.75 8.50
B249VSS 400 2 50 7.50 3.00 6.00 4.96 6.25 9.75 8.50

Dimensions with 3-Way Valve

Valve Nominal
Dimensions (Inches)

Size

Value Body COP Inches DN [mm] A B C D E F H1 H2
B340VS 75 1½ 40 7.00 2.00 8.00 4.44 2.25 6.25 9.75 8.50
B350VS 75 2 50 15.00 6.00 8.00 5.38 2.75 6.25 9.75 8.50

N44611

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800-543-9038 USA
866-805-7089 CANADA
203-791-8396 LATIN AMERICA / CARIBBEAN
**Wiring Diagrams**

1. Provide overload protection and disconnect as required.
2. Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
3. Actuators may also be powered by 24 VDC.
4. Position feedback cannot be used with Triac sink controller.
5. The actuator internal common reference is not compatible. Control signal may be pulsed from either the Hot (source) or the Common (sink) 24 VAC line.
6. Contact closures A & B also can be triacs. A & B should both be closed for triac source and open for triac sink.
7. For triac sink the common connection from the actuator must be connected to the hot connection of the controller.

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**Valve Nominal Size**

**Dimensions with 2" GM... and 2-Way Valve**

<table>
<thead>
<tr>
<th>Valve Body</th>
<th>COP</th>
<th>Inches</th>
<th>DN [mm]</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>F</th>
<th>H1*</th>
<th>H2*</th>
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<td>400</td>
<td>1½</td>
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<td>7.50</td>
<td>3.00</td>
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<td>4.75</td>
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<td>B250VS</td>
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<td>50</td>
<td>15.00</td>
<td>3.00</td>
<td>8.00</td>
<td>5.37</td>
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<td>B265VS</td>
<td>100</td>
<td>2½</td>
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<td>3.00</td>
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<tr>
<td>B280VS</td>
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<tr>
<td>B249VSS</td>
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<td>7.50</td>
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<td>15.00</td>
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*Handles not available on spring return series or dual mounted actuators

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**Valve Nominal Size**

**Dimensions with 2" GM... and 3-Way Valve**

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<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>H1*</th>
<th>H2*</th>
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</thead>
<tbody>
<tr>
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<td>8.00</td>
<td>5.38</td>
<td>2.75</td>
<td>6.25</td>
<td>9.75</td>
<td>8.50</td>
</tr>
</tbody>
</table>

*Handles not available on spring return series or dual mounted actuators

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**Piping**

The valve should be mounted in a weather-protected area in a location that is within the ambient limits of the actuator. Allow sufficient room for valve with actuator and for service. Allow 6" for cover removal and 12" for complete actuator removal. The assembly can be mounted with the actuator vertical or horizontal in relation to the pipe. The actuators should never be mounted underneath the valve, as condensation can build up and result in a failure of the actuators. Do not reverse flow direction.